TECHNICAL MANUAL

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL

MODEM, DIGITAL DATA MD-921/G

(NSN 5820-00-155-8581)

This copy is a reprint which includes current pages from Change 1

H E A D Q U A R T E R S , D E P A R T M E N T O F T H E A R M Y

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 PSK modem. Perform all possible maintenance with power removed. If necessary to perform maintenance with covers removed and power on, be extremely careful to avoid contact with high voltage.

DON'T TAKE CHANCES!

TM 11-5820-803-12
NAVELEX 0967-LP-169-3011)
TO 31R5-2G-261
CHANGE NO. 2

DEPARTMENTS OF THE ARMY,
THE NAVY, AND THE AIR FORCE
Washington, DC, 18 October 1985

Operator's' and Organizational Maintenance Manual
MODEM, DIGITAL DATA MD-921/G (NSN 5820-00-155-8581)

TM 11-5820-80-12, 7 June 1976, is changed as follows.

1. New or changed material is indicated by a vertical bar in the margin of the page.
2. Remove pages and insert new pages as indicated below.

Remove	Insert
i through 1-2	i through 1-2
2-19 and 2-20	2-19 and 2-20
4-1 and 4-2	4-1 and 4-2
5-1 through 5-4	5-1 through 5-4
A-1	A-1/(A-2 blank)

3. File this change sheet in the front of the publication for reference purposes.

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Operator's and Organizational Maintenance Manual

MODEM, DIGITAL DATA MD-921/G
(NSN 5820-00-155-8581)

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 07703-5007.

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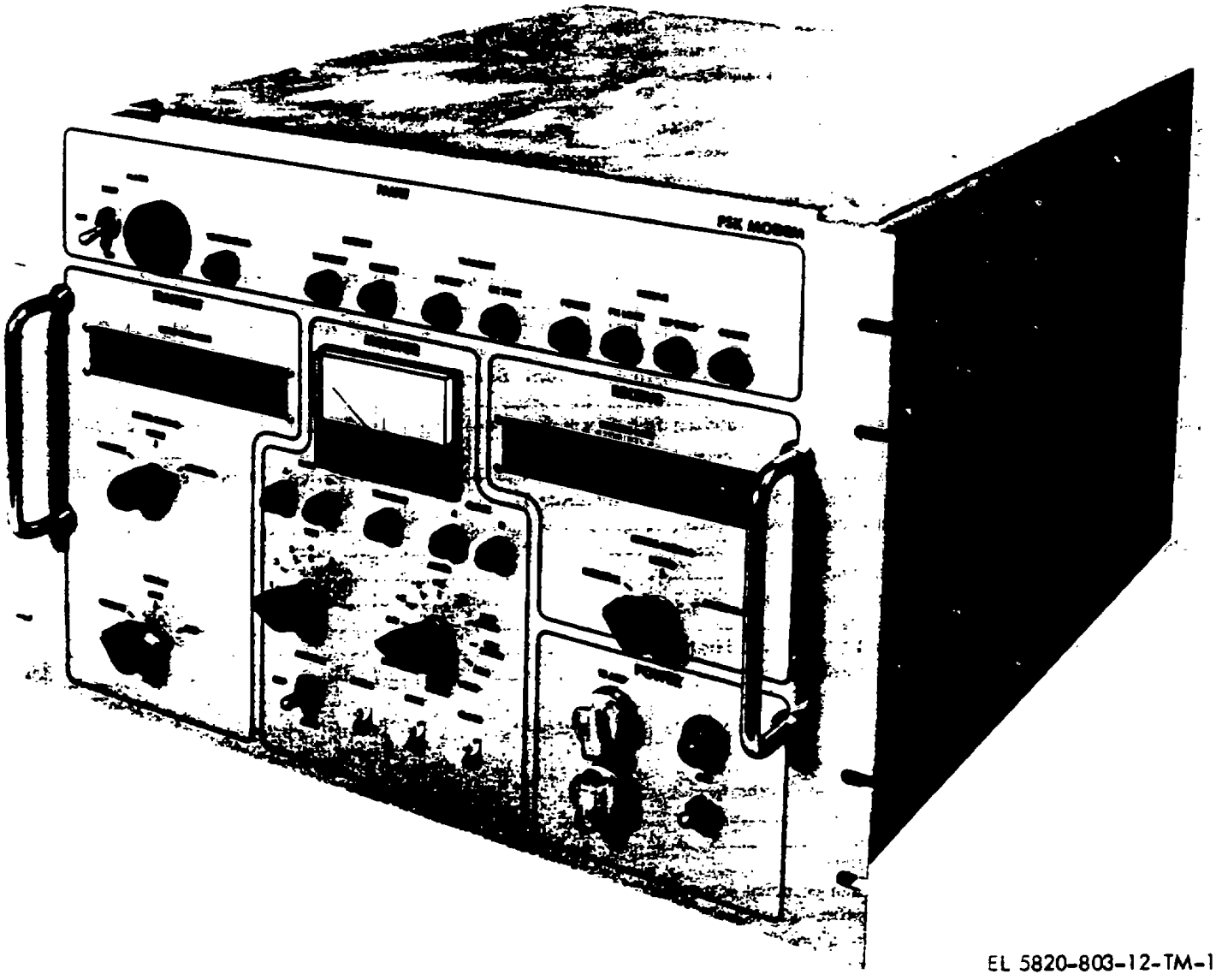

Figure 1-1. Modem, Digital Data MD-921/G (PSK modem).

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope.
This manual describes Modem, Digital Data MD-921/G, hereinafter referred to as the PSK modem (fig. 1-1). It includes installation, operation, maintenance, and troubleshooting for operator/ organizational maintenance. Appendix A contains references and appendix C contains the maintenance allocation chart.

1-2. Consolidated Index of Army Publications and Blank Forms
Refer to the latest issue of DA Pam 310-1 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 by DA Pam 738-750 as contained in the Maintenance Management Update. Air Force personnel will use AFR 66-1 for maintenance reporting and TO-00-35D54 for unsatisfactory equipment reporting. Navy personnel will report maintenance performed a utilizing the Maintenance Data Collection Subsystem a (MDCS) IAW OPNAVINST 4790.2 Vol 3 and unsatisfactory material/conditions (UR submissions) IAW OPNAVINST 4790.2 Vol 2, chapter 17. s

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 4355.73A AFR 400-54/ MCO 4430.3F.

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.

1-4. Reporting Equipment Improvement Recommendation (EIR)
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 your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-ME-MP, Fort Monmouth, New Jersey 07703-5007. We'll send you a reply.

1-5. Administrative Storage
a. Administrative storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the PMCS charts before storing. When removing the equipment from administrative storage, the PMCS should be performed to assure operational readiness. Disassembly and repacking equipment for shipment or limited storage is covered in SB 38-100.

b. COMSEC equipment must be removed before storage, and turned in to the COMSEC account custodian.

1-5.1. Destruction of Army Electronics Materiel
Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2. COMSEC equipment and keying information have first priority.

Section II. DESCRIPTION AND DATA

1-6. Purpose and Use
The PSK modem provides a means of interfacing digital data over the Defense Satellite Communications System (DSCS). The modem converts between the baseband data signals required by a digital user and the modulated 70 MHz signals required by a satellite ground terminal (fig. 1-2). The modem has independent transmit and receive sections which provide the user with the capability of full duplex digital communication. The modem will process data at any rate between 19.200 kb/s and 9.9999 Mb/s. Self-test, link test, and on-line fault monitoring functions are built into the modem. Internal or external error-correcting coders/decoders can)be employed if required to improve the quality of the communications.

1-7. Description
The PSK modem (figs. 1-3 and 1-4) is designed for rack mounting in a standard 19-inch equipment rack. It is 12 1/4 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 two card file assemblies, each of which has two files capable of accepting 24 cards. One assembly is accessible through the top cover and the other through the bottom cover. The top assembly, A2A1, contains 17 printed circuit cards in the Al file, 19 cards in the A2 file. The bottom assembly, A2A2, contains 20 cards in the A1 file and 9 cards in the A2 file. Located on

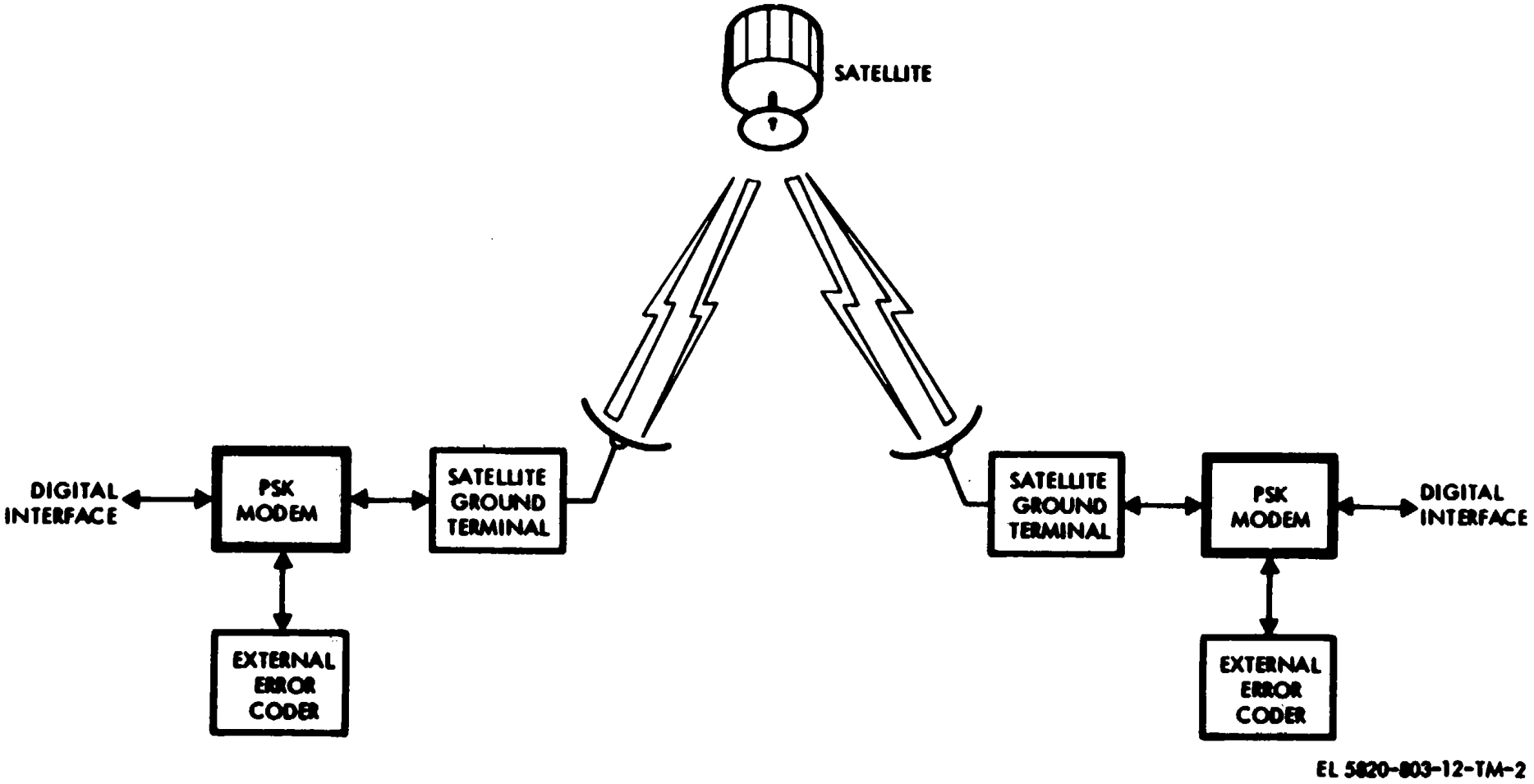

Figure 1-2. PSK modem system interface.

the A1 file and 9 cards in the A2 file. Located on the top section of the chassis forward of the card file are the oscillator assemblies A2Y1, A2Y2, and the coaxial relay, A2K1. The power supply, A2PS1, is located on the bottom section of the chassis forward of the card file.

1-8. System Application

A variety of system configurations are possible using the PSK Modem (fig. 1-5). The major options are listed in a through d below.

a. Earth Terminals. The modulated 70 MHz interface signals are compatible with various equipment including the following:

(1) AN/MSC-46.
(2) AN/TSC-54.
(3) AN/MSC-60 (HT).
(4) AN/MSC-61 (MT).

b. Error-Correcting Coders/Decoders. The modem operates in the following error-correcting coding and decoding modes:

(1) No coding.
(2) Internal moderate gain coder/decoder.
(3) External high gain coder/decoder.

c. Data Rates. The modem is capable of processing any data rate between 19.200 kb/s and 9.9999 Mb/s if no error-correcting coding is used. If internal external error correcting coding is used, the data rates are between 19.200 kb/s and 5.0000 Mb/s. Transmit and receive section data rates are independently selectable.

d. Digital User Interfaces. The interface between the PSK Modem (usually located in or near the earth terminal) and the digital user may be accomplished in several ways as listed below. For detailed information on applications and interface requirements, refer to the system planning section of chapter 2.

(1) Direct interface with a nearby digital user via the MIL-STD-188 inputs and outputs of the modem.

(2) Interface with a remotely located digital user via 50Ω or 75Ω coaxial cable, or 75 Ω balanced cable. This type of interface requires a Modem, Digital Data MD-920/G (ICF modem (TM 11-5820-804-12)) at the digital user end of the cable.

(3) Interface with a remotely located digital user via a line-of-sight (LOS) microwave link. This type of interface also requires an ICF Modem at the digital user end of the link.

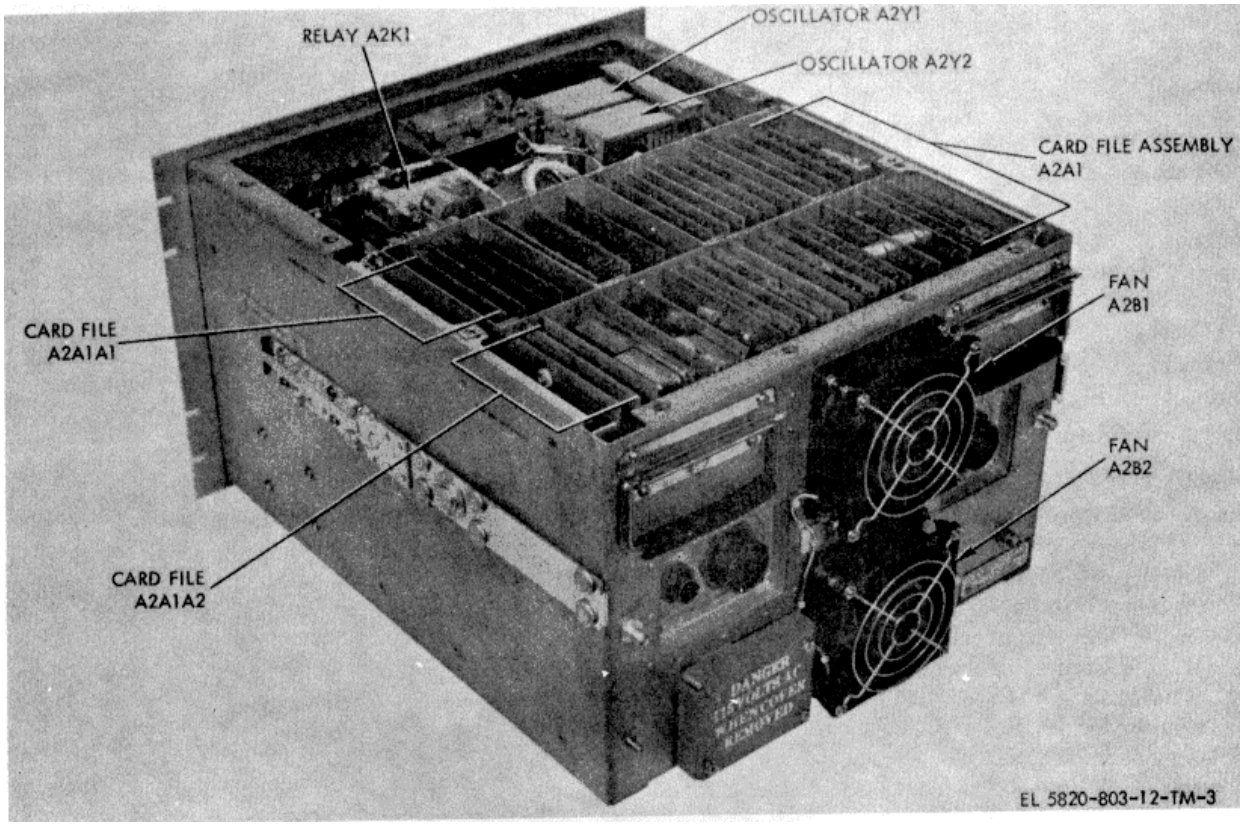

Figure 1-3. PSK modem viewed from top rear (top cover removed).

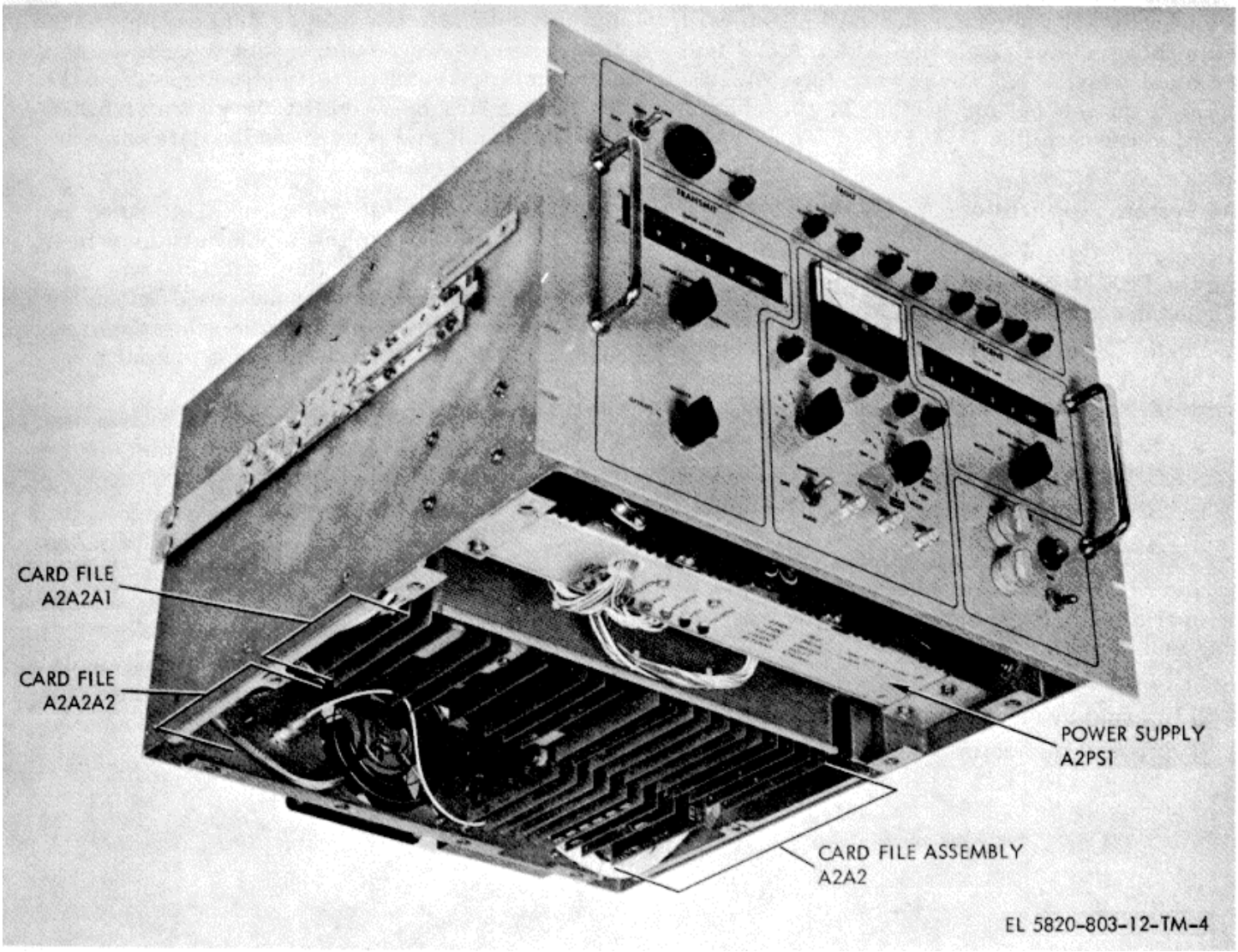

Figure 1-4. PSK modem viewed from bottom front (bottom cover removed).

1-9. Items Comprising an Operable Equipment

Accessory Equipment
- AC Power Cord, SM-C-79676
- Site Interface Mating Connector J5, MS-3126E24-61W
- Coder/Decoder Interface Mating Connector J6, MS-3126E24-61P
- Glenier Strain Relief (2 each), GTR20524B (SM-A-7313582)
- Chassis Slide Halves (2 each), 110QDP-22-A-1

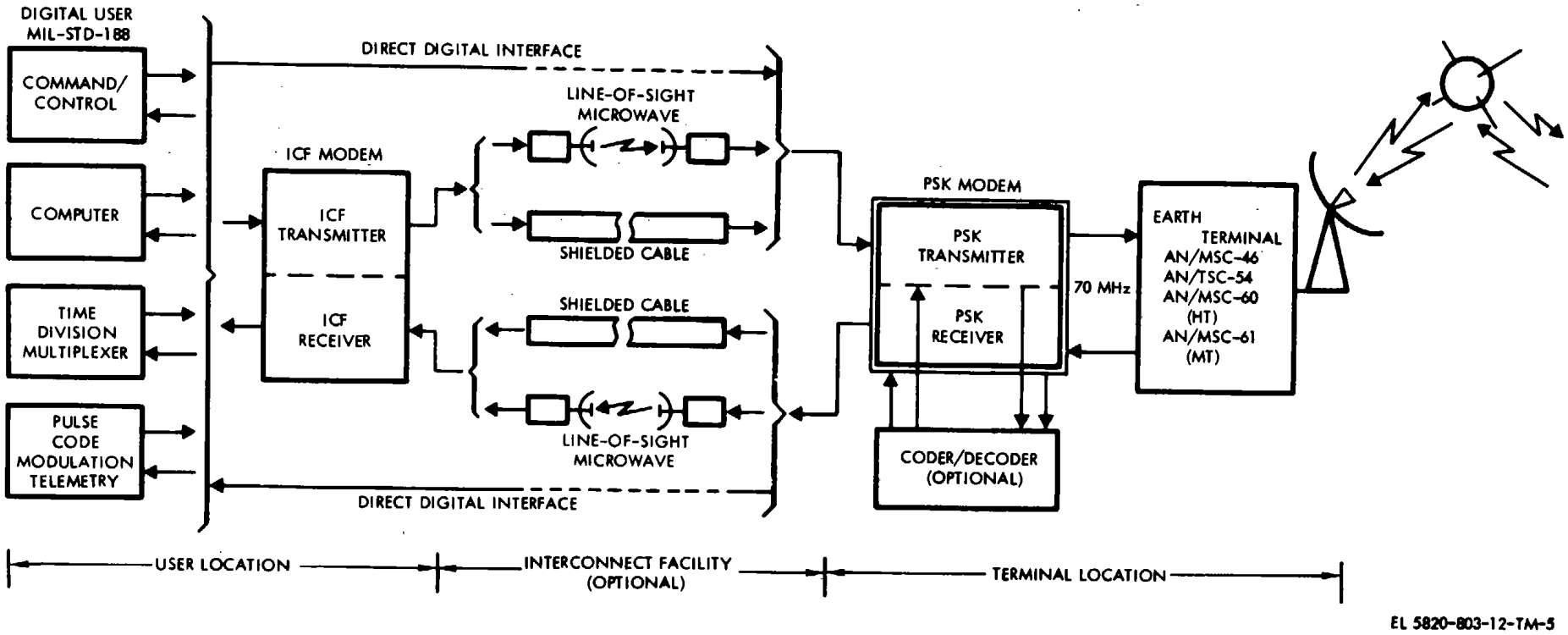

Figure 1-5. PSK modem applications.

