TECHNICAL MANUAL

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL

MODEM, DIGITAL DATA MD-920/G
(NSN 5820-00-155-8576)

This copy is a reprint which includes current pages from Changes 1 and 2

HEADQUARTERS, DEPARTMENT OF THE ARMY

JUNE 1976

WARNING

HIGH VOLTAGE

is used in this equipment

DEATH ON CONTACT

may result if safety precautions
are not observed

115 volts ac is present within the ICF modem. Perform all possible maintenance with power removed. If necessary to perform operations with covers removed and power on, be extremely careful to avoid contact with high voltage.

DON‘T TAKE CHANCES!

TM 11-5820-804-12
NAVELEX 0969-LP-169-4013
TO 31R5-2G-271
C 3

CHANGE

No. 3

DEPARTMENTS OF THE ARMY
THE NAVY, AND THE AIR FORCE
Washington, DC, 1 December 1987

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL
MODEM, DIGITAL DATA MD-920A/G
(NSN 5820-01-057-6356)

TM 11-5820-804-12/NAVELEX 0969-LP-1694013/TO 31R5-2G-271, 7 June 1976, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page. Added or revised illustrations are indicated by a vertical bar adjacent to the identification number.

Remove pages	*Insert pages*
i through 1-2	i through 1-2
5-1 and 5-2	5-1 and 5-2
A-1	A-1/(A-2 blank)

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No. 11-5820-804-12
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No. 31R5-2G-271

DEPARTMENTS OF THE ARMY,

THE NAVY AND THE AIR FORCE

WASHINGTON, DC, *7 June 1976*

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL

MODEM, DIGITAL DATA MD-920A/G
(NSN 5820-01-057-6356)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to: Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-ME-MP, Fort Monmouth, New Jersey 07703-5000.

For Air Force, submit AFTO Form 22 (Technical Order System Publication Improvement Report and Reply) in accordance with paragraph 6-5, Section VI, T.O. 00-5-1. Forward direct to prime ALC/MST.

For Navy, mail comments to the Commander, Space and Naval Warfare Systems Command, ATTN: SPAWAR 8122, Washington, DC, 20363-5100.

In either case a reply will be furnished direct to you.

LIST OF ILLUSTRATIONS

LIST OF TABLES

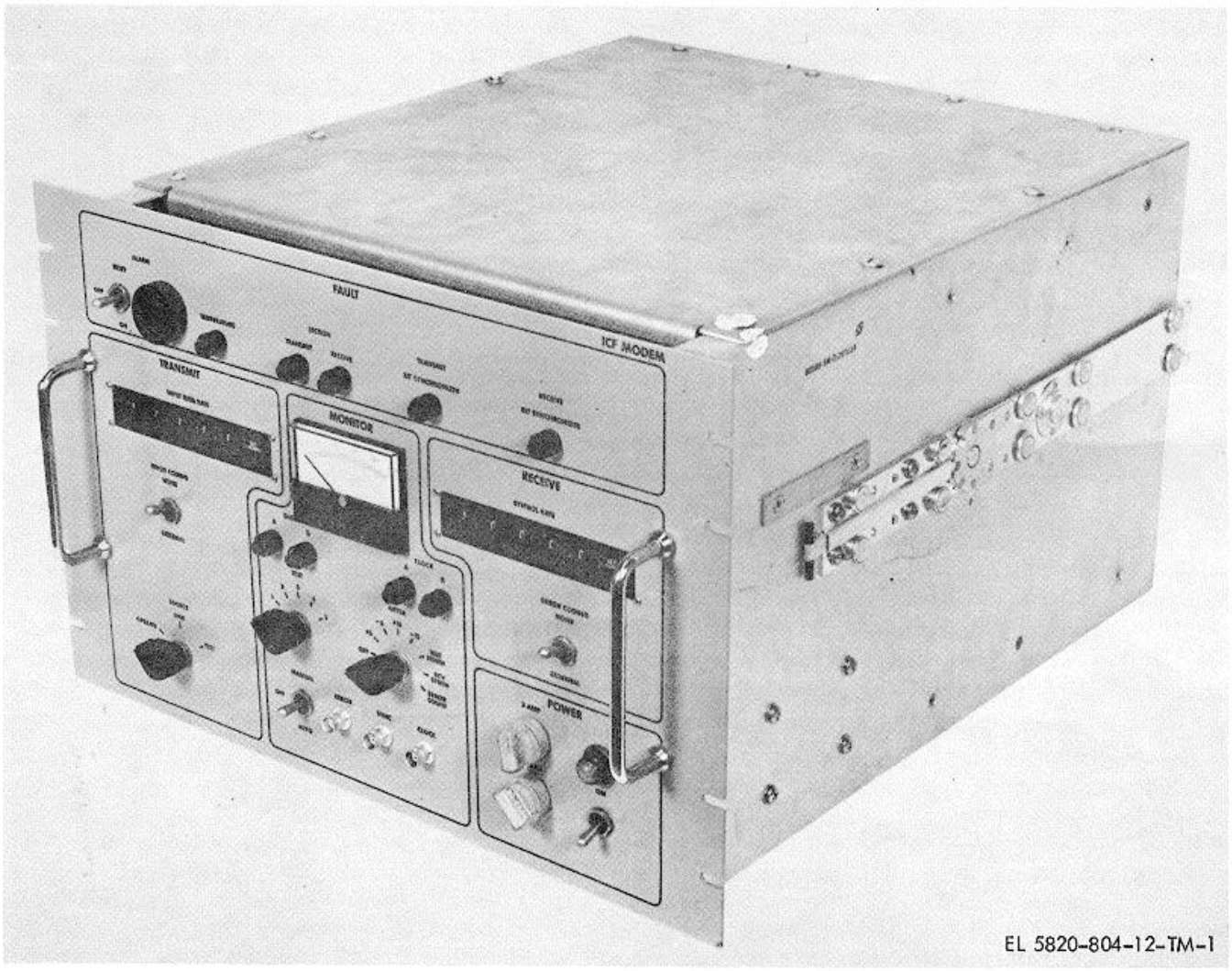


Figure 1-1. Modem, digital data MD-920A/G (ICF Modem).

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope.

This manual describes Modem, Digital Data MD920A/G, hereinafter to as the ICF modem (fig. 1-1). It includes installation, operation, maintenance, and troubleshooting for operator/ organizational maintenance. Appendix A contains references and Appendix B contains the maintenance allocation chart.

1-2. Consolidated Index of Army Publications and Blank Forms

Refer to the latest issue of DA Pam 25-30 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

1-3. Maintenance Forms, records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed DA Pam 738-750, as contained in Maintenance Management Update. Air Force Personnel will use AFR 66-1 for maintenance reporting and TO-0035D54 for unsatisfactory equipment reporting. Navy personnel will report maintenance performed utilizing the Maintenance Data Collection Subsystem (MDCS) IAW OPNAVINST 4790.2, Vol 3 and unsatisfactory material/conditions (UR submissions) IAW OPNAVINST 4790.2, Vol 2, chapter 17.

b. Report of Packaging and handling Deficiencies. Fill out and forward SF 364 (Report of Discrepancy ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73B/AFR 400-54/ MCO 430.3H.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 5538/NAVSUPINST 4610.33C/AFR 75-18/MCO P4610.19D/DLAR 4500.15.

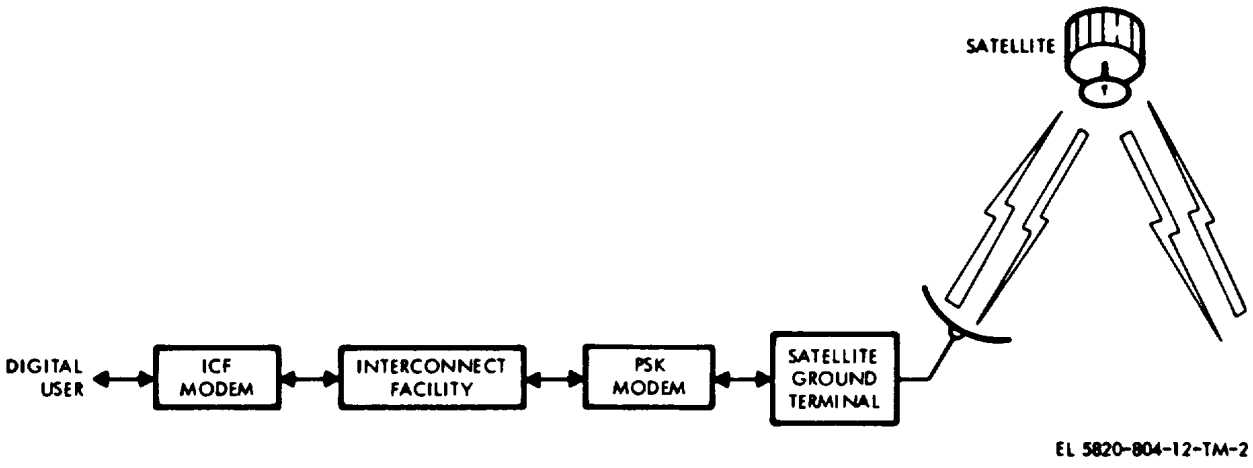


Figure 1-2. ICF modem system interface

1-3.1. Reporting Equipment Improvement Recommendations (EIR)

a. Army. If your equipment needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-PA-MA-D, Fort Monmouth, New Jersey 07703-5000. We'll send you a reply.

b. Air Force. Air Force personnel are encouraged to submit EIR's in accordance with AFR 900-4.

c. Navy. Navy personnel are encouraged to submit EIR's through their local Beneficial Suggestion Program.

1-4. Administrative Storage

Administrative storage of the ICF modem shall be handled as follows:

a. The IFC modem must be stored in a dry, sheltered area not subject to long periods of extreme cold and heat.

b. Before storing the unit, clean it (para 4-5) and spot-paint bare metal parts on the front panel (para 5-4).

c. Before and after storage, perform organizational preventive maintenance checks and services (table 5-1).

d. Every 30 days in storage, the ICF modem shall be connected to ac power source and turned on for 10 minutes. Also operate all switches at least five times to clean the contacts.

1-5. Destruction of Army Electronics Materiel

Destruction of Army Electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

Section II. DESCRIPTION AND DATA

1-6. Purpose and Use

The ICF modem provides a means of interfacing digital data with a Modem, Digital Data MD-921/G (PSK modem) in a remotely-located satellite communication terminal. The ICF modem converts between the baseband data signals required by a digital user and the signal format required for transmissions over the interconnect facility link (fig. 1-2). The modem has independent transmit and receive sections which provide the user with the capability for fully duplex digital communication. The modem will process data at any rate between 19.200 kb/s and 5.0000 Mb/s. Self-test and on-line fault monitoring functions are built into the modem. An external error-correcting coder/ decoder can be employed if required to improve the quality of the communications.

1-7. Description

The ICF modem (fig. 1-3 and 1-4) is designed for rack mounting in a standard 19-inch equipment rack. It is 12'/4 inches high and 22 inches deep.

Operating controls are located on the front panel and under the top cover behind the front panel. Indicators and test jacks are also located on the front panel. Two fans and the external interface connectors are located on the rear of the chassis. The chassis contains one card file assembly, which has two files capable of accepting 24 cards each. The card file assembly is accessible through the top cover. The card file assembly, A2A1, contains 16 printed circuit cards in the A1 file and 21 cards in the A2 file. Located on the top section of the chassis forward of the card file are the oscillator assemblies A2Y1 and A2Y2. The power supply, A2PS1, is located on the bottom section of the chassis forward of the card file.

1-8. System Application

Several system configurations are possible using the ICF modem (fig. 1-5). The major interfaces and options are listed in following paragraphs.

a. Data Rates. The modem is capable of processing any data rate between 19.200 kb/s and 5.0000 Mb/s. Transmit and receive section data rates are independently selectable.

b. Remote Site Interfaces. The interface between ICF modem and the MD-921/G (usually located in or near the earth terminal) may be accomplished in the two ways listed below. For detailed information on applications and interface requirements, refer to the systems planning section of chapter 2.

(1) Interface with a remotely located MD921/G via 50Ω or 75Ω coaxial cable, or 75Ω balanced cable.

(2) Interface with a remotely located MD921/G via a line-of-sight (LOS) microwave link.

(3) Interface with a remotely located MD-921/G via a fiber optic (FO) cable link.

c. Error-Correcting Coder/Decoder. The modem operates either in the no coding mode or with an external high gain coder/decoder.

d. Digital User Interface. Direct interface with a nearby digital user is accomplished via the MIL-**STD-188 inputs and outputs of the modem.**

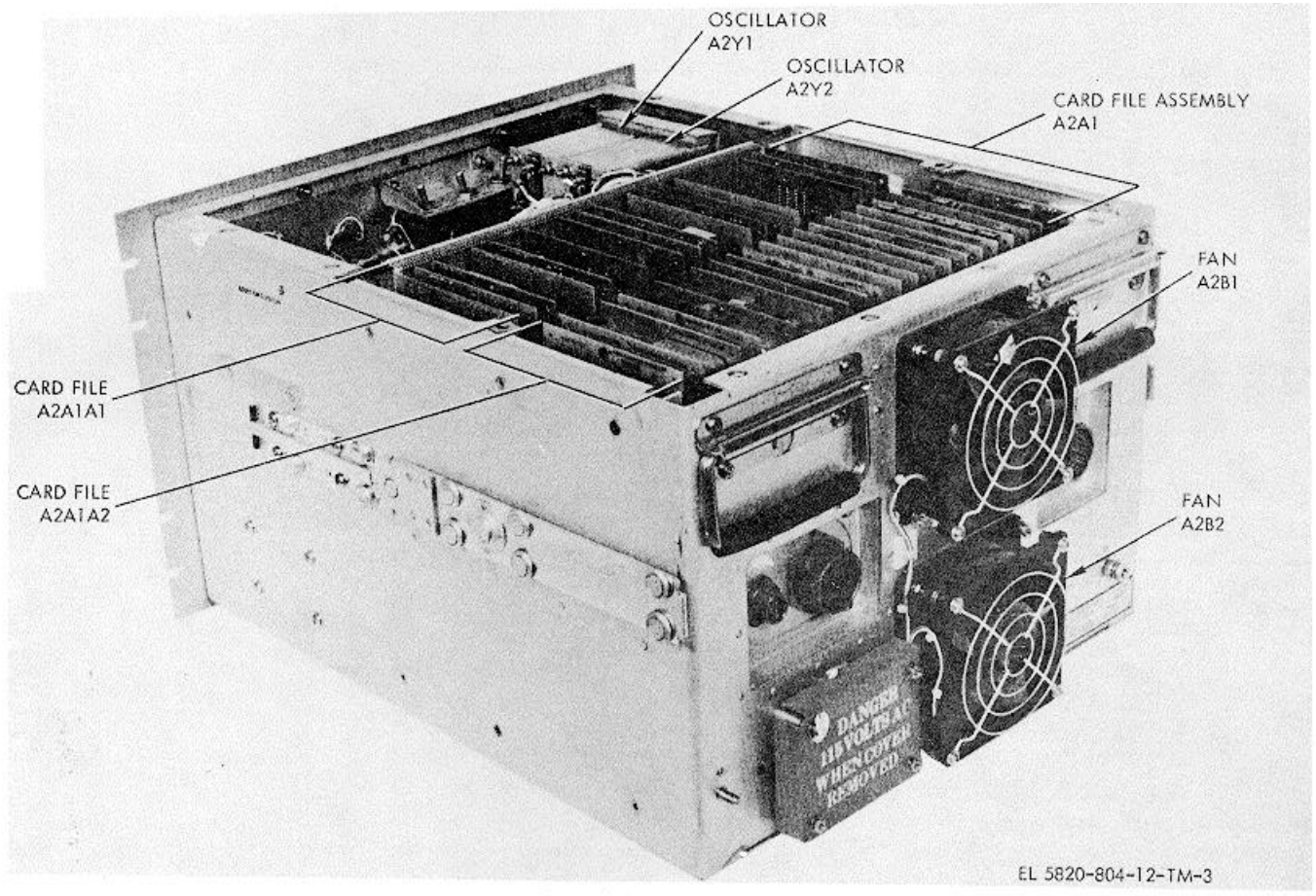


Figure 1-3. ICF modem viewed from top rear (top cover removed).

1-9. Items Comprising and Operable Equipment

a. ICF Modem (fig. 1-1). Modem, Digital Data MD-9250A/G (NSN 5820-01-057-6356; SM-D-877791.

b. Accessory Equipment

(1) AC Power Cord, SM-C-759676.

(2) Site Interface Mating Connector J5, MS-3126E24-61W.

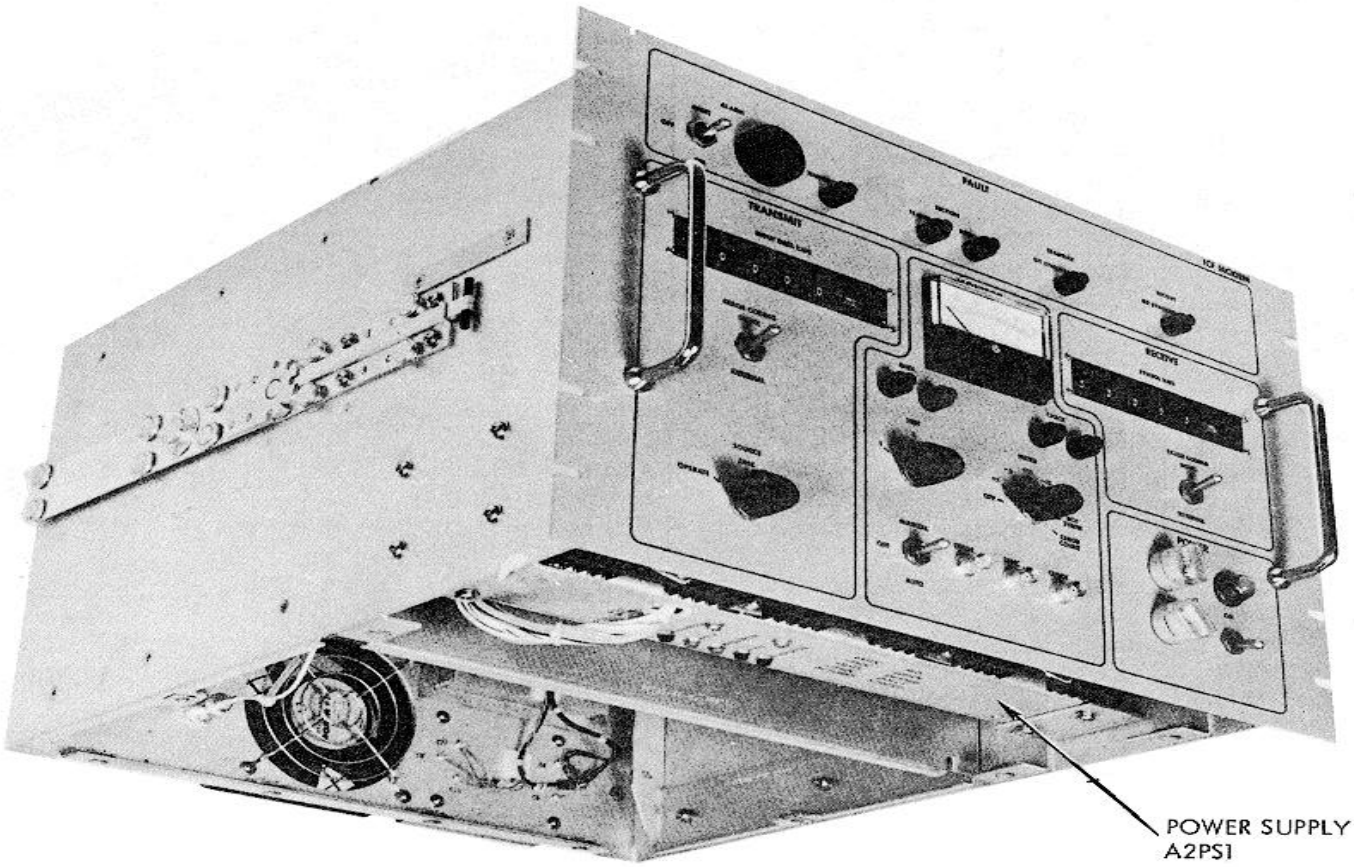
(3) Coder/Decoder Interface Mating Connector J6, MS-3126E24-61P.

(4) Glenier Strain Relief (2 each), GTR20524B (SM-A-731358-2).

(5) Chassis Slide Halves (2 each), 11OQDP-22-A-1.

1-10. Tabulated Data

Prime Power	
Voltage	120 ± 10 percent volts ac single phase
Current	3 amperes maximum
Frequency	45 to 420 Hz
Power	300 watts maximum
Operating Conditions	
Operating	Continuous
Temperature	32°F to 120°F
Relative Humidity	5 to 100 percent
Elevation	Up to 10,000 feet
Line of Sight Baseboard Interface	
Output	
Power Level	–12 dBm (terminated)
Impedance	75 ohms, ± 10 percent, unbalanced



EL 5820-804-12-TM-4

Figure 1-4. ICF modem viewed from bottom front (bottom cover removed).

