

CHAPTER 2 INSTALLATION

2.1 GENERAL

This chapter explains how to install the ST-8000A MODEM in a data communications system. Included are: (1) directions for unpacking the modem, (2) setting power and signal option switches and jumpers, (3) making cable connections, (4) and typical connections that may be used between the ST-8000A and other equipment. Close attention to these steps is required to assure proper operation of the MODEM in the data system.

2.2 UNPACKING AND INSPECTION

2.2.1 Unpacking

Each ST-8000A FSK MODEM is packed as shown in Figure 2.1. The unit is double-boxed. The outer box is a special weather-proof box. The inner box is vacuum sealed against moisture penetration. If it is necessary to return the ST-8000A to the factory for repair or otherwise re-ship the ST-8000A, these packing techniques must be followed. See Section 6.7 for re-packing instructions.

Before opening the shipping carton, examine it carefully for evidence of shipping damage. Note all exterior damage. Open the outer shipping carton and remove the inner carton. Retain the outer carton for later use. Examine and note any damage found to the inner carton. Open the water-proof sealed bag around the inner carton and remove the inner carton. The inner carton is sealed with shipping tape. Cut the tape to remove the unit.

Remove the ST-8000A and its cushioning end-caps from the inner carton. Again, examine the packing materials and unit itself for evidence of shipping damage - note all found.

Packed on top of the ST-8000A are the Accessory Bag and packages of desiccant. Discard the desiccant and set the Accessory Bag aside.

At this point, if shipping damage has been found, file a written claim with the shipping agency and forward a copy of the claim to your supplying agency (HAL Communications, shipping depot, etc.).

NOTE: Claims for shipping damage must originate at receiving end. Claims cannot be originated by HAL or the supplying Depot. In case of damage, keep all shipping materials. A representative of the shipping agency will want to examine all items.

Assuming no shipping damage has been found, remove the ST-8000A from its inner protective bag. Re-assemble all shipping materials and store them in a cool dry location where they may be re-used should it be necessary to re-ship the ST-8000A at a future time.

If the ST-8000A package temperature is substantially different from that of the unpacking room (i.e., the package is much colder than the shipping room), let the unpackaged ST-8000A sit for at least one hour before operating.

2.2.2 ST-8000A Accessories

Open the Accessory Bag (PN970-08005) and check its contents against Table 2.1 below.

TABLE 2.1

ST-8000A ACCESSORIES

QTY	HAL P/N	DESCRIPTION	NOTES
1	333-17250	IEC AC POWER CORD	Std U.S. Power
1	390-10355	MS27473E10F35S CONNECTOR	P4, MATES J4
1	390-10506	MS27506F10-2 CABLE CLAMP	For P4
1	390-12985	MS27473E12F98S CONNECTOR	P3, For MIL Power
1	390-12506	MS27506F12-2 CABLE CLAMP	For P3
1	390-14355	MS27473E14F35PA CONNECTOR	P2, Mates J2
1	390-14356	MS27473E14F35PB CONNECTOR	P1, Mates J1
2	390-14506	MS27506F14-2 CABLE CLAMP	For P1 & P2
1	413-06061	6-32x3/8" RH PHIL SS Screw	Attach MIL Adptr
1	423-06000	No. 6 FLAT-WASHER (SS)	Attach MIL Adptr
1	440-03330	1/4" CABLE CLAMP	Attach MIL Adptr
2	770-05001	FUSE, 0.5AMP SLOW-BLOW	Spare Fuses
1	870-08005	ST-8000A OPERATOR'S MANUAL	This Document
1	960-80015	MIL AC POWER ADAPTER CABLE	Used for MIL PWR

If any of these materials are missing from the ST-8000A Accessory Box, please inform HAL Communications Corp. in writing, stating the HAL Serial Number of the unit and which item(s) is missing. Contact HAL at:

HAL COMMUNICATIONS CORP.
1201 W. KENYON ROAD
P.O. BOX 365
URBANA, ILLINOIS 61801
Phone: (217) 367-7373
FAX: (217) 367-1701

2.3 POWER REQUIREMENTS

2.3.1 Voltage and Frequency

The ST-8000A MODEM may be operated from Alternating Current (AC) power line sources with the following characteristics:

AC VOLTAGE: 115 VAC $\pm 10\%$ (103.5 - 126.5 VAC)
230 VAC $\pm 10\%$ (207.0 - 253.0 VAC)

AC FREQUENCY: 47 Hz to 440 Hz

Use of an AC power source that has stable voltage and frequency is recommended.