1-10. Tabulated Data.

Prime Power	
Voltage	120 ±10 percent volts ac, single phase
Current	5 amperes maximum
Frequency	45 to 420 Hz
Power	500 watts maximum
Operating Conditions	
Operation	Continuous
Temperature	32°F to 120°F
Relative Humidity	5 to 100 percent
Elevation	Up to 10,000 feet
IF Interface	
Modulator	
Power Level	+10 dBm (terminated)
Impedance	50 ohm, ±10 percent, unbalanced
Frequency Uncertainty	± 1 kHz at 70 MHz
Frequency Output	70 MHz center frequency, double sideband suppressed carrier
Type Modulation	Binary phase shift keying (PSK)
3 dB Bandwidth of Internal Filtering	
#1 (19.200 kb/s to 999.99 kb/s symbol rate)	3 MHz maximum
#2 (1.0000 Mb/s to 3.9999 Mb/s symbol rate)	12 MHz maximum
#3 (4.0000 Mb/s to 9.9999 Mb/s symbol rate)	No filter
Demodulator	
Power Level	-20 to -75 dBm or 0 to -55 dBm, selectable
Impedance	50 ohm, ± 10 percent, unbalanced
Acquisition Time	45 seconds maximum
Acquisition Range	± 5 kHz at 70 MHz
Frequency Input	70 MHz center frequency, double sideband suppressed carrier
Type Modulation	Binary phase shift keying (PSK)
Bit Error Rate Performance	1.1 dB maximum at symbol rates from 19.200 kb/s to 1.0000 Mb/s. 1.3 dB maximum at symbol rates from 1.0000 Mb/s to 9.9999 Mb/s
Line of Sight Baseband Interface	
Output	
Power Level	-12 dBm (terminated)
Impedance	75 ohms, ±10 percent, unbalanced
Input	
Power Level	-25 to -35 dBm (terminated)
Impedance	75 ohms, ± 10 percent, unbalanced
Data Rate 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
Data Rate Range	19.2 kb/s to 5.0 Mb/s
Line Drivers and Receivers	
Input/Output Voltage	Positive and negative 6 ± 1.5 volts open circuit (measured between signal pair)
Sense One state, positive voltage	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 volt maximum input required to cause correct switching

CHAPTER 2

SERVICE UPON RECEIPT AND INSTALLATION

Section I. SYSTEMS PLANNING

2-1. General

The PSK modem can be used in a variety of applications. The 70 MHz IF interfaces are compatible with several types of earth terminals. The PSK modem operates without error correcting coding, or with either an internal or an external coder/decoder. The PSK modem interfaces directly between an earth terminal and a digital user (fig. 2-1). Optionally, the PSK modem can interface with a remotely located digital user via a shielded cable or a line-of-sight (LOS) microwave link. The PSK modem includes circuits that aid in testing the performance of a digital satellite communications link, as well as providing a self-test function. The operating configurations of the PSK modem are controlled by front panel and internal switches.

2-2. Earth Terminal Interface Signals

(fig. 2-1)

a. 70-MHz Output Signal Characteristics.

(1) The transmitter output is provided to the terminal via TNC connector AT1J1 located on the rear panel of the modem. This output is a biphase modulated phase-shift-keyed (PSK) signal with a center frequency of 70 MHz. A PSK signal is one in which the modulation is accomplished by switching the phase angle of the output carrier. When biphase PSK is employed, the phase angle of the output carrier is switched between only two states to represent the data pattern. This type of signal modulation is illustrated in figure 2-2. In the case shown, a ZERO data bit results in a 0-degree carrier phase angle. When the data state b. changes to a ONE, the carrier phase angle is switched to 180 degrees and maintained until the data state reverts to ZERO. The resulting spectrum for this type of signal is shown in figure 2-3 for a random data pattern. The width of the spectrum is proportional to the symbol rate of the modulation (symbol rate is twice data rate if error correcting encoding is used). Therefore, as the symbol rate is increased, the system bandwidth allocated for the transmission of data must be increased proportionally. Because of this variance, the available bandwidth of the network used to interface the modulated 70 MHz signal with the earth terminal must be taken into consideration during systems planning.

(2) As shown in figure 2-3, most of the signal energy is contained in the frequency band at 70 MHz$\pm$Rs, (Rs, = symbol rate). However, the modulation spreads signal energy into the sidebands. When the PSK modem is used in frequency division multiple access (FDMA) satellite communications systems, these sidebands may interfere with other signals present at the satellite at nearby frequencies. For this reason, it may be necessary to filter the transmitter output to reduce the amplitude of these sidebands. The PSK modem transmitter output contains internal filters reduce sideband amplitudes. The internal filters are automatically selected by the setting of the INPUT DATA RATE switches and the TRANSMIT ERROR CODING switch. The filters selected for the various switch settings are listed in table 2-1. In some system applications, it may be necessary to add additional filtering between the 70 MHz modem output and the upconverter.

(3) The output power of the 70 MHz transmitted signal is +10 dBm. The input power requirements of the upconverter used in the earth terminal must be reviewed for compatibility. If necessary, an appropriate attenuator should be added to the system in series with the 70 MHz output of the PSK modem.

b. 70 MHz Input Signal Characteristics.

(1) The 70 MHz input to the PSK modem is received from the output of the downconverter in the earth terminal. Connection of this signal to the modem is made via TNC connector AT2J1 located on the rear panel. This interface is a biphase-modulated PSK signal with a center frequency of 70 MHz. The waveform and spectrum characteristics of this signal are the same as the 70 MHz output. The major differences in characteristics are the 70 MHz input signal is degraded

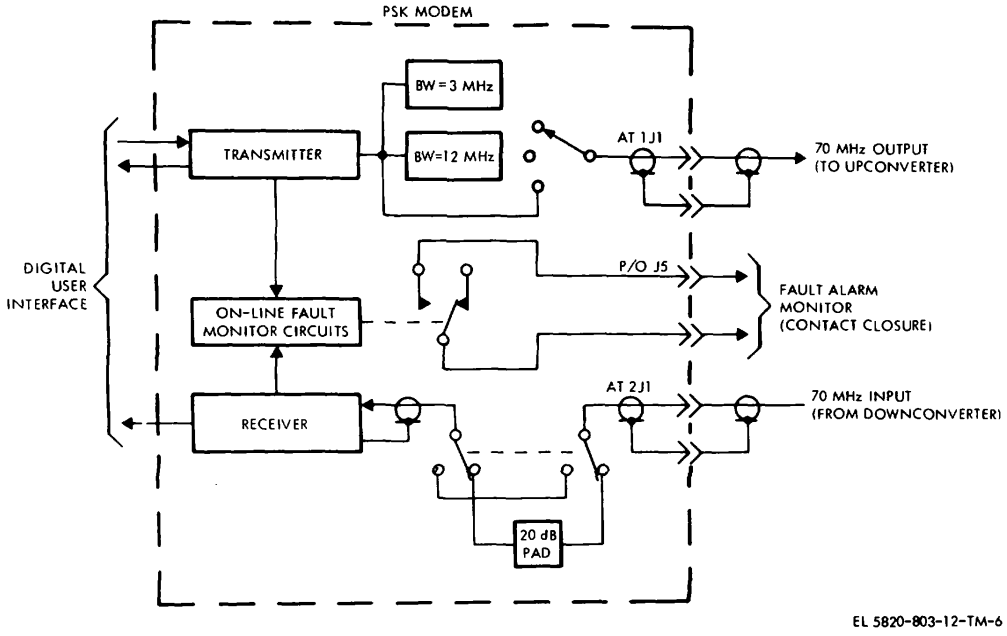

Figure 2-1. PSK modem interface.

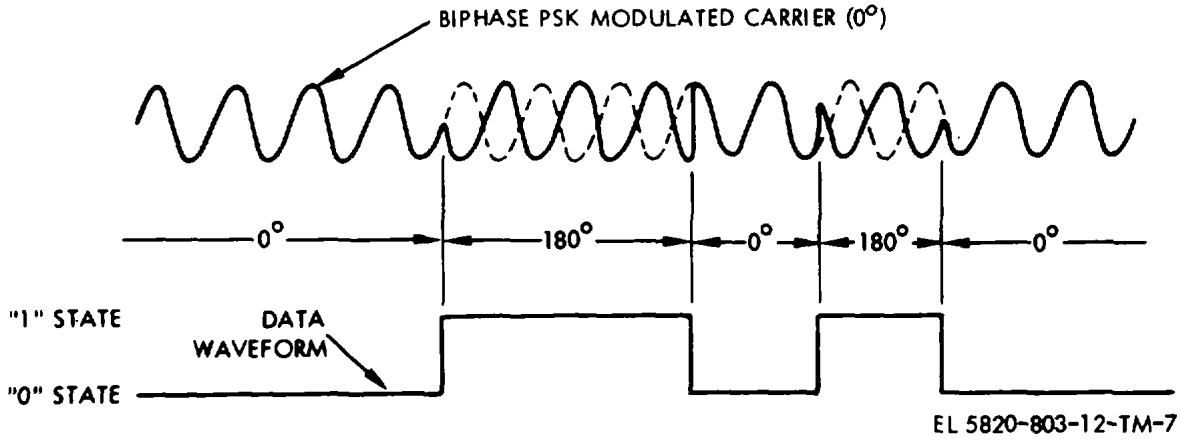

Figure 2-2. Biphase PSK modulation

by system noise and the 70 MHz input power level is lower and may vary over a considerable range.

(2) The PSK modem accepts input signal power variations of 55 dB in any installation. The ability to select either of two different ranges is provided to allow for differences in installations. The selectable ranges are 0 to -55 dBm or -20 to -75 dBm. Range selection should be determined prior to installation by a review of the earth terminal characteristics (expected power level and variation at the downconverter output) and interface network or cable (expected cable or network losses). Detailed information on setting the internal range selection switch is given in paragraph 2-20a.

c. Fault Alarm Monitor Signal Characteristics.

The PSK modem contains several on-line fault monitoring circuits which monitor the fault status of both the transmitter and receiver. A relay contained in the PSK modem is operated to provide a contact closure

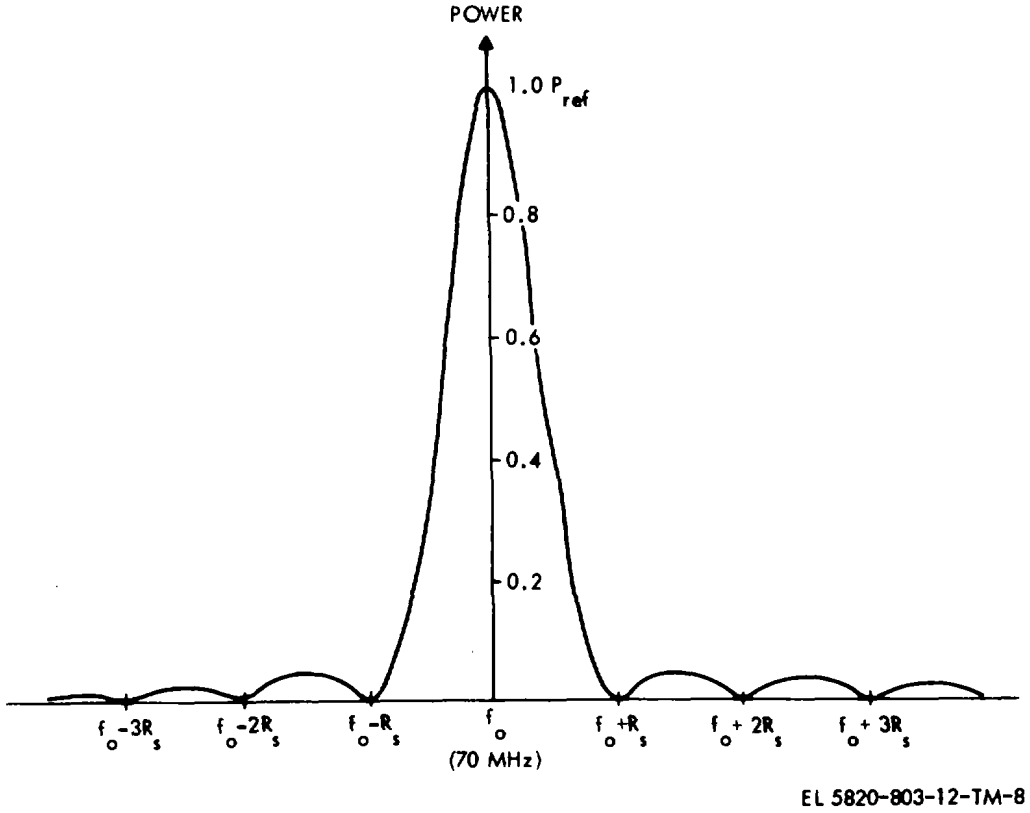

Figure 2-3. Random data modulation spectrum.

whenever one or more faults occur. This relay is shown in figure 2-1 in the no-fault (restored) condition. The contact closure (short circuit during a fault condition) is available between two pins at rear panel site interface connector J5. 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 operation requirements of the site.

2-3. Earth Terminal Interface Consideration.

Several factors which may degrade the earth terminal interface signals have been discussed in the preceding paragraph. An additional factor to consider is signal leakage from the 70 MHz transmitter output to the 70 MHz receiver input. The receiver is capable of accepting signals at power levels as small as 85 dB less than the transmitter output power level of +10 dBm. Since the transmitter operates at the same frequency as the receiver, the modem location, interface cabling, patching facilities, and cable routing should all be chosen to provide maximum isolation between input and output. For best results, the PSK modem should be located near the earth terminal up/ downconverters. The 70 MHz interfaces should be connected via shielded 50-ohm RF cables. Cable lengths and intermediate patching devices should be minimized. In any installation, the following items should be considered, although items in e and f below should not present serious problems if the above guidelines are followed:

a. If the upconverter maximum input power specification is less than the +10 dBm output power level supplied by the PSK modem transmitter, an appropriate attenuator should be added to the system.

Table 2-1. Selection of Internal Transmitter Filter

INPUT DATA RATE switch setting	*TRANSMIT ERROR CODING switch setting*	*3 dB bandwidth of transmit filter*
From 19.200 KB/S to 999.99 KB/S	NONE	3 MHz
From 19.200 KB/S to 499.99 KB/S	INTERNAL or EXTERNAL	3 MHz
From 1.0000 MB/S to 3.9999 MB/S	NONE	12 MHz
From 500.00 KB/S to 1.9999 MB/S	INTERNAL or EXTERNAL	12 MHz
From 4.0000 MB/S to 9.9999 MB/S	NONE	No filter
From 2.0000 MB/S to 5.0000 MB/S	INTERNAL or EXTERNAL	No filter

b. Additional transmitter filtering may be required for system operation.

c. The signal power levels and variations expected at the 70 MHz input to the receiver must be determined. This information is necessary so that the correct internal range switch setting may be made during installation.

d. If the fault alarm monitor output is to be used, the installer must be provided with sufficient information to connect and test this function.

e. If the modem is not located in or near the earth terminal, insure that the power losses caused by the interconnecting 70 MHz input and output cables or networks do not significantly degrade equipment operation. Also, insure that interconnecting cables or networks provide sufficient bandwidth to support the expected symbol rates of the 70 MHz input and the 70 MHz output signals.

NOTE

In general, a system with a gain/loss variation less than 1 dB over the range of 70 MHz $\pm$ 2 R_S, is adequate to support the symbol rate (R_S).

f. Interface cables or networks, grounding devices, cable routes, and patching devices must be carefully chosen to minimize cross talk between the 70 MHz interfaces.

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 from 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 occurring 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 x 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 PSK modem receiver input. 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_b/N_o) for any data rate can be shown on one curve (figure 2-4). As shown in figure 2-4, if only differential coding is used, the E N,, ratio required to obtain a low bit error rate is higher than that required to obtain the same error rate with the internal or external coder. For example, if a digital user requires an error rate equal to or less than 1 x 10-5, the minimum (E_b/N_o),, ratio needed to support this requirement using only differential coding is +9.8 dB. If the internal coder/decoder is used, the (E_b/N_o),, ratio required is reduced by 2.7 dB to +7.1 dB. If an external KY-801/GSC (Viterbi) coder/decoder is used, the (E_b/N_o),, ratio required is further reduced an additional 2.6 dB to +4.5 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 PSK modem, the data rate, the bit error rate required by the digital user, and the link margin required. To aid in understanding how these factors enter into the determination, consider the case in which a digital communications system must support a 50 kb/s digitized voice link. The link margin required is 1.0 dB, and the digital user needs a worst-case bit error rate of 1 x 10^{-3} The signal-to-noise density ratio (C/KT) provided by the system, which is determined by the earth terminal figure of merit, geographical location at the terminal, implementation losses of the terminal equipment, and power capability or allocation of the satellite, must first be determined. Further assuming that analysis of the system indicates an available C/KT of 57.1 dB-Hz, the effective C/KT may then be determined by subtracting the link margin and the PSK Modem implementation loss as follows:

Effective C/KT = System C/KT (Link Margin + PSK modem Implementation Loss)

Effective C/KT = 57.1 (1.0 + 1.1) = 55 dB Hz

Knowing the data rate (50 kb/s), the equivalent signal-to-noise ratio (E_b/N_o,) referenced to a noise bandwidth equal to the data rate ($R_{1)}$)can be determined from the formula:

$$(E_b/N_o) = C/KT\ 10 \log R_{1)}$$

This function is plotted for convenience in figure 2-5. The resulting (Eb/No) is +8 dB. As shown in the performance curves of figure 2-4, the PSK modem operating only with differential coding will provide an error rate of 4 x 10^{-4} at E_b/N_o, = 8 dB. Error-correcting coding would therefore not be required to provide a bit error rate of less than 1 X 10^{-3}.

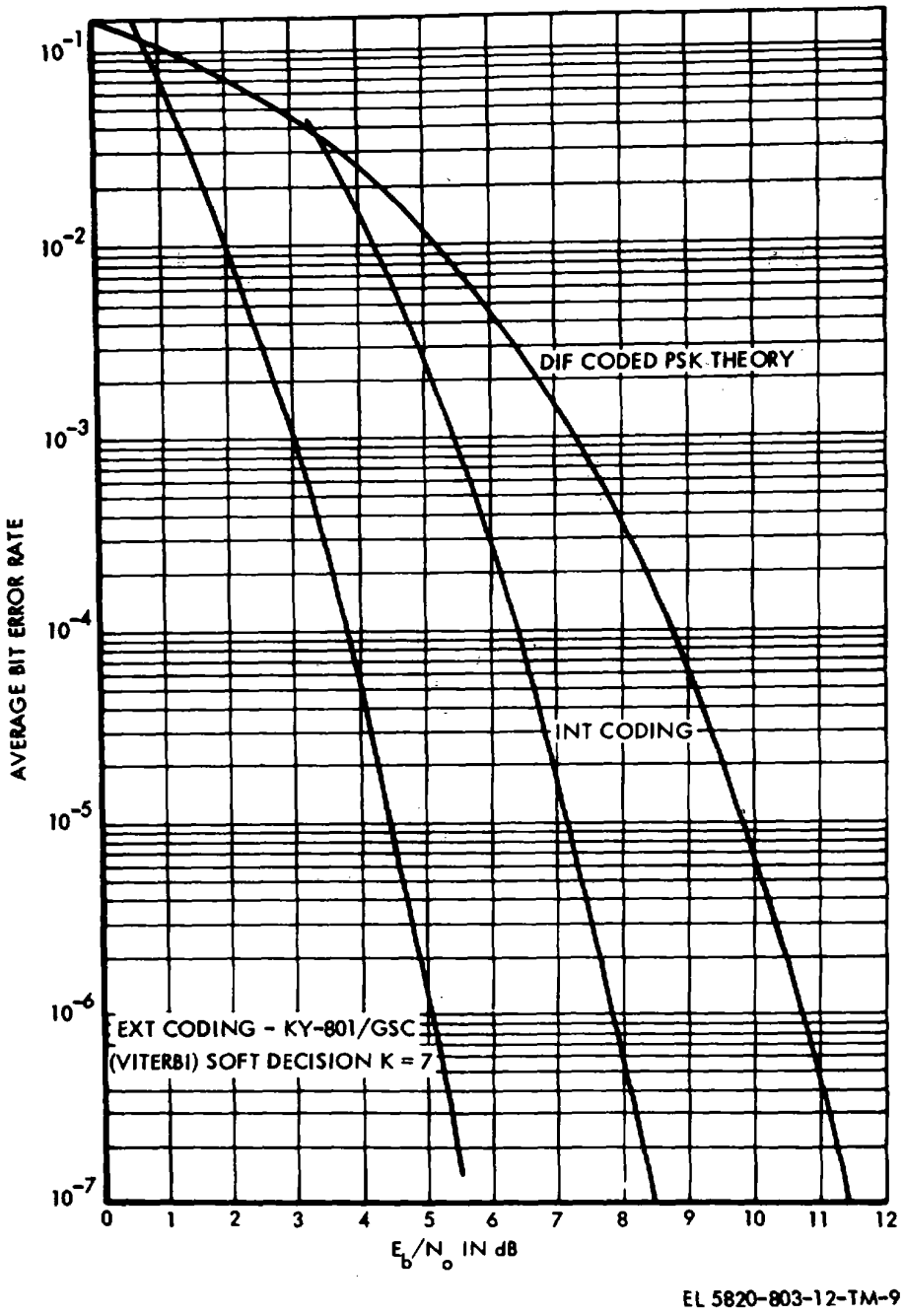

Figure 2-4. PSK modem theoretical bit error rate performance for various coding configurations (best case performance).

d. However, should the digital user require a minimum bit error rate of 1×10^{-5} instead of 1×10^{-3}, operation with differential coding only would not provide an acceptable bit error rate. In this case, using the internal coder/decoder would result in an acceptable bit error rate of 4.4×10^{-6} as indicated in figure 2-4.

e. Assuming that the digital user's data rate is changed to 100 kb/s, that he still requires 1×10^{-5} maximum bit error rate, but the satellite will not support any increase in the C/KT, then the following situation exists. Operating with the same link parameters, the resulting E_b/N_o,, from figure 2-5 (for an effective C/KT of 55 dB and a data rate of 100 kb/s,) is now 5 dB. Referring, to the performance curves of figure 2-4 the resulting error rates for the various options are:

(1) Differential coding only 1.2×10^{-2}.