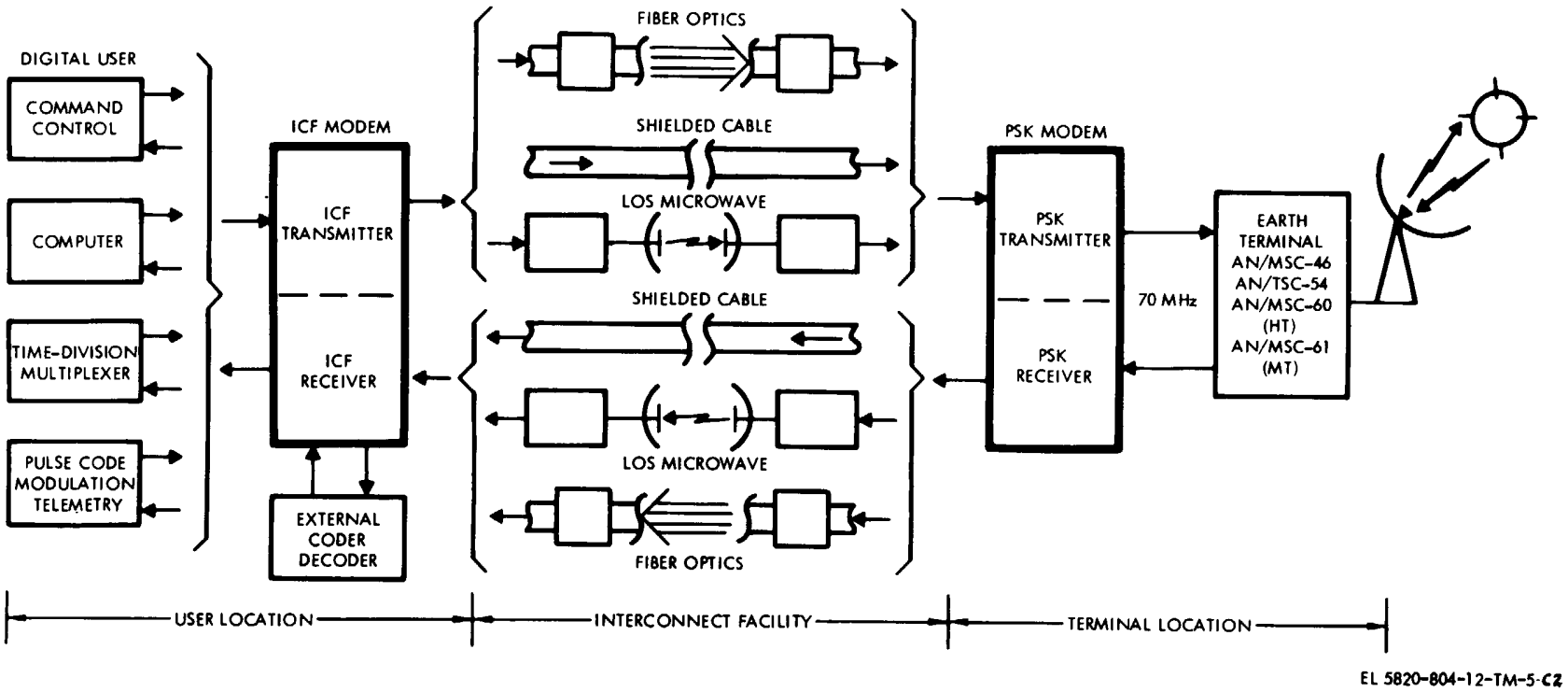


Figure 1-5. ICF modem applications.

Input	
Power Level	-25 to -35 dBm (terminated)
Impedance	75 ohms, + 10 percent, unbalanced
Frequency Range	19.2 kb/s to 5.0 Mb/s
Shielded RF Cable Interface	
Output	
Power Level	+ 23, + 10, and 0 dBm (terminated)
Impedance	50 ohms, + 10 percent, unbalanced 75 ohms, + 10 percent, unbalanced 75 ohms, +10 percent, balanced
Input	
Power Level	+5 to -15 dBm (terminated)
Impedance	50 ohms, + 10 percent, unbalanced 75 ohms, + 10 percent, unbalanced 75 ohms, + 10 percent, balanced
Frequency Range	19.2 kb/s to 5.0 Mb/s
Line Drivers and Receivers	
Output Voltage	Positive and negative 6+ 1.5 volts opet circuit (measured between signal pair)
Sense	Zero state, negative voltage
Source Impedance	75 ohms, + 10 percent, balanced
Short Circuit Current	0.1 ampere or less
Wave Shape	With 75 ohms + 10 percent resistive load, rise and fall times are 20 nanoseconds or less.
Line Receiver Input	
Impedance	75 ohms, + 10 percent, balanced
Line Receiver Sensitivity	+0.1 volts maximum input required to cause correct switching.
Fiber Optics Interface	
Line Drivers and Receivers	
Output Voltage	Positive and negative 6+1.5 volts opet circuit (measured between signal pair)
Source Impedance	75 ohms, + 10 percent, balanced
Line Receiver Input	
Impedance	75 ohms, + 10 percent, balanced
Line Receiver Sensitivity	+0.1 volts maximum input required to cause correct switching
Frequency Range	19.2 kb/s to 9.9999 Mb/s

CHAPTER 2

SERVICE UPON RECEIPT AND INSTALLATION

Section I. SYSTEMS PLANNING

2-1. General

The ICF modem interfaces between a PSK modem and a digital user over either a shielded cable, a line-of-sight (LOS) microwave link or a fiber optic (FO cable link (fig. 2-1, 2-2 and 2-2.1). The ICF modem includes circuits that aid in testing the performance of a digital satellite communications link as well as providing a self-test function. The ICF modem may be used in conjunction with an external error correcting coder/decoder. The operating configurations of the ICF modem are controlled by front panel and internal switches.

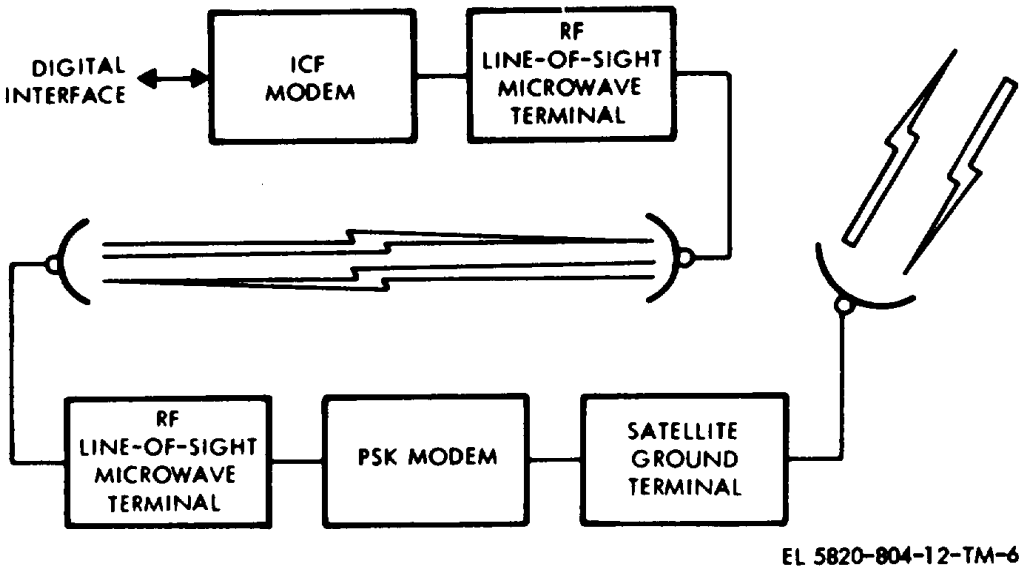


Figure 2-1. ICF/PSK modem configuration via line-of-sight (LOS).

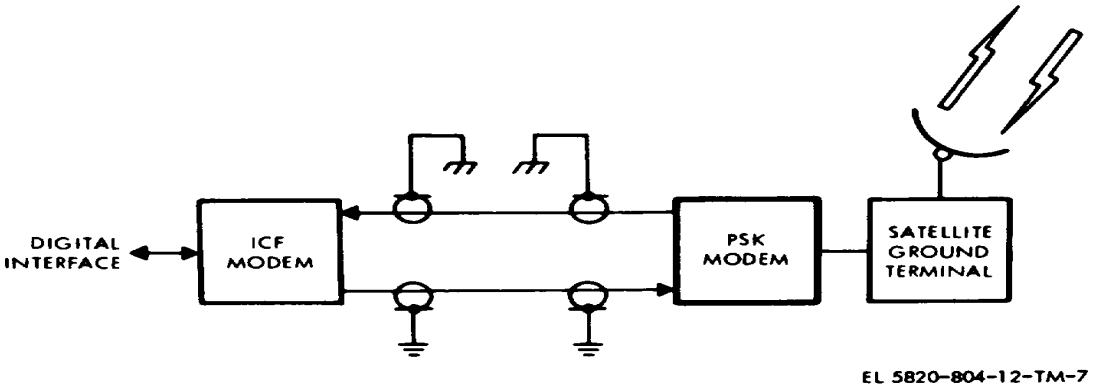


Figure 2-2. ICF/PSM configuration via shielded rf cable.

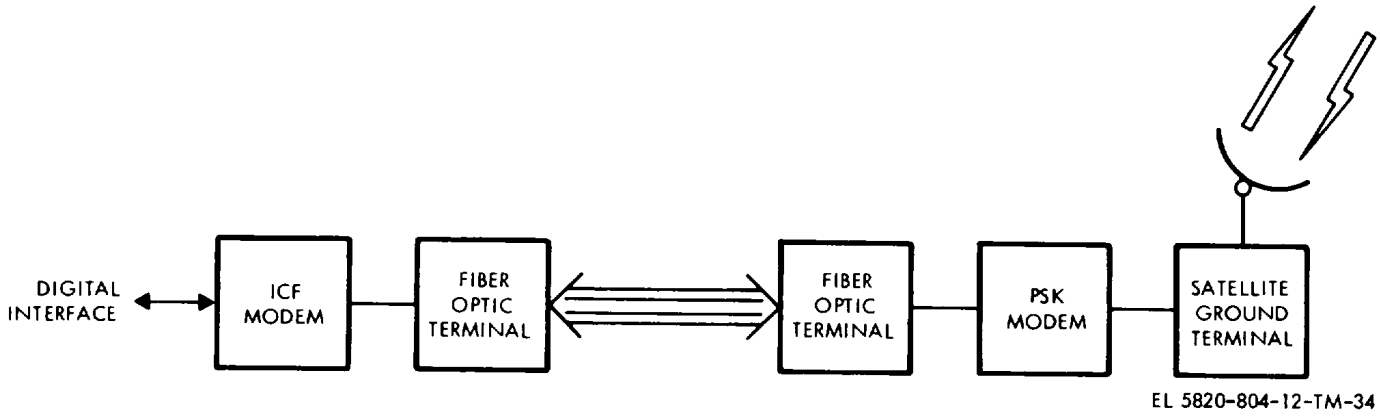


Figure 2-2.1. ICF/PSK modem configuration via fiber optic (FO) cable.

2-2. ICF Interface

a. General. All ICF interface signals are available at rear panel site interface connector J5, except the LOS input, which is a rear panel BNC connector. The PSK and ICF modems contain identical LOS/cable/FO driver circuits and LOS/cable/FO receiver and decoder circuits. These circuits provide the appropriate interface levels and code conversion to and from the digital user's format to make the interface signal compatible with either transmission system The fault indicator status of the ICF modem may be monitored remotely.

b. Input Signals. The desired ICF input signal is internally selected at installation. Details for the LOS/cable/FO receiver and decoder input selection are given in paragraph 2-17. Any one of the following input sources may be selected:

(1) 75-ohm balanced cable.
(2) 75-ohm unbalanced cable.
(3) 50-ohm unbalanced cable.
(4) LOS microwave receiver.
(5) 75-ohm balanced FO NRZ receiver.

NOTE

If a cable is used for the interface, the required equalization procedure is given in paragraph 2-18.

c. Output Signals. All outputs available to the ICF system are present on the ICF modem rear panel and their levels are controlled by internal switches. Detailed instructions for setting these switches are given in paragraph 2-3. Any one (but only one) of the following outputs may be connected.

(1) 75-ohm balanced cable driver.
(2) 75-ohm unbalanced cable driver.
(3) 50 ohm balanced cable driver.
(4) LOS microwave driver.
(5) 75-ohm balanced FO NRZ driver.

d. Fault Alarm Monitor Signal Characteristics. The ICF modem contains several on-line fault monitoring circuits which monitor the fault status of both the transmitter and receiver. A relay contained in the ICF modem is actuated to provide a contact closure whenever one or more faults occur. This relay is shown in figure 2-3 in the no-fault (deenergized) condition. The fault alarm monitor output is used in conjunction with a compatible remote monitoring device. Connection of this signal is optional dependent upon the configuration and operational requirements of the site.

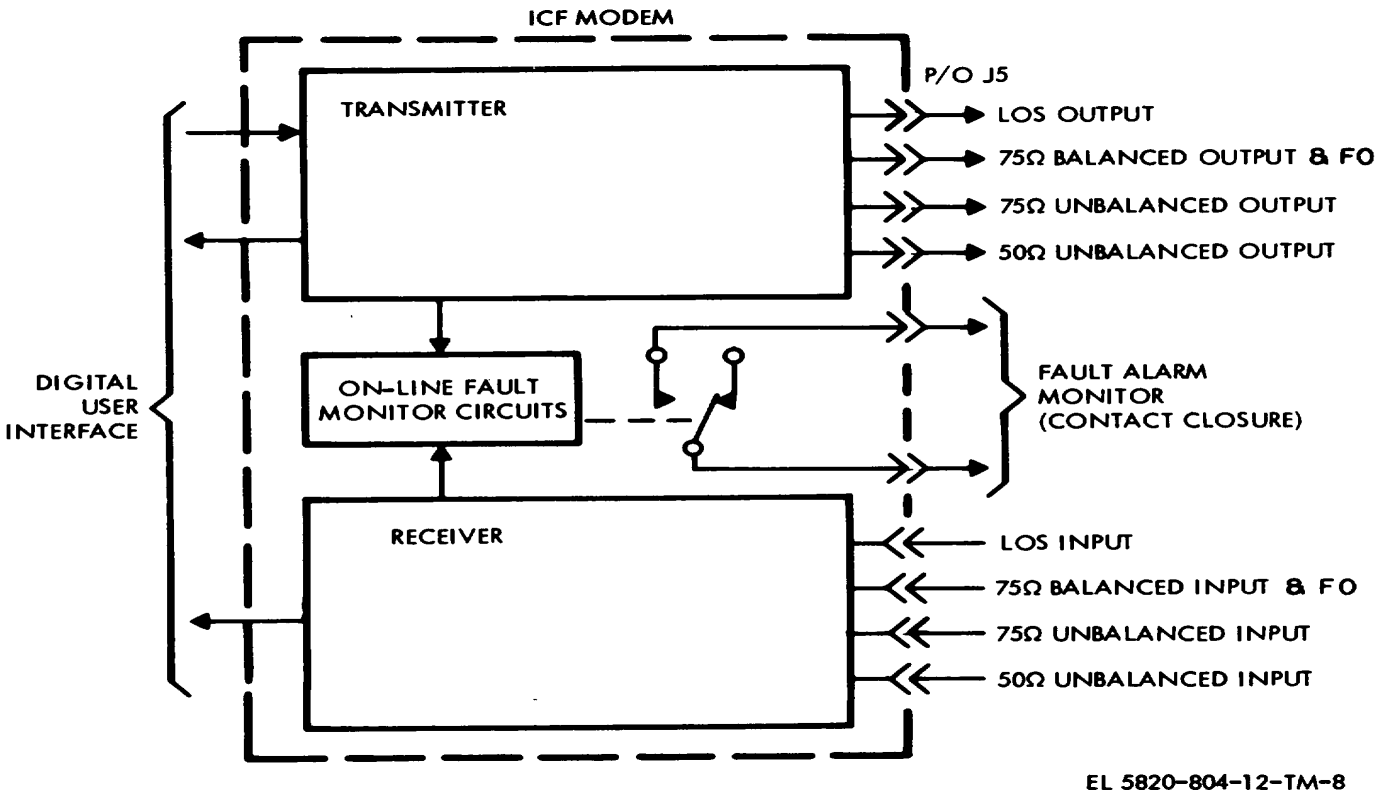


Figure 2-3. ICF interface.

2-3. ICF System Requirements

a. Signal Characteristics. A non-return to zero (NRZ) data format, in which a logic 0 is transmitted as a negative voltage, is employed at the digital user interface. The NRZ format results in a baseband signal that would be difficult to equalize over a long cable and would cause degraded operation over a line-of-sight microwave link if automatic frequency control (AFC) is used in the FM receivers. Therefore, the ICF (and the PSK) modem contains circuits which convert between a NRZ format and a bipolar NRZ format (fig. 2-4). The bipolar NRZ format, in which logic ZERO'S are transmitted as 0 volts and logic ONE's are transmitted as

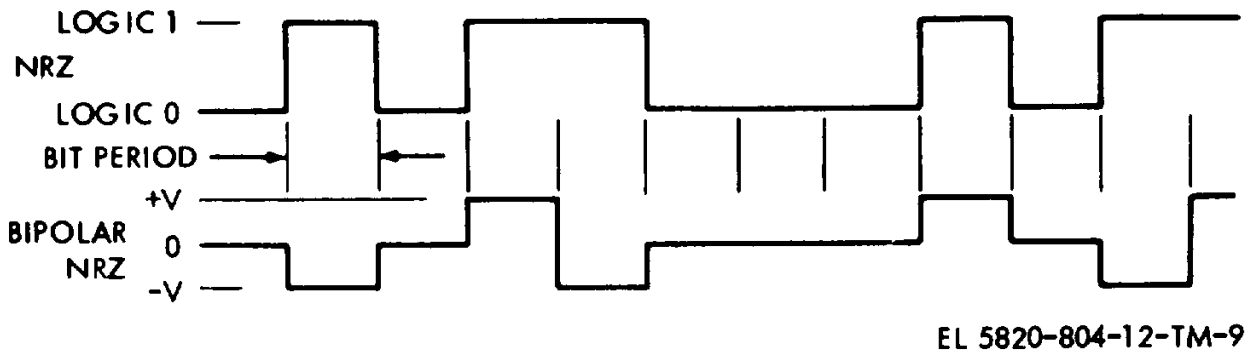


Figure 2-4. NRZ and bipolar NRZ data

alternating equal positive and negative voltages, is used for data transmission over the interconnect facility.

B. Line-of-Sight (LOS)Microwave Installations.

(1) The general form of the baseband signal spectrum for the bipolar NRZ data format (random data) is shown in figure 2-5. Most of the signal energy is contained in the frequency range from DC to the data rate (R_D), and additional signal power occurs in the higher frequency sidebands. In general, an overall interconnect facility system bandwidth equal to twice the data rate (or the symbol rate if coding is used) is required to obtain adequate system performance; three times the data rate provides improved performance.

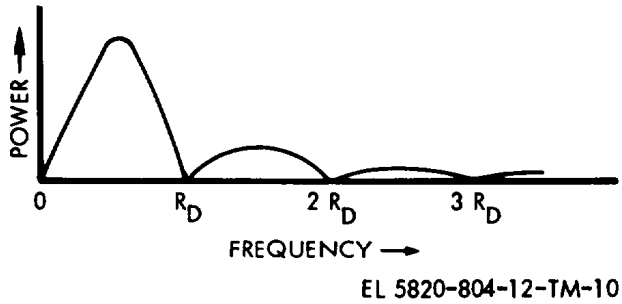


Figure 2-5. Bipolar NRZ data signal spectrum.

(2) The ICF modem receiver contains internal filters to reduce the high-frequency noise at the line-of-sight microwave system output. The recommended usage of these filters is given below:

Symbol rate	*3dB filter bandwidth*	*Approximate noise bandwidth*
19.200 kb/s to 22.5.00 kb/s	550 kHz	710 kHz
225.01 kb/s to 1.8000 Mb/s	3.6 MHz	5.7 MHz
1.8000 Mb/s to 5.0000 Mb/s	10 MHz	16 MHz

(3) Detailed instructions for selecting the filters are given in paragraph 2-17. A worst-case signal-to-noise ratio at the ICF modem receiver input of 20 dB is required from the line-of-sight microwave system.

c. Cable Installations.

(1) *Cable selection*. The cable selected for data transmission using an ICF modem should normally provide no more than 30 dB power loss at 5 MHz (regardless of the actual data rate). The cable loss for installation must be determined from the cable manufacturer's data and the cable length. For example, assume that RG-217/U cable (unbalanced type cable) is being considered for a 10,000-foot installation. The cable loss characteristic, in dB/100 feet, for RG-217/U cable is shown in figure 2-6. From figure 2-6, it can be seen that cable loss characteristic (a) at 5 MHz is 0.28 dB/100 feet. Therefore, for a cable length (L) of 10,000 feet of RG-217/U, the total cable loss can be determined from the relationship:

$$\text{cable loss} = (a_5 L) \div 100$$
$$\text{cable loss} = (0.28 \times 10{,}000) \div 100 = 28 \text{ dB}$$

Since the cable loss in the example given above is less than 30 dB, that length of RG-217/U would be usable in the installation. Cable selection may be simplified by using the length requirement to determine the maximum value of the loss characteristic (a) at 5 MHz which can be used. The maximum value of a can be determined from the relationship:

$$a_{max} = 3000 \div L$$

(2) *Cable classification*. The transmission of baseband data over an interconnect facility cable results in unequal phase distortion at the output. The ICF modem receiver contains equalization networks to compensate for this phase distortion. Detailed instructions for adjusting the equalizers are given in paragraph 2-18. Further information on configuring the LOS/cable receiver and decoder circuits to provide the appropriate equalization is given in paragraph 2-17, depending on whether the cable is classified as long, medium, or short. Although the phase distortion is not directly related to the 5 MHz cable loss, the parameters are so closely related that' cable loss may be used to determine the equalization requirements. To determine cable classification, calculate the cable loss based on the cable length and attenuation factor at 5 MHz (loss = $a_5 L/100$) and assign the appropriate classification in accordance with the following list to ensure proper alinement (para 2-18).