The ST-8000A Rear Panel is shown in Figure 2.2. Devices associated with AC Power input are located on the left end of the rear panel:

J3 - IEC AC Power Input
F1 - AC Power Fuse (0.5AMP SLOW-BLOW)
ACV - AC Voltage Selector Switch (115 or 230)
FREQ - AC Frequency Selector Switch (50/60 or 400)

Before connecting the ST-8000A to AC Power:

1. SELECT THE PROPER INPUT VOLTAGE:

Set ACV to "115" for AC voltages between 103.5 and 126.5 VAC;

Set ACV to "230" for AC voltages between 207 and 253 VAC.

2. SELECT THE PROPER INPUT FREQUENCY RANGE:

Set FREQ to "50/60" for frequencies between 47 and 200 Hz

Set FREQ to "400" for all frequencies above 200 Hz.

The fuse size (0.5 AMP SLOW-BLOW) need not be changed for different voltages or frequencies.

WARNING

DO NOT CONNECT AC POWER UNTIL AFTER SETTING THE INTERNAL
OPTION SWITCHES AND JUMPERS AS DESCRIBED IN SECTION 2.5.

2.3.2 AC Power Cord

The ST-8000A rear panel AC Power connector (J3) is a standard IEC-630 type of internationally approved AC connector. This connector is internationally approved for use in most countries of the world. In particular, the ST-8000A is "Host-Nation Approved" for connection to AC power lines in the United States, Germany, and the United Kingdom. The inlet connector and internal AC wiring of the ST-8000A conforms to UL1950 (U.S.) and EN-60950 (Europe).

2.3.2.1 United States AC Power Connection:

An approved U.S. AC power cord is included in the accessory box of each ST-8000A. This power cord plugs directly into rear panel connector J3 and may be plugged into any standard "U-ground, 3-prong" 115/120 VAC outlet.

NOTE: The ST-8000A may be connected for 230/240 VAC operation in the United States. The supplied U.S. power cord is not approved for 240 VAC use. If the ST-8000A is connected to 240 VAC power sources in the United States, the user must obtain the proper approved cord to plug into J3.

2.3.2.2 Host Nation AC Power Connection:

Rear panel connector J3 and internal ST-8000A wiring meet all requirements of EN-60950. The ST-8000A meets requirements of Germany and the United Kingdom (and many other countries of the world). The user must obtain and use an approved AC power cord for the country in which the FSK MODEM is installed. HAL can provide suggested vendors and part numbers for these cords, but it is recommended that the approved AC cord be obtained in the desired host nation.

2.3.2.3 Military AC Power Connection:

The ST-8000A may be connected into U.S. Military AC power distribution systems that use the MS27473E12F98S connector. In this case, use the supplied MIL POWER AC ADAPTER CABLE (960-80015). This adapter cable should be attached to the rear panel using the 6-32 screw, washer, and cable clamp as shown in Figure 2.3. The Military connector does not meet UL-1950 or EN-60950 and therefore does not meet "Host Nation Approval" requirements. The adapter cable should only be used when required by existing Military system cabling.

2.4 RACK MOUNTING

The ST-8000A is designed to mount in a standard 19 inch (48.3 cm) wide rack cabinet. It requires 3.5 inches (8.9 cm) of vertical panel space. The ST-8000A cabinet is 18" deep (45.7 cm). If a fully-enclosed rack cabinet is used, it is recommended that the cabinet have a minimum inside depth of 20 inches (50.8 cm) to leave room for rear panel connectors and cables.