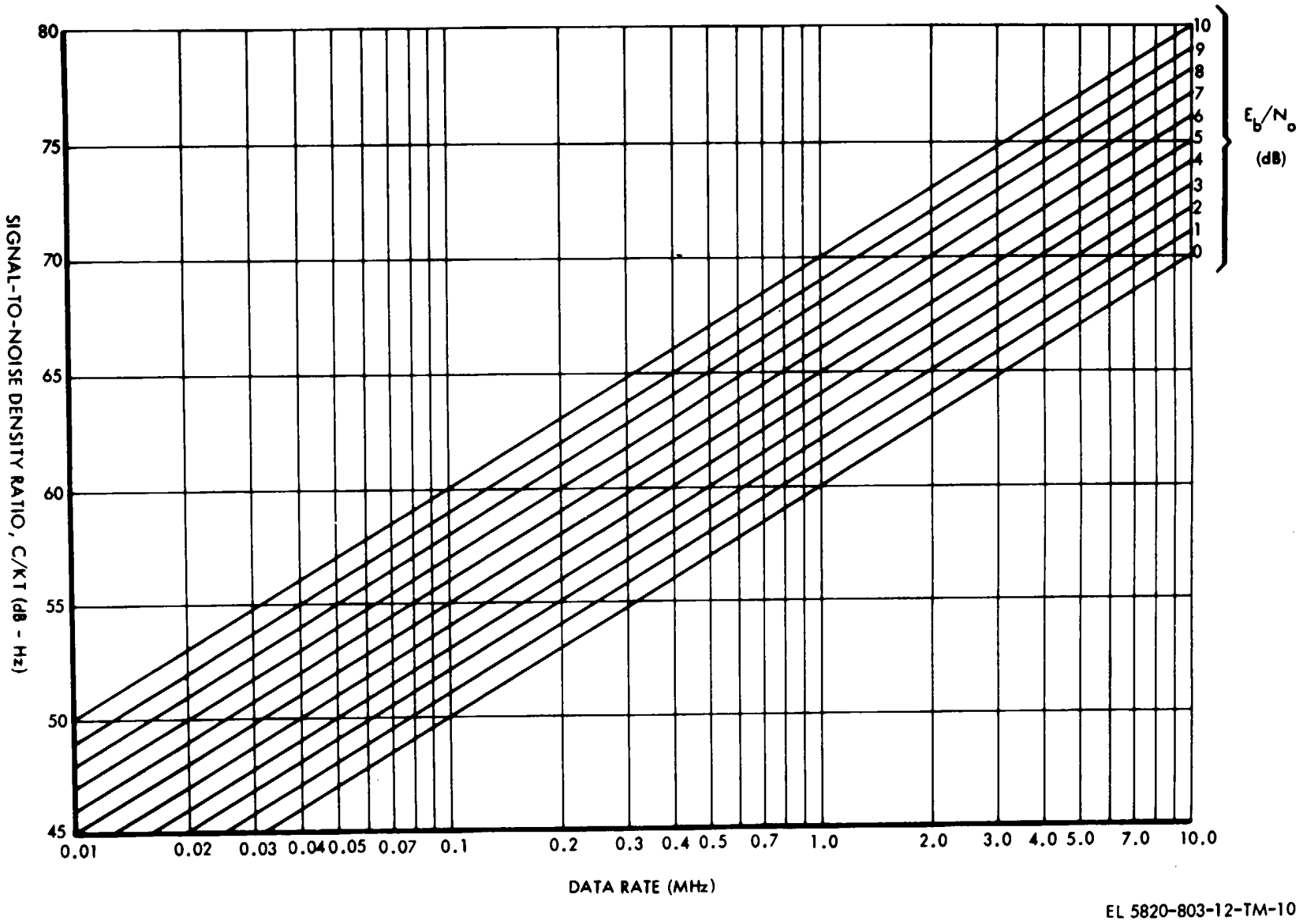

Figure 2-5. $(E_b/N_o) = C/KT - 10 \log R_D$.

(2) Internal coder/decoder 4.3×10^{-3}.
(3) External Viterbi coder/decoder 1.3×10^{-6}.

Therefore, the only option which satisfies the requirements is the use of an external (Viterbi) coder/decoder, KY-801/GSC.

2-5. Differential Coding

a. The biphase PSK modulation technique produces an ambiguity over the communications link. The 70 MHz input to the receiver is switched back and forth between two phases (fig. 2-2) depending on the data transmitted. Although the receiver detects the phase shifts, it cannot distinguish which phase represents a ONE and which phase represents a ZERO. The demodulated data processed by the receiver is as likely to be inverted as not differential coding may be used to resolve this ONE/ZERO ambiguity.

b. The operation of a differential encoder is illustrated in A, figure 2-6. 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.

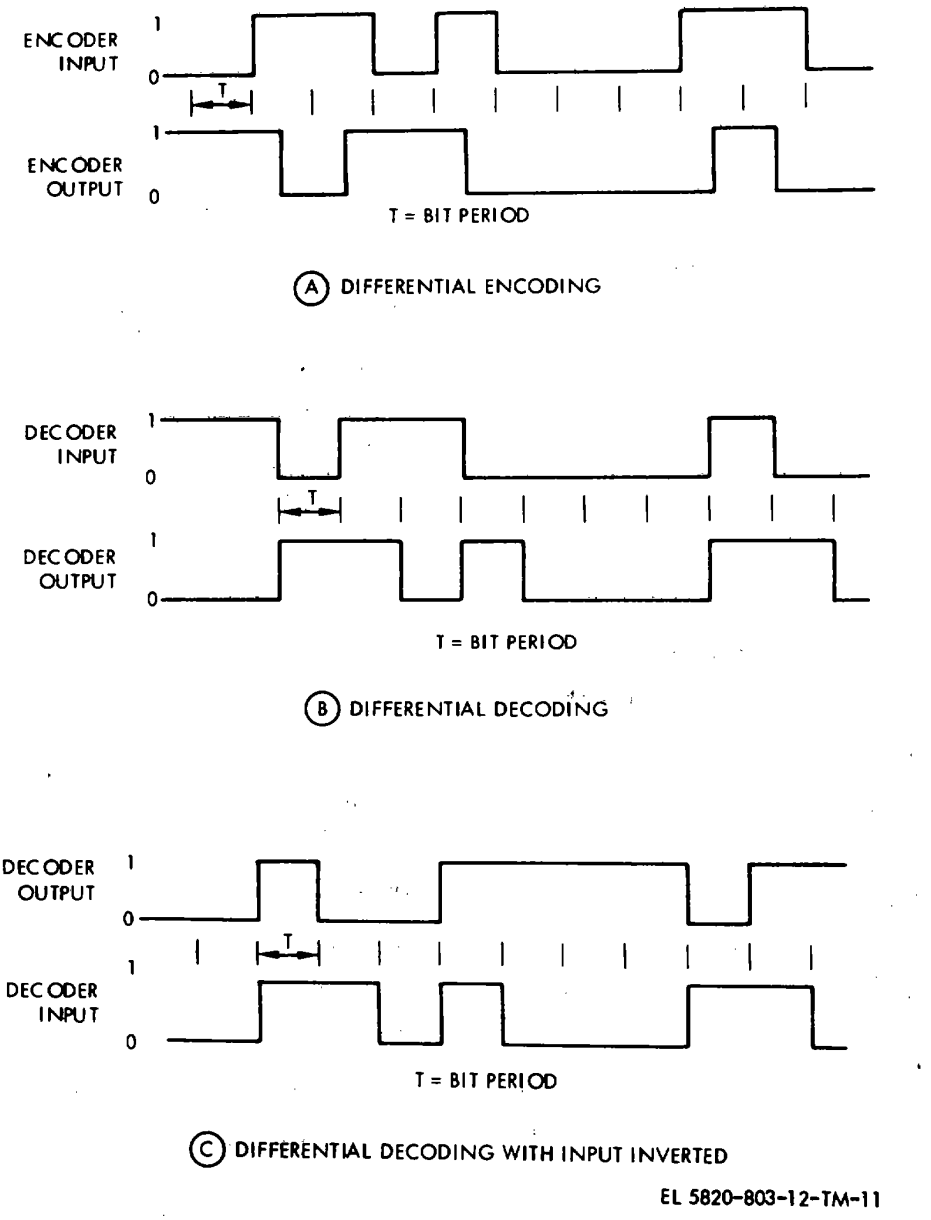

Figure 2-6. Differential encoding and decoding waveshapes.

c. The operation of a differential decoder is illustrated in B, figure 2-6 which shows the same encoded output sequence developed in A. 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 2-6.

d. The operation of a differential decoder is illustrated in C, figure 2-6 with the encoded output sequence of A 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 2-6.

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 PSK modem front panel, must be placed in the ON position to run the modem self-test. The operator's task will be simplified if these controls are also normally in the ON position during operation. Therefore, use of the internal differential coder and decoder in the PSK modem is advantageous even though the external coder/decoder or the digital user may be capable of providing the same function.

2-6. Coding/Decoding Implementation

a. Operational signal paths of the PSK modem with the associated coders and decoders is illustrated in figure 2-7. 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	INTERNAL, NONE, or EXTERNAL
(Receive) DIFF DECODE	ON or OFF
RECEIVE ERROR CODING	INTERNAL, NONE, or EXTERNAL

b. The DIFF ENCODE and DIFF DECODE switches are normally placed in the ON position, unless ambiguity resolution is provided by either the digital user or an external coder/decoder.

c. Operation with either the internal error-correcting coding or no error-correcting coding is accomplished by setting the front panel TRANSMIT and RECEIVE ERROR CODING switches in the appropriate positions. Operation with an installed external error correcting coder/decoder (KY-801/GSC) is selectable by the same switches. If an external coder/decoder is required, it should be installed near the PSK modem such that the intermediate cabling does not exceed 10 feet in length. The interconnect wiring 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 2-19. The interface uses line drivers and receivers manufactured by Texas Instruments, part numbers SN75107 and SN75109. The interface signal data/clock phase relationships are shown in figure 2-8. All input and output clock lines may be inverted by setting the appropriate internal switch (para 2-20d).

d. The internal and external coders are similar in that they produce two output symbols for each input data bit. Therefore, when error-correcting coding is used, the symbol rate transmitted over the link is twice the data rate to and from the digital user.

e. As shown in figure 2-7, the baseband conditioner in the PSK modem transmitter operates directly on the data from the digital user. The modem transmitter INPUT DATA RATE selection switches must always be set to the digital user's data rate.

f. The baseband conditioner in the PSK modem receiver operates on the symbols transmitted over the communications link. Therefore, the setting of the SYMBOL RATE switches for the PSK modem receiver depends upon whether error-correcting coding is used in the link. If no error-correcting coding is used, the SYMBOL RATE switches are set to match the digital user's data rate. If either internal or external error-correcting coding is used, the SYMBOL RATE switches must be set to twice the digital user's data rate.

2-7. Digital User Interface

The PSK modem transmitter (fig. 2-9) accepts digital inputs for subsequent modulation from any one of several sources: 1) a line-of-sight (LOS) microwave link, 2) a shielded cable, or 3) a direct MIL-STD-188 user interface. The PSK modem receiver provides compatible digital output capabilities. The PSK modem additionally provides an internally generated clock output at a rate equal to the setting of the INPUT DATA RATE switches. All digital user interface signals, with the

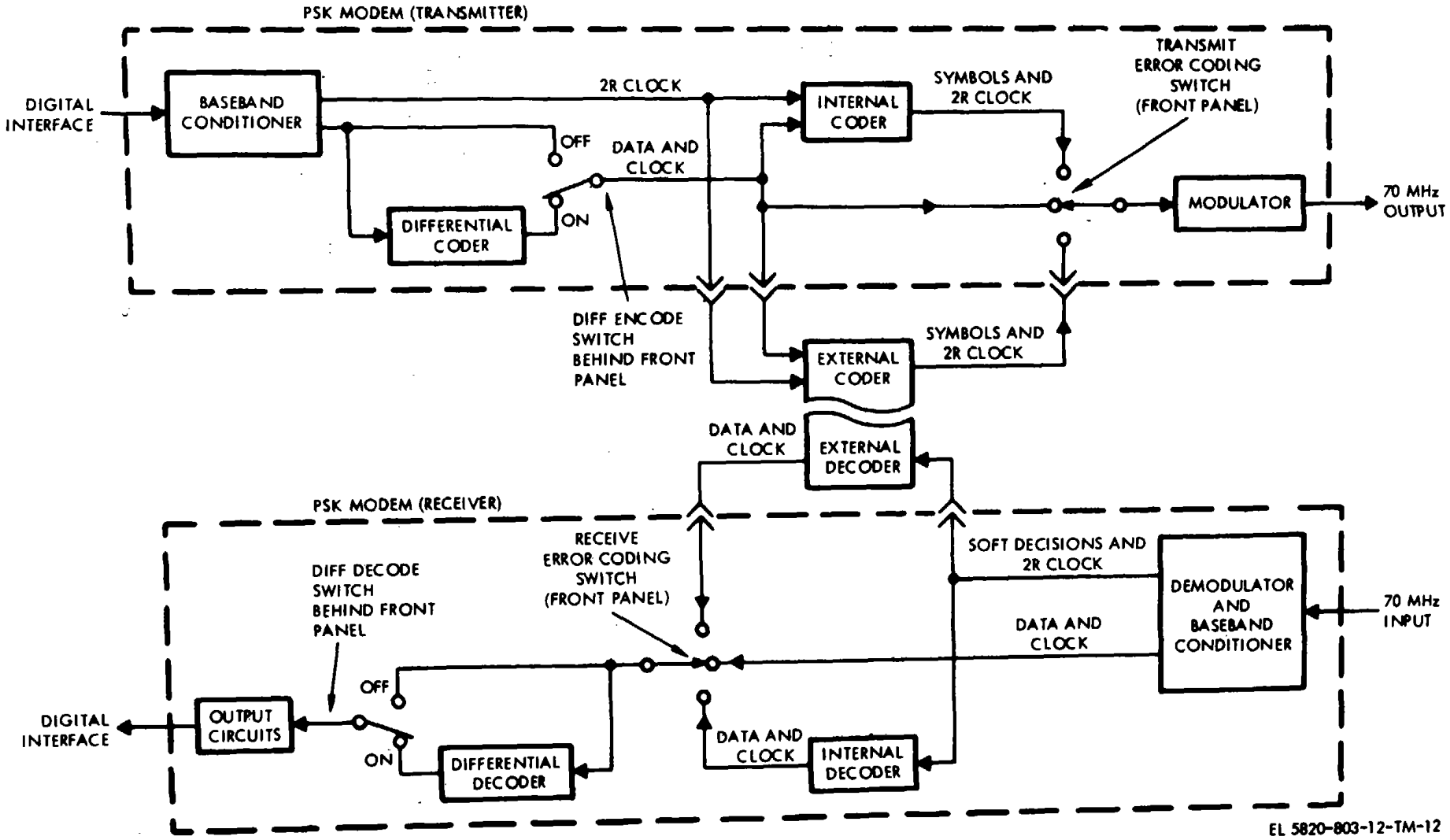

Figure 2-7. Coder/decoder signal paths.

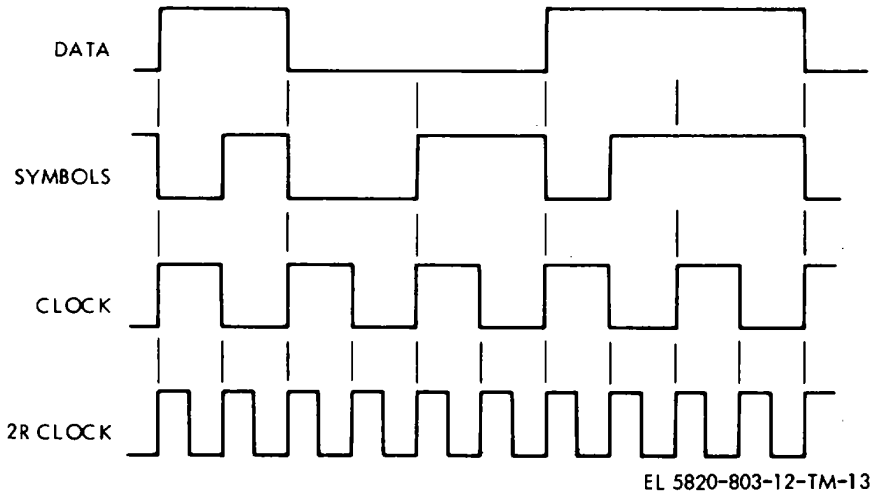

Figure 2-8. External coder/decoder interface phasing.

exception of the LOS input, are provided at the site interface connector, J5, on the rear panel of the modem. The LOS input is a BNC type connector also located on the rear panel. Further information on interface connections is given in paragraph 2-19.

2-8. Direct Digital Interface

(fig. 2-9)

When the PSK modem interfaces with a digital user located near the modem, a direct digital interface via balanced line drivers and receivers is employed. The interface signals are listed in a and b below.

a. Input Signals.

(1) The *standard data input* accepts data from the digital user for modulation, coding, and transmission over the communications link. The PSK modem is capable of synchronizing an internal clock to the data input for use in the coder and transmitter operation.

(2) Use of the *standard clock input* is optional. The PSK modem may be configured to use this input clock to control modulation, coding, and transmission of the standard data input signal. An internal switch in the PSK modem provides the capability of inverting the clock signal. See paragraph 2-20b for further details on setting of this switch.

b. Output Signals. All direct digital outputs may be inverted by internal switches in the PSK modem. See paragraph 2-20c 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 ±0.005%, is available to the digital user as an optional clock source.

(2) The *standard data* output is that data which is received and decoded by the PSK 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 PSK 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 2-10 and 2-11. 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 PSK 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.

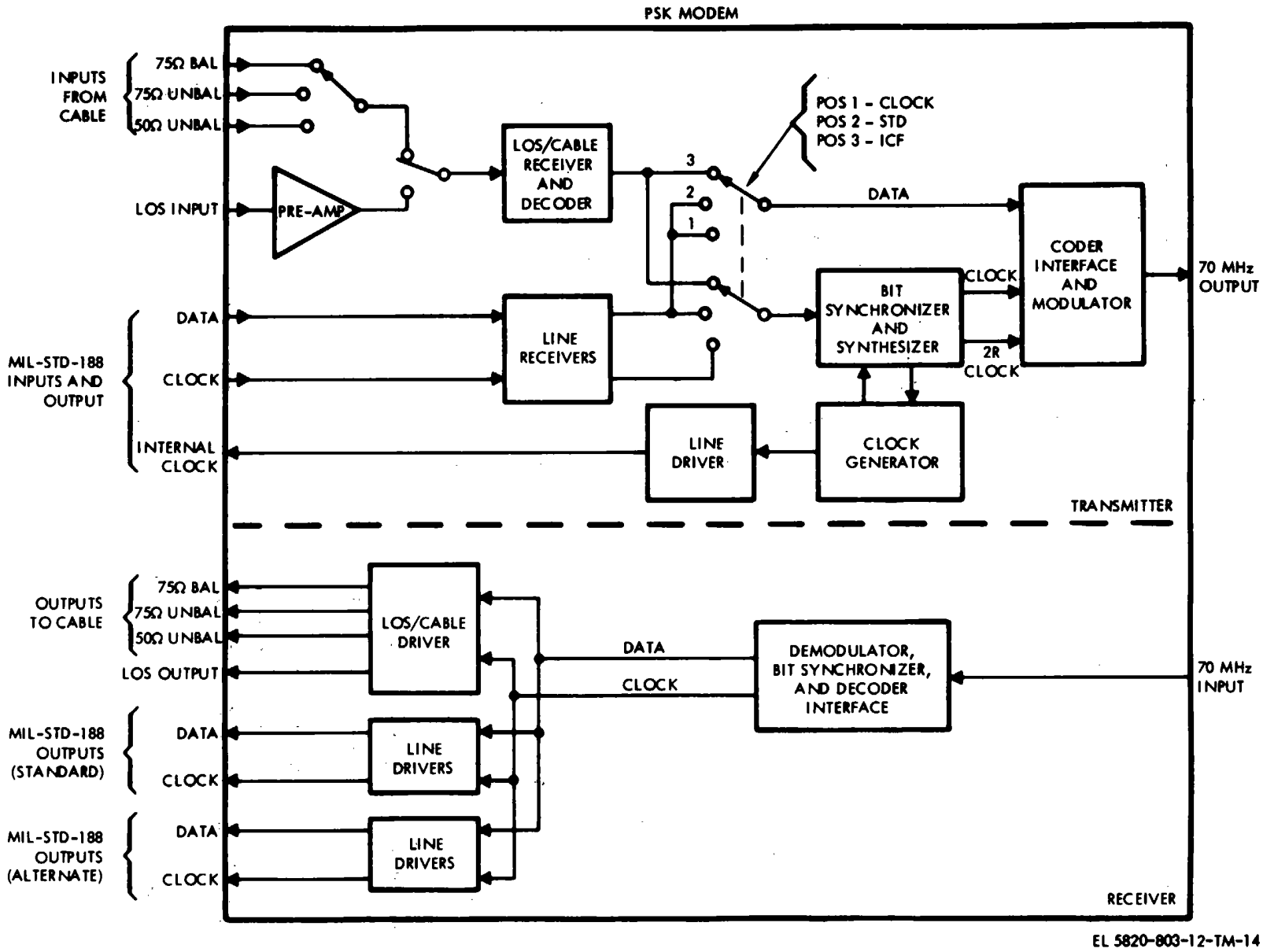

Figure 2-9. Digital user interface.

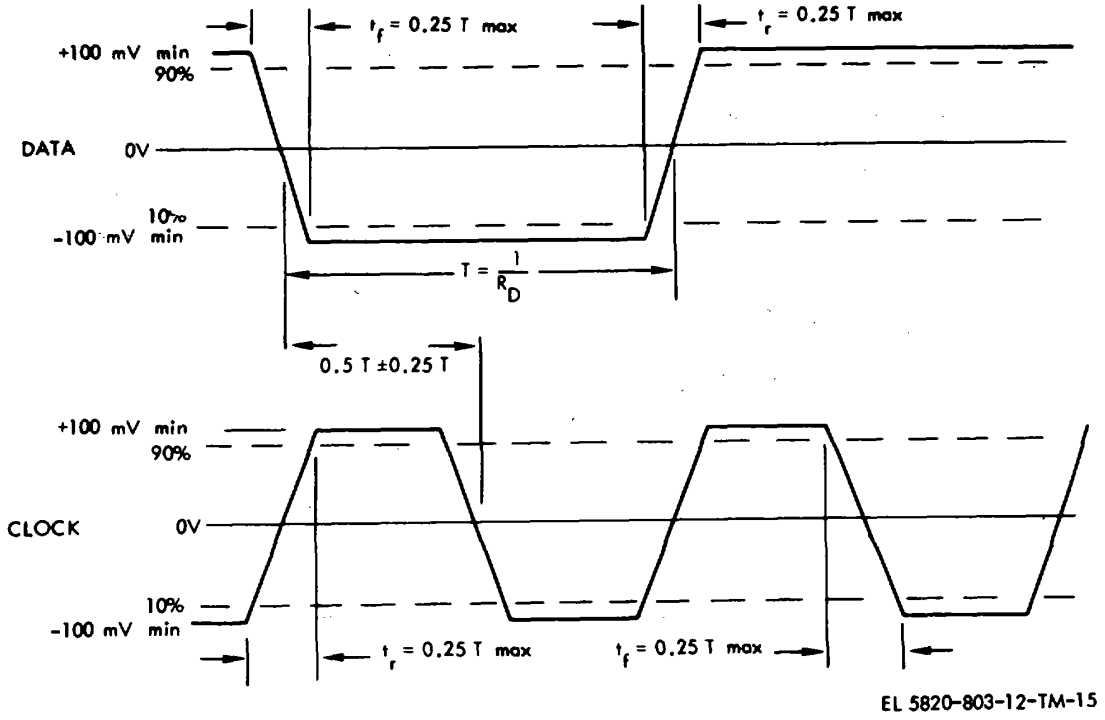

Figure 2-10. Required standard data and clock input charateristics (normal polarity).