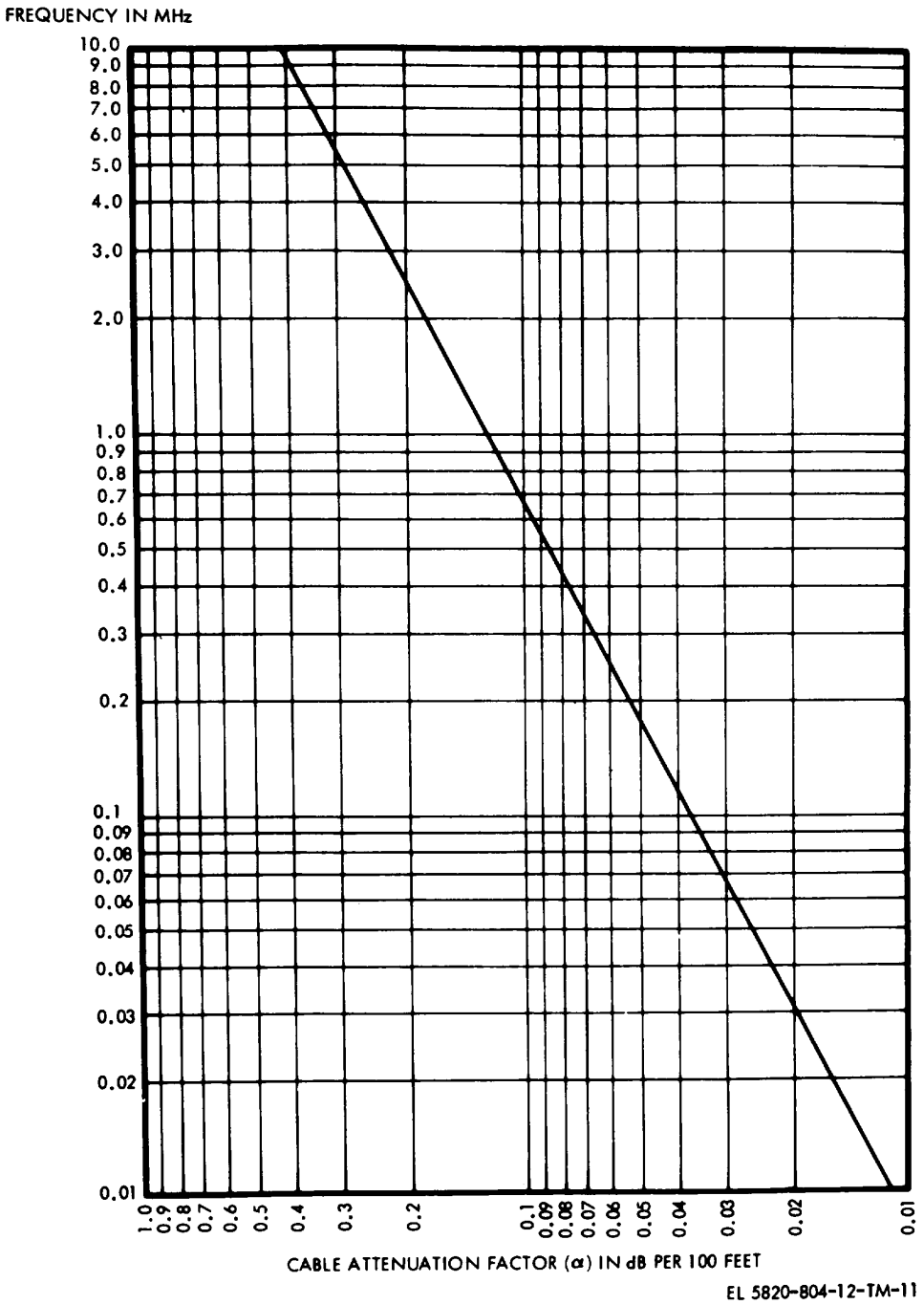


Figure 2-6. Attenuation characteristics of RG-217/U cable.

Cable loss at 5 MHz	Classification
to 3dB	short
3dB to 12dB	midrange
12dB to 30 dB	long

(*3) ICF transmitter output power.* The output power level on all LOS/cable outputs is controlled by a single internal switch which is set during installation of the modem (para 2-17). The proper switch setting depends on the interconnect facility cable loss. The switch is set so that maximum power is available to the LOS/cable receiver at the far end of the cable, but that this power does not exceed +5 dBm. After the cable attenuation characteristics at 5 MHz are used to determine the cable loss (as described in preceding paragraphs), one of the three available power levels (0 dBm, 10 dBm, or 23 dBm) is selected to provide the maximum power, but not exceeding +5 dBm, at the far end of the cable.

d. Fiber Optic (FO) NRZ Installations. The NRZ digital interface is composed of balanced line drivers and receivers. The following factors must be considered in planning the use of this interface.

(1) The use of 75 ohm balanced transmission cable, such as RG-108A/U is recommended (although not necessary for short runs).

(2) The output must be terminated in 75-ohms.

(3) The length of cable which may be driven is a function of the data rate, the phase distortion of the cable used, and the cable power loss.

Detailed instructions for selecting this interface are given in paragraph 2-17.

2-4. Coding/Decoding Options

a. The transmission of digital data over a satellite communications link typically results in random errors in the data sent to the digital user via the PSK modem receiver. These errors are primarily caused by the noise inherent in the satellite link. The performance of a digital communication link is generally measured in terms of the average bit error rate at the digital output of the link. Average bit error rate is determined by dividing the number of bit errors occuring in a large number of bits by the total number of bits in the sample. The resulting number is the probability of error associated with each bit. For example, if it is determined that 40 errors have occurred in a total of 10,000 bits, the average bit error rate (or bit error probability) is 40/10,000 or 4×10^{-3}.

b. The bit error rate produced by a satellite communications link is a function of the data rate and the signal-to-noise ratio present at the earth terminal output. If a noise bandwidth equal to the bit rate is always used as a reference, the bit error rate as a function of signal-to-noise ratio (E_bN_o) for any data rate can be shown on one curve (fig. 2-7). As shown in figure 2-7, if only differential coding is used, the E_bN_o ratio required to obtain a low bit error rate is higher than that required to obtain the same error rate using the external coder in conjunction with the ICF modem. For example, if a digital user requires an error rate equal to or less than 1 x 10-5s, the minimum E_bN_o ratio needed to support this requirement using only differential coding is +9.8 dB. If an external Coder=Decoder KY-801/GSC (Viterbi coder/decoder) is used, the E_bN_o ratio required is reduced by 3.2 dB to +6.6 dB.

c. The requirement for use of error correcting coding equipment is determined by several factors. These factors are the signal-to-noise density ratio (C/KT) provided by the communications link, the implementation loss of the MD-921/G, the data rate, the bit error rate required by the digital user, and the link margin required. The external decoder signals provided by the MD-921/G are required for optimum decoding operation. Therefore, if an external coder/decoder is required, the best system performance will result if the external coding is used in conjunction with the MD-921/G rather than the ICF modem. Further information to aid in understanding the requirements and trade-offs involved in applying an external coder/decoder is given in the MD-921/G manual. TM 11-5820-803-12.

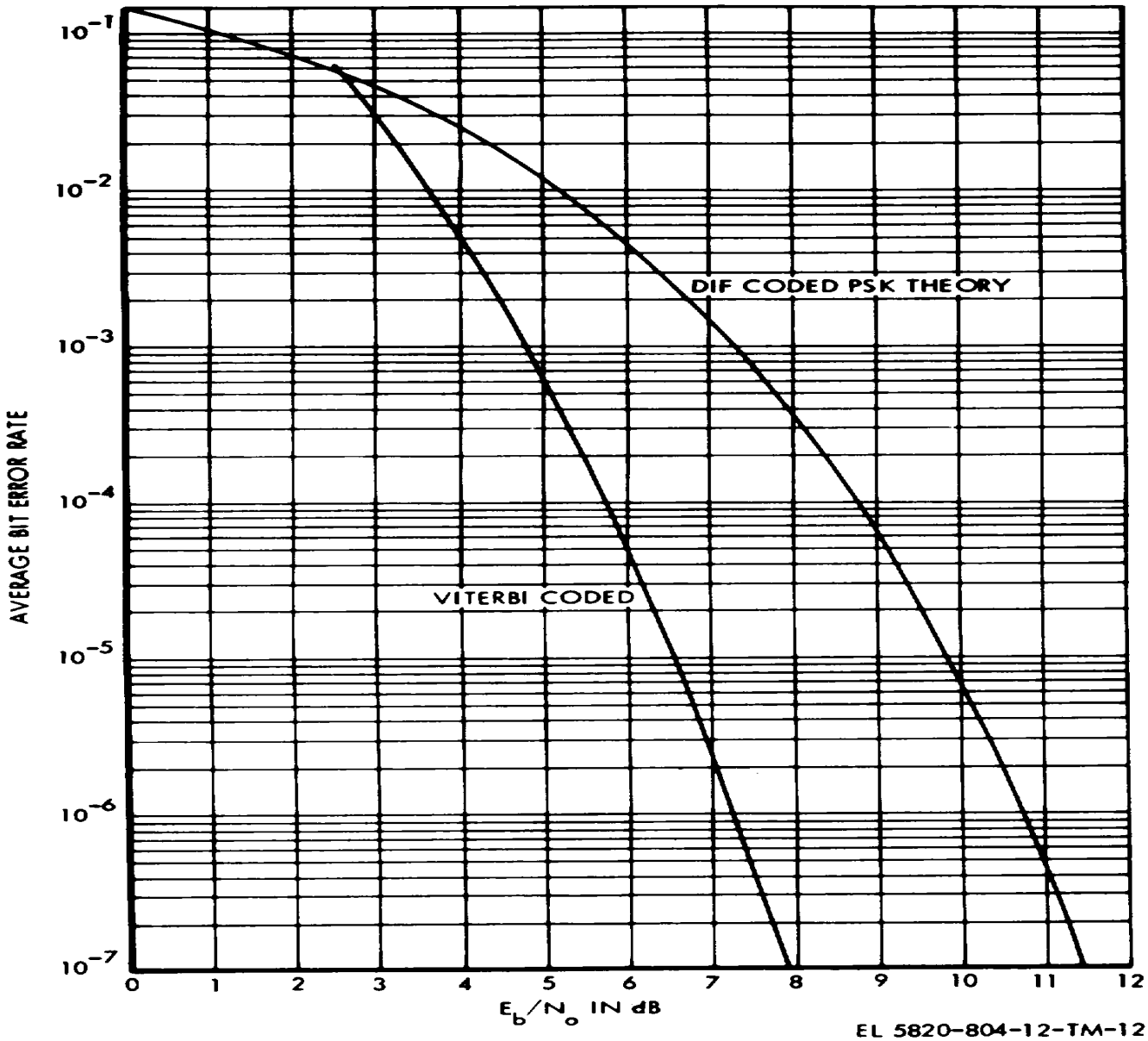


Figure 2-7. Theoretical bit error rate for PSK/OCF modem combination with and without external error coding at IFC MODEM.

2-5. Differential Coding

a. The modulation technique used by the PSK modem produces an ambiguity over the communications link. Although the PSK modem receiver detects the modulated data states received from the satellite, it cannot distinguish which state represents a ONE and which state represents a ZERO. The demodulated data process by the PSK modem is as likely to be inverted as not. Differential coding in either the PSK or the ICF modem may be used to resolve this ONE/ZERO ambiguity.

b. The operation of a differential encoder is illustrated in A, figure 2-8. A transition in the output data

is produced for each ONE in the input data. No transitions are produced for the ZERO's in the input data.

c. The operation of a differential decoder is illustrated in B, figure 2-8 which shows the same encoded output sequence developed in A, figure 2-8. If a transition occurs between bit periods, a ONE is produced at the output. If no transition occurs between bit periods, a ZERO is produced. The decoder output sequence is identical to the encoder input shown in A, figure 2-8.

d. The operation of a differential decoder is illustrated in C, figure 2-8 with the encoded output sequence of A, figure 2-8 inverted. Again, transitions are decoded as ONE's and no transitions as ZERO's. The decoder output sequence is identical to the encoder input shown in A, figure 2-8.

e. The following considerations apply to the use of differential coding:

(1) Differential coding is generally required, as the PSK modulation technique inherently produces a ONE/ZERO ambiguity over the link.

(2) Differential coding does not affect the symbol rate or the modulation spectrum for random data.

(3) The differential coding/decoding controls, which are located behind the ICF modem front panel (fig. 3-1), must be placed in the OFF position to perform the self-test. The differential coding/decoding controls in the MD-921/G are also behind the front panel and are placed in the ON positions to perform self-test. Therefore, the tasks of both the PSK and the ICF modem operatos will be simplified if the link is configured to use differential coding in the MD-921/G and no differential coding in the ICF modem.

2-6. Coding/Decoding Implementation

a. Operation of the ICF modem with the associated coders and decoders is illustrated in figure 2-9. Separate switches provide independent selection of the coding and decoding modes of operation These switches are tabulated below:

Switch	**Selection**
(Transmit) DIFF ENCODE	ON or OFF
TRANSMIT ERROR CODING	NONE or EXTERNAL
(Receive) DIFF DECODE	ON or OFF
RECEIVE ERROR CODING	NONE or EXTERNAL

b. The DIFF ENCODE and DECODE switches are

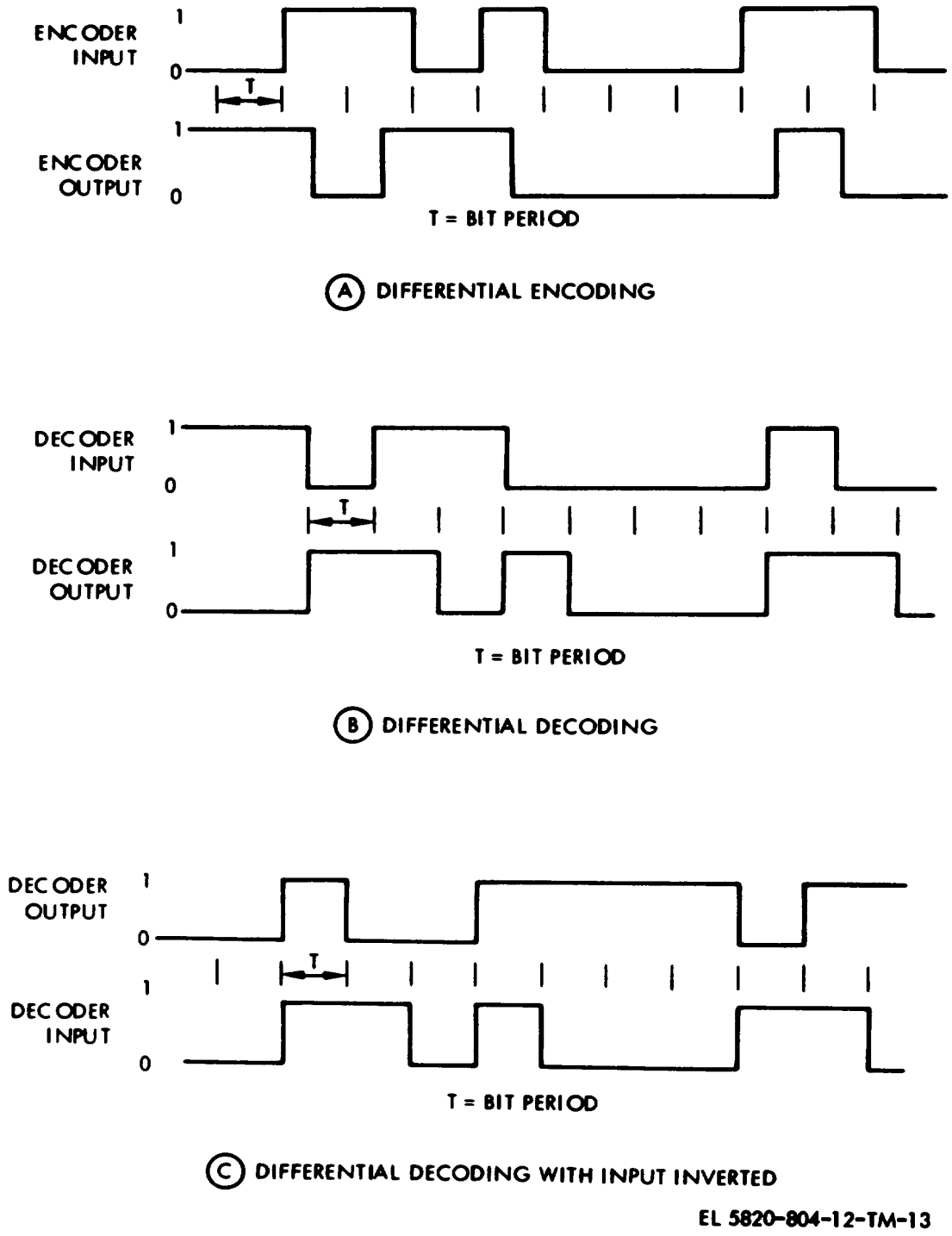


Figure 2-8. Differential encoding and decoding waveshapes.

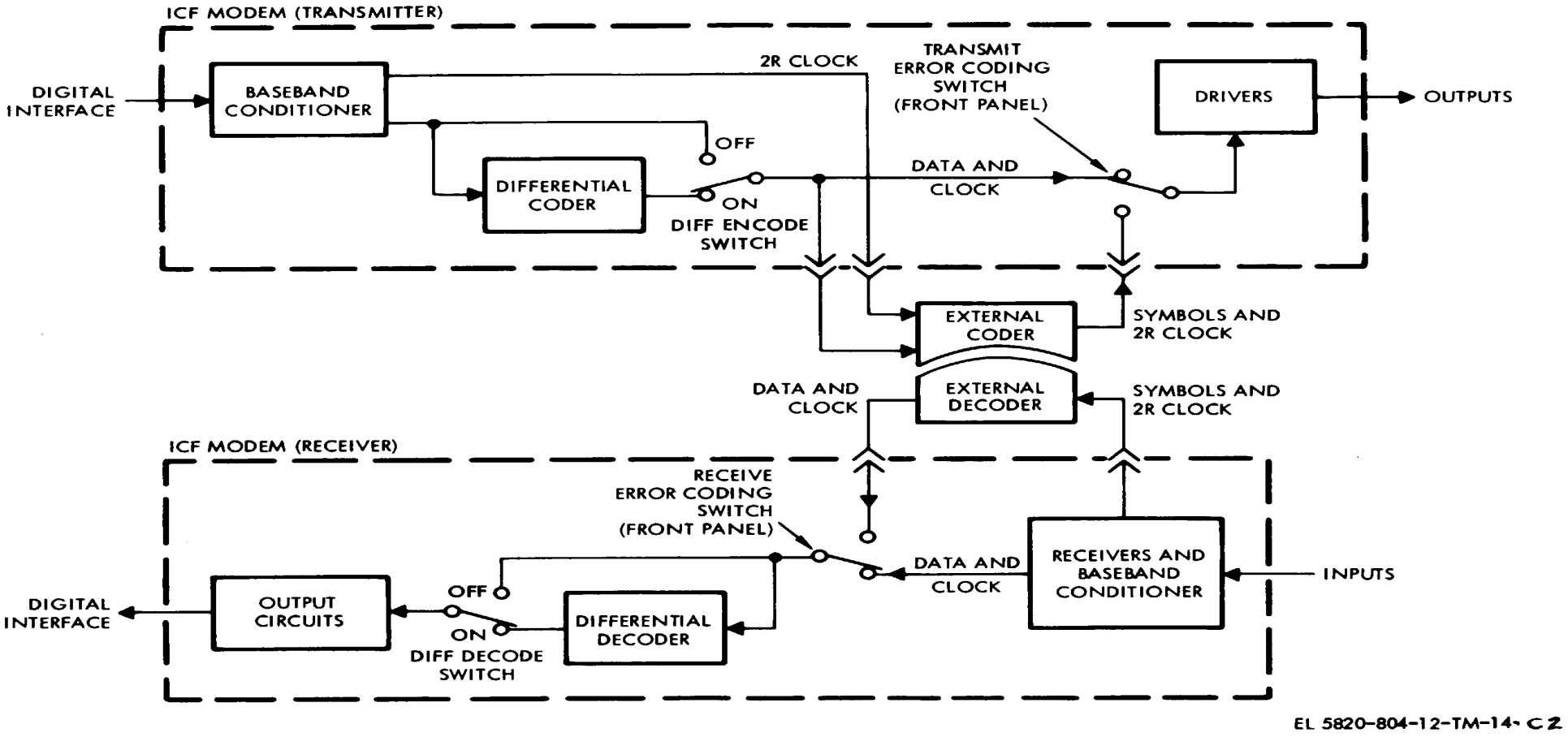


Figure 2-9. Coder/decoder signal paths.

normally placed in the OFF position.

c. Operation with no error-correcting coding is accomplished by setting the front panel TRANSMIT and RECEIVE ERROR CODING switches to NONE. Operation with an installed, external, error-correcting coder/decoder (KY-801/G) is selectable by the same switches. If an external coder/decoder is required, it should be installed near the ICF modem such that the intermediate cabling does not exceed 10 feet in length. The interconnect cable should use 75 ohm balanced lines (such as RG-108A/U) for best results. All external coder/decoder signals interface via one multipin rear panel connector, J6. Further information on the coder/decoder interface is included in paragraph 2-16. The interface uses line drivers and receivers manufactured by Texas Instruments, part numbers SN7510 and SN75109. The interface signal data/clock phase relationships are shown in figure 2-10. All input and output clock signals may be inverted by setting the appropriate internal switch (para 2-17).

d. The external coder produces two output symbols for each input data bit. Therefore, when transmit error-correcting coding is used, the symbol rate transmitted from the ICF modem is twice the data rate from the digital user.

e. As shown in figure 2-9, the baseband conditioner in the ICF modem transmitter operates directly on the data from the digital user. The ICF modem transmitter INPUT DATA RATE selection switches must always be set to the digital user's data rate.

f. The baseband conditioner in the ICF modem receiver operates on the symbols received from the interconnect facility link. The setting of the SYMBOL RATE switches for the ICF modem receiver depends on whether or not error-correcting coding is used in the ICF installation. If no receive error coding is used, the SYMBOL RATE switches are set to match the digital user's data rate. If external receive error coding is used, the SYMBOL RATE switches must be set to twice the digital user's data rate.