The ST-8000A weighs approximately 16 pounds (7.3 kg). To install the ST-8000A in a rack cabinet, two people are recommended. One should hold the rear and the other the front. The ST-8000A is fastened to the rack cabinet with four screws at the standard RS-310-C77 spacing of 18.5 inches (47 cm) x 3.00 inches (7.62 cm). Mounting screws vary with rack cabinet styles and types and are not furnished with the ST-8000A.

In some installations, it may be desirable to mount the ST-8000A using chassis slides and/or front and rear mounting. Please consult HAL Communications for details concerning additional rack mounting options. Exact dimensional data for the intended cabinet is required to prepare a quotation for such mountings.

Whenever the ST-8000A is mounted in an enclosed rack cabinet, the user must provide adequate ventilation within the cabinet. HAL recommends that the cabinet be pressurized with a forced-air blower. A major heat source (i.e., transmitter or oscilloscope) should not be mounted directly below the ST-8000A. Multiple ST-8000A MODEMS may be placed in a direct vertical stack arrangement. The cabinet blower system should contain its own air filter system to reduce dirt and dust injected into the ST-8000A.

The ST-8000A may be used in a table-top configuration. Table feet and a front tilt-bail are available from HAL Communications at additional cost.

NOTE: BEFORE MOUNTING THE ST-8000A IN A RACK, SET THE INTERNAL OPTION SWITCHES AND JUMPERS DESCRIBED IN THE FOLLOWING SECTION.

2.5 USER-SET OPTION SWITCHES AND JUMPERS

All user set internal option switches and jumpers are located on two stacked circuit boards. All user set option switches and jumpers can be accessed once the top cover is removed. No further disassembly is required. The ST-8000A includes 6 internal switches and 9 internal jumpers which may be set to tailor modem operations to system requirements. These option switches and jumpers should be set before installing the ST-8000A in a rack cabinet and before connecting AC power. This section describes how to set these options. It is recommended that the user read both this section and section 2.6 (CABLE CONNECTIONS) before changing any option switch or jumper. The required option settings may vary with the intended system applications and cabling.

WARNING

The following steps require removal of the protective top cover of the ST-8000A cabinet. AC POWER SHOULD NOT BE CONNECTED WHILE THESE STEPS ARE PERFORMED.

CAUTION

The ST-8000A contains Electostatic Sensitive Discharge (ESD) devices. While all internal parts are grounded to the metal exterior cabinet, it is recommended that an approved ESD work-station be used while making these adjustments.

To gain access to the internal option switches and jumpers, place the ST-8000A on the work surface (ESD protected) so that it faces towards you.

REMOVE sixteen (16) 4-40x1/4" Flat-Head Phillips Screws from the top cover. Use a "No. 1 Phillips" screw driver.

Remove the top cover. Set the top cover and the 16 screws aside for later re-installation.

The location of the user-set option switches and jumpers are shown in Figure 2.4. Do NOT change any other jumper or switch that you may view inside the ST-8000A. For clarity, circuit board

components not involved in the setup are not shown in Figure 2.4.

2.5.1 Demodulator Input Impedance (A1J6)

The demodulator input impedance is set by jumper J6 located in the left rear corner of the MODEM circuit board (lower board). This jumper may be set for an input impedance of either 600 ohms (±10%) or 10,000 ohms (±10%). In both conditions, the demodulator input is balanced to ground and transformer-isolated from other ST-8000A circuitry. The two jumper settings are shown in Figure 2.5. The factory default setting is the right hand position (600 ohms).

FIGURE 2.5 DEMODULATOR INPUT IMPEDANCE (A1J6)

2.5.2 Automatic Mark Hold (AMH) Settings (A1SW1, A1SW2)

Automatic Mark Hold (AMH) parameters are set by option switches SW1 and SW2 located in the right-hand corner of the MODEM circuit board (lower board).

Switch SW1 sets the AMH Threshold level in 6 dB increments from 0 dBm to -42 dBm. If the AMH feature is enabled (via front panel keypad or remote control command), the demodulator data output will be placed into a MARK-hold state whenever the average demodulator input audio signal level is consistently below the AMH Threshold level set on SW1.