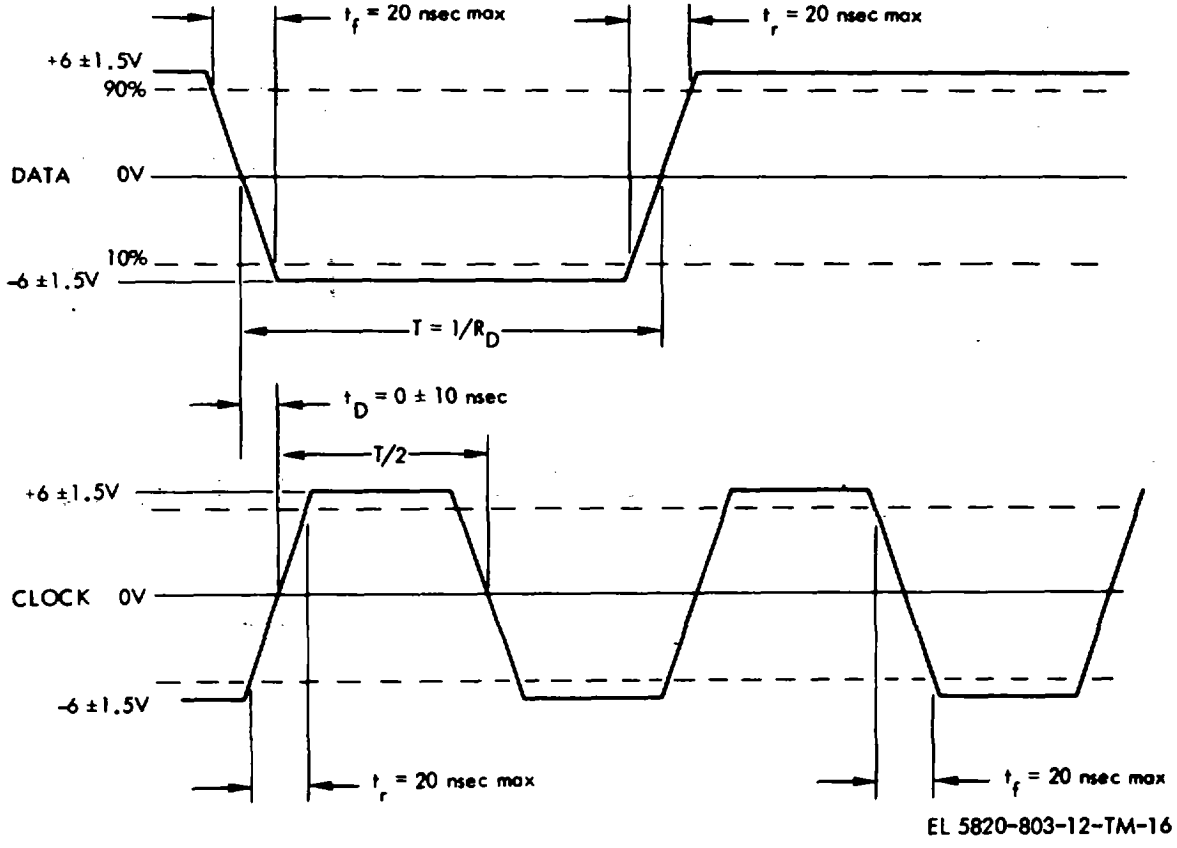

Figure 2-11. Open circuit standard data and clock output characteristics (normal polarity).

2-9. ICF Interfaces

a. General. The PSK modem is capable of interfacing with the digital user over a line-of-sight (LOS) microwave link (fig. 2-12) or a shielded cable (fig. 2-13) using an Interconnect Facility (ICF) modem located at the digital user site. Both the PSK and ICF modems contain identical LOS/cable driver circuits and LOS/cable 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

b. Cable Installation.

(1) *Cable selection.* The cable selected for data transmission 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 is being considered for a 10,000-foot installation. The cable loss characteristic, in dB/100 feet, for RG-217/U cable (unbalanced type cable) is shown in figure 2-14. From figure 2-14, it can be seen that cable loss characteristics (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:

$$\text{cable loss} = (a_l) \div 100.$$

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

Since the cable loss in the example given above is less than 30 dB, that length of RG-217/U would be usable

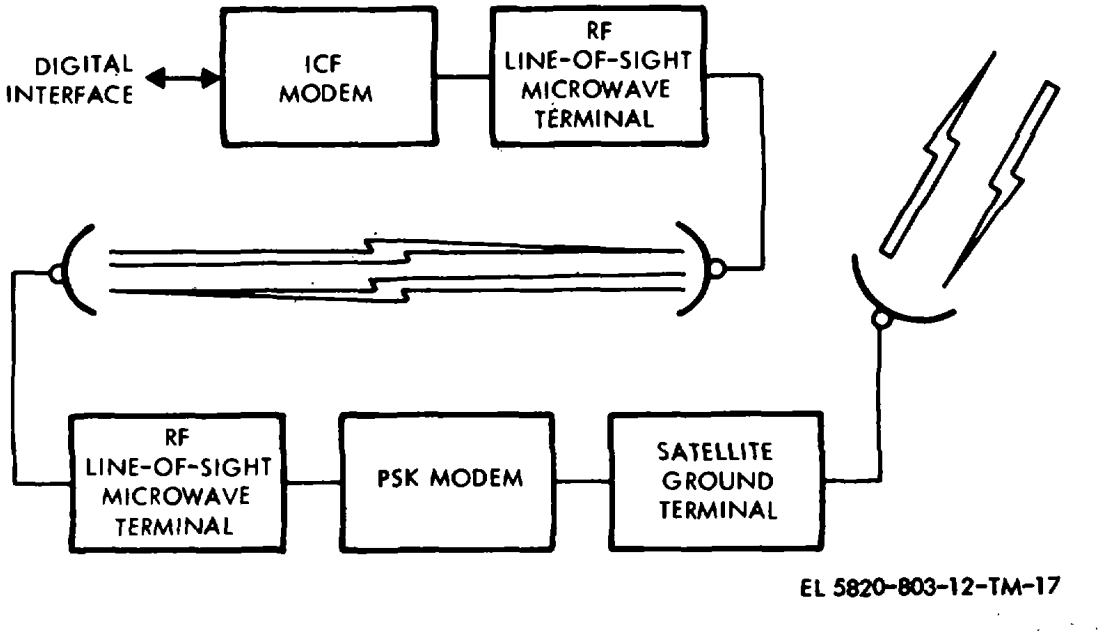

Figure 2-12. ICF/PSK modem configuration via line-of- sight (LOS) microwave terminal.

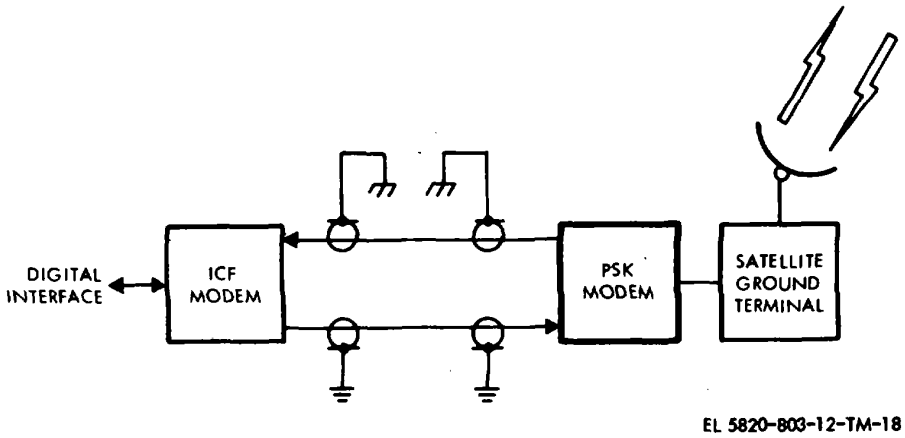

Figure 2-13. ICF/PSK modem configuration via shielded RF cable.

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:

$$\alpha_{max} = 3000 \div$$

(2) *Cable classification*. The transmission of baseband data over an interconnect facility cable results in unequal phase distortion at the output. The PSK modem LOS/cable receiver and decoder circuits contain equalization networks to compensate for this phase distortion. Detailed instructions for adjusting the equalizers are given in paragraph 2-21. Further information on configuring the LOS/cable receiver and decoder circuits to provide the appropriate equalization is given in paragraph 2-20, 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 = α_5/100) and assign the appropriate classification in accordance with the following list to ensure proper alinement (para 2-21).

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

c. Input Signals. The desired input from the ICF modem is internally selected at installation. Details for the LOS/cable receiver and decoder input selection are given in paragraph 2-20f. The modem must also be configured to derive internal timing from and transmit the selected ICF input. Any one of the following input sources may be selected:

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

NOTE

If a cable is used for the ICF interface, the required equalization procedure is given in paragraph 2-21.

d. Output Signals. All outputs available to the ICF system are present at the PSK modem rear panel and their levels are controlled by a single internal switch. Detailed instructions for setting this switch are given in paragraph 2-20e. 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 unbalanced cable driver.
(4) LOS microwave driver.

2-10. Test and Monitor Capabilities.

a. Link Test. The PSK modem provides the capability, with adequate coordination between earth terminal sites, of measuring the quality of a digital communications link. The transmit link test setup (para 3-6) provides instructions for using the PSK modem to transmit an internally generated 2047 bit sequence over the satellite link. The receive link test procedure (para 3-7) provides instructions for using the PSK modem to receive this same sequence from a satellite link, 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. Terminal Test. If an earth terminal is configured to receive its own transmissions, the link test capabilities of the PSK modem may be used to determine the operational status at the terminal.

c. Self-Test. The PSK modem contains internal self-test circuits which play a major role in the 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. Signal-to-Noise Indication. The PSK modem contains a circuit which monitors the operation of the baseband conditioner in the receiver during normal communications. The resulting front-panel meter indication may be used to estimate the input signal-to-noise ratio to the PSK modem (fig. 2-15) or the error rate occurring in the received data (fig. 2-16). For the most accurate results, the operator should be instructed to plot calibration curves at the operational data rate of the receive link. The data for calibration curves is collected by performing the noise test (para 4-6) and noting the error rate and meter reading for each value of (E_b/N_o) tested.

e. On-Line Fault Monitoring. The on-line fault indicators monitor various characteristics of the signals being processed by the system. It is recommended that the function of the indicators be reviewed and utilized in the site operating and troubleshooting procedures.

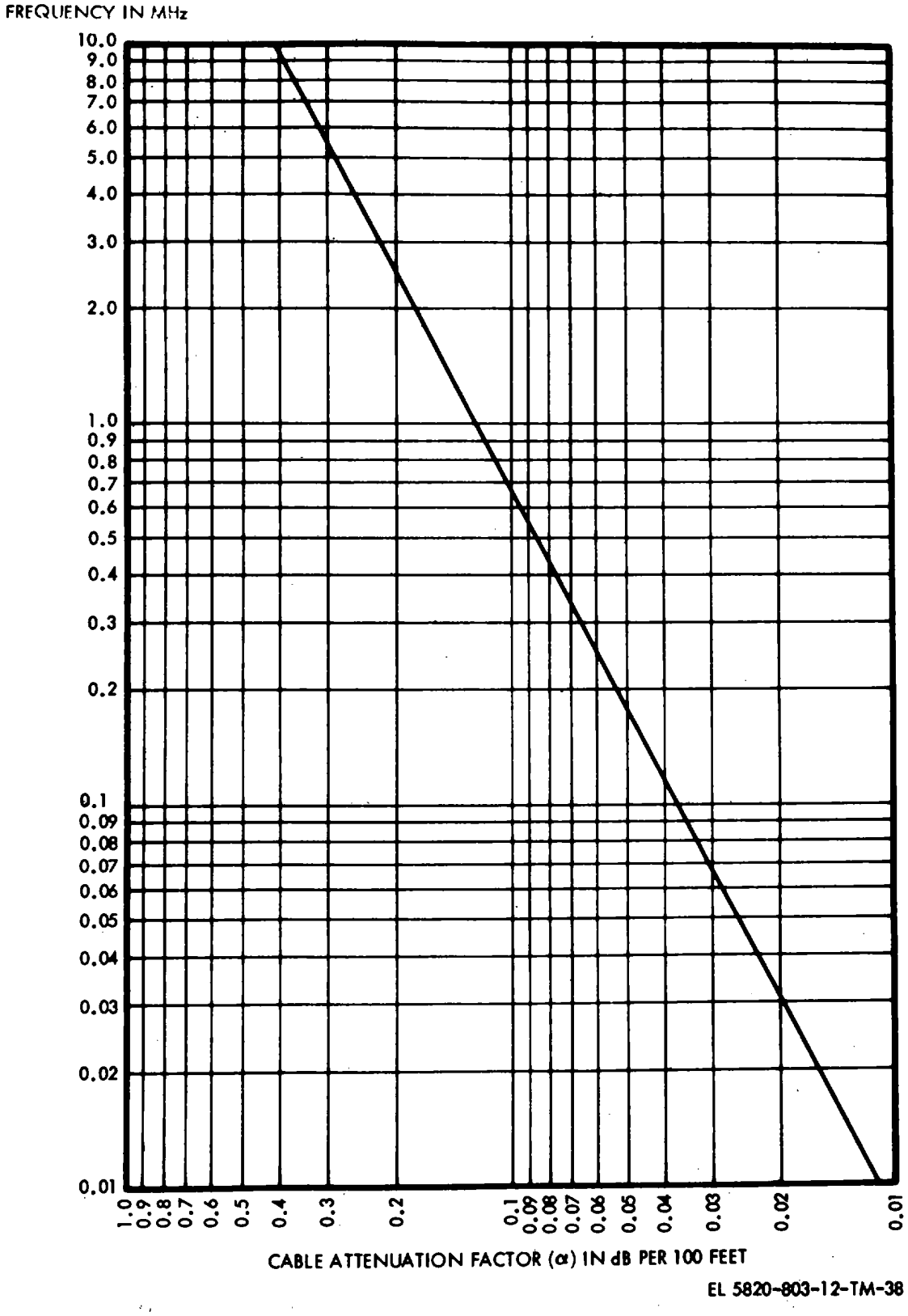

Figure 2-14. Attenuation characteristics of RG-217/U cable.

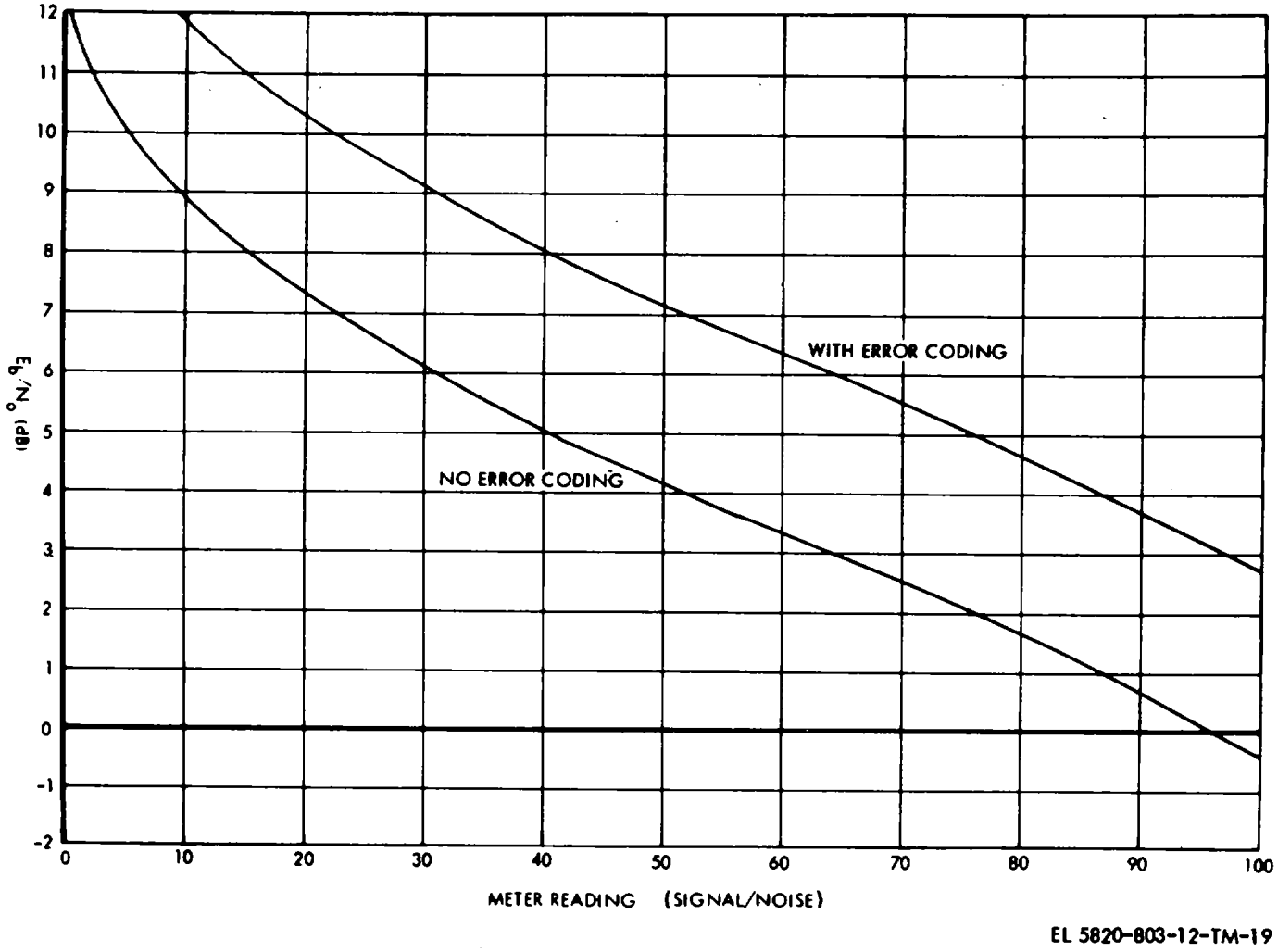

Figure 2-15. (E_b/N_o) as a function of signal/noise meter reading.

2-11. Special Applications

a. The PSK modem input and output digital user interfaces are compatible with each other. The interface signals normally connected to a digital user may be connected directly to another PSK modem to implement a ground relay configuration, as shown in figure 2-17. If the two earth terminals are widely separated, the PSK modem may also be interfaced with another PSK modem over a shielded cable or a line-of-sight (LOS) microwave link. For detailed information on cable interface, refer to paragraph 2-9 b. All coding options may also be used in a relay configuration.

b. In the external coding mode, the PSK modem is intended for normal operation with an external rate one-half Viterbi coder/decoder (KY-801/GSC). However, the modem may be used in conjunction with other types of coders/decoders, within the following constraints:

(1) The interface levels (line drivers and receivers) must be compatible (see paragraph 2-6 for further information on interface levels).

(2) The bit-error rate performance with external coding depends upon the type of external coder/decoder used.

(3) The PSK modem may be used in conjunction with other than rate one-half coder/decoders; e.g, a rate three-fourths coder/decoder. In this case, however:

(a) The coder section must be capable of operating with only one clock input at the input data rate, and must produce an output clock at the output symbol rate.

(b) The decoder section must be capable of operating with only one clock input at the symbol rate, and must produce an output clock at the output data rate.

(c) The PSK modem operating procedures must be revised to reflect the appropriate data rate to symbol rate relationship.

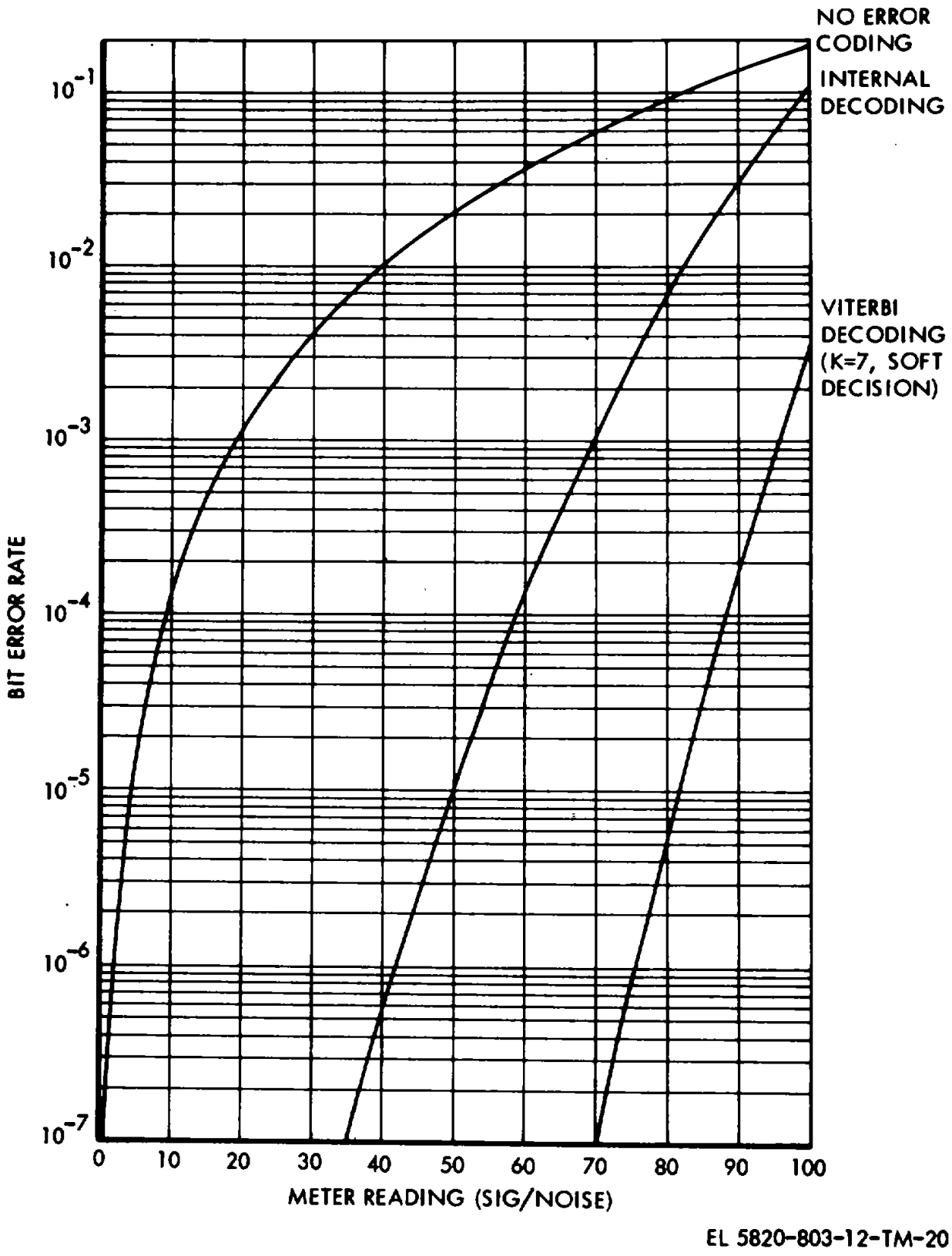

Figure 2-16. Bit error rate versus signal/noise meter reading for differentially encoded signals using various error coding modes.