2-7. Direct Digital Interface

The ICF modem (fig. 2-11) interfaces with a digital user located near the modem. A direct digital interface via balanced line drivers and receivers is employed. The interface signals, which are available at rear panel site interface connector J5, are listed in a and b below.

a. Input Signals.

(1) The standard data input accepts data from the digital user for coding and transmission over the communications link. The ICF modem is capable of synchronizing an internal clock to the data input for use in the coder and transmitter operation (see description of controls and indicators, STD/CLK/ICF switch).

(2) Use of the standard clock input is optional. The ICF modem may be configured to use this input clock to control coding and transmission of the standard data input signal (see description of controls and indicators, STD/CLK/ICF switch). An internal switch in the ICF modem provides the capability of inverting this signal. See paragraph 2-17 for further details on operating this switch.

b. Output Signals. All direct digital outputs may be inverted by internal switches in the ICF modem. (See paragraph 2-17 for further details of switch settings. (1) The internal clock output is derived from an internal reference clock generator. This internally generated clock, which is equal in rate to the setting of the INPUT DATA RATE switches $\pm$0.005%, is provided to the digital user as an optional clock source.

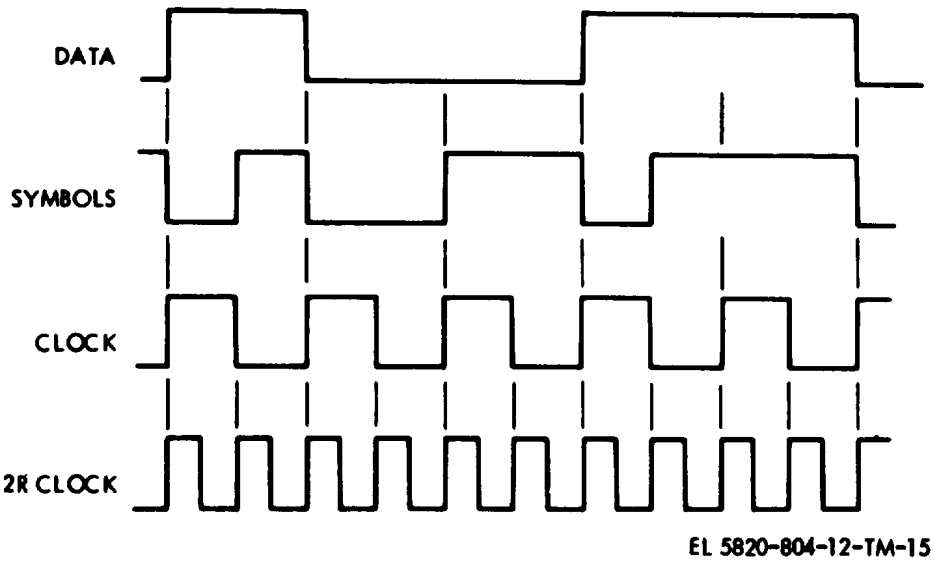


Figure 2-10. External coder/decoder interface phasing.

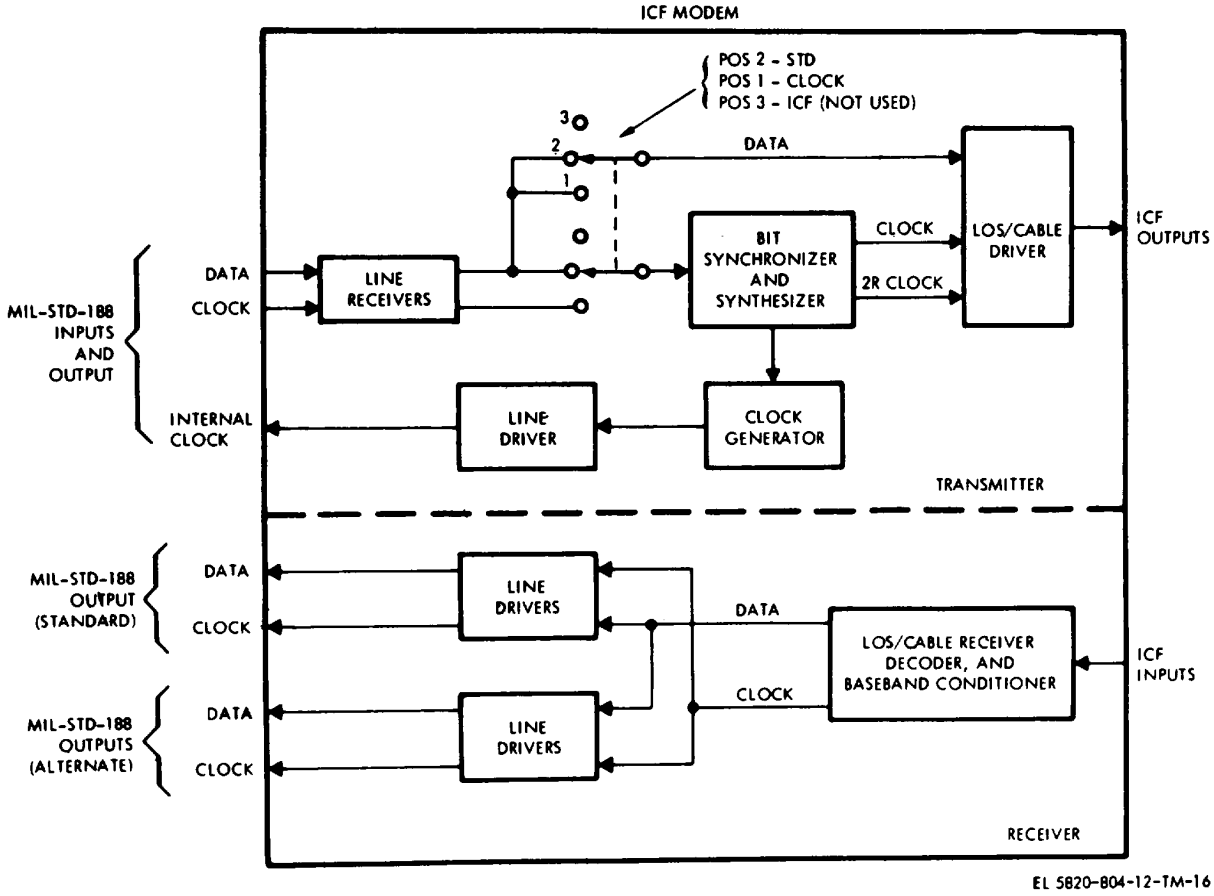


Figure 2-11. Digital user interface.

(2) The standard data output is that data which is received and decoded by the ICF modem receiver.

(3) The standard clock output is a clock signal which is synchronized with the standard data output and is internally regenerated by the ICF modem receiver.

(4) The alternate data and clock outputs are identical to the standard data and clock outputs. The input and output characteristics of the data and clock signals are illustrated in figures 2-12 and 2-13. All the input and output impedances are 75 ohms ± 10%. The following factors must be considered in planning the direct digital user interfaces:

(a) The use of 75-ohm balanced transmission cable, such as RG-108A/U is recommended (although not necessary for short runs).

(b) All direct digital outputs should be terminated with 75-ohm loads. Unused outputs should be terminated at the ICF modem rear panel connector.

(c) The length of cable which may be driven is a function of the data rate, the phase distortion of the cable used, and the loss of the cable type used.

a. Link Test. The ICF modem provides the capability, with adequate coordination between terminal sites, of measuring the quality of a digital communications link. The transmit link test setup (para 3-6) provides instructions for using the ICF Modem to transmit an internally-generated 2047 bit sequence over the interconnect facility to the satellite link. The receive link test procedure (para 3-7) provides instructions for using the ICF modem to receive this same sequence from the satellite link via the interconnect facility, perform an internal data comparison, and determine the error rate introduced in the link. If necessary, the test may be performed for communications transmitted from a site without disturbing the communications being received, and vice versa.

b. Site Test. If an earth terminal (or the MD-921/G) is configured to receive its own transmissions, the link

2-8. Test and Monitor Capabilities

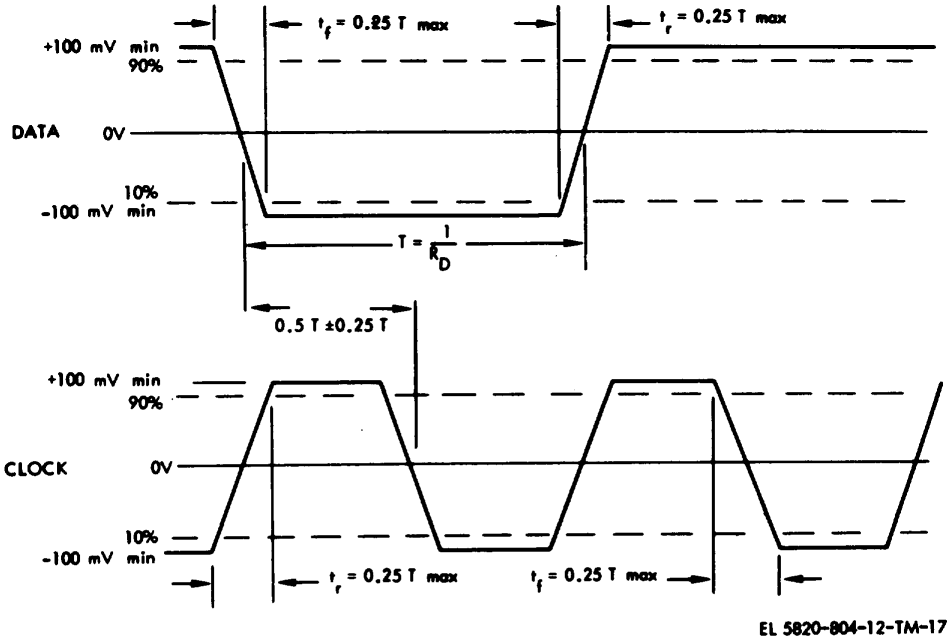


Figure 2-12. Standard data and clock input characteristics (normal polarity).

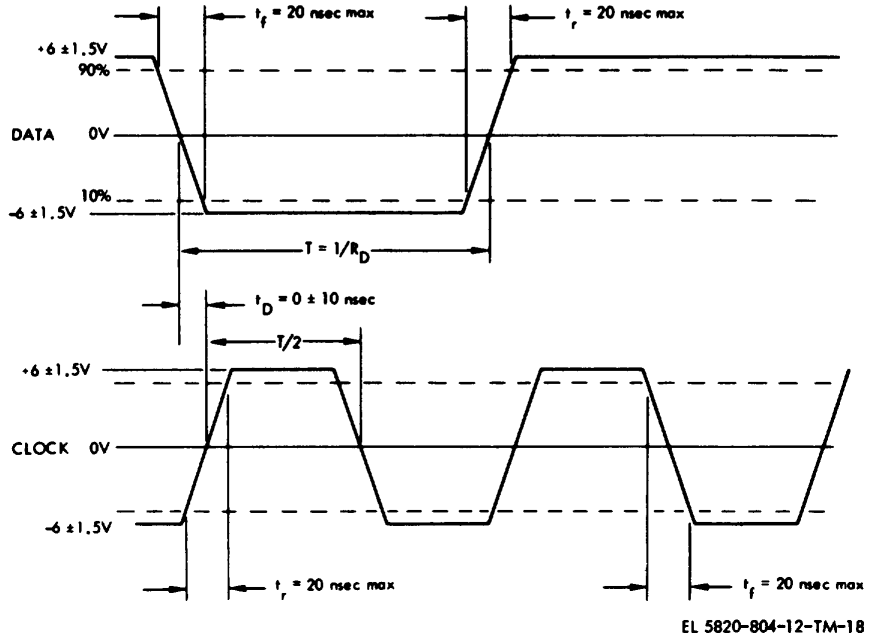


Figure 2-13. Open circuit standard data and clock output characteristics (normal polarity).

test capabilities of the ICF modem may be used to determine the operational status of the terminal and/or the interconnect facility.

c. Self-Test. The ICF modem contains internal self test circuits which play a major role in fault isolation! of the modem. In addition, this self-test capability provides a means of rapidly verifying modem operation to aid in isolating a communication system malfunction.

d. On-Line Fault Monitoring. The on-line fault indicators provide a means of monitoring various characteristics of the signals being processed by the system. See description of controls and indicators in para 3-2). The function of these indicators should be reviewed and utilized in the site operating and troubleshooting procedures.

2-9. Special Applications

The ICF input and output interfaces of the modem are compatible with each other. If desired, two ICF modems may be connected as shown in figure 2-14 to provide an interface between two digital users over either a shielded cable, a LOS microwave link or a FO cable link. The coding options may be used in this configuration.

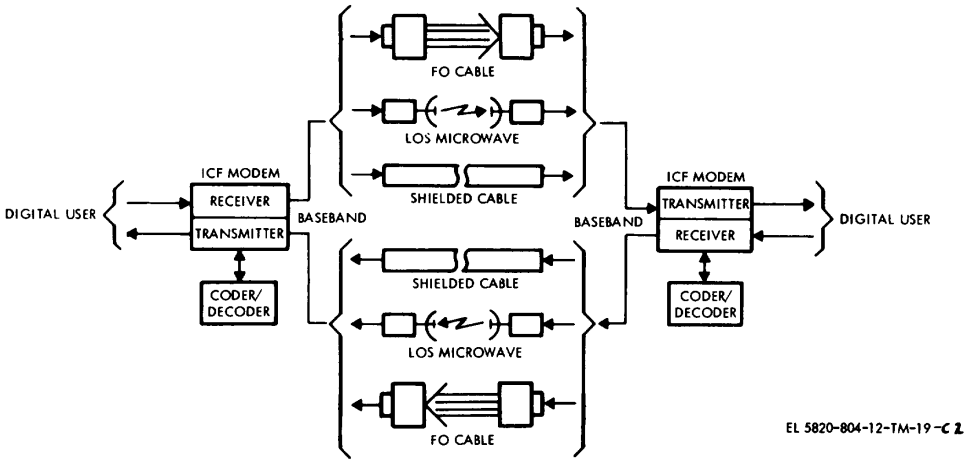


Figure 2-14. Two ICF modems used to interface two digital users.

Section II. SITE AND SHELTER REQUIREMENTS

2-10. Sitting

No specific siting requirements are required since the ICF modem is rack mounted and hardwire connected to the interconnect facility and the direct digital interace.

2-11. Shelter Requirements

The ICF modem is rack mounted in a standard 19-inch equipment rack. The modem weight is 60 pounds The dimensions required for installation are: height 12 1/4 inches, depth 22 inches in a standard 19-inch rack. The equipment is mounted on extendible slide rails. The mounting has the capability of tilting when extended for access to either the top or bottom of the equipment. A minimum of 30 inches clearance is required to extend and service the equipment in the rack. A side view of the ICF modem is shown in figure 2-15 for reference purposes. The air inlet areas are near the front of the unit on the top and bottom and the two exhaust fans are on the rear of the unit. The installation must allow free air flow through these areas.

Section III. SERVICE UPON RECEIPT OF MATERIAL

2-12. Unpacking

The ICF modem is packaged within wooden or cardboard containers and sealed with tape; no unusual unpackaging procedures need be observed. Be careful when removing the unit from the container to prevent damage to the equipment. Retain the packaging material for possible future use.

2-13. Checking Unpacked Equipment

a. Insert the equipment for damage incurred during shipment. If the equipment. has been damaged, report the damage on DD Form 6 (Packaging Improvement

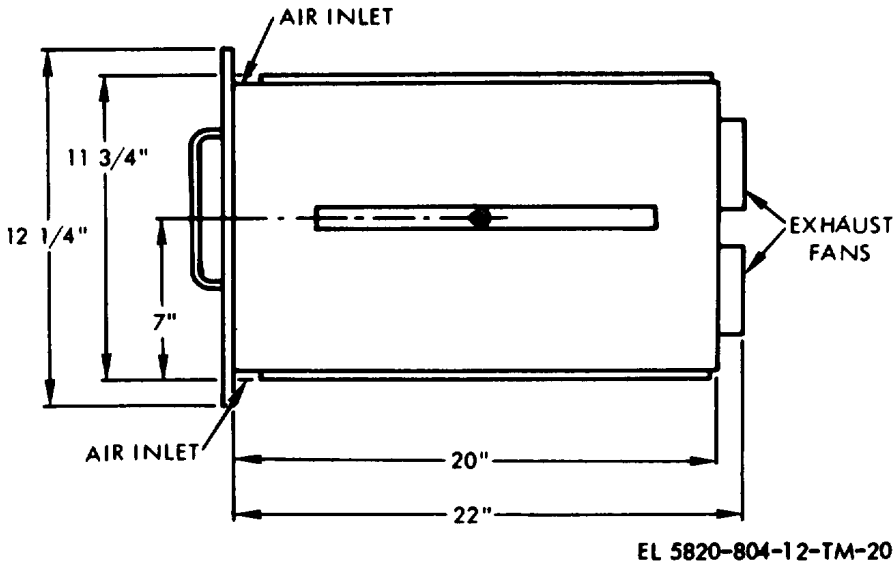


Figure 2-15. ICF modem overall dimensions.

Report) as prescribed in AR 700-58 (para 1-1c).

b. Check the equipment against the packing list shipped with the equipment to see if the shipment is complete. Refer to paragraph 1-10 for listing of ICF modem components. Report all discrepancies in accordance with DISREP instructions for SF 361 (para 1-3*c*). The equipment should be placed in service even though a minor assembly or part that does not affect proper functioning is missing or damaged..

c. Check to see whether the equipment has been modified. (Equipment which has been modified will have the MWO number near the nomenclature plate.)Check also to see whether all currently applicable MWO's have been applied. (Current MWO's applicable to the equipment are listed in DA PAM 310-7 as applicable.)

Section IV. INSTALLATION INSTRUCTIONS

2-14. Tools, Test Equipment, and Materials Required for Installation

Tools required for installation of ICF modem are contained in Tool Kit, Electronic Equipment TK-105/G (SC 5180-91-CL- R07). No test equipment or materials are required, other than the test equipment required by higher category of maintenance personnel for installation checkout and the Tektronix 485A oscilloscope required for circuit lineup.

2-15. Installation Instructions

CAUTION

To minimize possibility of personnel injury or equipment damage, two men are required to install or remove the modem.

The ICF Modem is shipped with the chassis half of Jonathan 110 QDP-22-1 (SM-A-571569-2) slides. The mating slide sections must be mounted in the rack prior to modem installation. To install the modem, de- press the retaining catches on the rack section of the slides and push modem into the cabinet. If a cable retractor is to be installed, it is recommended that a Jonathan CRS-25 (SM-A-571570-1) type be used. The electrical connections are given in paragraph 2-16. When dressing the cables, be sure adequate length is provided for pivoting the modem a full 90 degrees in both vertical directions from the normal position.

2-16. External Connections

a. When the ICF modem has been mounted in the equipment rack as described in paragraph 2-15, it must be interconnected into the system. This involves connecting input ac power, site interface, and coder interface at the rear panel of the ICF Modem (fig. 2-16). The reference designations and title of each interconnecting cable are listed in table 2-1.

b. The site and coder interface, J5 and J6, are multiconductor cables. Table 2-2 lists the signals carried by J5 while table 2-3 provides similar in- formation for J6.

c. Connections to ground terminals (E2 and E5)

depend on the site. If separate chassis and signal ground buses are provided in the rack, point-to-point connections should be made between the terminals and the respective buses. Connection at the signal ground (E5) is optional. In all cases, the chassis ground terminal (E2) should be connected to the site ground system as a safety precaution.