The time delay required for the demodulator to change to the MARK-hold state is set by option switch SW2. SW2 may be set for AMH delays of 1.0 second to 5.0 seconds in increments of 0.5 seconds. The AMH delay time is defined as the time that is required for the demodulator to change to MARK-hold state when the signal level changes from 3 dB greater than the set AMH Threshold level (SW1) to 3 dB less than the set level.

The factory default settings are: -42 dBm for SW1 and 1.0 second for SW2. Setting of SW1 and SW2 is shown in Figure 2.6.

2.5.3 Demodulator LOS / Carrier Detect (CD) Setting (A1J9)

The demodulator Loss Of Signal (LOS) or Carrier Detect (CD) signal polarity is set via option jumper A1J9. Jumper J9 is located at the right-rear corner of the MODEM circuit board (lower board). The LOS/CD signal output is derived from the AMH circuit and therefore AMH must be enabled to use this output signal. The factory default setting of J9 produces a negative voltage upon LOS (+V for CD). The setting of jumper J9 is shown in Figure 2.7.

FIGURE 2.7 LOS/CD JUMPER (A1J9)

2.5.4 Modulator Tone Auto-Mute Setting (A1J8)

The modulator Auto-Mute feature provides ON/OFF control of the modulator output FSK tones. In the ST-8000A, Auto-Mute may be turned ON or OFF via an internal option jumper, A1J8. When active, Auto-Mute senses transmit data (TXD) activity, enabling the modulator FSK tone output and closing the keyline relay whenever TXD activity is sensed. The ST-8000A also includes a DRTS input that may be used to instantly enable modulator output and the keyline relay.

The keyline relay is always controlled by the Auto-Mute feature. Jumper A1J8 may be set so that Auto-Mute also turns the modulator FSK tones ON or OFF, or so that the modulator tones are always ON. The factory default setting of J8 is for Auto-Mute control of modulator tone output. Settings of option jumper J8 are shown in Figure 2.8.

FIGURE 2.6 AMH THRESHOLD AND DELAY (A1SW1, A1SW2)

FIGURE 2.6 AMH THRESHOLD AND DELAY (A1SW1, A1SW2)

2.5.5 Remote Control Data Rate (A2SW3)

Option switch A2SW3 is located on the left-rear of the top circuit board, the CONTROL board (Assembly A2). This switch controls the data rate of communications between the ST-8000A and a remote control terminal (not the "radio" or "wire-line" modem data rate). The data rate may be set from 110 baud to 38,400 baud. The factory default setting of SW3 is 9600 baud. Settings for SW3 are shown in Figure 2.9. If more than one switch is ON, the rate is set to the highest rate selected.

2.5.6 Remote Control Address (A2SW4)

Multiple ST-8000A FSK Modems may be parallel-connected to a single remote control terminal. When this feature is used, each ST-8000A FSK Modem in the connection must be set to a different remote control address. This remote control address is set with option switch A2SW4. Option switch A2SW4 is located near the left-rear of the CONTROL circuit board (top board). Note that the address set by SW4 sets both the unit address (01 through 09) and the Channel Number for the modulator and demodulator sections of each modem. The remote control commands required to access the different modems and the modulator/demodulator sections of each modem change with each address set. A careful reading of Chapter 4 of this manual (REMOTE CONTROL) is recommended. The factory default setting of A2SW4 is to Unit Address 01, Channel 01 and 02, the normal configuration for a single-modem system. A2SW4 settings are shown in Figure 2.10. If more than one switch is ON, the unit address is set to the lowest unit number switch closed (ON).

2.5.7 Auto-Mute Delay (A2SW1, A2SW2)

The Auto-Mute feature senses transmit data (TXD) activity and enables or disables the Modulator FSK tone output. When transmit data activity is detected, the keyline is immediately set to the closed (transmit) condition. When transmit data activity ceases (goes to continuous MARK or SPACE condition), the keyline will open (receive state) after a time delay. The time delay is set by option switches A2SW1 and A2SW2. This delay may be set from 1.0 millisecond (msec, 0.001 seconds) to 9.999 seconds.