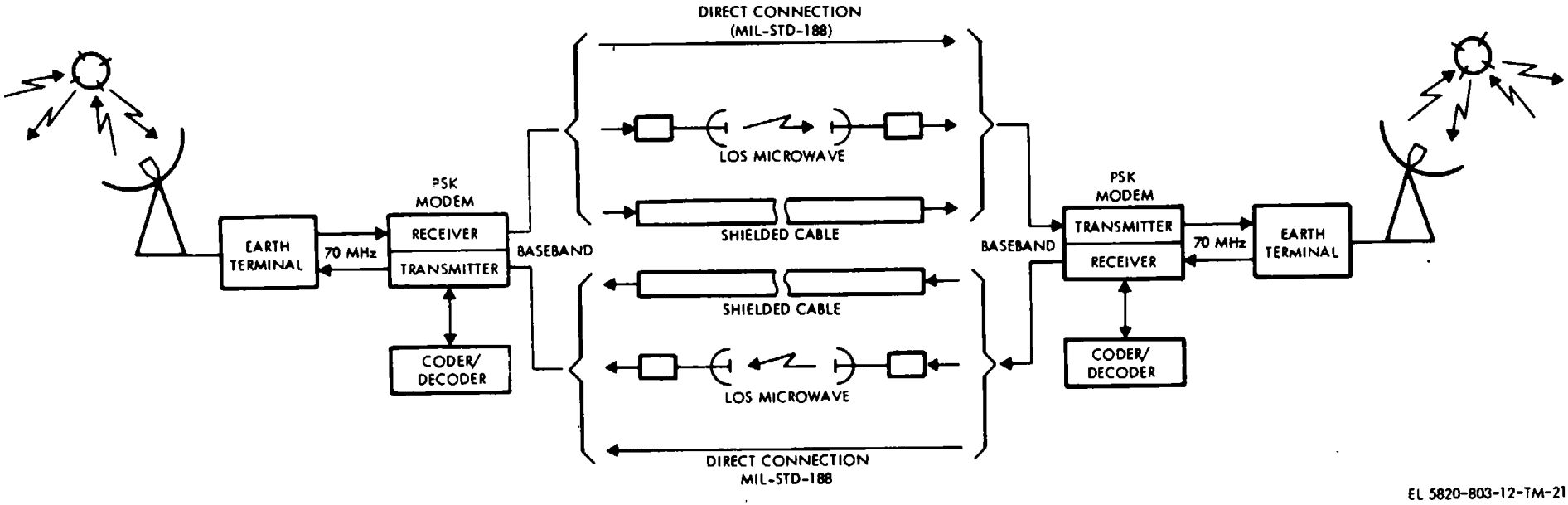

Figure 2-17. Two PSK modems used in ground relay applications.

Section II. SITE AND SHELTER REQUIREMENTS

2-12. Siting

No specific sitting requirements are required since the PSK modem is rack mounted and hardwire connected to the earth terminal and the digital interface.

2-13. Shelter Requirements.

The PSK modem is rack mounted in a standard 19-inch equipment rack. The modem weight is 80 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 extendable 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 PSK modem is shown in figure 2-18 for reference purposes. The air inlet areas are near the font 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 area.

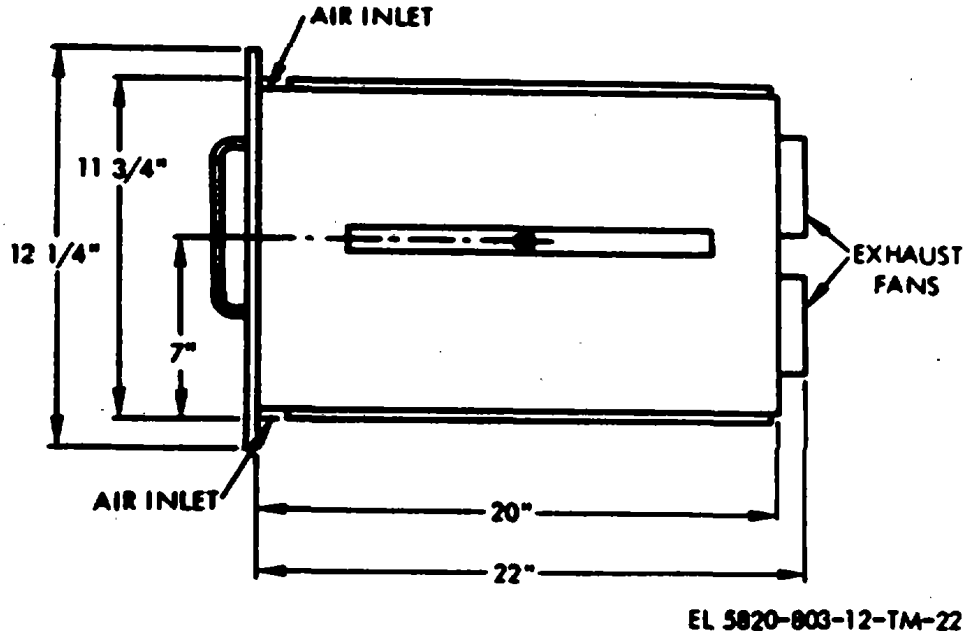

Figure 2-18. PSK modem overall dimensions.

Section III. SERVICE UPON RECEIPT OF MATERIEL

2-14. Unpacking

The PSK modem is packaged in cardboard or wooden containers and sealed with tape and no unusual unpackaging procedures need to be observed; however, exercise care when removing the unit from the container to prevent damage to the equipment. Retain the packaging material for possible future use.

2-15. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on DD Form 6 (Packaging improvement Report) as prescribed in (para 1-1c) AR 700-58.

b. Check the equipment against the packing slip to see if the shipment is complete. Refer to paragraph 1-10 for listing of PSK modem components. Report all discrepancies in accordance with the instructions in paragraph 1-3e. The equipment should be placed in service even though a minor assembly or part that does not affect proper functioning is missing.

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 310-1.).

Section IV. INSTALLATION INSTRUCTIONS

2-16. Tools, Test Equipment, and Materials Required for Installation.

Tools required for installation of PSK modem are contained in Tool Kit, Electronic Equipment T]10/G (SC 518091-CL-07). 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.

2-17. Installation Instructions.

CAUTION

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

The PSK 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, depress

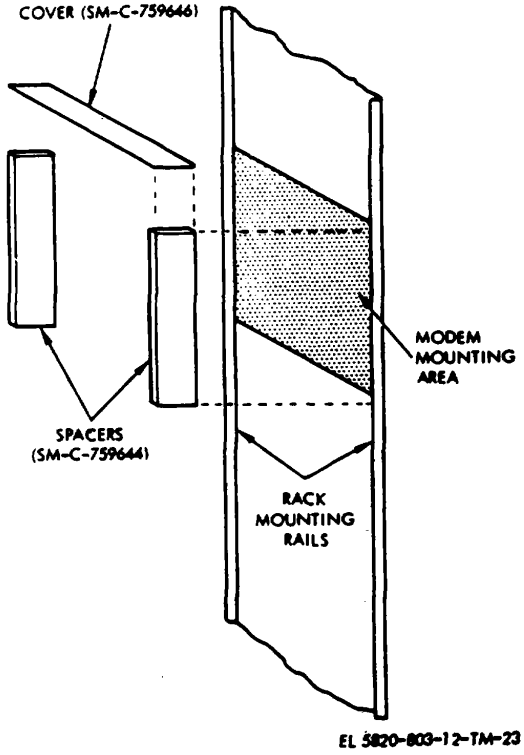

Figure 2-19. Special installation accessories.

the retaining catches on the rack section of the slides and push modem into cabinet. If a cable retractor is to be installed, it is recommended that a Jonathan CRS-25 (SM-A571570-1) type be used. The electrical connections are given in paragraph 2-19. When dressing the cables, care should be taken to ensure adequate length for pivoting the modem a full 90 degrees in both directions from the normal position.

2-18. Special Installation

Certain installations may require mounting of the PSK modem so that the front panel of the unit protrudes from the front of the rack. This installation is either to ensure air flow through the modem cooling air inlets (fig. 2-18), or is the result of installation in a shallow rack. This type of installation differs from normal only in that two Spacers and a cover, illustrated in figure 2-19, must first be attached to the rack.

2-19. External Connections

a. When the PSK modem has been mounted in the equipment rack as described in paragraph 2-17 or 2-18, it must be interconnected into the system This involves connecting input ac power, ground, site interface, coder interface, and 70 MHz input and output connections at the rear panel of the PSK modem (fig. 2-20). The reference designations and title of each interface connector are listed in table 2-2.

b. The site and coder interface, J5 and J6, are multi-conductor cables Table 2-3 lists the signals carried by J5 while table 2-4 provides similar information for J& 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 of the signal ground (ES) is optional In all cases, the chassis ground terminal should be connected to the site ground system as a safety precaution.

2-20. Switch and Internal Control Settings

The internal switches are located on selected plug-in card assemblies in the PSK modem. The switches are screwdriver-operated and have either two or three switch positions. It is necessary to remove and reinstall two of the plug-in card assemblies to set the switches, but most of the switches may be operated without removing the cards. Refer to figures 1-3 and 1-4 to determine card

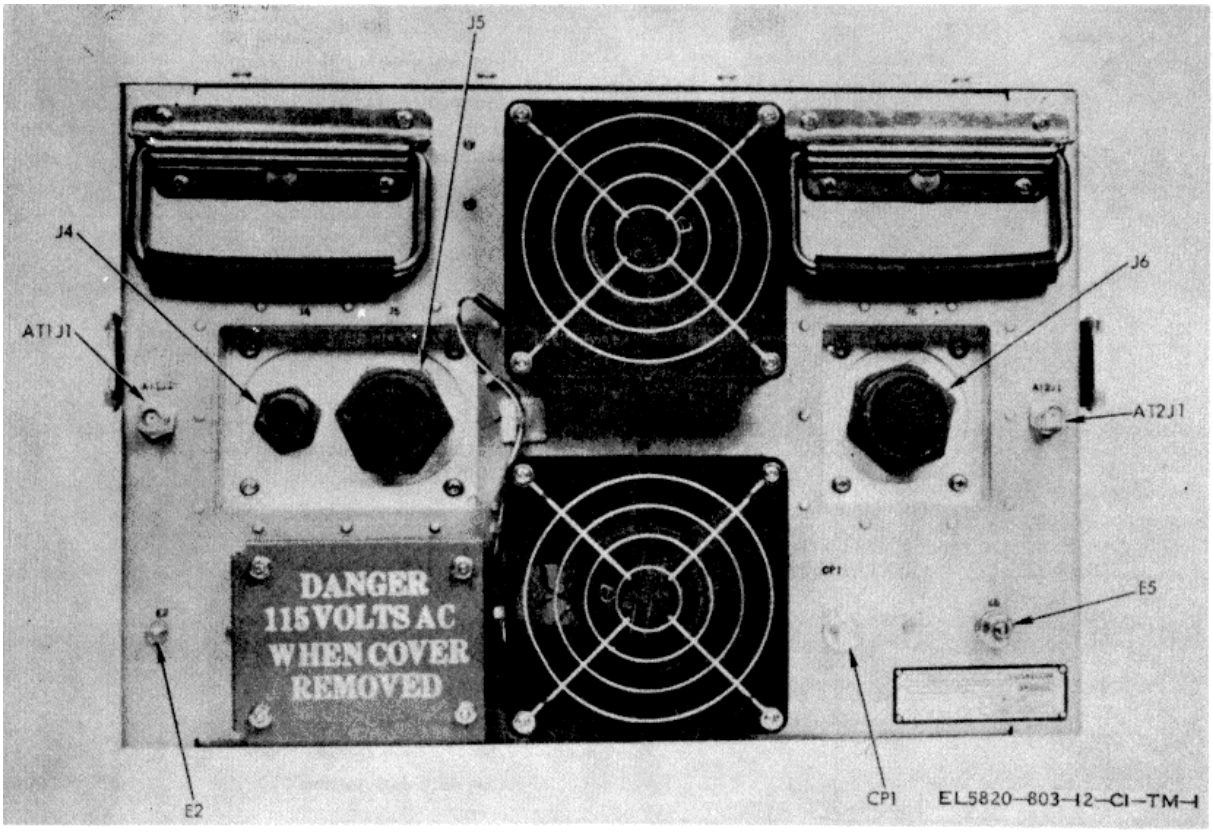

Figure 2-20. PSK modem, rear view.

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 PSK modem top and bottom covers, and set the internal switches as specified in the following paragraphs.

a. Set S1 on input filter card assembly A21A1A22 (fig. 2-21) according to the site requirements (para 2-2a). For installations where the PSK modem is located in or near the following terminals, set the switch to the 0 to -55 dBm range (position 2).

(1) AN/MSG-46.
(2) AN/TSC-54.
(3) AN/MSC-60 (HT).
(4) AN/MSC-61 (MT).

b. Set S1 on input interface card assembly A2A2A2A4 (fig. 2-22) for normal polarity (position 1) unless otherwise directed by the digital user (para 2-8a).

Table 2-2. PSK Modem Interconnections (fig. 2-20).

Reference designation	*Title*	*Mating connector*
AT1J1	70 MHz output	TNC coaxial plug
AT2J1	70 MHz input	TNC coaxial plug
J4	AC power	(cable supplied)
J5	Site interface	MS3126E24-61P with Glenier 90^0 Qwik-TY GTR20S24B (SM-A-7313582)
J6	Coder/decoder interface	MS3126E24-61PW with Glenier 90O Qwik-TY GTR20S24B (SM-A-731358-2)
CP1	LOS Input	BNC coaxial
E2	Chassis ground	Terminal lug
E5	Signal ground	Terminal lug

Table 2-3. 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, 50 ohm, unbalanced
F	Rtn.	ICFIN60	
f	Shield		
J	Sig.		Bipolar NRZ input, 75 ohm unbalanced
K	Ret.	ICFIN75	
i	Shield		
L	+		Internal clock output
M	-	INTCLK	
k	Shield		
AA	EXTALM 1		Fault Alarm
BB	EXTALM 2		(contact closure)
DD	Sig	LOS OUT	LOS output
EE	Ret.		
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, 50 ohm, unbalanced
Y	Ret.	ICFOU50	
t	Shield		
Z	Sig.		Bipolar NRZ output, 76 ohm, unbalanced
a	Rtn.	ICFOU75	
u	Shield		
b	+		Bipolar NRZ output, 75 ohm, balanced
c	-	ICFOUB	
	Shield		
w	+		Bipolar NRZ input, 76 ohm, balanced
x	-	ICFIB75	
z	Shield		

Table 2-4. Coder Interface (J6) Signal List

Pin number		*Signal*	*Description*
A	+	DATTE	Data to encoder
B	-		
c	Shield		
C	+	RCKTE	R clock to encoder
D	-		
d	Shield		
E	+	2RCKTE	2R clock to encoder
f	-		
e	Shield		
F	+	DATFE	Data from encoder
G	-		
g	Shield		
L	+	2RCKFE	2R clock from encoder
M	-		
k	Shield		
N	+	SGNTD	Sign Bit to decoder
P	-		
m	Shield		
R	+	MSBTD	MSB to decoder
P	-		
n	Shield		
S	+	LSBTD	LSB to decoder
T	-		
q	Shield		
v	+	2RCKTD	2R clock to decoder
w	-		
HH	Shield		
Z	+	RCKTD	R clock to decoder
b	-		
a	Shield		
JJ	+	DATFD	Data from decoder
x	-		
y	Shield		
KK	+	RCKFD	R clock from decoder
z	-		
AA	Shield		

c. Set S1 and S2 on line driver card assemblies A2A2A1A21, A2A2A1A22, and A2A2A1A23 (fig. 2-23) for normal polarity (position 1) unless other wise directed by the digital user (table 2-5 and para 2-8b).

d. Set S1 through S6 on coder interface card assembly A2A2A2A5 (fig. 2-24) for normal polarity (position 1) if an external coder/decoder is used in the installation (table 2-6 and para 2-6 c).

e. For digital user interface via an LOS microwave link, set S1 on LOS/cable driver card assembly A2A2A2A3 (fig. 2-25) for a -12 dBm output power level (position 2) at the LOS output. For digital user interface' via a shielded cable, the final switch setting must be determined by coordination with the ICF modem site. Set the switch (A2A2A2A3S1) initially to position 2 (para 2-9 c).,

f. For digital user interface via either a shielded cable or an LOS microwave link, set S1 through S4 on LOS/cable receiver and decoder card assembly A2A2A2A1 (fig. 2-26 and 2-27) according to table 2-7 and the installation configuration. Table 2-8, describing the switch functions, is provided for reference purposes.

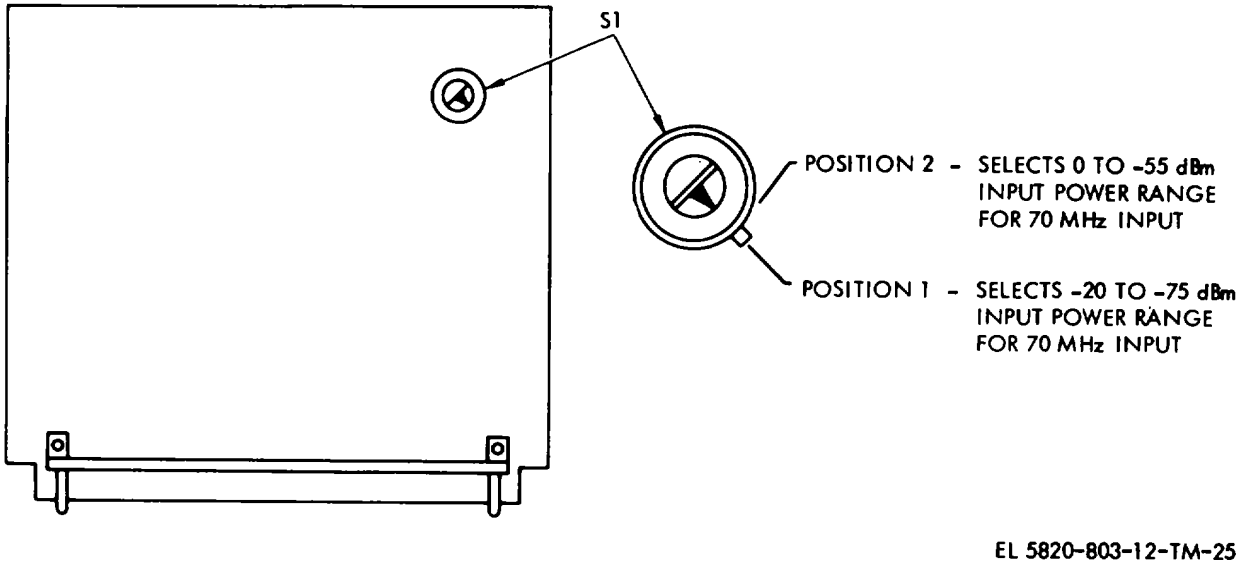

Figure 2-21. 70 MHz input signal range selection switch S1 (viewed from component side of input filter card, SM-D-7S1133: A2A1A1A22).

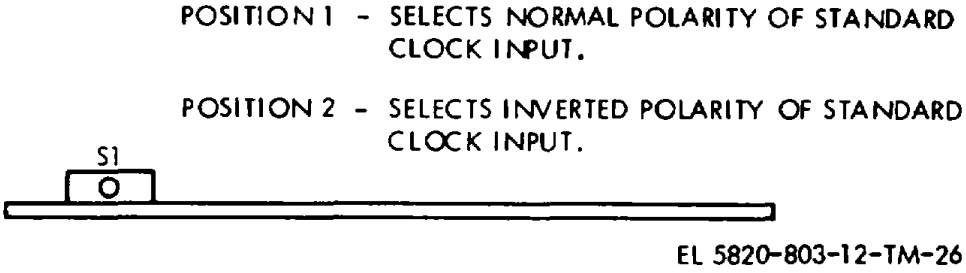

Figure 2-22. Standard clock input inverter switch S1 (viewed from top of input interface card, SM-D-742037, A2AA2A4).

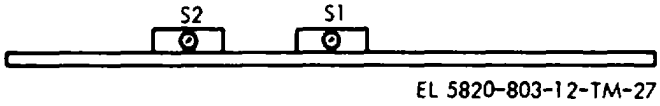

Figure 2-23. Line driver polarity inverter switches S1 and S2 (viewed from top of line driver card, SM-D-742053, A2A2A1A21, A1A2A1A22, A1A2A1A23).

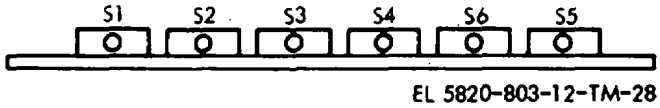

Figure 2-24. External coder interface clock inverter switches S1 through S6 (viewed from top of coder interface card, SM-A-74049, A2A2A2A5).

2-21. Circuit Lineup

NOTE

The following installation procedures must be made with the assistance of direct support maintenance personnel.

If the PSK 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 2-27, according to the instructions in paragraph 2-20f. Then the card must be aligned per the following procedure (refer to figure 2-26 for location of controls and test points):

NOTE

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

a. The initial adjustments are made at a data rte of 5.0000 Mb/s regardless of the normal system

POSITION 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.

POSITION 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.

POSITION 3 -SELECTS 0 dBm 43 dB OUTPUT POWER LEVEL AT CABLE DRIVER OUTPUTS AND -22 :3 dB OUTPUT POWER LEVEL AT LOS MICROWAVE DRIVER OUTPUT.

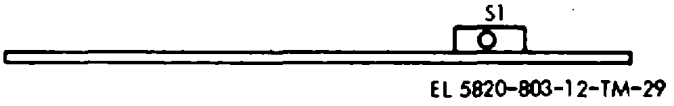

Figure 2-25. LOS/cable driver output level selection S1 (viewed from top of LOS/cable driver, card, SM-D-74F081, A2A2A2A3).

operating rate. Coordinate with the remote ICF modem site to obtain a 5.0000 Mb/s data input.

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

c. Adjust oscilloscope sweep rate to 100 nsec/cm 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 (A2A2A2A1) 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 pp.