Table 2-1. ICF Modem Interconnections (fig. 2-16)

Reference designation	*Title*	*Connector*
J4	AC Power	(cable supplied)
J5	Site Interface	MS3126E24-61P with Glenier 90 0 Qwik-TY

Table 2-1. ICF Modern Interconnections (fig. 2-19)-continued

Reference designation	*Title*	*Connector*
J6	Coder/Decoder	GTR20S24B (SM-A-731358-2) MS3126E24-61PW With Glenier 90° Qwik-TY GTR20S24B (SM-A -731358-2)
CP1	LOS Input	BNC coaxial
E2	Chassis Ground	Terminal Lug
E5	Signal Ground	Terminal Lug

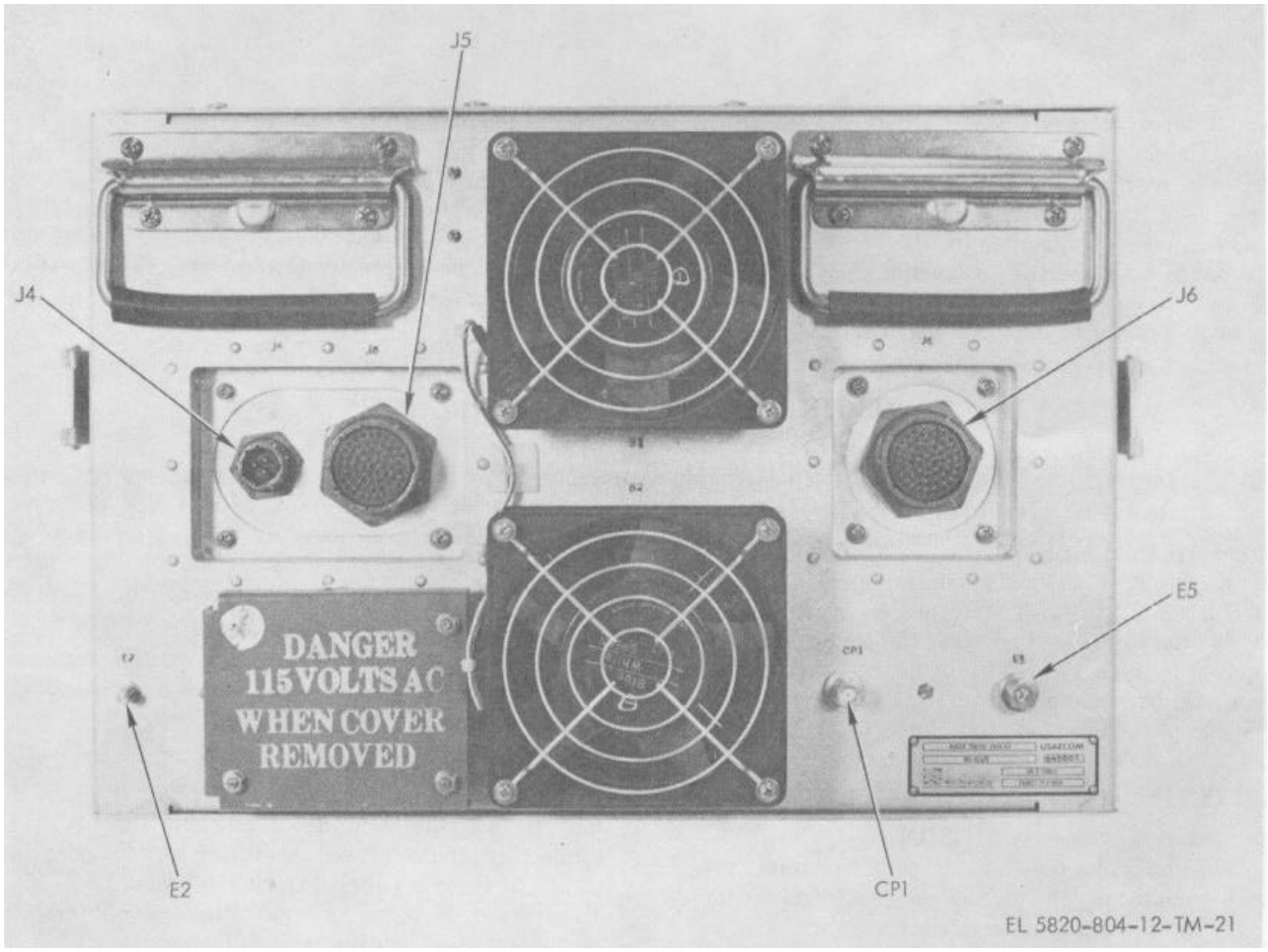


Figure 2-16. ICF modem rear view.

Table 2-2. Site Interface (J5) Signal List

Pin number	Signal		Description
A	+		Standard data input
B	-	INSTD	
d	Shield		
C	+		Standard clock input
D	-	INCLK	
e	Shield		
E	Sig .		Bipolar Nrz input.
F	Rtn.	ICFIN50	50 ohm, unbalanced
f	Shield		
J	Sig .		Bipolar NRZ input,
K	Ret.	ICFIN75	75 ohm unbalanced
	Shield		
L	+		Internal clock output
M	-	INTCLK	
k	Shield		
AA	EXTALM 1		Fault Alarm
BB	EXTALM 2		(contact closure)
DD	Sig.		
EE	Ret.	LOS OUT	LOS output
N	+		Standard data output
P	-	DATOUT	
m	Shield		
R	+		Alternate data output
S	-	ALTOUT	
n	Shield		
T	+		Standard clock output
U	-	CLKOUT	
q	Shield		
V	+		Alternate clock output
W	-	ALTCLK	
s	Shield		
X	Sig.		Bipolar NRZ output,
Y	ret.	ICFOU50	50 ohm. unbalanced
t	Shield		
Z	Sig.		Bipolar NRZ output,
a	Rtn.	ICFOU75	75 ohm, unbalanced
u	Shield		
b	+		Bipolar NRZ/NRZ output,
c	-	ICFOB75	75 ohm, balanced
v	Shield		
w	+		Bipolar NRZ/NRZ input,
x	-	ICFIB75	75 ohm, balanced
z	Shield		

Table 2-3. Coder Interface (J6) Signal List

Pin number	Signal		Description
v	+		2R clock to decoder
w	-	2RCKTD	
HH	Shield		
Z	+		R clock to decoder
b	-	RCKTD	
a	Shield		
JJ	+		Data from decoder
x	-	DATFD	
y	Shield		
KK	+		R clock from decoder
z	-	RCKFD	
AA	Shield		

2-17. Switch and Internal Control Settings

The internal switches are located on selected plug-in care assemblies in the ICF modem. The switches are screwdriver-operated and have either two or three switch positions. It is necessary to remove and replace one of the plug-in card assemblies to set the switches, but most of the switches may be operated without removing the card. Refer to figures 1-3 and 1-4 to determine card file locations and reference designations. The reference designations of the plug-in cards are marked on the card files next to each card location. Remove the ICF modem top cover, and set the internal switches as specified in the following paragraphs.

a. Set switch S1 on input interface card assembly A2A1A2A4 (fig. 2-17) for normal polarity (position 1) unless otherwise directed by the digital user (para 2-7*a*).

b. Set switches S1 and S2 on line driver card assemblies A2A1A1A21, A2A1A1A22, and A2A1A1A23 (fig. 2-18) for normal polarity (position 1) unless otherwise directed by the digital user (table 2-4 and para 2-7 *b*).

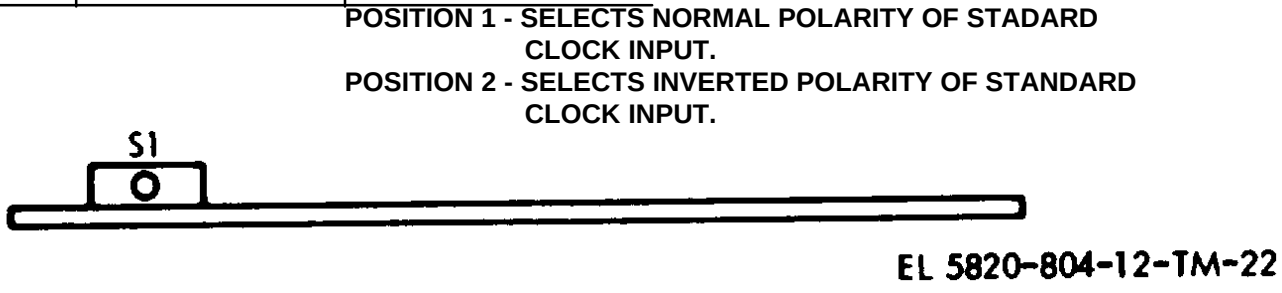


Figure 2-17. Standard clock input inverting switch S1 (viewed from top of input interface card, SM-D-742037, A2A1A2A4)

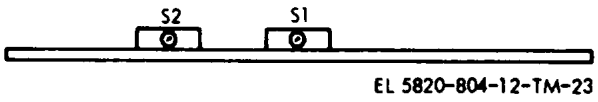


Figure 2-18. Line driver polarity inverting switches S1 and S2 (viewed from to of line driver card, SM-D-742053, A2A1A1A21, A2A1A1A22, or A2A1A1A23).

Table 2-4. Direct Digital Output Interface Polarity Selection

Switch	*Position*	*Function*
A2A1A1A21S1	1	Selects normal polarity of internal clock input.
	2	Selects inverted polarity of internal clock input.
A2A1A1A21S2	1	Selects normal polarity of NRZ driver output.
	2	Selects inverted polarity of NRZ driver output.
A2A1A1A22S1	1	Selects normal polarity of standard data output.
	2	Selects inverted polarity of standard data output.
A2A1A1A22S2	1	Selects normal polarity of standard clock output.
	2	Selects inverted polarity of standard clock output.
A2A1A1A23S1	1	Selects normal polarity of alternate data output.
	2	Selects inverted polarity of alternate data output.
A2A1A1A23S2	1	Selects normal polarity of alternate clock output
	2	Selects inverted polarity of alternate clock output.

c. Set switches S1 through S6 on coder interface card assembly A2A1A2A5 (fig. 2-19) for normal polarity (position 1) if an external coder/encoder is used in the installation (table 2-5 and para 2-6*b*).

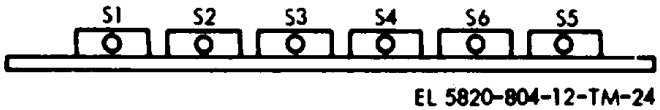


Figure 2-19. External coder interface clock inverting switches S1 through S6 (viewed from top of coder interface card, SM-D-742049, A2A1A2A5).

Table 2-5. External Coder/Decoder Interface Clock Polarity Selection

Switch	*Position*	*Function*
A2A1A2A5S	1	Normal polarity of 2R clock from external encoder.
	2	Inverted polarity of 2R clock from external encoder.
A2A1A2A5S2	1	Normal polarity of R clock from external decoder.
	2	Inverted polarity of R clock from external decoder.
A1A2A5S3	1	Normal polarity of R clock to external encoder
	2	Inverted polarity of R clock to external encoder.
A2A2A5S4	1	Normal polarity of 2R clock to external encoder.
	2	Inverted polarity of 2R clock to external encoder.
A2A1A2A5S5	1	Normal polarity of R clock to external decoder.
	2	Inverted polarity of R clock to external decoder.
A2A1A2A5S6	1	Normal polarity of 2R clock to external decoder.
	2	Inverted polarity of 2R clock to external decoder.

d. For interconnect facility interface via an LOS microwave link, set switch S1 on LOS/ cable driver card assembly A2A1A2A3 (fig. 2-20) for a -12 dBm output power level (position 2) at the LOS output. For earth terminal interface via a shielded cable, the final switch setting must be determined by coordination with the MD-921/G site in accordance with paragraph 2-3. Set the switch (A2AlA2A3SI) initially to position 2(table 2-6 and para 2-2*c*).

Figure 2-20. LOS/cable driver output level selection switch S1 (viewed from top of LOS/cable driver card, SM-D-742081, A2A1A2A3).

Table 2-6. Power Level Selection at LOS/Cable Driver Outputs

Switch	*Position*	*Function*
A2A12A3S1	1	Selects +23 dBm +3 dB output power level at cable driver outputs and + 1 dBm +3 dB output power level at LOS microwave driver output.
	2	Selects + 10 dBm +3 dB output power level at cable driver outputs and -12 dBm +3 dB output power level at LOS microwave driver output
	3	Selects 0 dBm + 3 dB output power level at cable driver outputs and -22 dBm +3 dB output power level at LOS microwave driver output

e. For interconnect facility interface via either a shielded cable or a LOS microwave link, set switches S1 through S4 on LOS/cable receiver and decoder card assembly A2A1A2A1 (fig. 2-21 and 2-22) according to table 2-7 and the installation configuration. Table 2-3 describes the switch functions. Set switches S1and S2 on the NRZ interface card to position 1 (para 2-17*f* describes this switching).

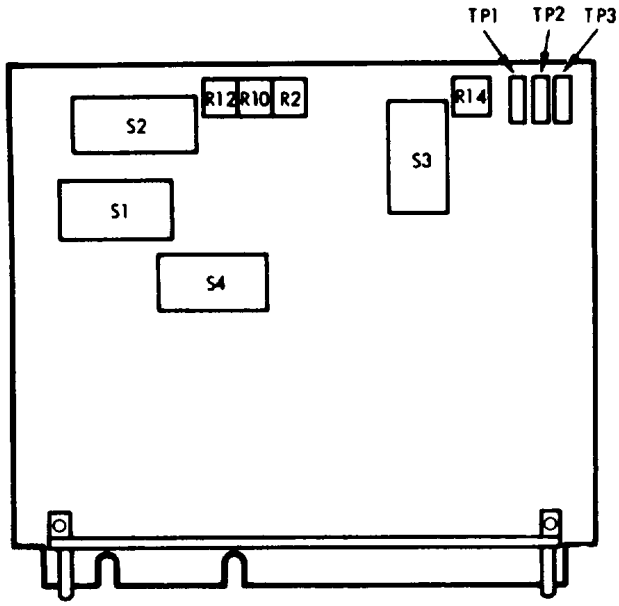


Figure 2-21. LOS/cable receiver and decoder selection switches S1 through S4 (viewed from component side of LOS/cable receiver decoder card SM-D-742089, A2A1A2A1).

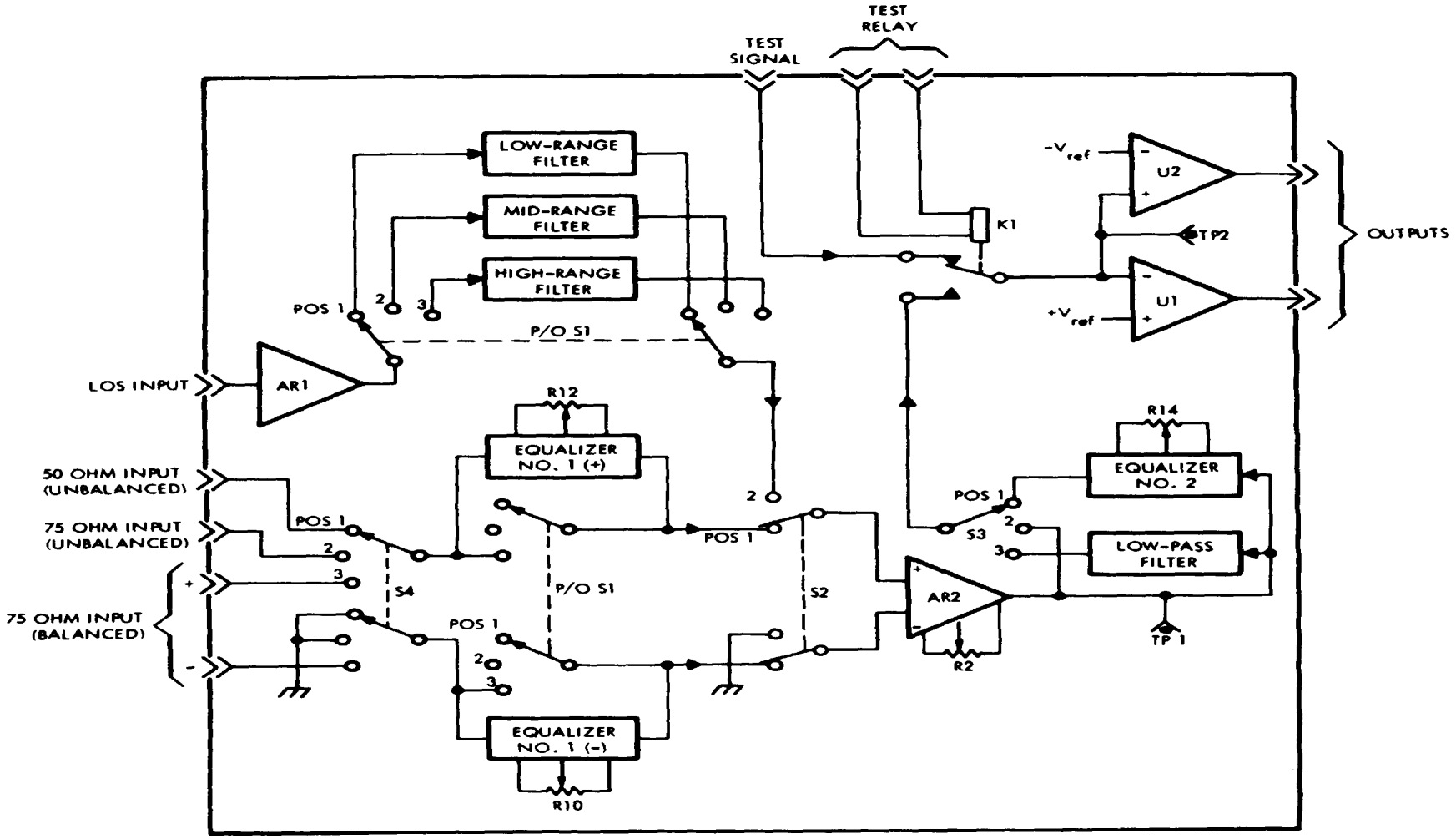


Figure 2-22. LOS/cable receiver and decoder adjustments.

Table 2-7. LOS/Cable Receiver and Decoder Switch Settings

Conditions		Switch settings on A2A1A2A1 S1	S2	S3	S4
LOS microwave interface	Symbol Rate 19.200 kb/s to 225.00 kb/s	1	2	3	NA
	Symbol Rate 225.01 kb/s to 1.8000 Mb/s	2	2	3	NA
	Symbol Rate 1.8001 Mb/s to 5.0000 Mb/s	3	2	3	NA
50-ohm unbalanced cable	Long	1	1	1	1
	Midrange	1	1	2	1
	Short	3	1	2	1
75-ohm unbalanced cable	Long	1	1	1	2
	Midrange	1	1	2	2
	Short	3	1	2	2
75-ohm balanced cable	Midrange	1	1	2	3
	Short	3	1	2	3

NOTES

Long cable > 4000 ft. for RG-217/U
Midrange cable = 1000 to 4000 ft. for RG-217/U
Short cable < 1000 ft. for RG-217/U
For classification of other cable types, see paragraph 2-3c

Table 2-8. Operation of LOS/Calble Receiver and Decoder Selection Switches

Switch	Position	Function
A2A1A2A1S1	1	Selects input filter for use at input data rates from 19.200 kb/s to 225.00 kb/s if LOD microwave input is used: selects no first stage of equilization if any cable input is used.
	2	Selects input filter for use at input data rates from 225.01 kb/s to 1.8000 Mb/s if LOS microwave input is used.
	3	Selects input filter for use at input data rates from 1.8001 Mb/s to 5.0000 Mb/s if LOS microwave input is used: selects use of first stage of equilization if any cable input is used.
A2A1A2A1S2	1	Selects operation with cable inputs.
	2	Selects operation with LOS microwave input.
A2A1A2A1S3	1	Selects use of second stage of equilization at decoder input.
	2	Selects use of no equilization or filtering at decoder input.
	3	Selects use of low pass filter at decoder input.
A2A1A2A1S4	1	Selects 50-ohm unbalanced cable input.
	2	Selects 75-ohm unbalanced cable input.
	3	Selects 75ohm balanced cable input.

Table 2-9. Operation of NRZ Interface Selection Switches

Switch	Position	Function
A1A1A2A2S1	1	Connects the 75-ohm balanced output of the LOS/cable driver to the 75-ohm balanced output of the ICF modem.
	2	Connects the output of the NRZ driver to the 75-ohm balanced output of the ICF modem.
A2A1A2A2S2	1	Connects the 75-ohm balanced input of the ICF modem to the 75-ohm balanced input of the LOS/cable receiver.
	2	Connects the 75-ohm balanced input of the ICF modem to the input of the NRZ receiver.

f. For interconnect facility interface via an FO NRZ cable link, set switches S1 and S2 on NRZ interface card assembly A2A1A2A2 to position 2. (Position 1 of switches S1 and S2 are used for LOS/ cable interfacing.) Figure 2-22.1 shows switch locations and table 2-9 describes switch functions.

2-18. Circuit Lineup

If the ICF modem installation requires interface with a remote digital user over either a shielded cable or a line-of-sight (LOS) microwave link, the LOS/cable receiver and decoder card must be configured to suit the system requirements. This is accomplished by setting the switches on the LOS/cable receiver and decoder card, shown functionally in figure 2-22, according to the instructions in paragraph 2-17. Then the card must be alined per the following procedure. (Refer to fig. 2-21 for location of controls and test points.)

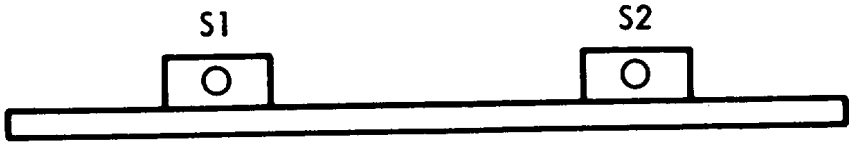


Figure 2-22.1 NRZ interface selection switches S1 and S2 (viewed from top of NRZ interface card, SM-d-877791, A2A1A2A2).

NOTE

It is recommended that any spare LOS/cable receiver and decoder cards (SM-D742089) provided to the site also be placed in the modem and aligned prior to placing the modem in service.

a. The initial adjustments are made at a data rate of 5.0000 Mb/s regardless of the normal system operating rate. Coordinate with the remote PSK Modem site to furnish a 5.0000 Mb/s data input.

b. Set all vaiable resistors (R2, R10, R12, R14) on the LOS/cable receiver and decoder and fully clockwise.

c. Adjust the oscilloscope for a 100 nsec/cm sweep and perform one of the following alinements depending on the site configuration:

(1) For an LOS input, use an oscilloscope to monitor TP1 on the LOS/cable receiver and decoder card (A2AlA2Al) and adjust R2 for an amplitude of 2.4 V p-p. Then monitor TP2 and, if necessary, readjust R2 for an amplitude of 1.2 V p-p.