Setting of Auto-Mute Delay switches A2SW1 and A2SW2 is shown in Figure 2.11. Note that the switches are arranged in four decimal digits, each digit encoded in "binary-code-decimal" (BCD) format. Therefore, to set these switches, the desired time delay must first be converted to four BCD digits, a total of 16 binary switch settings. The recommended procedure to follow is:

1. Write the desired delay in four digit format to 1.0 ms resolution. For example:

1 Second = 1.000
 250 milliseconds = 0.250
 2.75 seconds = 2.750

2. Convert each of the four digits into BCD format.
 For example:

Desired Delay = 1.327 Seconds

Units digit = 1

BCD = 0001 (0x8 + 0x4 + 0x2 + 1x1)
 SW2-1 = OFF, SW2-2 = OFF, SW2-3 = OFF, SW2-4 = ON

100 ms digit = 3

BCD = 0011 (0x8 + 0x4 + 1x2 + 1x1)
 SW2-5 = OFF, SW2-6 = OFF, SW2-7 = ON, SW2-8 = ON

10 ms digit = 2

BCD = 0010 (0x8 + 0x4 + 1x2 + 0x1)
 SW1-1 = OFF, SW1-2 = OFF, SW1-3 = ON, SW1-4 = OFF

1 ma digit = 7

BCD = 0111 ($0 \times 8 + 1 \times 4 + 1 \times 2 + 1 \times 1$)

SW1-5 = OFF, SW1-6 = ON, SW1-7 = ON, SW1-8 = ON

A2SW1 and A2SW2 are shown in Figure 2.11. The factory default setting of SW1 and SW2 is for a 250 millisecond Auto-Mute Delay.

Caution must be used when setting very low delays. The Auto-Mute Delay should not be set to be less than twice the period of the character anticipated. For example, if the ST-8000A is used with a 50 baud BAUDOT (7.5 bits per character), set Auto-Mute delay to be greater than $2 \times 7.5 \times 20$ milliseconds (1/50) or 300 ms.

2.5.8 RS-232 / MIL-188 Data Format (A2J2, J6, J7)

Option jumpers A2J2, A2J6, and A2J7 are located on the upper circuit board (CONTROL, Assembly A2) near the front of the cabinet. Jumper J2 is towards the right-side of the board; J6 and J7 are in the right-front center area of the board.

Jumper A2J2 sets the polarity of transmit data (TXD) that then drives the FSK modulator. Note that this is the DATA I/O port and not the REMOTE port. The factory default setting of J2 is "232", for RS-232 data.

Jumper A2J6 sets the polarity of the demodulator received data mid-bit clock signal. In the "232" position, the mid-bit clock signal has a high-to-low (+V to -V) transition at the center of each received data bit. In the "188" position, the clock transition is "low-to-high" (-V to +V). The normal RS-232 polarity and factory default setting of J2 is "232". This is also standard for most MIL-188 data systems. Some MIL-188 systems may require reverse clock polarity and J6 should then be set for "188" polarity to be used in these systems.

Jumper A2J7 sets the format of all data lines to and from the Remote Control Terminal. Note that this jumper does not affect the data format of the DATA I/O port. The factory default setting of J7 is "232" for RS-232 data.

Jumpers A2J2, A2J6, and A2J7 are shown in Figure 2.12.

2.5.9 Remote Control Terminations (A2J4, A2J8)

When the ST-8000A is connected in a multi-modem remote control network, one modem in the network must have termination resistors on the signal lines and all other modems must not be terminated. It is recommended that the first modem in the "daisy-chain" (Unit 01) be the modem with the termination on the remote signal lines. These terminations are set by jumpers A2J4 and A2J8.

When only one ST-8000A is connected to a Remote Control terminal, the remote control data signal lines should be terminated. The factory default setting of jumpers J4 and J8 is with the termination installed (single unit). Jumpers A2J4, and A2J8 are shown in Figure 2.13 with factory settings.

FIGURE 2.13 REMOTE CONTROL TERMINATIONS (A2J4 AND A2J8)

2.5.10 Log Option Settings and Replace Cover

This completes the setting of all internal ST-8000A option switches and jumpers. Before replacing the top cover, it is highly recommended that you record the settings chosen in Table 2.2.