(2) For a short cable input, use an oscilloscope to monitor TP1 on the LOS/cable receiver and decoder card (A2A2A2A1). If the amplitude is greater than 2.0 V p-p, adjust R12 (and adjust R10 equally if the 75 ohm 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 pp.

(3) For a midrange cable input, use an oscilloscope to monitor TP1 on the LOS/cable receiver and decoder card (A2A2A2A1). 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 F equalization by turning R12 (and adjust R10 equally if the 75 ohm balanced input is used) counterclockwise until a signal similar to B, figure 2-28 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 an 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 (A2A2A2A1). If the amplitude is less than 2.4 V p-p, adjust R2 to obtain an amplitude of 2.4 V pp. If the amplitude is greater than 2.4 V pp, proceed even if the signal obviously causes saturation of the amplifier. Adjust the first stage of equalization by turning R12 (and adjust R10 equally if the 75 ohm balanced input is used) counterclockwise until a signal similar to A, figure 2-28 is observed. Because the amplitude will decrease, it may be necessary to increase the oscilloscope gain to observe this adjustment. Then, adjust R2 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,

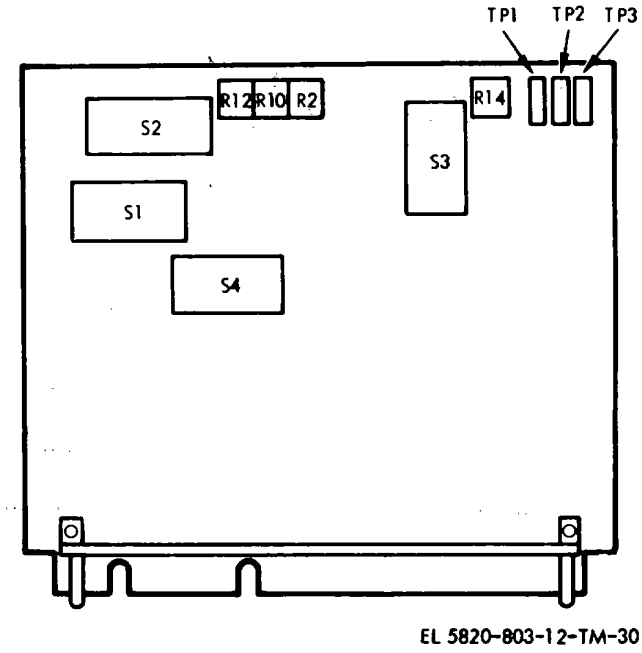

Figure 2-26. LOS/cable receiver and decoder selection switches S1 though S4 (viewed from component side of LOS/cable receiver and decoder card, SM-D-742089, A2A2A2A1).

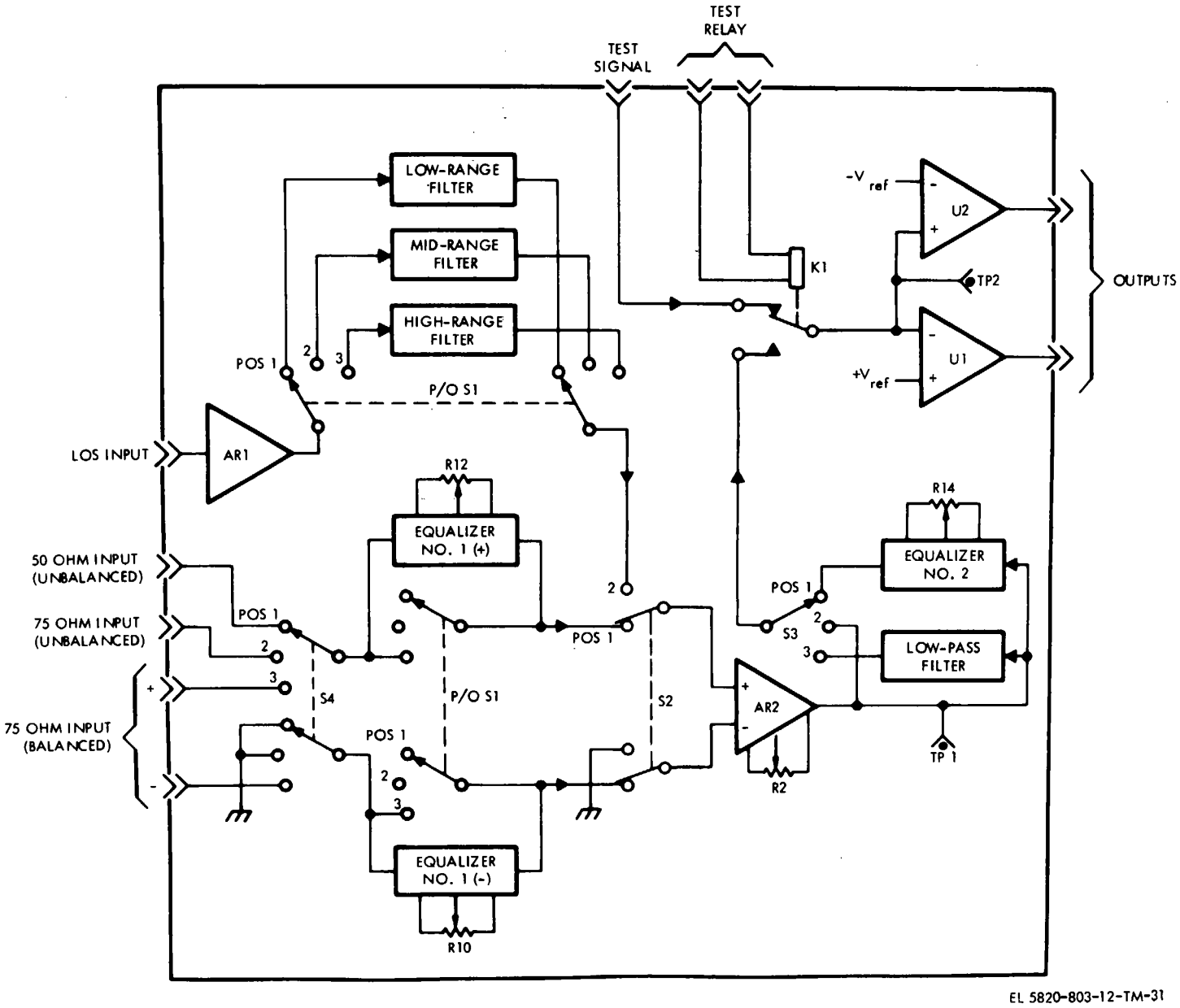

Figure 2-27. LOS/cable receiver and decoder adjustments.

figure 2-28 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 remote ICF modem site to return to the operational data rate.

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

Table 2-5. Direct Digital Output Interface Polarity Selection.

Switch	*Positioning*	*Function*
A2A2A1A21S1	1	Selects normal polarity of internal clock output.
	2	Selects inverted polarity of internal clock output.
A2A2A1A21S2	-	Not used.
A2A2A1A22S1	1	Selects normal polarity of standard data output.
	2	Selects inverted polarity of standard data output.
A2A2A1A22S2	1	Selects normal polarity of standard clock output.
	2	Selects inverted polarity of standard clock output.
A2A2A1A23S1	1	Selects normal polarity of alternate data output.
	2	Selects inverted polarity of alternate data output.
A2A2A1A23S2	1	Selects normal polarity of alternate clock output.
	2	Selects inverted polarity of alternate clock output.

Table 2-6. External Coder/Decoder Interface Clock Polarity Selection.

Switch	*Positioning*	*Function*
A2A2AA5S1	1	Selects normal polarity of 2R clock from external encoder.
	2	Selects inverted polarity of 2R clock from external encoder.
A2A2A2A5S2	I	Selects normal polarity of R clock from external decoder.
	2	Selects inverted polarity of R clock from external decoder.
A?A22AA5S3	1	Selects normal polarity of R clock to external encoder.
	2	Selects inverted polarity of R clock to external encoder.
A2A2A2A5S4	1	Selects normal polarity of 2R clock to external encoder.
	2	Selects inverted polarity of 2R clock to external encoder.
A2A2A2A5S5	1	Selects normal polarity of R clock to external decoder.
	2	Selects inverted polarity of R clock to external decoder
A2A2A2A5S6	1	Selects normal polarity of 2R clock to external decoder.
	2	Selects inverted polarity of 2R clock to external decoder.

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

		Switch setting on A2A2A2A1			
	Conditions	S1	S2	S3	S4
	Input data rate 19.200 kb/s to 225.00 kb/s	1	2	3	NA
LOS microwave interface	Input data rate 225.01 kb/s to 1.8000 Mb/s'	2	2	3	NA
	Input data 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
76-ohm balanced cable Long	1	1	1	3	
	Midrange	1	1	2	3
	Short	3	1	2	3

NOTE

1. Long cable ≥ 4000 ft. for RG-217/U.
2. Mid-range cable = 1000 to 4000 ft. for RG-217/U.
3. Short cable ≤1000 ft. for RG-217/U.
4. Refer to paragraph 2-9 b for length classifications of other cable types.

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

Switch	*Positioning*	*Function*
A2AA22A1S1	1	Selects input filter for use at input data rates from 19.200 kb/s to 225.00 kb/s if LOS microwave input is used; selects no first stage of equalization 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 5.000 Mb/s if LOS microwave input is used; selects use of first stage of equalization if any cable input is used.
A2A2A2A1S2	1	Selects operation with cable inputs.
	2	Selects operation with LOS microwave input.
A2A2A2A1S3	1	Selects use of second stage of equalization at decoder input.
	2	Selects use of no equalization or filtering at decoder input.
	3	Selects use of low pass filter at decoder input.
A2A2A2A1S4	1	Selects 50-ohm unbalanced cable input.
	2	Selects 75-ohm unbalanced cable input.
	3	Selects 75-ohm balanced cable input.

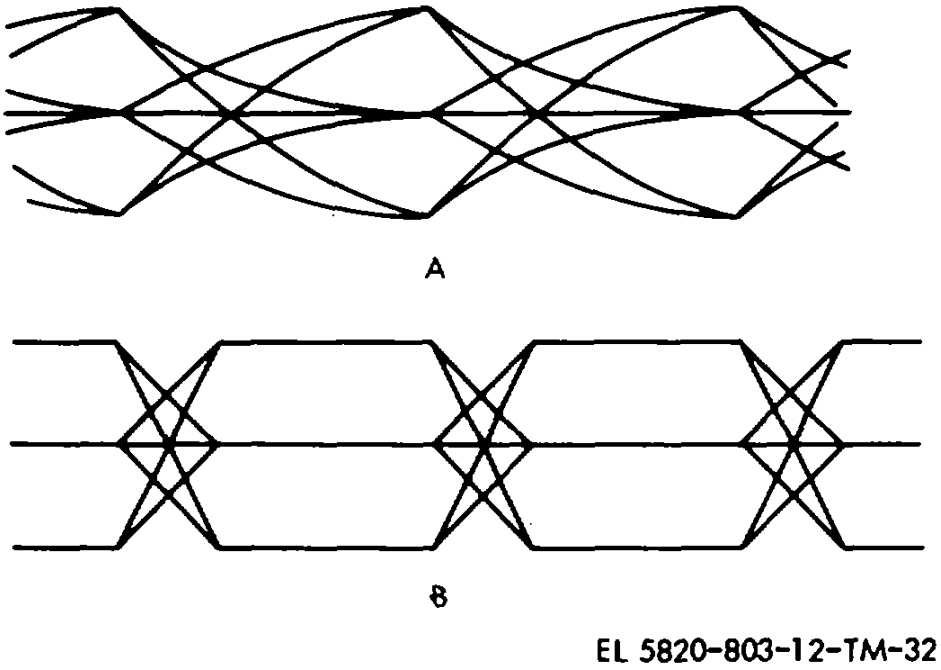

Figure 2-28. Equalization waveforms

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. CONTROLS AND INDICATORS

3-1. Damage from Improper Settings

To avoid damage to internal circuits of the PSK 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.

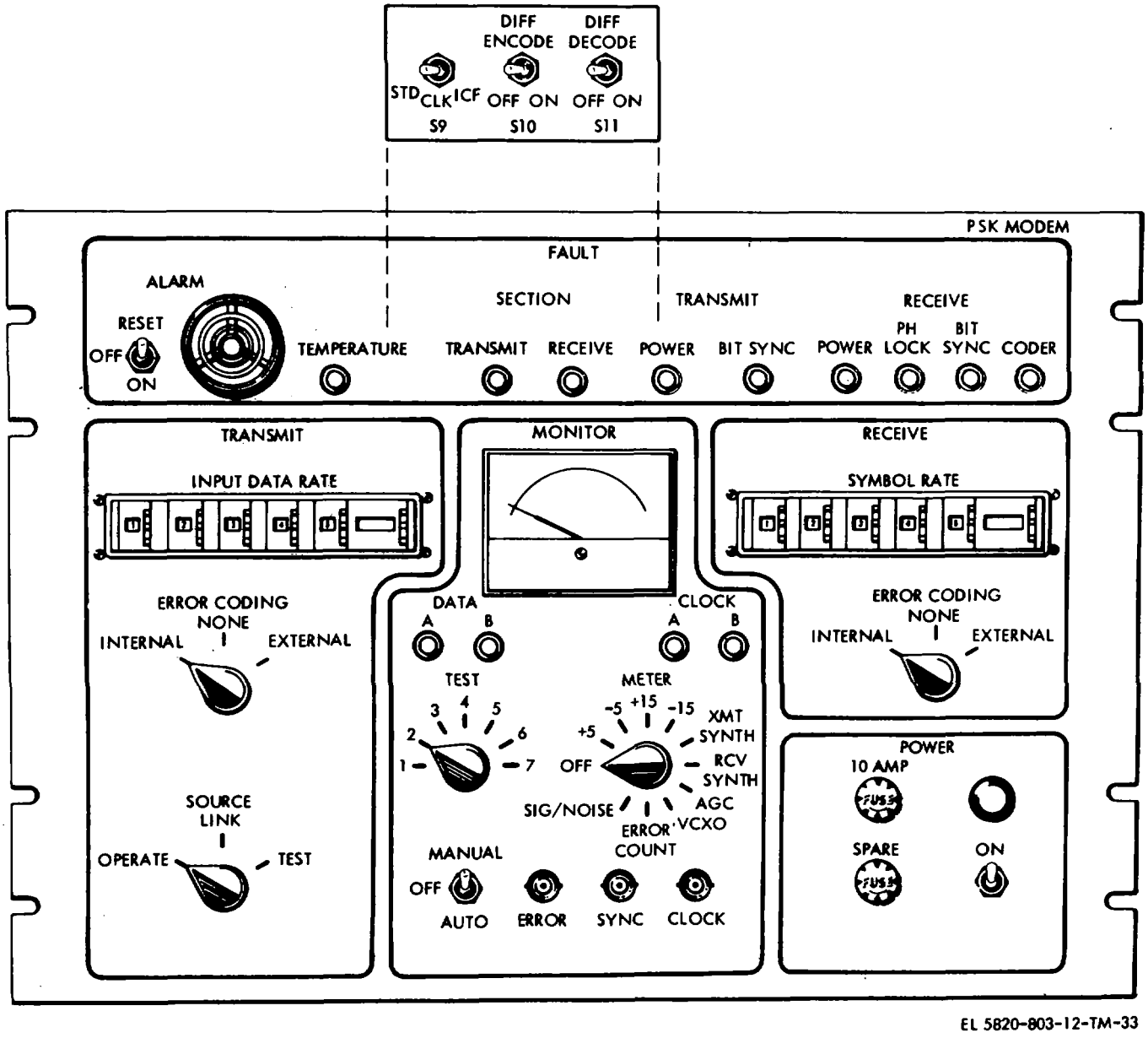

Figure 3-1. PSK modem, operator controls.

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

Controls, 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 in enabled.
Audible alarm	Provides audible signal when a fault or overtemperature condition occurs.
TEMPERATURE indicator	Illuminates when an overtemperature 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/OFF/ON switch is set to RESET. TRANSMIT**
POWER indicator	Indicates when a loss of transmitter power occurs.
BIT SYNC indicator	Indicates when a loss of transmitter bit synchronization occurs.
RECEIVE	
POWER indicator	Indicates when a loss of receiver power occurs.
PH LOCK indicator	Indicates when a loss of carrier phase lock occurs.
BIT SYNC indicator	Indicates when a loss of receiver bit synchronization occurs.
CODER indicator	Indicates when the branch sync fails in the internal receive error coding mode.
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 kb/s to 9.9999 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 9.9999 Mb/s
ERROR CODING, three position rotary switch	INTERNAL-Selects an internal rate one-half encoder. NONE-Selects a straight through path without error correction encoding. EXTERNAL-Selects an external encoder.
SOURCE, three position rotary switch	OPERATE-Connects the digital user's output data (which is selected by the STD/CLK/ICF switch) to the transmitter baseband 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 over the satellite communications link. 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 over the satellite communications link. Digital user communications are interrupted on the transmit portion of the link. TEST-Connects the internal 2047 bit sequence generator output to the transmitted 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 over the satellite communications link The 70 MHz receiver input is disconnected internally from the terminal output and connected to an attenuated sample of the transmitter output. The LOS/cable decoder is connected to a test signal from the LOS/cable driver. 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.

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

Controls, indicators, or connectors	*Function*
MONITOR section	
MONITOR meter	Specific function of meter is dependent on position of METER switch.
METER, 11 position rotary switch	OFF-Disables Meter +5-Measures internal +SV dc supply voltage -5-Measures internal -5V dc supply voltage +15-Measures internal +15V dc supply voltage -15-Measures internal -16V 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. AGC-Measures automatic gain control voltage in receiver. VCXO-Checks voltage controlled crystal oscillator control voltage in receiver. 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 communications 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 setting. SIG/NOISE-Displays a voltage derived from the operation of the receive bit sync by the internal error comparator. Indication may be used as an estimate of receiver input E_b/N_o, or receiver output bit error rate (para 2-10d).
DATA A and B indicators	Indicators illuminate to indicate the logic state present at internal error comparator data input. 1. DATA A on indicates a logic 1 2. DATA B on indicates a logic 0 The data 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.
TRANSMIT indicator	Illuminates to indicate presence of modulation and adequate power at 70 MHz output.
TEST, seven 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. Internally switches the 70 MHz receiver input from the terminal output to an attenuated sample of the 70 MHz transmitter output. 3. Connects the LOS/cable receiver input to the LOS/cable driver output test signal.; The TEST switch selects the data and clock inputs to the internal error comparator and, in position 3, injects the sequence at an additional point in the circuitry. Position --Connects the internal error comparator to monitor the internal 2047 bit sequence generator outputs. Position 2 Connects the internal error comparator to monitor the transmit bit synchronizer outputs. Position 3-Connects the receive bit synchronizer input to the internal 2047 bit sequence generator output, and connects the internal error comparator to monitor the receive bit synchronizer outputs. Position 4-Connects the internal error comparator to monitor the standard data and clock outputs (end-to-end test).

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

Controls, indicators, or connectors	*Function*
	Position 5-Connects the internal error comparator to monitor the alternate data and clock outputs.
	Position 6 Connects the internal error comparator to monitor LOS/cable receiver and decoder output.
	Position 7-Same as position 4.
MANUAL/OFF/AUTO, three position toggle switch	MANUAL-Causes internal error comparator to sample input data and synchronize comparator circuits.
	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 DATA 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 9.9999 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 9.9999 Mb/s
ERROR CODING, three position rotary switch	INTERNAL-Selects the internal rate one-half decoder.
	NONE-Selects a straight through path without error correction decoding.
	EXTERNAL-Selects an external decoder.
POWER section	
10 AMP fuse	Overload protection.
SPARE fuse	Spare 10 amp fuse.
Indicator	Illuminates when power is applied.
ON toggle switch	ON-Applies ac power to the PSK Modem.
Controls Behind Front Panel	
STD/CLK/ICF switch	Enabled by placing the TRANSMIT SOURCE switch in the OPERATE position. Selects either the direct digital (standard) data input or the LOS/cable input for transmission over the link. Also determines whether transmitter timing is derived from the input data or an input clock.
	STD-Selects 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-Selects the LOS/cable input for transmission and timing derivation.
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 PSK modem may be used for self-testing, link-testing, or duplex digital communications. The required procedures are included in this section. Before placing the modem into operation, the site requirements must be reviewed, and the normal operational switch settings must be entered per table 3-2. Purpose of the various modes are briefly described in following paragraphs.

a. Preliminary Starting Procedure. 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,

Table 3-2. Operational Switch Settings.

Control section	*Switch*	*Setting*	*Notes*
FAULT	ALARM	.....	Per site requirements
TRANSMIT	INPUT DATA RATE	.....	Equal to digital user's output data rate
	ERROR CODING	.....	Per site requirements
	SOURCE	OPERATE	
MONITOR	TEST	1	
	METER	SIG/NOISE	
	MANUAL/OFF/AUTO	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	
Behind front panel	STD/CLK/ICF	.....	Per site requirements
	DIFF ENCODE	.....	Per site requirements
	DIFF DECODE	.....	Per site requirements

or upon request to aid in locating a communications system malfunction.

c. *Transmit Link Test*. The transmit link test setup (para 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.

d. *Receive Link Test*. The receive link test (para 3-7) 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 modem at the remote end of the link to be set up or a transmit link test. This is generally accomplished either by direct request or by prior scheduling. Also, the site transmit/receive equipment may be arranged so that its own transmissions are received via satellite.

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

CAUTION

When power is applied to a modem in an operating terminal, the carrier is immediately transmitted. Improper upconverter settings or INPUT DATA RATE switch settings will cause interference with other satellite users.

a. Prior to applying power to the PSK modem, set the 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 warm-up.

NOTE

If mission requirements do not permit a proper warm-up 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.

CAUTION

Performing self-test on a modem while the system is operating may cause interference with other satellite

Table 3-3. Self-Test Initial Switch Settings.

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

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 RESET	All FAULT indicators	Illuminated	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	46 TO 64	OM
	-5	Meter	46 TO 64	OM
	+15	Meter	46 TO 54	OM
	-16	Meter	46 TO 54	OM
	XMIT SYNTH	Meter	40 TO 60	OM
	RCV SYNTH	Meter	40 TO 60	OM
	AGC	Meter	72 TO 92*	OM
	VCXO	Meter	40 TO 60	OM
	ERROR COUNT	.....	.....	.....
(MONITOR) TEST	1	Meter	0	OM
		All MONITOR indicators	Illuminated	
	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
	6	Same as above	No change	OM
	7	Same as above	No change	OM
(MONITOR) METER	SIG/NOISE	Meter	0	OM
		All MONITOR indicators	DATA B extinguished others illuminated	
(FAULT) ALARM	RESET (momentary)	All FAULT indicators	Extinguished	OM

*35 to 55 if A2A1A1A2AS1 is in position 2 (to -655 dBm input power range). Refer to paragraph 2-20a to determine installation requirements.

Table 3-5. Coder/Decoder Test Procedure.

(Control section) Switch	Setting	Indicator	Normal indication	Corrective action
(MONITOR) TEST	7	.....	.....	
(MONITOR) METER	ERROR COUNT	Meter	0	OM
		All MONITOR indicators -	Illuminated	OM
FAULT ALARM	RESET (momentary)	All FAULT indicators	Extinguished	OM

users. If the self-test requires setting the INPUT DATA RATE switches to any rate greater than the" operational rate, the terminal output power for the carrier associated with the modem under test should be reduced.