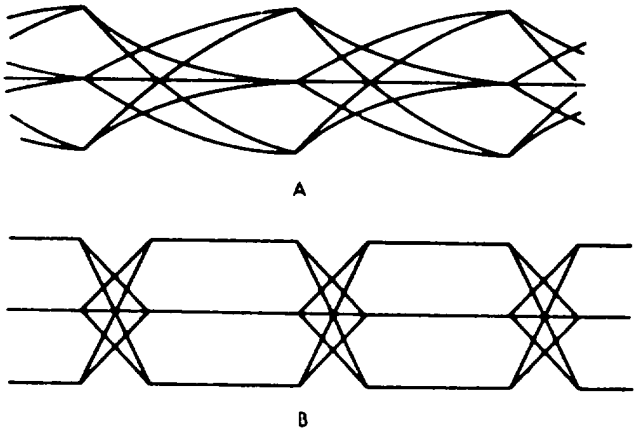
(2) For a short cable input, use an oscilloscope to monitor TP1 on the LOS/cable receiver and decoder card (A2AlA2Al). If the amplitude is greater than 2.0 V p-p., adjust R12 (and adjust R10 equally if the balanced input is used) to obtain an amplitude of 2.0 V p-p. After this adjustment, or if the initial amplitude was less than or equal to 2.0 V p-p, adjust R2 to obtain an amplitude of 2.4 V p-p. Then monitor TP2 and readjust R2 if necessary to obtain an amplitude of 1.2 V p-p.

(3) For a midrange cable input, use an oscilloscope to monitor TP1 on the LOS/cable receiver and decoder card (A2AlA2Al). If the amplitude is less than 2.4 V p-p, adjust R2 to obtain an amplitude of 2.4 V p-p. If the amplitude is greater than 2.4 V p-p. proceed even if the signal obviously causes saturation of the amplifier. Adjust the equalization by turning R12 (and adjust R10 equally if the balanced input is used) counterclockwise until a signal similar to B, figure 2-23 is observed. Because the amplitude will decrease, it may be necessary to increase the oscilloscope gain to observe this adjustment. Then adjust R2 to obtain an amplitude of 2.4 V p-p. Monitor TP2 and, if necessary, readjust R2 to obtain n amplitude of 1.2 V p-p.

(4) For a long cable input, use an oscilloscope to monitor TP1 on the LOS/cable receiver and decoder card (A2AlA2Al). If the amplitude is less than 2.4 V p-p, adjust R2 to obtain an amplitude of 2.4 V p-p. If he amplitude is greater than 2.4 V p-p. , proceed even f the signal obviously causes saturation of the amplifier. Adjust the first stage of equalization by turning t12 (and adjust'R10 equally if the balanced input is used) counterclockwise until a signal similar to A, figure 2-23 is observed. Because the amplitude will increase, it may be necessary to increase the oscilloscope gain to observe this adjustment. Then, adjust L2 to provide the maximum amplitude obtainable without causing saturation of the amplifier. Monitor TP2 and adjust the second stage of equalization by turning R14 counterclockwise until either a waveform similar to B, figure 2-23 is obtained or the amplitude decreases to 1.2 V p-p. If necessary, readjust R2 to obtain an amplitude of 1.2 V p-p.

d. Coordinate with the PSK modem site to return the operational data rate.

e. Monitor TP2 and, if necessary, readjust R2 to obtain an amplitude of 1.2 V p-p.



EL 5820-804-12-TM-28

Figure 2-23. Equalization waveforms.

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. CONTROLS AND INDICATORS

3-1. Damage from Improper Settings

To avoid damage to internal circuits of the ICF modem, be sure that the POWER switch is in the off position when prime power is applied.

3-2. Operator Controls, Indicators, and Connectors

The operator controls, indicators, and connectors are illustrated in figure 3-1 and described in table 3-1.

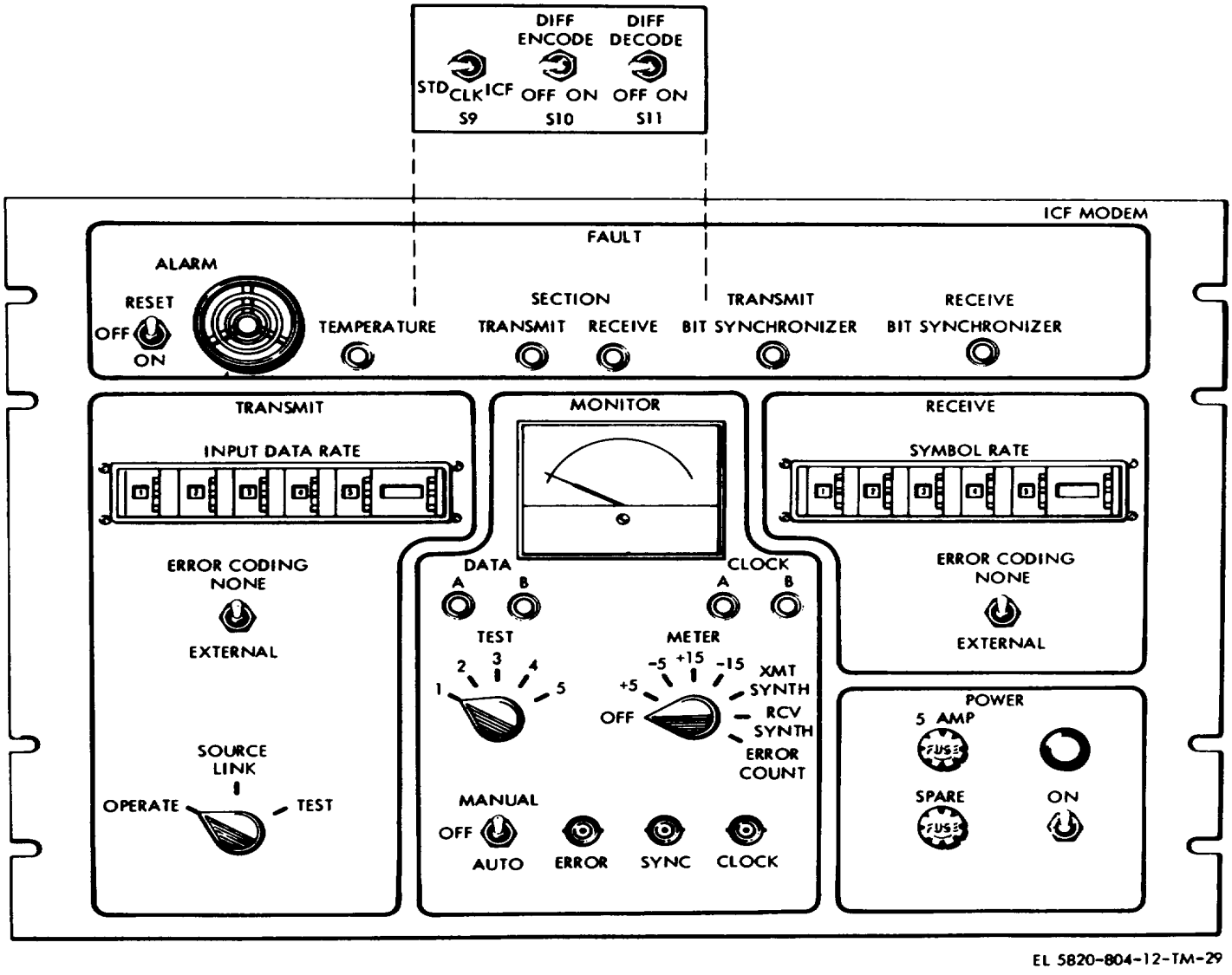


Figure 3-1. ICF modem, operator controls.

Table 3-1. Operator Controls, Indicators, and Connectors

Control, indicators, or connectors	*Function*
FAULT section	
ALARM	
RESET/OFF/ON, three position toggle switch	RESET-Resets fault detection circuits, and tests FAULT indicators and audible alarm. OFF-Disables audible alarm (except for overtemperature condition). ON-Audible alarm is enabled.
Audible alarm	Provides audible signal when a fault or overtemperature condition occurs.
TEMPERATURE indicator	Illuminates when an over-temperature condition exists.
SECTION	
TRANSMIT indicator	Illuminates when a fault occurs in the transmit section.
RECEIVE indicator	Illuminates when a fault occurs in the receiver section.
NOTE **The remaining FAULT Section indicators flash on and off to indicate an existing fault but remain illuminated after fault is cleared. These indicators are then extinguished when RESET/OFFION switch is set to RESET.**	
TRANSMIT	
BIT SYNC indicator	Indicates when a loss of transmitter bit synchronization occurs.
RECEIVE	
BIT SYNC indicator	Indicates when a loss of receiver bit synchronization occurs.
TRANSMIT section	
INPUT DATA RATE, thumbwheel switch, six sections. Section one-9 positions, sections two through five-10 positions and section six-3 positions.	Selects transmit data rate and internal clock output rate from 19.200 kbs to 5.0000 Mbh in three bands: Band 1-19.200 kb/s to 99.999 kb/s Band 2-100.00 kb/s to 999.99 kbs Band 3-1.0000 Mb/s to 5.0000 Mb/s
ERROR CODING, two position toggle switch	NONE-elects a straight through path without error correction encoding. EXTERNAL-elects an external encoder.
SOURCE, three position rotary switch	OPERATE-Connects the digital user's output data (which is selected by the STD/CLKACF switch) to the transmitter baeband conditioner input. Also disables the internal 2047 bit sequence generator. In this mode, the digital user's output data, coded or uncoded depending on the TRANSMIT ERROR CODING and the DIFF ENCODE switch settings, is transmitted to the satellite communications terminal. LINK-Connects the internal 2047 bit sequence generator output to the transmitter baseband conditioner input. In this mode, the 2047 bit sequence, coded or uncoded depending on the TRANSMIT ERROR CODING and the DIFF ENCODE switch settings, is transmitted to the satellite communications terminal. Digital user communications are interrupted on the transmit portion of the link. TEST-Connects the internal 2047 bit sequence generator output to the transmitter baseband conditioner input. In this mode, the 2047 bit sequence, coded or uncoded depending on the TRANSMIT ERROR CODING and DIFF ENCODE switch settings, is transmitted to the satellite communications link. The selected receiver is connected to a test signal from its companion drivers. The TEST switch is also enabled. Digital user communications are interrupted on both the transmit and receive portions of the link. and the data sent to the digital user will vary depending on the TRANSMIT section, RECEIVE section, and TEST switch settings.
MONITOR section	
MONITOR meter	Specific function of meter is dependent on position of METER switch.
METER, 8 position rotary switch	OFF-Disables meter + 5-Measures internal + 5 V dc supply voltage -5-Measures internal -5V dc supply voltage +15-Measures internal + 15 V dc supply voltage -15-Measures internal - 15V dc supply voltage XMT SYNTH-Checks phase detector output voltage in transmit frequency synthesizer. RCV SYNTH-Checks phase detector output voltage in receive frequency synthesizer. ERROR COUNT-Displays voltage proportional to error rate measured by internal error comparator. Scale factor is error rate (percent) = meter reading - 4. Function displayed depends on TRANSMIT SOURCE and TEST switch settings. 1. With the TRANSMIT SOURCE switch in the OPERATE or LINK positions, the error comparator monitors the standard data and clock outputs of the receiver. If the 2047 bit sequence (coded or uncoded) is received from the communi-

Table 3-1. Operator Controls, Indicators, and Connectors-continued

Controls, indicators, or connectors	*Function*
MONITOR section-Continued	
METER, 8 position rotary switch - Continued	cations link and the appropriate decoding is selected, the error comparator measures the bit error rate provided by the receive link. 2. With the TRANSMIT SOURCE switch in the TEST position, the error rate measurement depends on the TEST switch h setting.
DATA A and B indicators	Indicators illuminate to indicate the logic state present at internal error comparator date input. 1. DATA A on indicates a logic 1 2. DATA B on indicates a logic 0 The date monitored at the internal error comparator input is dependent on the TRANSMIT SOURCE, METER, and TEST switch settings.
CLOCK A and B indicators	Same as DATA indicators except that clock is monitored
TEST, five position rotary switch	Enabled by placing the TRANSMIT SOURCE switch in the TEST position, which also: 1. Connects the internal 2047 bit sequence generator to the transmitter baseband conditioner input. 2. Connects the LOS/cable receiver input to the LOSI cable driver output test signal. The TEST switch selects the data and clock input to the internal error comparator. Position 1-Connects the internal error comparator to monitor the internal 2047 bit sequence generator outputs. Position 2-nnects the internal error comparator to monitor the transmit bit synchronizer outputs. Position 3-nnects the internal error comparator to monitor the receive bit synchronizer outputs. Position 4-nnects the internal error comparator to monitor the standard data and clock outputs (end-to-end test) Position 5Connects the internal error comparator to monitor the alternate data and clock outputs.
MANUAL/OFF/AUTO, three position toggle switch	MANUAL-Causes internal error comparator to sample input data and synchronize comparator circuits.
MANUALOFF/AUTO, three position toggle switch-Continued	OFF-Disables automatic mode. AUTO-Activates automatic resynchronization of internal error comparator when error rate measurement exceeds 25 percent.
ERROR connector	Provides an output pulse from the internal error comparator for each bit error detected.
SYNC connector	Provides a sync pulse from the internal 2047 bit sequence generator (1/2047 of INPUT DATE RATE switch setting).
CLOCK connector	Provides the clock signal from the internal error comparator.
RECEIVE section	
SYMBOL RATE thumbwheel switch	Selects receive symbol rate of 19.200 kb/s to 5.0000 Mb/s in three bands: Band 1-19.200 Kb/s to 99.999 Kb/s Band 2-100.00 Kb/s to 999.99 Kb/s Band 3-1.0000 Mb/s to 5.0000 Mb/s
ERROR CODING, two position toggle switch	NONE-Selects a straight through path without error correction decoding. EXTERNAL elects an external decoder.
POWER section	
5 AMP fuse	Overload protection.
SPARE fuse	Spare 5 amp fuse.
Indicator	Illuminates when power is applied.
ON toggle switch	ON-Applies ac power to the ICF Modem.
Controls behind front panel	
STD/CLK/ICF switch	Enabled by placing the TRANSMIT SOURCE switch in the OPERATE position. Selects whether transmitter timing is derived from the input data or an input clock. STD-Select the direct digital (standard) data input for transmission and timing derivation. CLK Selects the direct digital (standard)data input for transmission and the direct digital clock input for timing derivation. ICF-Not used.
DIFF ENCODE, two position toggle switch	ON-Activates differential encoder in transmitter. OFF-Disables differential encoder in transmitter.
DIFF DECODE, two position toggle switch	ON-Activates differential decoder in receiver. OFF-Disables differential decoder in receiver.

Section II. OPERATION UNDER USUAL CONDITIONS

3-3. General

The ICF modem may be used for self-testing, link-testing or duplex digital communications. The required procedures are included in this section. Before acing the modem into operation, the site requirements must be reviewed, and the normal operational switch settings must be entered per table 3-2. purposes of the various modes are briefly described in following paragraphs.

a. Preliminary Starting Procedures. The preliminary starting procedure (para 3-4) prepares the modem for operation.

b. Self-Test. The self-test procedure (para 3-5) is performed to ensure the modem is operating properly. self-test is performed as a part of the routine modem maintenance cycle, the preliminary starting procedure, or upon request to aid in locating a communications system malfunction.

c. Transmit Link Test. The transmit link test Sara 3-6) is performed to determine the quality of the data received at the remote end of the link. This test is performed as a part of the routine site maintenance procedure, the site procedure for establishing a communications link, or upon request to aid in locating a communications system malfunction.

Table 3-2. Operational Switch Settings

Control section	*Switch*	*Setting*	*Notes*
FAULT	ALARM	———	Per site requirements
TRANS-MIT data	INPUT DATA RATE	———	Equal to digital user's output rate
	ERROR CODING	———	Per site requirements
	SOURCE	OPERATE	
MONITOR	TEST	1	
	METER	OFF	
	MONITOR	AUTO	
RECEIVE	SYMBOL RATE	———	Equal to digital user's input data rate with no receive error correction coding; equal to twice digital user's input data rate with receive error coding.
	ERROR CODING	———	Per site requirements
POWER	ON/OFF	ON	

Table 3-2. Operational Switch Settings -continued

Control section	*Switch*	*Setting*	*Notes*
Behind front	STD/CLK/ICF	———	per site requirements
panel	DIFF ENCODE	———	Per site requirements
	DIFF DECODE	———	Per site requirements

d. Receive Link Test. The receive link test (para B-7) is performed to determine the quality of the data received from the remote end of the link. This test is performed as a part of the routine site maintenance procedure, the site procedure for establishing a communications link, or upon request to aid in locating a communications system malfunction. Performing this test requires the PSK (or ICF) modem at the remote end of the satellite communications link to be set up or a transmit link test. This is generally accomplished either by direct request or by prior scheduling. Also, h earth terminal transmit/receive equipment may be arranged so that its own transmissions are received.

e. Normal Duplex Link Communications. Duplex link communications (para 3-8) is the normal mode of operation in which the modem provides the required interface between an earth terminal and a digital user.

3-4. Preliminary Starting Procedure

a. Prior to applying power to the ICF modem, set he following controls as indicated.

Control	*Position*
TRANSMIT SOURCE	LINK
TRANSMIT ERROR CODING	Normal operational setting (table 3-2)
INPUT DATA RATE	Normal operational setting (table 3-2)
ALARM	OFF

b. Set the POWER switch to the ON position, and allow 30 minutes for warmup.

NOTE

If mission requirements do not permit a proper warmup period, the modem can be operated (with possible degraded performance) immediately after application of power.

c. Perform a self-test per paragraph 3-5.

3-5. Self-Test

CAUTION

Performing self-test on a modem while the system is operating interrupts digital user communications on both the transmit and receive links.

a. If modem is nonoperating, perform the preliminary starting procedure (para 3-4).

b. Initiate the test by changing the modem switch settings as required to correspond to table 3-3.

Table 3-3. Self-Test Initial Switch Settings

Control section	*Switch*	*Position*
FAULT	ALARM	OFF
TRANS-	INPUT DATA RATE	Same as operational INPUT
MIT		DATA RATE (table 3-2)
	ERROR CODING	NONE
	SOURCE	TEST
MONITOR	TEST	1
	METER	OFF
	MANUAL/OFF/AUTO	AUTO
RECEIVE	SYMBOL RATE	Same as operational INPUT
		DATA RATE (table 3-2)
	ERROR CODING	NONE

Table 3-3. Self-Test Initial Switch Setting–continued

Control section	*Switch*	*Position*
POWER	ON/off	ON
	STD/CLK/ICF operational setting (table 3-2)	Same as
Behind upper front panel	DIFF ENCODE	OFF
	DIFF DECODE	OFF

c. Perform the self-test in accordance with table 3-4 following instructions:

(1) In the sequence shown on the table, set each front panel switch indicated in the first column to the corresponding setting(s) indicated in the second column.

(2) each switch setting, observe the indicator(s) listed in the third column, and verify the results required by the fourth column.

Table 3-4 . Self-Test Procedure

(Control section switch	*Setting*	*Indicator*	*Normal indication*	*Corrective action*
.....	.....	POWER ON	Illuminated	Replace lamp or fuse
(FAULT) ALARM	Hold in ALL FAULT RESET	Illuminated indicators	Replace lamp	
		Audible ALARM	Tone	Organizational maintenance (OM)
(FAULT) ALARM	Release to OFF	Audible ALARM	No tone	OM
		TEMPERATURE	Extinguished	OM
(MONITOR) METER	+5	Meter	46TO54	OM
	-5 Meter	46TO54	OM	
	+15	Meter	46TO54	OM
	-15	Meter	46TO54	OM
	XMITSYNTH	Meter	40 to 60	OM
	RCVSYNTH	Meter	40TO60	OM
	ERROR COUNT	.....	.....	.....
(MONITOR) TEST	1	Meter	0	OM
		All MONITOR Indicators	Illuminated	OM
	2	Same as above	No change	OM
	3	Same as above	No change	OM
	4	Same as above	No change	OM
	5	Same as above	No change	OM
(FAULT) ALARM	RESETALL FAULT (momentary)	Extinguished indicators	OM	

d. If operational INPUT DATA RATE (table 3-2) is not the same as operational SYMBOL RATE, set both switch groups to the operational SYMBOL RATE and repeat procedures of table 3-4.

e. If either the DIFF ENCODE or DIFF DECODE switch is operationally set to ON, set both these switches to ON and verify that MONITOR meter indicates O and that DATA and CLOCK indicators are illuminated.

f. If both ERROR CODING switches are operationally set to NONE (table 3-2) omit procedures of table 3-5.

g. If the RECEIVE ERROR CODING switch is operationally set to EXTERNAL, set both ERROR.

CODING switches to that position, set SYMBOL RATE switches to operational positions, and set INPUT DATA RATE switches to one-half the operational SYMBOL RATE. Then perform the coder test in accordance with table 3-5.

h. If the TRANSMIT ERROR CODING switch is operationally set to EXTERNAL, set both ERROR CODING switches to that position, set INPUT DATA RATE switches to operational positions, and set SYMBOL RATE switches to twice the INPUT DATA RATE. Then perform (or repeat) the coder test in accordance with table 3-5.

Table 3-5. Coder/Decoder Test Procedure

(Control section) switch	*Setting*	*Indicator*	*Normal indicator*	*Corrective action*
(MONITOR) TEST	5	.....	.....	
(MONITOR) METER	ERROR COUNT	Meter 2		OM
		All MONITOR indicators	Illuminated	OM
FAULT ALARM	RESET (momentary)	AS FAULT indicators	Extinguished	OM

i. If at any point in the self-test or coder test the required indication does not appear, perform corrective action or refer the problem to organizational maintenance as indicated by an OM in the Corrective action column.