After recording the options chosen, replace the top cover and fasten it with the 16 4-40x1/4" flat-head screws removed in section 2.5. Use a "No.1" Phillips screw-driver. Tighten all screws but avoid over-tightening.

TABLE 2.2

INTERNAL OPTION LOG

ST-8000A Serial No. _____

DATE ____ / ____ / ____

TECHNICIAN _____

PARAMETER	SET	FACTORY SETTINGS	DEFAULT	REFERENCE
AC POWER VOLTAGE:		115 ___ 230 ___	115	(2.3.1)
AC FREQUENCY:		50/60 ___ 400 ___	50/60	(2.3.1)
DEMODO INPUT Z:	(A1J6)	600 ___ 10K ___	600	(2.5.1)
AMH THRESHOLD:	(A1SW1)	_____ dBm	-42 dBm	(2.5.2)
AMH DELAY:	(A1SW2)	_____ Seconds	1.0 Sec	(2.5.2)
DEMODO LOS:	(A1J9)	-V ___ +V ___	-V	(2.5.3)
MOD AUTO-MUTE:	(A1J8)	AUTO ___ ON ___	AUTO	(2.5.4)
REMOTE RATE:	(A2SW3)	_____ Baud	9600 Bd	(2.5.5)
REMOTE ADDRESS:	(A2SW4)	UNIT ___	01	(2.5.6)
MUTE DELAY:	(A2SW1, SW2)	_____ Seconds	250 ms	(2.5.7)
RX CLOCK POLARITY:	(A2J2)	232 ___ 188 ___	232	(2.5.8)
TXD FORMAT:	(A2J6)	232 ___ 188 ___	232	(2.5.8)
REMOTE DATA:	(A2J7)	232 ___ 188 ___	232	(2.5.8)

REMOTE TERM (TXD): (A2J4) TERM ___ OPEN ___ TERM (2.5.9)

REMOTE TERM (DTR): (A2J8) TERM ___ OPEN ___ TERM (2.5.9)

2.6 CABLE CONNECTIONS

This section describes how to interconnect the ST-8000A to external equipment. Be sure that power is disconnected from all equipment before interconnections are installed.

2.6.1 Audio I/O Connections (Connector J2)

Audio input and output as well as keyline connections are made to ST-8000A rear panel connector J2. Signal connections and ratings for J2 are shown in Table 2.2.

TABLE 2.3
AUDIO I/O CONNECTOR J2

PIN	SIGNAL	RATINGS	NOTES
1	MODULATOR FSK AUDIO OUTPUT	-30 to 0 dBm, 600 ohms.	1
2	No Connection (N.C.)	-----	
3	MODULATOR FSK AUDIO OUTPUT	-30 to 0 dBm, 600 ohms.	1
4	No Connection (N.C.)	-----	
5	KEYLINE RELAY CONTACT	+50V, 0.2A Maximum.	2
6	KEYLINE RELAY CONTACT	+50V, 0.2A Maximum.	2
7	No Connection (N.C.)	-----	
8	Jumper wire to J1, Pin 8	200V, 5A Maximum	
9	No Connection (N.C.)	-----	
10	DEMODULATOR FSK AUDIO INPUT	-45 to +6 dBm, 600/10K.	3
11	No Connection (N.C.)	-----	
12	DEMODULATOR FSK AUDIO INPUT	-45 to +6 dBm, 600/10K.	3
13			
14	No Connection (N.C.)	-----	
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37	SHIELD (Ground)	GROUND	

NOTES:

1. Pins 1 & 3 (Modulator Output) are balanced audiooutput connections.
2. Pins 5 & 6 (Keyline Output) are keyline relay contacts (XMIT = Pin 5 connected to Pin 6). Keyline also connected to J1, Pins 15 & 16.

3. Pins 10 & 12 (Demodulator Input) are balanced audio input connections.
4. Rear panel connector J2 is type MS27508E14F35SA.
5. Mating cable connector is type MS2743E14F35PA.