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.

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

(1) In the sequence shown on the table, set each front panel switch indicated in the first 36 column to the corresponding setting(s) indicated in the second column.

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

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

f. If the RECEIVE ERROR CODING switch is operationally set to INTERNAL or 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

Control	
TRANSMIT SOURCE	
TRANSMIT ERROR CODING	
INPUT DATA RATE	
DIFF ENCODE	
ALARM	

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

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

3-7. Receive Link Test Procedure.

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

Control	
RECEIVE ERROR CODING	
SYMBOL RATE	
DIFF DECODE (behind front panel)	
METER	
MANUAL/OFF/AUTO (Monitor)	

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

3-6. Transmit Link Test Setup

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.*
TRANSMIT SOURCE	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.

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*
RECEIVE ERROR CODING	Normal operational setting (table 3-2)
SYMBOL RATE	Normal operational setting (table 3-2)
DIFF DECODE (behind front panel)	Normal operational setting (table 3-2)
METER	ERROR COUNT
MANUAL/OFF/AUTO (Monitor)	AUTO

e. When the PSK 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 PSK modem front panel. Adjust the counter interval as required to make the measurement.

NOTE

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

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 INTERNAL or EXTERNAL.

(3) Couple the 7002 error rate counter to the PSK modem by connecting the ERROR connector on the PSK modem front panel to the ERRORS connector on the error rate counter front panel, and connecting the CLOCK connector on the PSK modem front panel to the CLOCK connector on the error rate counter front panel. On the error rate counter, place the START switch to the AUTO BLANK position, the STOP switch to the ERROR 103 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 to OFF and other modem controls per table 3-2.

c. Observe the TRANSIT MONITOR indicator (located below the meter) and verify it is illuminated.

d. Allow 45 seconds for acquisition, and momentarily depress the FAULT switch to RESET. Verify all FAULT indicators are OFF when switch is released.

e. Observe the meter indication and verify the reading is 'within the requirements of the site procedures.

f. 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 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 a 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 PSK modem consist of leaning, inspection, testing, 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. The test equipment required for system test are an Electronic Frequency Counter, Hewlett-Packard, HP 5245L, or equivalent and a Test Set, Modem TS3580( )/G.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

4-3. General.

To ensure that the PSK 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 re listed and described in table 4-1. 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 Pam 738-750, Maintenance Management Update.

NOTE

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

Table 4-1. Operator' s Preventive Maintenance Checks and Service

NOTE

The checks in the interval columns are to be performed in the order listed.

B - Before operation

Item No	Interval B	Item to be inspected Procedure	Equipment in not ready/available if:
1	*	Blower motors Start the equipment as instructed in paragraph 3-4.	Equipment fails to support assigned mission.

Table 4-1. Preventive Maintenance Checks and Services (Continued)

Item No	Interval B	Item to be inspected Procedure	Equipment in not ready/available if:
2	*	PSK modem. Perform the self-test check as described in paragraph 3-5.	Equipment fails to support assigned mission.
3	*	PSK modem. Perform the self-test check as described in paragraph 4-4.	Equipment fails to support assigned mission

*Do this check before each deployment to a mission location This will permit any existing problems to be corrected before the mission starts. The check does not need to be done again until redeployment.
a. Perform after deployment, before operation and as required.

Table 4-2. (Deleted)

Table 4-3. Operational Checks.

Switch	Settings	Indicators	Required indication	Corrective action
		POWER ON	Illuminated	Replace lamp
		ALL MONITOR indicators	Illuminated	Replace lamp
ALARM RESET/ON	Hold in RESET	ALL FAULT indicators	Illuminated	Replace lamp
		Audible alarm	Tone	Organizational maintenance
METER (function select switch)	+5	MONITOR meter	46 to 54	Organizational maintenance
	-5	MONITOR meter	46 to 54	Organizational maintenance
	+15	MONITOR meter	46 to 54	Organizational maintenance
	-15	MONITOR meter	46 to 54	Organizational maintenance
	XMT SYNTH	MONITOR meter	40 to 60	Organizational maintenance
	RCV SYNTH	MONITOR meter	40 to 60	Organizational maintenance
	AGC	MONITOR meter	0 to 100. no drift	Organizational maintenance
	VCXO	MONITOR meter	35 to 65	Organizational maintenance
	SIG/NOISE	MONITOR meter	per site requirements	Organizational maintenance

4-4. Operational Checks

The following procedure, when properly performed, does not interrupt digital traffic Do not disturb any control setting 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 potion 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 organizational maintenance V, indicated in the final column. Upon conclusion of the test, return the ALARM and METER switches to their normal operating positions.

Section III. MAINTENANCE OF PSK MODEM

4-5. General

The maintenance procedures in this section are accomplished at the operator/crew. category. If a discrepancy occurs, a higher category of maintenance must be notified to repair the discrepancy.

4-6. Noise Test Procedures

a. General

(1) The noise test procedure is performed on a regular basis to determine whether the PSK modem is operating with an acceptable bit error rate when the signal is degraded by noise. The PSK

Table 4-4. BER Test Control Settings.

Control	*Position*
ALARM RESET/OFF	OFF
TRANSMIT SOURCE	LINK
TRANSMIT ERROR CODING	Same as normal operational setting for RECEIVE ERROR CODING switch (table 3-2).
INPUT DATA RATE	Same as normal operational setting of SYMBOL RATE switches if no error coding is used; one-half the normal operational setting of the SYMBOL RATE switches if error coding is used.
DIFF ENCODE	Normal operational setting (table 3-2)
DIFF REECHOED	Normal operational setting (table 3-2)
SYMBOL RATE '	Normal operational setting (table 3-2)
RECEIVE ERROR CODING	Normal operational setting (table 3-2)
METER	ERROR COUNT

modem terminal interfaces (70 MHz input and output) must be disconnected from the terminal to conduct this test. Weekly testing is recommended; however, the test schedule may vary depending on the operational requirements at the site.

(2) To perform this test, a calibrated energy per bit to noise density (El/N,) ratio must first be established (para 3-10d). The calibrated noisy signal required may be generated by using the Test Set, Modem TS-3580( )/G. Bit error rate measurements are then made (b below), using this noisy signal, to verify that the modem is operating within tolerance.

(3) To provide a more comprehensive indication of the actual bit error rate performance of a PSK modem, bit error rate measurements are taken for several E_b/N_o, values. The selected E,/N,, con values are based on the type of coding used. The measured bit error rate for each E_b/N_o, value is plotted on the theoretical bit error rate performance graph (fig. 2-4). Actual performance must be within 1.8 dB of the appropriate theoretical coding curve. The selected E/N,, values for the coding options are:

Coding	*E_b/N_o, in dB*
Differential	3, 5, and 11.5
Internal	5, 7, and 8.5
External	3 and 5.5

b. Bit Error Rate (BER) Measurement.

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

(2) Set the modem controls per table 4-4 and connect the equipment per figure 4-1.

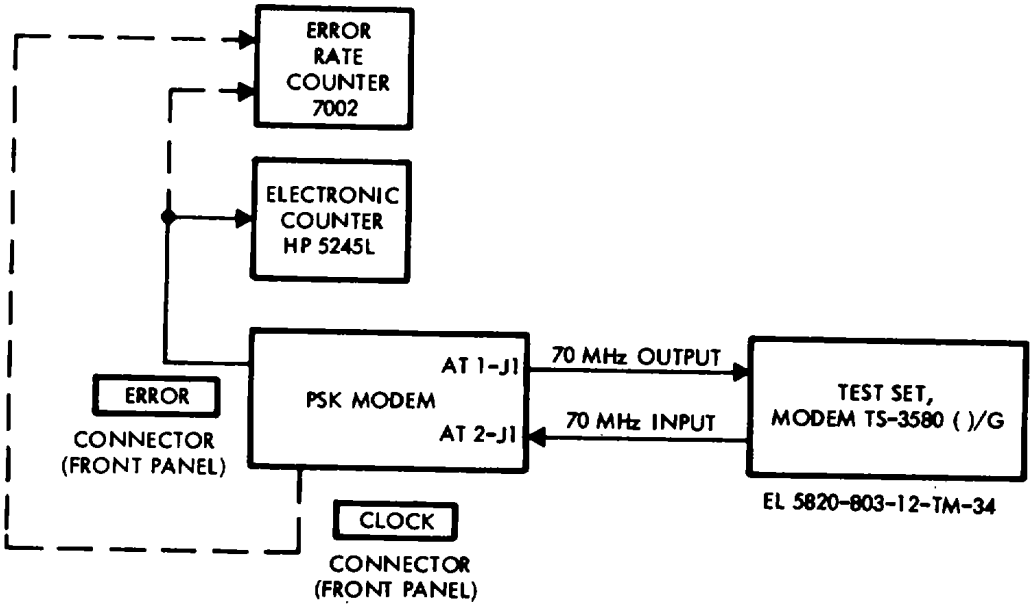

Figure 4-1. Bit error rate measurement, test setup.

(3) Adjust the E/N,, of the TS3580( )/ the 70 MHz receiver input to the desired v (a(3) above). Use the operating instructions for Test Set, Modem TS-3580 ( )/G.

(4) Measure the bit error rate using method described in paragraph 3-7e(2) or (3).

4-7. Cleaning

a. Remove dust and loose dirt with a clean 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. 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 PSK modem consist of inspection, testing, and replacement of fuse and lamp sockets, switches, alarm buzzer, and meter. The organizational maintenance personnel will also re-run operator tests that indicated malfunctions to verify need for referral to direct support maintenance.

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

The tools required for organizational maintenance are contained in Tool Kit, Electronic Equipment TK-105. A Simpson 270 Multimeter is required for voltage 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

5-3. Preventive Maintenance Checks and Services

To ensure that the PSK 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 5-1. 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 Pam 738-750, as contained in the Maintenance Management Update.

NOTE

If the equipment must be kept in continuos 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 be fore returning the equipment to operation.

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 43-011.

Table 5-1. Organizational Preventive Maintenance Checks and Services.

NOTE

The checks in the "Interval" column are to be performed in the order listed.

M-Monthly

Item No	Interval M	Item to be inspected Procedure	Equipment in not ready/available if:
1	a	PSK modem	Ensure that equipment functions properly as explained in Chapter 3. If problems occur, perform troubleshooting procedures in Section III of Chapter 5.
2	a	External cable assemblies	Ensure that cable assemblies are not loose or damaged.

Section III. ORGANIZATIONAL MAINTENANCE TROUBLESHOOTING AND REPAIR

5-5. Troubleshooting

Organizational maintenance troubleshooting of the PSK modem is required when an apparent malfunction or equipment damage is reported by the operator/crew. Organizational maintenance troubleshooting actions are detailed in table 5-2 Any trouble that is beyond the scope of organizational maintenance shall be referred to higher category of maintenance.

CAUTION

NEVER leave the bottom cover off while the PSK modem is turned on longer than necessary to make tests and measurements. Power supply A2PS1 may be damaged when the bottom cover (which arranges for proper airflow for cooling) is not in place while the unit is turned on.

WARNING

115V ac is present within the PSK modem. Perform all possible maintenance with power removed. If necessary to perform operations with covers removed and power on, use extreme care to avoid contact with high voltage.

5-6. Equipment Damage Repair

Organizational repair is limited to inspection and replacement of blowers, 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 any damaged items the repair of which is beyond the scope of organizational maintenance to higher category of maintenance.

NOTE

Most maintenance actions involving front panel components require that power supply A2PS1 be removed to facilitate access to the components. Refer to paragraph 5-13 for power supply removal and reinstallation procedures.

5-7. Self-Test Failure

If the PSK modem fails to provide a specified indication during self-test, carefully repeat the test in its entirety to ensure 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 leads or damaged socket. Repair or replace as required. If the fault alarm fails to sound when specified, remove cover and connect VOM to verify that +5V de 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 5-10, 5-11, and 5-12. If failure symptoms remain, refer the malfunction to direct support.

5-8. Noise Test Failure

If an unacceptable BER is calculated during noise testing,' carefully examine the test setup, equipment control settings, and repeat the test to ensure that the apparent malfunction was not caused by operator error. If the BER remains unacceptable, refer the malfunction to direct support.

Table 5-2. roubleshooting.

Malfunction	*Probable cause*	*Corrective action*
1. Equipment damage.	Mishandling.	Paragraph 5-6
2. Required indicator does not illuminate during self-teat (indicator replacement does not remedy).	a. Operator error.	Paragraph 5-7
	b. Faulty wiring.	
	c. Damaged indicator socket.	
3. Fault alarm does not sound during self-test.	Alarm buzzer defective.	Paragraph 5-7
4. Meter indicates incorrectly during self-test.	Meter defective.	Paragraph 5-7
5. Unacceptable BER during noise teat	Operator error.	Paragraph 5-8
6. Blower(s) not operating.	Blower defective.	Paragraph 5-9
7. Other malfunctions	a. Cards or connectors not properly seated.	Paragraph 5-10
	b. Power supply out of adjustment.	Paragraph 5-11
	c. Thumbwheel switch assembly defective.	Paragraph 5-12

Table 5-3. Power Supply-measurements.

Voltage	*Limits*	*Connector pin*
+5V	+4.95 to +5.05V	A2A2A2A947
-6V	-4.95 to -5.05V	A2A2A2A9--4
+15V	+ 14.98 to + 15.02V	A2A2A2A9-13
- 15V	- 14.98 to -15.02V	A2A2A2A9-15

5-9. 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.

5-10. Cards or Connector Not Properly Seated

Remove power and remove top and bottom covers. Inspect that all cards are flush with one another in the file. Check to see that each card is properly employed in its card guides Inspect all connectors to ensure that they are properly seated.

5-11. Power Supply Out of Adjustment

a. Remove power and remove the bottom cover of the modem. Observe caution in paragraph 5-5 for operation of the modem with the covers removed.

b. Remove the alarm circuits card, A2A2A2A9 and install the card extender in its place.

c. Using the digital voltmeter to monitor the appropriate connector pin (fig. 5-1), adjust each power supply (A2PS1) voltage as required to obtain outputs within the limits of table 5-3. 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 voltages returned to A2E2.

5-12. 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.

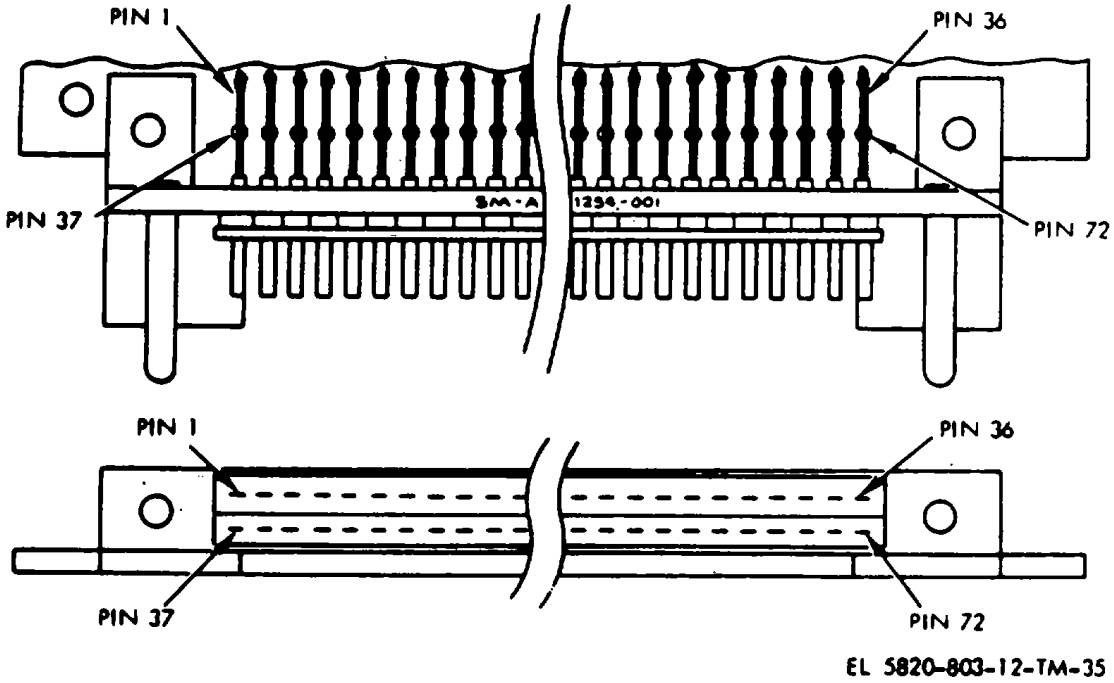

Figure 5-1. Typical PC card pin locations.

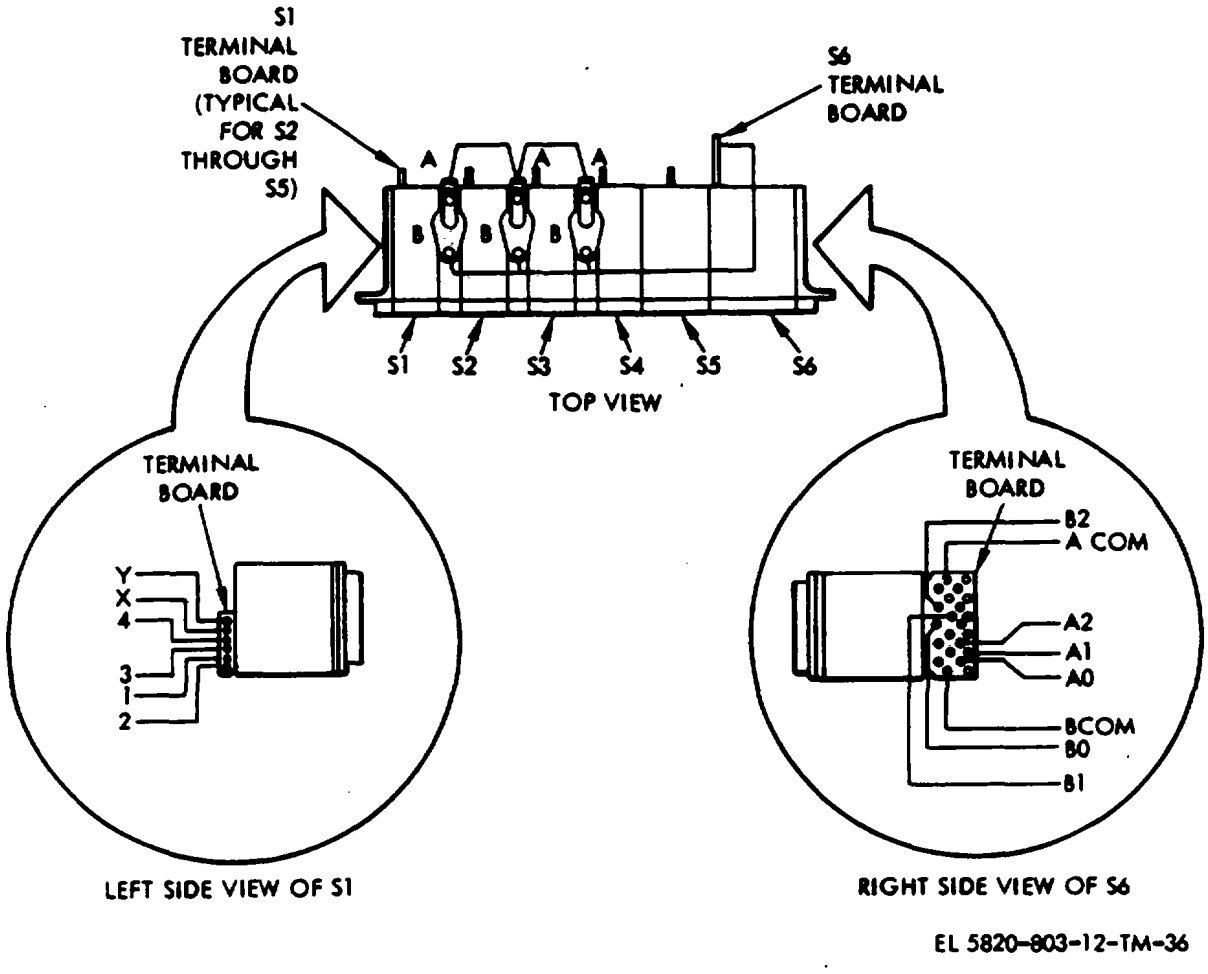

Figure 5-2. Thumbwheel switch, assembly Terminal boards.

Table 5-4. Thumbwheel switch, Truth Tables.

Switch S1					Switches S2 through S5				
Dial reading	Common X(•), Y(o)connected to terminal				Dial reading	Common X(•), Y(o)connected to terminal			
	1	2	3	4		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		
	Common A, B connected to terminal	
Dial reading	A	B
KB/S XX.XXX	A0	B0
KB/S XXX.XX	A1	B1
MB/S X.XXXX	A2	B2

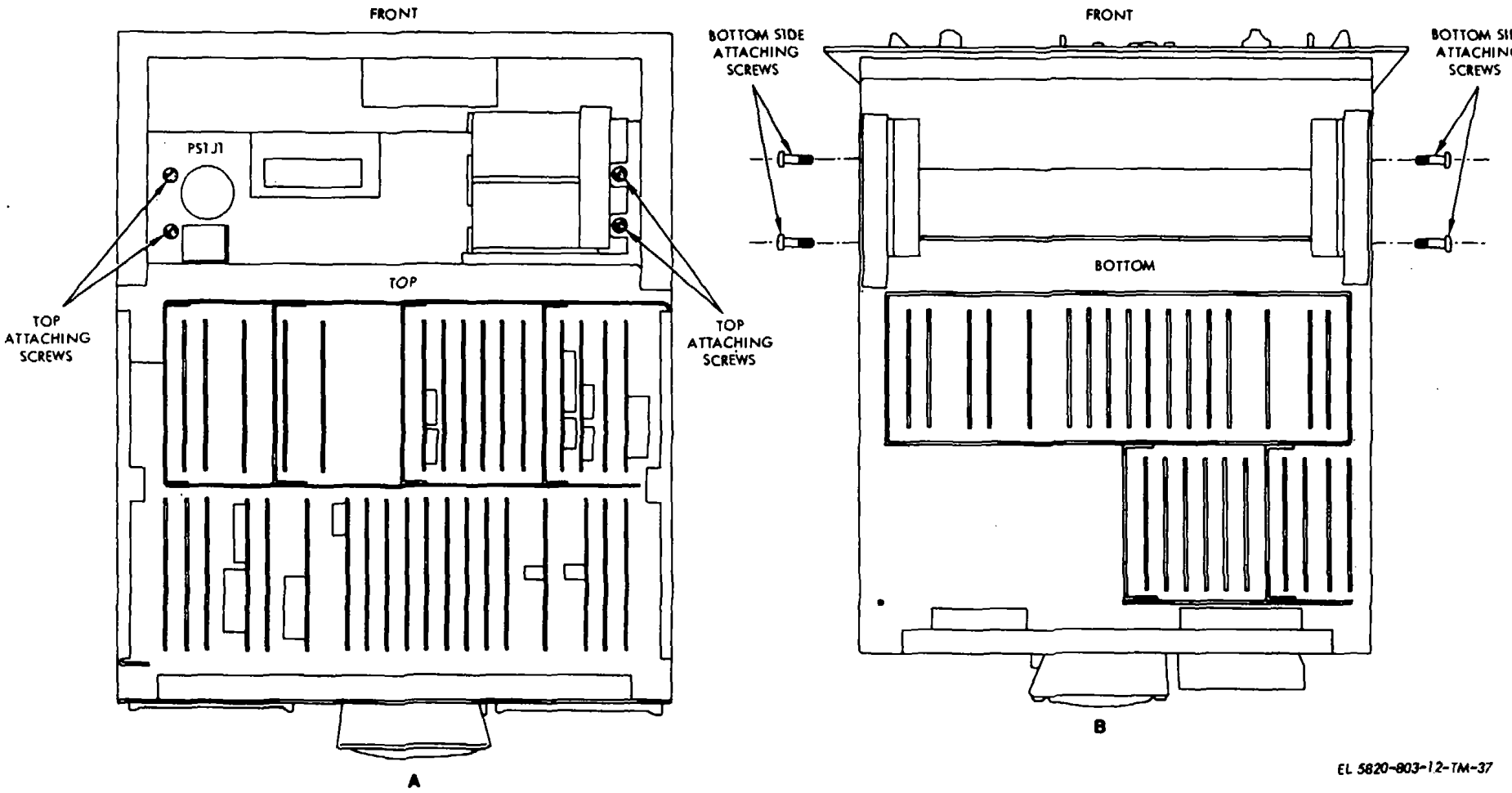

Figure 5-3. Power supply removal and installation.