3-6. Transmit Link Test

a. The following modem setup procedure allows the terminal at the other end of the satellite communications link to perform a receive link test (para 3-7. See paragraph 3-3 c for the transmit link test requirements.

CAUTION

Performing this test interrupts digital user communication on the transmit link.

b. If modem is nonoperating, perform the preliminary starting procedure (para 3-4).

c. Set the following controls as indicated:

Control	*Position*
TRANSMITSOURCE	LINK
TRANSMIT ERROR CODING	Normal operational setting (table 3-2)
INPUT DATA RATE	Normal operational setting (table 3-2)
DIFF ENCODE	Normal operational setting (table 3-2)
ALARM	OFF

d. Momentarily depress the fault ALARM switch to RESET. Verify the TRANSMIT SECTION and the TRANSMIT BIT SYNCHRONIZER fault indicators are extinguished when the switch is released.

e. Maintain control settings for time period required b site procedures or schedule.

3-7. Receive Link Test Procedure

a. See paragraph 3-3 d for receive link test requirements.

b. If the modem is nonoperating, perform the preliminary starting procedure (para 3-4).

c. If the transmit communications link is in normal operation, retain the TRANSMIT SOURCE switch in the OPERATE position; otherwise, set the TRANSMIT SOURCE switch to the LINK position.

d. Set the following controls as indicated::

Control	*Position*
SRECEIVE ERROR CODING	Normal operational setting (table 3-2)
SYMBOL RATE	Normal operational setting (table 3-2)
DIFF DECODE	Normal operational setting (table 3-2)
METER	ERROR COUNT
MANUAL/OFF/AUTO Monitor)	AULTO

e. When the modem at the other end of the communications link has been set up for the transmit link test (para 3-6), determine the error rate of the link by one of the three following methods and verify the error rate is within the requirements of the site procedures.

(1) Observe the meter indication.

NOTE

Error Rate (percent) = meter reading÷4

(2) Connect an electronic frequency counter to the ERROR connector on the front panel. Adjust the counter interval as required to make the measurement.

NOTE

$$\textbf{Error rate} = \frac{\textbf{error count}}{\textbf{data rate x counter interval (second)}}$$

Data rate = SYMBOL RATE if RECEIVE ERROR CODING switch is set to NONE.

Data rate = SYMBOL RATE - 2 if RECEIVE ERROR CODING switch is set to EXTERNAL.

(3) Couple the 7002 error rate counter to the ICF modem by connecting the ERROR connector on the ICF modem front panel to the ERRORS connector on the error rate counter front panel, and connecting the CLOCK connector on the ICF modem front panel to the CLOCK connector on the error rate counter front panel. On the error rate counter, place the START.

switch o the AULTO BLANK position, the STOP switch to the ERROR 10^3 position, and turn the POWER/DISPLAY control fully clockwise. The ERROR COUNT display of the error rate counter provides a direct readout of the bit error rate.

NOTE

If an OVERFLOW indication instead of a valid bit error rate appears on the ERROR COUNT display, set the STOP switch to a lesser setting and repeat the error rate measurement

3-8. Normal Duplex Link Communications Procedures

a. If modem is nonoperating perform the preliminary starting procedure (para 3-4..

b. Set the ALARM switch OFF and other modem controls per table 3-2.

c. Momentarily depress the FAULT switch to RESET. Verify all FAULT indicators are OFF when switch is released.

d. Set the ALARM switch per table 3-2.

3-9. Stopping Procedure for Standby Condition

If the modem must be maintained in a standby condition (POWER ON), set SOURCE switch to LINK position to modulate the earth terminal output carrier. This operation reduces the possibility of intermodulation products interfering with other satellite users.

3-10. Stopping Procedure for Shutdown

The modem is switched to shutdown condition by setting the POWER ON switch to the off (downward) position.

CHAPTER 4

OPERATOR/CREW MAINTENANCE INSTRUCTIONS

Section I. OPERATOR/CREW TOOLS AND EQUIPMENT

4-1. Scope of Operator/Crew Maintenance

The maintenance duties assigned to operator/crew for the ICF modem consist of cleaning, inspection, checks and services, and replacement of fuse, indicators and lenses.

4-2. Test Equipment and Material Required For Operator/Crew Maintenance

Material required for cleaning are lint-free cleaning cloths, a soft-bristle brush, and trichloroethane. No test equipment is required for system tests.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

4-3. General

To insure that the ICF modem is always ready for operation, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services to be performed while the modem is not operating are listed and described in table 4-1. Preventive maintenance procedures to be performed while the modem is operating are listed in table 4-2. Defects discovered during operation of the unit will be noted for future corrections to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment. Record all deficiencies, together with the corrective action taken, on DA form 2404 (TM38-750).

NOTE

If the equipment must be kept in continuous operation, check and service only those items that can be accomplished without disturbing operation. As soon as the equipment can be shut down, perform all the required checks and services before returning the equipment to operation.

Table 4-1. Preventive Maintenance Checks and Services-Weekly Schedule (Modem Not Operating)

Switch no.	Indicator Required	Procedure	Reference
1	Rack and modem	Check for completeness and and general condition	Refer to organizational maintenance if parts are damaged or missing. See paragraph 4-5 for cleaning instructions.
2	Indicators and switches	Check to see that switches (except for POWER/ON switch) operate freely	Replace defective indicator lamps or lenses refer to organizational maintenance if switches are damaged
3	Thumb wheel switches	Check to see that switches operate freely.	If switches appear damaged, refer to organizational maintenance
4	Meter	Check to see that meter front is clean and undamaged.	See paragraph 4 -5 for cleaning instructions. Refer to organizational maintenance if meter appears damaged.
5	Blowers	Perform the preliminary starting procedure (para 3-4)and verify that blowers are operating.	Refer to organizational maintenance if blowers do not operate.
6	Modem operation	Perform the self-test (para 3-5).	Refer to organizational maintenance as indicated by the self-test tables.

Table 4-2. Preventive Maintenance Checks and Services - Weekly Schedule (Modem Operating)

Switch no.	Indicator Required	Procedure	Reference
1	Rack and modem	Inspect for completeness and general condition.	Refer to organizational maintenance if parts are damaged or missing.
2	Indicators and blowers	Check to see that the POWER ON, DATA, and CLOCK indicators are illuminated. Check that blowers are operating.	Replace defective indicators or lenses. Refer to organizational maintenance if items are damaged or not operating.
3	Meter	Check to see that meter front is clean and undamaged.	See paragraph 4-5 for cleaning instructions. Refer to organizational maintenance if meter appears damaged.

Table 4-2. Preventive Maintenance Checks and Services-Weekly Schedule Modem Operating)-continued

Switch Setting	Indicator Required	Procedure	Reference
4	Operation	Perform operational checks (para 4 -4).	Refer to organizational maintenance if required indications are not present.

4-4. Operational Checks

The following procedure, when properly performed, does not interrupt digital traffic. Do not disturb any control settings except as directed in the procedure. In the sequence shown in table 4-3, set the front panel switch listed in the first column to each position listed in the second column. For each switch position, observe the indicator(s) listed in the third column, and verify proper operation as specified in the fourth column. If the required indication is not obtained, perform the corrective action or refer the problem to higher category of maintenance as indicated in the final column. Upon conclusion of the test, return the ALARM and METER switches to their normal operating positions.

Table 4-3. Operational Checks

Switch	Setting	indicator	Required indication	Corrective action
		POWER ON	Illuminated	Replace lamp
		ALL MONITOR indicators	Illuminated	Replace lamp
ALARM	Hold in	All FAULT	Illuminated	Replace lamp
RESET/OFF/ ON	RESET	indicators Audible alarm	Tone	Organizational maintenance

Table4-3. Operational Checks-continued

Switch ALARM	Setting Release to	Indicator All FAULT	Required indication Extinguished	Corrective action Organizational maintenance
RESET/OFF/ ON	OFF	indicators Audible alarm	No tone	Organizational maintenance
METER (function select switch)	+ 5	MONITOR meter	46 to 54	Organizational maintenance
	-5	MONITOR meter	46to54	Organizational maintenance
	+ 15	MONITOR meter	46 to 54	Organizational maintenance
	-15	MONITOR meter	46 to 54	Organizational maintenance
	XMIT SYNTH	MONITOR meter	40 to 60	Organizational maintenance
	RCV SYNTH	MONITOR meter	40 to 60	Organizational maintenance

4-5. Cleaning

a. Remove dust and loose dirt with a clean soft lint free cloth.

b. Remove dust, dirt, and other foreign matter from all plugs and jacks with a soft bristle brush.

WARNING

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable, but exposure of the fumes to an open flame converts the fumes to highly toxic, dangerous gases.

c. Remove grease, fungus, and ground in dirt. with a lint-free cloth dampened with trichloroethane.

CHAPTER 5

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

5-1. Scope of Organizational Maintenance

The maintenance duties assigned to organizational maintenance personnel for the ICF modem consist of inspection, testing, and replacement of fuse and lamp sockets, switches, alarm buzzer, and meter. The organization maintenance personnel will also rerun operator tests that indicated malfunctions to verify need for referral to direct support maintenance.

5-2. Test Equipment and Material Required for Organizational Maintenance Services

The tools required for organizational maintenance are contained in Tool Kit, Electronic Equipment TK-105/G. A Simpson 270 Multimeter is required for voltage age and continuity checks. The Fluke 8000A-01 Digital Voltmeter, Protolab 7920 card puller, and SM-D-759649 card extender are required for power supply adjustment.

Section II. ORGANIZATIONAL MAINTENANCE PREVENTIVE MAINTENANCE CHECKS AND SERVICES

5-3. Preventive Maintenance Checks and Services (PMCS)

Preventive Maintenance Checks and Services (PMCS) are essential to the operation of the ICF modem and to prevent possible damage that might occur through neglect or failure to observe warning symptoms in a timely manner.

- Always keep in mind and observe WARNING S and CAUTIONS contained in this technical manual and plates installed on the equipment that are associated with the functions you are about to perform. Perform our monthly PMCS from table 5-1.

- If your equipment fails to operate, troubleshoot within your capabilities. Report any deficiencies as appropriate using the proper form as specified in DA Pam 738-750.

NOTE

Within designated intervals these checks are to co be performed in the order listed.

If the equipment must be kept in continuous operation, check and service only those items that can be checked and serviced without disturbing operation. Make the checks and services when the equipment can be shut down.

Table 5-1. Preventive Maintenance Checks and Services (PMCS)

Items	to be inspected	Procedures check and have repaired or adjusted as necessary
1	Thumbwheel switches	Operate each position of switches at least five times to effect a self-cleaning wiping action of internal contacts. Dirty switches are suspected. Refer to paragraph 5-1i1.

5-4. Painting Instructions

a. The organizational maintenance repainting responsibility is limited to paint touchup of minor control panel scratches. No refinishing is required.

CAUTION

Do not apply paint to any area of the modem except the control panel front and edges.

b. When retouching is required, the paint type required for use is No. P515E per MIL-F-14072. Refer to TB 43-0118 Field Instructions for Painting and Preserving Communications-Electronics Equipment.

Section III. ORGANIZATIONAL MAINTENANCE TROUBLESHOOT!NG AND REPAIR

5-5. Troubleshooting

Organizational maintenance troubleshooting of the modem is required when as apparent malfunction equipment damage is reported by the operation crew. Organizational maintenance troubleshooting actions are detailed in table 5-2. Any trouble that is beyond the scope of organizational maintenance.

Table 5-2. Troubleshooting

	Malfunction	Probable cause	Corrective action
1.	Equipment damage.	Mishandling.	Paragraph 5-5
2.	Required indicator does not illuminate during self-test (indicator replacement does not remedy).	a. Operator error. b. Faulty wiring c. Damaged indicator socket.	Paragraph 5-6
3.	Fault alarm does not sound during self-test.	Alarm buzzer defective.	Paragraph 5-6
4.	Meter indicates incorrectly during self-test.	Meter defective.	Paragraph 5-6
5.	Blower(s) not operating.	Blower defective.	Paragraph 5 -7
6.	Other malfunctions.	a. Cards or connectors not properly seated. b. Power supply out of adjustment. c. Thumbwheel switch assembly defective.	Paragraph 5-8 Paragraph 5-9 Paragraph 5-10

Section IV. MAINTENANCE

WARNING

115V ac is present within the ICF modem. Perform all possible maintenance with power removed. If necessary to perform, operations with covers removed and power on, be extremely careful to avoid contact with high voltage.

5-6. Equipment Damage Repair

Organizational repair is limited to replacement of fuse holders, indicator sockets, meter, and switches except for A1S5. If any of these items are damaged, remove cover, tag leads, and replace the damaged component. Reconnect leads, reinstall cover, and perform self-test (para 3-5) to verify operability. Refer to higher category of maintenance any damaged items the repair which is beyond the scope of organizational maintenance.

NOTE

Most maintenance actions involving front panel components require that power supply 2PS1 be removed to facilitate access to the components. Refer to paragraph 5-12 for power supply removal and reinstallation procedures.

5-7. Self-Test Failure

If the modem fails to provide a specified indication during self-test, carefully repeat the test in its entirety to sure that the apparent failure was not caused by operator error. If an indicator fails to illuminate when specified and lamp replacement does not effect a remedy, remove cover and check for loose or broken or damaged socket. Repair or replace as required.

If the fault alarm fails to sound when specified, recover and connect VOM to verify that + 5V dc is present at positive lead to alarm buzzer. If voltage is present short negative lead of buzzer to ground. If buzzer does not then sound, replace the alarm buzzer. If meter operation is erratic or consistently reads high or low, replace meter. If the above maintenance actions fail to correct the malfunction or if the self-test failure symptom is other than those listed, perform procedures of paragraphs 5-9 through 5-11. If failure symptoms remain, refer the malfunction to direct support.

5-8. Blower(s) Not Operating

If both blowers are not operating, check for 115V ac between terminals E7 and E8. If voltage is not present, refer to direct support. If a single blower is not operating, omit the voltage check and replace the inoperative blower.

5-9. Card or Connectors Not Properly Seated

Remove power and remove top cover. Inspect that all cards are flush with one another in the files. Check to see that each card is properly emplaced in its card guides. Inspect all connectors to insure that they are properly seated.

5-10. Power Supply Out of Adjustment

a. Remove power and remove the top and bottom cover of the modem.

b. Remove the alarm circuits card, A2A1A2A10 and install the card extender in its place.

c. Using the digital voltmeter to monitor the ap-

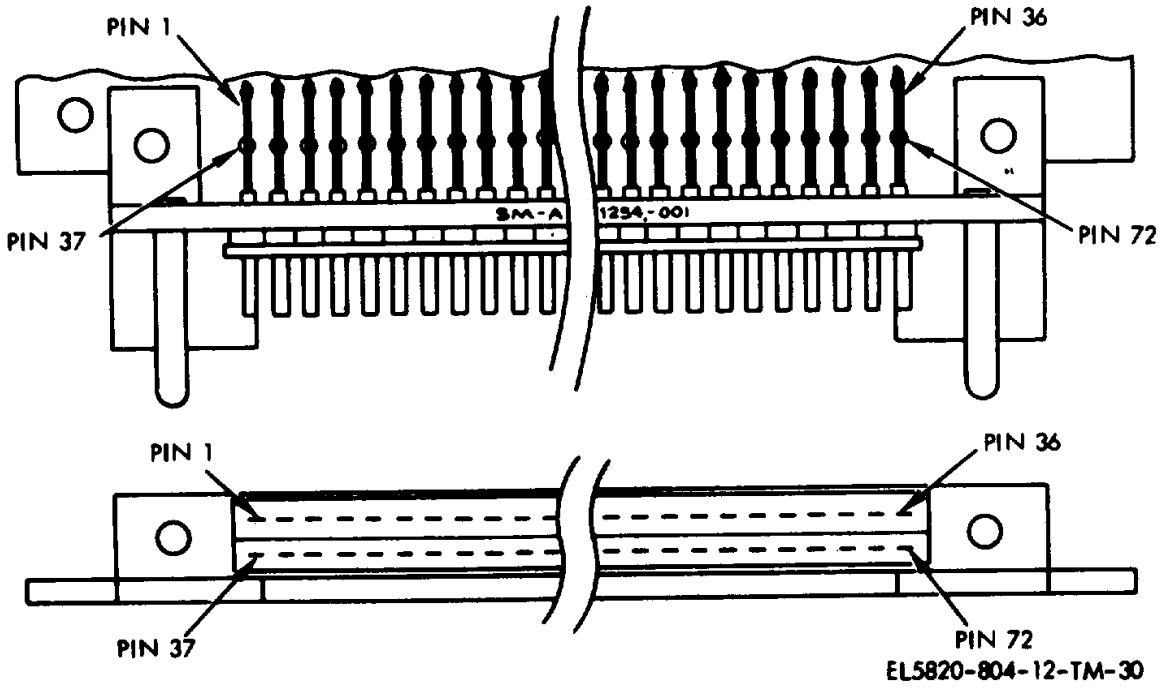


Figure 5-1. Typical PC card pin locations.

propriate connector pin (fig. 5-1), adjust each power supply (A2PS1) voltage as required to obtain outputs within the limits of table 5-2. The voltage adjustments are located within the power supply, and each access hole is clearly marked to indicate the voltage controlled by the adjustment.

NOTE
All voltage returned to A2E2.

Table 5-3. Power Supply Measurements

Voltage	Limits	Connector pin
+5V	+4.95 to +5.05V	A2A1A2A9-47
-5V	-4.95 to - 5.05V	A2A1A2A9-48
+15V	+ 14.98 to + 15.02V	A2A1A2A9-13
-15V	-14.98 to -15.02V	A2A1A2A9-15

5-11. Thumbwheel Switch Assembly Defective

If trouble symptoms indicate that modem is not operating at selected data or symbol rates, a continuity check of the thumbwheel switch assemblies (fig. 5-2) per table 5-4 will determine whether these assemblies are functioning properly. If continuity per the table is not obtained, replace the defective switch assembly. If continuity per the table is established and trouble symptom remains, refer to higher category of maintenance.

a. Remove power and modem top cover.

b. Check switch continuity in each dial position in accordance with table 5-4.

Table 5-4. Thumbwheel Switch, Truth Tables

Switch S1 Common X(•), Y(o) connected to terminal					Switches S2 through S5 Common X(•) Y(o) connected to terminal				
Dial reading	1	2	3	4	Dial reading	1	2	3	4
1	o	o	o	•	0	•	o	o	•
2	•	•	•	o	1	o	o	o	•
3	o	•	•	o	2	•	•	•	o
4	•	o	•	o•	3	o	•	•	o
5	o	o	•	o	4	•	o	•	o
6	•	•	o	o	5	o	o	•	o
7	o	•	o	o	6	•	•	o	o
8	•	o	o	o	7	o	•	o	o
9	o	o	o	o	8	•	o	o	o
					9	o	o	o	o

Switch S6

Dial reading	Common A, B connected to terminal	
	A	B
KB/S XX.XXX	A0	B0
KB/S XXX.XX	A1	B1
MB/S X.XXXX	A2	B2

5-12. Power Supply Removal and Reinstallation Procedures

a. With modem top cover removed, disconnect the ac power cable PS1J1 and the dc connector to the top file. Remove four phillips head screws (A, fig.5-3). Remove bottom cover and remove two lower phillips head screws from each side near bottom of the modem (B, fig 5-3) Extract power supply with attached mounting brackets from bottom of modem.

b. To reinstall the supply, reverse the procedures

of *a* above. Leave screws untightened and insure that the mounting brackets are flush with the bottom sides of the modem; then tighten screws.

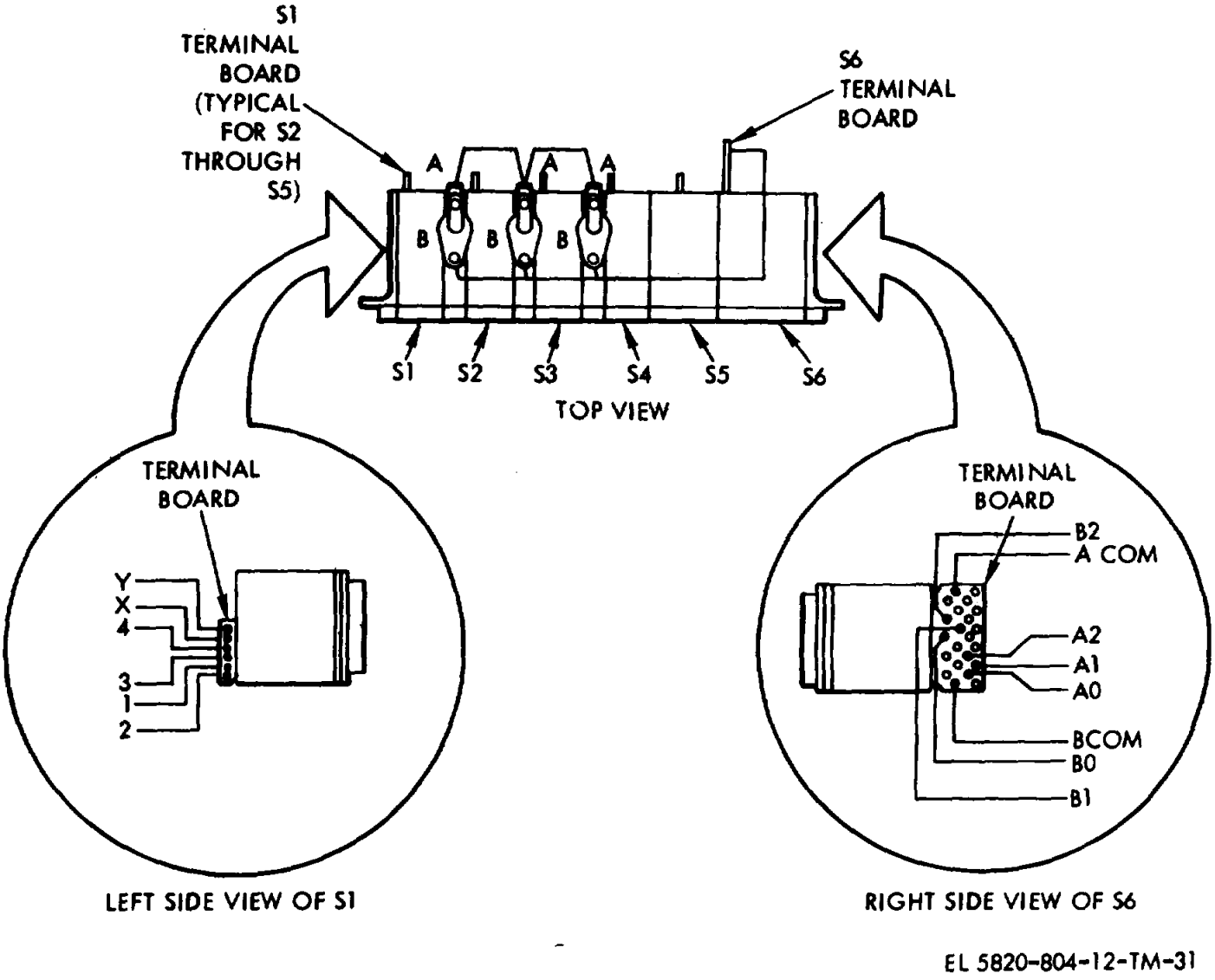


Figure 5-2. Thumbwheel switch assembly terminal boards.