5-13. 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 Phillip's head screws (A, fig. 5-3). With modem bottom cover removed, disconnect dc connector to bottom file. Remove two lower Phillip's 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 ensure that the mounting brackets are flush with the bottom sides of the modem; then tighten screws.

APPENDIX A

REFERENCES

AR 735-11-2	Reporting of Transportation Discrepancies in Shipment.
DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms.
DA Pam 738-750	The Army Maintenance Management System (TAMMS).
SB 38-100	Preservation, Packaging, Packing and Marking Materials, Supplies and Equipment Used by the Army.
TB 43-0118	Field Instructions for: Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TM 11-5820-803-20P	Organizational Maintenance Repair Parts and Special Tools List for Modem Digital Data-Phase Shift Keying MD-921/G (NSN 5820-00-155-8581).
TM 11-5820-803-34	Direct Support and General Support Maintenance Manual: Modem, Digital Data MD-921/G (NSN 5820-00-155-8581).
TM 11-5820-804-12	Operator's and Organizational Maintenance Manual for Modem, Digital Data MD-920/G (NSN 5820-01-057-6356).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Materiel 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 MD-921/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. in 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 vary at different maintenance categories, appropriate "worktime" figures 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.

Subcolumns of column 4 are as follows:

O-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.

C-4. Tool and Test Equipment Requirements (Table 1)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

SECTION II. MAINTENANCE ALLOCATION CHART FOR MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L[12]	D	(5) TOOLS AND EQUIPMENT
00	Modem, Digital-Phase Shift	Inspect	0.1					
		Test 1	0.1					
	Keying MD-921/G	Test 2	0.2					22,24
		Test 3		0.1				20
		Service		0.1				
		Align			1.5			9,13,15, 22,23,33
		Install			1.0			15,25
		Replace			1.5			15,25
		Repair 4		0.1				25
		Repair 5			0.1			17,25
		Overhaul					24.0	1-43
01	Control Panel, A1	Inspect	0.1					
		Test 6	0.1					
		Test 7			0.1			20
		Service		0.1				
		Repair 8	0.1					
		Repair 9		0.1				25
		Repair 10				0.2		25
0101	Switch Assembly, A1A1	Inspect		0.1				
		Test		0.1				20
		Replace		0.1				25
		Repair				0.2		25
0102	Switch Assembly, A1A2 (same as FGC group 0101)							
02	Modem Subassembly, A2	Inspect		0.1				
		Test			0.8			20
		Repair 11			0.1			17,25

(1) Self-test
(2) Operational noise test
(3) Self-test, external continuity checks
(4) Minor soldering operations
(5) By replacement of subassemblies
(6) Lamp test
(7) Continuity checks
(7.1) Repair per next higher assembly 0205-
(8) By replacement of fuses and indicators
(9) By replacement of switches (except A1S5), sockets, and meter
(10) By replacement of switch A1S5
(11) By replacement of subassemblies including nonrepairable components AT1 J1, AT2J2, A1FL1, K1, Y1, and Y2.
(12) See paragraph C-3d

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
0201	RF Modem and Bit Sync Assy, Inspect		0.1					
	A2A1	Test			0.4			20
		Align			1.2			9,13, 15,22,24, 33,36
		Repair[11]			0.1			17,25
020101	Modulation Filter, A2A1A1A2	Inspect		0.1				
		Test				0.4		2,8,9,10, 11,12
		Replace			0.1			
		Repair				0.1		25
020102	70 MHz Output Amplifier, Inspect		0.1					
	A2A1A1A3	Test				0.4		2,8, 9,10, 11,12, 13
		Adjust				0.1		2,8,9
		Replace			0.1			17
		Repair				0.1		25
020103	Data Receiver and Modulator, Inspect		0.1					
	A2A1A1A4	Test				0.4		2,7, 8,9, 13,15,21
		Replace			0.1			17
		Repair				0.1		25
020104	70 MHz Crystal Oscillator, Inspect		0.1					
	A2A1A1A5	Test				0.3		1,8,9,10, 13,16,21
		Adjust				0.2		1,8,9,10
		Replace			0.1			17
		Repair				0.1		25

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020105	Times 2 Multiplier and Crystal Oscillator, A2A1A1A7	Inspect	0.1					
		Test				0.4		1,8,9,10, 11,19,21
		Adjust				0.1		1,8,11
		Replace			0.1			
		Repair				0.1		25
020106	Phase Compensator and Detector Driver, A2A1A1A9	Inspect		0.1				
		Test				0.4		4,7,8,9, 18,19,21
		Adjust				0.1		4,7,8,9, 19,21
		Replace			0.1			17
		Repair				0.1		25
020107	Data Detector and Driver, A2A1A1A11	Inspect	0.1					
		Test				0.4		4, 8,9,11, 12,13,15, 19,20
		Adjust				0.2		4,8,9,11, 12,13,19
		Replace			0.1			17
		Repair				0.1		25
020108	Data and Phase Lock Loop Filter, A2A1A1A14	Inspect		0.1				
		Test				0.3		4,8,9,10, 12
		Replace			0.1			
		Repair				0.1		25

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020109	21.4-MHz Phase Lock Loop Amplifier and Filter, Test A2A1A1A15	Inspect		0.1				
					0.4		4,8,10,	11,12, 13
		Adjust				0.1		4, 8,11, 12
		Replace			0.1			17
		Repair				0.1		25
020110	21.4-MHz Distribution Amplifier, A2A1A1A16	Inspect		0.1				
		Test				0.3		4,8,9, 11,12,19
		Replace			0.1			17
		Repair				0.1		25
020111	Times 2 Multiplier, A2A1A1A17	Inspect		0.1				
		Test				0.4		4, 7,8, 9,10, 19
		Replace			0.1			17
		Repair				0.1		25
020112	21 .4-MHz Data Amplifier and Filter, A2A1A1A18	Inspect		0.1				
		Test				0.4		4,8,9,11, 12,13
		Adjust				0.1		4, 8,11, 12
		Replace			0.1			17
		Repair				0.1		25

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020113	Coherent Detector and Sweep Generator, A2A1A1A 9	Inspect		0.1				
		Test				0.4		5,8,9,10, 13,14,15, 21
		Adjust				0.1		5,8,13
		Replace			0.1			17
		Repair				0.1		25
020114	70-MHz Gain Control Amplifier, A21A1A1A21	Inspect	0.1					
		Test				0.4		2,8,9,10, 11,12,16
		Replace			0.1			
		Repair				0.1		
020115	Input Filter and Preamplifier, A2A1A1A22	Inspect	0.1					
		Test				0.4		2,7, 8,9, 10,11,12
		Replace			0.1			17
		Repair				0.1		25
020116	Detector and AGC Amplifier, A2A1A1A23	Inspect	0.1					
		Test				0.4		6,8,13, 14,15,16
		Adjust				0.1		6,8,13, 16
		Replace			0.1			17
		Repair				0.1		25

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020117	Loop Amplifier and VCXO, Inspect A2A1A1A24		0.1					
		Test				0.4		5,8,9,10, 13,16,21
		Adjust				0.1		5,8,9,10, 13,16,21
		Replace			0.1			17
		Repair				0.1		25
020118	Quantizer, A2A1A2A1	Inspect		0.1				
		Test				0.1		34,35
		Replace			0.1			17
		Repair				0.1		25
020119	Dump Circuit, A2A1A2A2	Inspect		0.1				
		Test				0.1		34,35
		Adjust				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020120	Integrator, A2A1A2A3	Inspect		0.1				
		Test				0.3		6,8,10, 13,14,15, 16
		Adjust				0.1		6,8,10, 13,14,15, 16
		Replace			0.1			17
		Repair				0.1		25
020121	Integrator, A2A1A2A5 (same as FGC group 020120)							

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020122	Dump Circuit, A2A1A2A7 (Same as FGC 020119)							
020123	Quantizer, A2A1A2A8 (Same as FGC 020118)							
020124	Timing and AGC, A2A1A2A9	Inspect		0.1				
		Test				0.3		6, 8, 13, 15, 16
		Adjust				0.3		6, 8, 13, 15, 16
		Replace			0.1			17
		Repair				0.1		25
020125	Phase and Loss of Lock Detector A2A1A2A10	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020126	Loop Filter, A2A1A2A11	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020127	D/A Converter, A2A1A2A12	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020128	15-MHz Amplifier, A2A1A2A13	Inspect		0.1				
		Test				0.4		1, 7, 8, 11, 12, 13, 16
		Replace			0.1			17
		Repair				0.1		25
020129	Mixer/Output Amplifier, A2A1A2A14	Inspect		0.1				
		Test				0.4		3, 7, 8, 9, 10, 11, 19
		Adjust				0.1		3, 7, 8, 9, 10, 11, 19
		Replace			0.1			17
		Repair				0.1		25
020130	45-MHz Amplifier, A2A1A2A15	Inspect		0.1				
		Test				0.4		3, 8, 9, 11, 12, 19
		Adjust				0.1		4, 7, 8, 9
		Replace			0.1			17
		Repair				0.1		25
020131	45-MHz Phase Lock Loop, A2A1A2A17	Inspect		0.1				
		Test				0.4		1, 8, 9, 10, 13
		Ad just				0.1		1, 8, 13
		Replace			0.1			17
		Repair				0.1		25
020132	Reference Divider, A2A1A2A19	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020133	Reference Oscillator, A2A1A2A20	Inspect		0.1				
		Test				0.4		3, 8, 9, 10, 12, 15
		Adjust				0.1		3, 8, 10
		Replace			0.1			17
		Repair				0.1		25
020134	Program Divider, A2A1A2A22	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020135	Counter Encoder, A2A1A2A23	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020136	Demodulator Relay Control, A2A1A2A24	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
0202	Interface and Bit Synchronizer Assembly A2A2	Inspect		0.1				
		Test			0.4			20
		Align			0.3			15
		Repair[13]			0.1			17, 25
020201	Counter Encoder, A2A2A1A1 (same as FGC group 020135)							
020202	Program Divider, A2A2A1A2 (same as FGC group 020134)							

(13) **By replacement of subassemblies**

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020203	Reference Oscillator, A2A2A1A3 (same as FGC group 020133)							
020204	Reference Divider, A2A2A1A5 (same as FGC group 020132)							
020205	45-MHz Phase Lock Loop, A2A2A1A6 (same as FGC group 020131)							
020206	45-MHz Amplifier, A2A2A1A8 (same as FGC group 020130)							
020207	Mixer Output Amplifier, A2A2A1A10 (same as FGC group 020129)							
020208	1 5-MHz Amplifier, A2A2AA1A11 (same as FGC group 020128)							
020209	D/A Converter, A2A2A1A15 (same as FGC group 020127)							
020210	Loop Filter, A2A2A1A16 (same as FGC group 020126)							
020211	Stable Clock, A2A2A1A12	Inspect		0.1				
		Test				0.4		3, 7, 8, 9, 10, 12, 15, 19, 21
		Replace			0.1			17
		Repair				0.1		25

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020212	Reference Divider, A2A2A1A14 (same as FGC group 020132)							
020213	Transmit Bit Detector, A2A2A1A17	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020214	Error Estimate, A2A2A1A18	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020215	Syndrome Weight, A2A2A1A19	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020216	Branch Synchronizer, A2A2A1A20	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020217	Line Driver, A2A2A1A21	Inspect		0.1				
		Test				0.3		6, 8, 10, 15
		Replace			0.1			17
		Repair				0.1		25
020218	Line Driver, A2A2A1A22 (same as FGC group 020217)							

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020219	Line Driver, A2A2A1A23 (same as FGC group 020217)							
020220	Bit Sync/Demodulator Relay Control, A2A2A1A24	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020221	LOS/Cable Receiver/Decoder, A2A2A2A1	Inspect		0.1				
		Test				0.3		6, 8, 13, 15, 16
		Adjust				0.1		6, 8, 15
		Replace			0.1			17
		Repair				0.1		25
020222	LOS/Cable Driver, A2A2A2A3	Inspect		0.1				
		Test				0.3		6, 8, 15
		Replace			0.1			17
		Repair				0.1		25
020223	Input Interface, A2A2A2A4	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020224	Coder Interface, A2A2A2A5	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020225	Coder Switch, A2A2A2A6	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020226	11 Bit PRN Sequence Generator, A2A2A2A7	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020227	Error Comparator, A2A2A2A8	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020228	D/A Meter, A2A2A2A9	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
020229	Alarm Circuits, A2A2A2A10	Inspect		0.1				
		Test				0.1		34, 35
		Replace			0.1			17
		Repair				0.1		25
0203	Fan Tubeaxial, A2B1 (Blower)	Inspect		0.1				
		Test		0.1				20
		Replace		0.1				25
		Repair				0.4		20, 25
0204	Fan, Tubeaxial A2B2 (Blower) (same as FGC group 0203)							

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
0205	Power Supply A2PSI	Inspect		0.1				
		Adjust		0.1				13, 17, 33
		Test			0.5			13, 15, 20 37, 38
		Test				0.4		13, 15, 20, 37, 38, 39
		Replace			0.6			25
		Repair			0.7			17, 25, 32
		Repair				0.6		17, 25, 32
020501	Transformer Assembly A1	Test				0.1		15, 20
		Replace				0.2		25
		Repair				0.2		25
020502	Printed Circuit Board A2	Replace			0.1			17
		Test				0.4		13, 15, 20 37, 38, 40 41, 42
		Repair				0.2		25
		Adjust				0.4		13, 15, 20 37, 38, 40 41, 42
020503	Circuit Card Assembly A3	Test				0.3		15, 20
		Replace				0.4		25
		Repair				0.2		25
020504	Component Board Assembly Number 1, A4	Test				0.2		15, 20
		Replace				0.3		25
		Repair				0.2		25
020505	Component Board Assembly Number 2, A5	Test				0.2		15, 20
		Replace				0.3		25
		Repair				0.2		25

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020506	Heat Sink Assembly Number 1, A6	(See note 7.1)						
020507	Heat Sink Assembly, Number 2, A7	(See note 7.1)						
020508	Heat Sink Assembly, Number 3 A8	(See note 7.1)						
020509	Terminal Board Assembly, A9	Test Replace Repair			0.2 0.3 0.3			13, 15, 20 25 25
020510	Rectifier Assembly, A10	Test Replace Repair			0.3 0.4 0.4			15, 20 25 25
0206	Cable, A2W1	Inspect Test Replace Repair		0.2		0.2 0.2		 20 25-32
0207	Cable, A2W2 (some as FGC group 0206)							
0208	Cable, A2W3 (same as FGC group 0206)							
0209	Cable, A2A4 (some as FGC group 0206)							

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
0210	Cable, A2W5 (some as FGC group 0206)							
0211	Cable, A2W6 (same as FGC group 0206)							
0212	Cable, A2W7 (same as FGC group 0206)							
0213	Cable, A2W8 (same as FGC group 0206)							
0214	Cable, A2W9 (same as FGC group 0206)							
0215	Cable, A2W10 (same as FGC group 0206)							
0216	Cable, A2W11 (some as FGC group 0206)							
0217	Oscillator, A2Y1	Inspect		0.1				
		Test			0.1			15, 17, 33
		Adjust			0.1			15, 17, 25,
					33			
		Replace			0.1			25
0218	Oscillator, A2Y2 (some as FGC group 0217)							

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
020506	Heat Sink Assembly Number 1, A6	(See note 7.1)						
020507	Heat Sink Assembly, Number 2, A7	(See note 7.1)						
020508	Heat Sink Assembly, Number 3 A8	(See note 7.1)						
020509	Terminal Board Assembly, A9	Test Replace Repair			0.2 0.3 0.3			13, 15, 20 25 25
020510	Rectifier Assembly, A10	Test Replace Repair			0.3 0.4 0.4			15, 20 25 25
0206	Cable, A2W1	Inspect Test Replace Repair		0.2	 0.1	 0.2 0.2		 20 25-32
0207	Cable, A2W2 (some as FGC group 0206)							
0208	Cable, A2W3 (same as FGC group 0206)							
0209	Cable, A2A4 (same as FGC group 0206)							

SECTION II MAINTENANCE ALLOCATION CHART
FOR
MODEM, DIGITAL DATA - PHASE SHIFT KEYING MD-921/G - Continued

(1) GROUP CODE	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	L	D	(5) TOOLS AND EQUIPMENT
0210	Cable, A2W5 (same as FGC group 0206)							
0211	Cable, A2W6 (some as FGC group 0206)							
0212	Cable, A2W7 (some as FGC group 0206)							
0213	Cable, A2W8 (same as FGC group 0206)							
0214	Cable, A2W9 (some as FGC group 0206)							
0215	Cable, A2W10 (same as FGC group 0206)							
0216	Cable, A2W11 (same as FGC group 0206)							
0217	Oscillator, A2Y1	Inspect		0.1				
		Test			0.1			15, 17, 33
		Adjust			0.1			15, 17, 25, 33
		Replace			0.1			25
0218	Oscillator, A2Y2 (same as FGC group 0217)							

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR MODEM, DIGITAL DATA-PHASE SHIFT KEYING MD-921/G.

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	L, D	Card Test Fixture T-14301	NOTE	T-14301 (91417)
2	L, D	Card Test Fixture T-14302	NOTE	T-14302 (91417)
3	L, D	Card Test Fixture T-14303	NOTE	T-14303 (91417)
4	L, D	Card Test Fixture T-14304-	NOTE	T-14304 (91417)
5	L, D	Card Test Fixture T-14305	NOTE	T-14305 (91417)
6	L, D	Card Test Fixture T-14306	NOTE	T-14306 (91417)
7	L, D	Attenuator Fixture T-14307 (2 required)	NOTE	T-14307 (91417)
8	L, D	Power Supply Fixture T-14318	NOTE	T-14318 (91417)
9	F, L, D	Power Meter, Millivac MV828B	6625-00-4374865	MV828B (85711)
10	C, F, L, D	Electronic Counter, HP 5245L with	6625-00 269-4593	HP 5245L (28480)
		HP 5253 Plugin	6625-00-226-3483	
11	F, L, D	Spectrum Analyzer HP 141T with	6625-00-424-4370	HP141T (28480)
		HP 85538 Plugin	6625-00 432-5055	
		HP 85528 Plugin	6625-00-431-9339	

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR MODEM, DIGITAL DATA-PHASE SHIFT KEYING MD-921/G-Continued

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
12	L, D	Sweep Generator, HP 8601A	6625-00-135-9866	HP 8601A (28480)
13	0, F, L, D	Digital Voltmeter, Fluke 8000A-01	6625-00-210-7584	8000A (89536)
14	L, D	Function Generator, Wavetek 142	NOTE	142 (23338)
15	F, L, D	Oscilloscope, Tektronix 485A	NOTE	485A (80009)
16	L, D	Precision Power Supply, Power Design 4010	NOTE	4010 (98095)
17	0, F, L, D	Card Puller, Protolab 7920	NOTE	7920 (31447)
18	L, D	Vector Voltmeter, HP 8405A	NOTE	HP 8405A (28480)
19	L, D	50-ohm Termination, Amphenol 35725-51 (2 required)	5985-00-843-1671	35725-51 (74868)
20	O, F, L, D	Multimeter, Simpson 270	6625-00-897-4051	270 (55026)
21	L, D	50-ohm feed-thru termination TEK 011-0049-01 (2 required)	5985-00-087-4954	011-0049-01 (80009)
22	C, F, D	Test Set, Modem TS-3580( )/G	NOTE	
23	F, D	Digital Communications Test Set TS-3642(V)I/G (Harris 7003)	NOTE	7003 (91417)
24	C, O, F, D	Error Rate Counter TS-3641/G (Harris 7002)	NOTE	7002 (91417)
25	O, F, L, D	Tool Kit, Electronic Equipment TK-105/G	5180-00-610-8177	

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR MODEM, DIGITAL DATA-PHASE SHIFT KEYING MD-921/G.

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
26	L, D	Pin Extraction Tool RX 20-25, Burndy	5720--00-808-6873	RX20-25 (09922)
27	L, D	Pin Extraction Tool, 600-0027-000, Teradyne	NOTE	600-0027-000 (31430)
28	L, D	Pin Insertion Tool MS 24256A20	5120-00-079-4598	
29	L, D	Pin Insertion Tool MS 24256A16 079-4599	5120-00-	
30	L, D	Pin Extraction Tool MS 24256R20	5120-00-079-601	
31	L, D	Pin Extraction Tool MS 24256R16 0794602	5120-00-	
32	L, D	Pin Crimp Tool and Turret M22520-1-01 and M22520-1-02	NOTE	
33	0, F, L, D	Card Extender (2) SM-D-759649	NOTE	759649 (91417)
34	L, D	Automatic Test System, GR-1792	NOTE	GR-1792 (24655)
35	L, D	Digital Card Test Adapter, T-14146	NOTE	T-14146 (91417)
36	F, L, D	Step Attenuators, HP 355C and HP	355D 6625-0-993-1377 5895-00-295-9824	

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR MODEM, DIGITAL DATA-PHASE SHIFT KEYING MD-921/G.

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
37	F, L, D	Auto Transformer, Variac W50M	NOTE	W50M (24655)
38	F, L, D	Power Supply/Oscillator Test Fixture, SM-D-882197	NOTE	T-14394 (91417)
39	L, D	AC Voltmeter, HP400F	NOTE	HP400F (28480)
40	L, D	Resistor Decode Box	NOTE	GR-1434M (24655)
41	L, D	Power Supply Test Set, SM-C-742003	NOTE	(91417)
42	L, D	Test Set, ACDC 66-991-000	NOTE	66-991-00C (08742)
43	L, D	Interface Test Unit SM-C-877812	NOTE	T-14397 (91417)

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

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