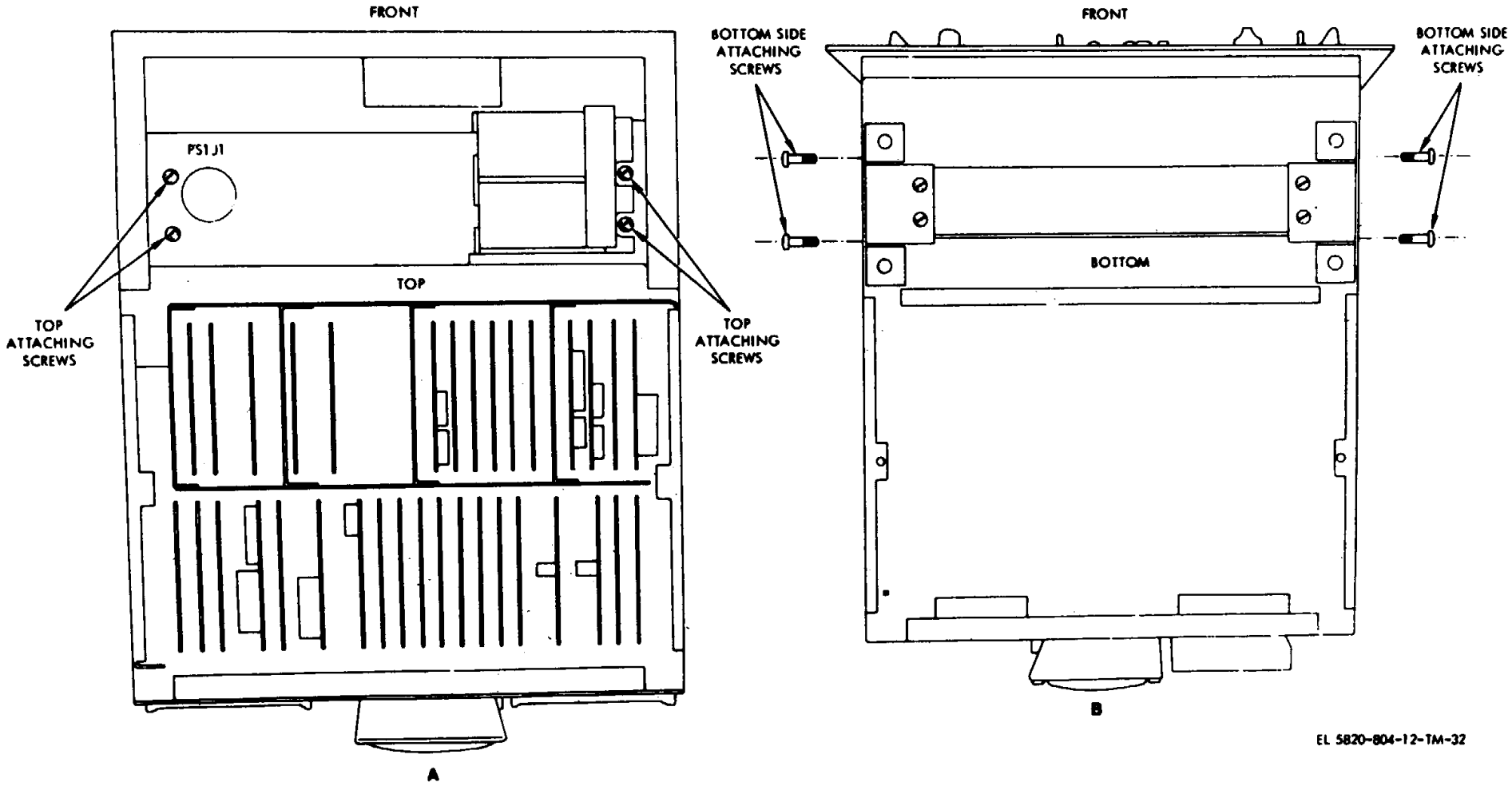


Figure 5-3. Power supply removal and installation

APPENDIX A

REFERENCES

DA Pam 25-30	Consolidated Index of Army Publications and Blank Forms.
DA Pam 738-750	The Army Maintenance Management System (TAMMS).
TM 11-5820-803-12	Operator and Organizational Maintenance Manual for Modem, Digital Data MD-921 /G.
TM 11-5820-804-20P	Organizational Maintenance Repair Parts and Special Tools List for Modem, Digital Data MD-920A/G.
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Meteriel to Prevent Enemy Use (Electronics Command.

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APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations for Modem, Digital Data-Interconnect Facility MD-92A/G. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean, preserve, drain, paint, or to replenish fuel/ lubricants/hydraulic fluids or compressed air supplies.

d. Adjust. Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

h. Replace. The act of substituting a serviceable like-type part, subassembly, model (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/assembly, end item or system. This function does not include the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

j. Overhaul. That periodic maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

C-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function varies at different maintenance categories, appropriate "worktime"

figure will be shown for each category. The number of man-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. If an intermediate facility (L) has been designated, the maintenance information required to perform this category of maintenance will be provided in the DMWR. Subcolumns of column 4 are as follows:

C– Operator/Crew
O– Organizational
F–- Direct Support
L– Selected repair activity (SRA). If a SRA facility is not available, this category of maintenance will be accomplished at a depot.
D–- Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tools sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITY MD-920 A/G

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	L[11]	D	(5) Tools and Equipment
00	Modem, Digital Data-Inter-	Inspect	0.1					
	connecting Facility	Test[1]	0.1					
	MD-920A/G	Test[2]		0.1				15
		Test[3]	0.1					8 or 29
		Service		0.1				
		Align			0.5			7,11,12, 25,28
		Install			1.0			12,17
		Replace			1.5			12,17
		Repair[4]		0.1				17
		Repair[5]			0.1			17,28
		Overhaul					24.0	1-43
01	Control Panel, A1	Inspect	0.1					
		Test[6]	0.1					
		Test[7]			0.1			15
		Service		0.1				
		Repair[8]	0.1					
		Repair[9]		0.1				17
		Repair[10]			0.2			17
0101	Switch Assembly, A1A1	Inspect		0.1				
		Test		0.1				15
		Replace		0.1				17
		Repair		0.2				17
0102	Switch Assembly, A1A2 (Same as group 0101)							
02	Modem Subassembly, A2	Inspect		0.1				
		Test			0.8			15
		Repair			0.1			17,28

(1) Self-test
(2) Self-test, external continuity checks
(3) Performance (link) test
(4) Minor soldering operations
(5) By replacement of subassemblies
(6) Lamp test
(7) Continuity checks
(8) By replacement of fuses and indicators
(9) By replacement of switches (except A1S5), sockets, and meter
(10) By replacement of switch A2S5
(11) See paragraph C-3d.

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITUY MD-920 A/G

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools and Equipment
			C	O	F	L[11]	D	
0201	Synthesizer and Bit Sync Assy, A2A1	Inspect		0.1				
		Test				0.4		14
		Align			0.5			17,11, 12,28
		Repair[5]		0.1	17,28			
020101	Counter Encoder, A2A1A1A1	Inspect		0.1				
		Test					0.1	26,27
		Replace			0.1			28
		Repair					0.1	17
020102	Program Divider, A2A1A1A2	Inspect		0.1				
		Test					0.1	26,27
		Replace			0.1			28
		Repair					0.1	17
020103	Reference Oscillator, A2A1A1A3	Inspect			0.1			
		Test				0.4		2,6,7,8, 10,12
		Adjust				0.1		2,6,8
		Replace			0.1			28
		Repair				0.1		17
020104	Reference Divider, A2A1A1A5	Inspect		0.1				
		Test					0.1	26,27
		Replace			0.1			28
		Repair					0.1	17
020105	45 MHz Phase Lock Loop, A2A1A1A6	Inspect		0.1				
		Test				0.4		1,6,7,8, 11
		Adjust				0.1		1,6,11
		Replace			0.1			28
		Repair				0.1		17

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITUY MD-920 A/G

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools and Equipment
			C	O	F	L[11]	D	
020106	45-MHz Amplifier, A2A1A2A8	Inspect		0.1				
		Test				0.4		2,6,7,9 10,14
		Adjust				0.1		3,5,6,7
		Replace			0.1			28
		Repair				0.1		17
020107	Mixer/Output Amplifier, A2A1A1A10	Inspect		0.1				
		Test				0.4		2,5,6,7, 8,9,14
		Adjust				0.1		2,5,6,7, 8,9,14
		Replace			0.1			28
		Repair				0.1		17
020108	15-MHz Amplifier, A2A1A1A11	Inspect		0.1				
		Test				0.4		1,5,6,9, 10,11,13
		Replace		0.1				28
		Repair				0.1		17
020109	Stable Clock, A2A1A1A12	Inspect		0.1				
		Test				0.4		2,5,6,7, 8,10,12, 14,15
		Replace			0.1			28
		Repair					0.1	17
020110	Reference Divider, A2A1A1A14 (Same as group 020104)							

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITUY MD-920 A/G

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	L[11]	D	(5) Tools and Equipment
020111	Digital to Analog Converter, A2A1A1A15	Inspect		0.1				
		Test					0.1	26,27
		Replace			0.1			28
		Repair					0.1	17
020112	Loop Filter, A2A1A1A16	Inspect		0.1				
		Test					0.1	26,27
		Replace			0.1			28
		Repair					0.1	17
020113	Transmit Bit Detector, A2A1A1A17	Inspect			0.1			
		Test					0.1	26,27
		Replace				0.1		28
		Repair					0.1	17
020114	Line Driver, A2A1A1A21	Inspect		0.1				
		Test				0.3		4,6,8,12
		Replace			0.1			28
		Repair				0.1		17
020115	Line Driver, A2A1A 2A22 (Same as group 020114)							
020116	Line Driver, AA12A1A23 (Same as group 020114)							
020117	LOS/Cable Receiver/Decoder, A21A2A1	Inspect		0.1				
		Test				0.3		4,6,11 12,13
		Adjust				0.1		4,6,12
		Replace			0.1			28
		Repair				0.1		17

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITUY MD-920 A/G

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	L[11]	D	(5) Tools and Equipment
020118	NRZ Interface, A2A1A2A2	Inspect		0.1				
		Test					0.3	15,26,27
		Replace			0.1			
		Repair					0.1	17
020119	LOS/Cable Driver, A2A1A2A3	Inspect		0.1				
		Test				0.3		4,6,12
		Replace			0.1			28
		Repair					0.1	17
020120	Input Interface, A2A1A2A4	Inspect		0.1				
		Test					0.1	26,27
		Replace			0.1			28
		Repair					0.1	17
020121	Coder Interface, A2A1A2A5	Inspect		0.1				
		Test					0-1	26,27
		Replace			0.1			28
		Repair					0.1	17
020122	Coder Switch, A2A1A2A6	Inspect		0.1				
		Test					0.1	26,27
		Replace			0.1			28
		Repair					0.1	17
020123	11 -Bit PRN Sequence Generator, A2A1A2A7	Inspect		0.1				
		Test					0.1	26,27
		Replace			0.1			28
		Repair					0.1	17
020124	Error Comparator, AA12A2AS	Inspect		0.1				
		Test					0.1	26,27
		Replace			0.1			28
		Repair					0.1	17

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITUY MD-920 A/G

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools and Equipment
			C	O	F	L[11]	D	
020125	D/A Meter, A2A1A2A9	Inspect		0.1				
		Test					0.1	26,27
		Replace			0.1			28
		Repair					0.1	17
020126	Alarm Circuits, A2A1A10	Inspect		0.1				
		Test					0.1	26,27
		Replace			0.1			28
		Repair					0.1	17
020127	Transmit Bit Detector, A2A1A2A11 (Same as group 020113)							
020128	Loop Filter, A2A1A2A12 (Same as group 020112)							
020129	Digital-to-Analog Converter, A2A1A2A13 (Same as group 020111)							
020130	15-MHz Amplifier, A2A1A2A14 (Same as group 020108)							
020131	Mixer/Output Amplifier, A2A1A2A15 (Same as group 020107)							
020132	45-MHz Amplifier, A2A1A2A16 (Same as group 020106)							
020133	45-MHz Phase Lock Loop, A2A1A2A18 (Same as group 020105)							

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITUY MD-920 A/G

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	L[11]	D	(5) Tools and Equipment
020134	Reference Divider, A2A1A2A20 (Same as group 020104)							
020135	Reference Oscillator, A2A1A2A21 (Same as group 020103)							
020136	Program Divider, A2A1A2A23 (Same as group 020102)							
020137	Counter Encoder, A2A1A2A24 (Same as group 020101)							
0202	Blower, A2B1; Fan Tubeaxial	Inspect		0.1				
		Test		0.1				15
		Replace		0.1				17
		Repair				0.4		15,17
0203	Blower, A2B2; Fan Tubeaxial (Same as group 0202)							
0204	Power Supply, A2PS1	Inspect		0.1				
		Adjust		0.1				11,25,28
		Test			0.5			11,12,15, 30,31
		Test				0.4		11,12,15, 30,31 ,32
		Replace			0.6			17
		Repair			0.7			18-26,28
		Repair				0.6		18-26,28

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITUY MD-920 A/G

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools and Equipment
			C	O	F	L[11]	D	
020401	Transformer Assembly, A1	Test Replace Repair				0.1 0.2 0.2		12,15 17 17
020402	Printed Circuit Bond, A2	Replace Test Repair Adjust			0.1	 0.4 0.2 0.4		28 11,12,15, 30,31 ,33, 34,35 17 11,12,15, 30,31,33, 34,35
020403	Circuit Card Assembly, A3	Test Replace Repair				0.3 0.4 0.2		12,15 17 17
020404	Component Board Assembly Number 1, A4	Test Replace Repair				0.2 0.3 0.2		12,15 17 17
020405	Component Board Assembly Number 2, A5	Test Replace Repair				0.2 0.3 0.2		12,15 17 17
020406	Heat Sink Assembly, Number 1, A6	*						
020407	Heat Sink Assembly, Number 2, A7	*						
020408	Heat Sink Assembly, Number 3, A8	*						

*All components with no maintenance function indicated are repaired at the next higher assembly of end item.

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITUY MD-920 A/G

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	L[11]	D	(5) Tools and Equipment
020409	Terminal Board Assembly, A9	Test			0.2			11,12,15
		Replace			0.3			17
		Repair			0.3			17
020410	Rectifier Assembly, A10	Test			0.3			12,15
		Replace			0.4			17
		Repair			0.4			17
0205	Cable, A2W2	Inspect		0.2				
		Test				0.2		15
		Replace			0.1			
		Repair				0.2		17-24
0206	Cable, A2W3 (Some as group 0205)							
0207	Cable, A2W9 (Some as group 0205)							
0208	Cable, A2W11 (Same as group 0205)							
0209	Oscillator, A2Y1	Inspect		0.1				
		Test			0.1			12,25,28
		Adjust			0.1			12,17, 25,28
		Replace			0.1			17
0210	Oscillator A2Y2 (Same as group 0209)							

TABLE 1. TOOL TEST EQUIPMENT REQUIREMENTS
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITY MD-920A/G

Tool or Test Equipment Ref Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
1	L,D	Card Test Fixture T-14301, SM.D868401	Note	T-14301 (91417)
2	L,D	Card Test Fixture T-14303, SM-w68410	Note	T-14303 (91417)
3	L,D	Card Test Fixture T-14304, SM-D868416	Note	T-14304 (91417)
4	L,D	Card Test Fixture T-14306	Note	T-14306 (91417)
5	L,D	Attenuator Fixture T-14307 (2 required) , SM-D877511 (91417)	Note	T-14307
6	L,D	Power Supply Fixture T-14318 (91417)	Note	T-14318
7	F,L,	Power Meter, Millivac MV828B	6625-00-437-4865	MV828B (85711)
8	C,F,L,D	Electronic Counter, HP 5245L with	6625-00-269-4593	HP 5245L (28480)
		HP 5253 Plugin	6625-00-226-3483	
9	L,D	Spectrum Analyzer IP-1216AM with	6625-00-424-4370	HP 141T (28480)
		Spectrum Analyzer Plug-In (RF) P-11 399A,	6625-00 432-5055	HP 8553B (28480)
		Sectrum Analyzer Plug-In (IF) PL-1388/U	6625-00-	HP 8552B
10	L,D	Sweep Generator, HP 8601A	6625-00-135-9866	HP 8601A (28480)
11	O,F,L,D	Digital Voltmeter, Fluke 800QA-01	6625-00-210-7584	8000A-01 (89536)

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITY MD-920A/G - Continued

Tool or Test Equipment Ref Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
12	F,L,D	Oscilloscope, Tektronix 485A	6625-00 485-8181	485A (80009)
13	L,D	Precision Power Supply, Power Design 4010	Note	4010 (98095)
14	L,D	50-ohm Termination, Amphenol 35725-51	5985-00 843-1671	35725-51 (74868)
15	O,F,L,D	Multimeter, Simpson 270	6625-00-897-4051	270 (55026)
16	L,D	50-ohm feed-thru termination TEK 011-0049-01	5985-00-087-4954	011-0049-01 (80009)
17	O,F, L,D	Tool Kit, Electronic Equipment TK-105/G	5180-00-610-8177	
18	L,D	Pin Extraction Tool RX 20-25, Burndy	5120-00-808-6873	RX 20-25 (09922)
19	L,D	Pin Extraction Tool, Tetradyne	Note	600-0027-000 (31413)
20	L,D	Pin Insertion Tool MS 2425620	5120-00-079-4598	
21	L,D	Pin Insertion Tool MS 242516	5120-00-079-4599	
22	L,D	Pin Extraction Tool MS 24256R20	5120-00-079-4601	
23	L,D	Pin Extraction Tool MS 24256P16	5120-00-079-4602	
24	L,D	Pin Crimp Tool and Turret M22520-1-01 and M22520-1-02	5120-00-165-3912, 016-6620	(81349) (81349)

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITY MD-920A/G - Continued

Tool or Test Equipment Ref Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
25	O,F,L, D	Card Extender (2) SM-D-759649		759649 (91417)
26	L,D	Test System Logic Circuit, GR-1792	6625-00-575-8024	GR-1792 (24655)
27	L,D	Digital Card Test Adapter, MD 8W405	Note	T-14146
28	O1F,L,D	Cord Puller, Protolob A7920	Note	7920 (31477)
29	C, F,D	Error Rate Counter TS-3641/G (Harris 7002)	Note	7002 (91417)
30	F,L,D	Auto Tranformers, Variac W50M	6120-00-894-1826	W50M (24655)
31	F,L,D	Power Supply/Oscillator Test Fixture, SM-D-882197	Note	T-14394 (91417)
32	L,D	AC Voltmeter, HP400F	6625-00 403-6S26	HP400F (28480)
33	L,D	Resistor Decade Box, Gen Rod 1434M	6625-00 935-1470	GR-1434M (24655)
34	L,D	Power Supply Test Set, SM-C-742003	Note	(91417)
35	L,D	Test Set, ACDC 66-991-000	Note	66-991-000 (08742)
36	L,D	Interface Test Unit SM-D-877812	Note	T-14397 (91417)
37	F,L,D	Oscilloscope Probe (X1O), Tektronix P6054A	6625-00 098-8141	P6054A (80009)

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
MODEM, DIGITAL DATA - INTERCONNECT FACILITY MD-920A/G - Continued

Tool or Test Equipment Ref Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
38	L,D	Function Generator, Wavetek 142	Note	142 (23338)
39	L,D	Pulse Generator, Datapulse 110B (2 ea)	Note	110B
40	L,D	Power Supply Fixture, SM-D-868418	Note	
41	L,D	Signal Generator, HP 606B	Note	606B (28480)
42	L,D	Signal Generator, HP 608F	Note	608F (23480)
43	L,D	Synchronizer, HP 8708A	Note	8708A (28480)

NOTE: The National stock numbers (NSN'&) that are missing from list have been requested and will be added by a changes upon receipt. Cogs

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