The ST-8000A may be used in radio systems, 4-Wire line connections, and 2-Wire line connections. These connections are discussed in the following sections.

2.6.1.1 Radio System Connections

Typical radio system connections to the ST-8000A are shown in Figures 2.14 and 2.15. A total of 6 wires and the cable shield must be connected.

USE OF SHIELDED CABLE IS RECOMMENDED WHEN CONNECTING TO RADIO EQUIPMENT.

2.6.1.1.1 Modulator FSK Audio Output:

The ST-8000A Modulator Output is available as a balanced, 600 ohm output on pins 1 and 3 of J2. The output level (voltage) is set by the front panel OUTPUT LEVEL control from less than -30 dBm (24.5 mV rms) to 0 dBm (0.775 V rms). When the ST-8000A is set to display CH2 parameters (MOD), the MARK and SPACE Bar graphs show the modulator output level in dBm.

NOTE: While the Modulator Output may be used with any load impedance of 600 ohms or greater, the bar graphs are calibrated for a 600 ohm output load impedance. The open-circuit (no load or very high impedance) output level is approximately 6 dB greater than the bar graph indication.

The ST-8000A Modulator Output should be connected to the radio transmitter audio input as shown in Figure 2.13. The impedance and voltage level requirements vary widely between different transmitter units. Transmitters equipped with a special 600 ohm audio input (often labeled "LINE IN") will typically require an output voltage of -10 to 0 dBm (245 mV to 775 mV rms).

2.6.1.1.2 Keyline Connection:

Pins 5 and 6 of ST-8000A connector J2 are isolated relay contacts that may be used to automatically control the transmit/receive mode of the radio system. Observe the maximum voltage and current limitations shown in Table 2.3 (50V, 0.2 Amperes).

The ST-8000A Keyline is controlled by the MUTE DELAY parameters. The delay is set with internal option switches A2SW1 and A2SW2. Section 2.5.7 provides a detailed description for setting these switches.

2.6.1.1.3 Demodulator FSK Audio Input:

Pins 10 and 12 of connector J2 are the audio input to the ST-8000A demodulator circuit. This input

to the ST-8000A should be connected to the radio receiver audio output. The ST-8000A requires audio input signals with voltage levels from -45 dBm (1.4 mV rms) to +6 dBm (1.5 V rms).

Two different matched audio input impedances may be selected by jumper A1J6, 600 ohms or 10,000 ohms (see Section 2.5.1). The audio input may be either balanced or unbalanced. For unbalanced connections, ground the wire connected to pin 12 at the receiver.

When multiple ST-8000A audio inputs are connected to one receiver (as when decoding individual channels of a Frequency Division Multiplex signal), it is recommended that the 10K ohm input impedance be set on all ST-8000A demodulators.

2.6.1.2 4-Wire Line Connections.

ST-8000A Modems may be connected to dedicated 4-wire transmission lines as shown in Figures 2.16 and 2.17. The Modulator Audio Output terminals (Pins 1 & 3) of one ST-8000A are connected to the Demodulator Audio Input terminals (pins 10 & 12) of the other unit. Set the demodulator input impedance to 600 ohms (A1J6) in both units. Set each OUTPUT LEVEL control to "0 dBm" (775 mV - full Clockwise rotation).

Care should be taken to ensure that modulator output tone frequencies match the demodulator tone frequencies of the other unit. Set both units so that MARK and SPACE frequencies match. Data may be transferred in both directions simultaneously (Full Duplex, FDX). The AUTO-MUTE feature may be set either ON or OFF for 4-wire FDX connections (A1J8).

Since all audio signal wires in Figure 2.17 are balanced with respect to ground, use of shielded cable is optional. However, shielded cable is highly recommended, particularly when the wires must run in near proximity to noisy power lines or transmitter cables and antennas.

The keyline output of the ST-8000A (J2 Pins 5 & 6) is not used in typical 4-wire line connections.

2.6.1.3 2-Wire Line Connections:

The ST-8000A may be used with 2-wire transmission lines as shown in Figure 2.18. In this case, set the demodulator input impedance of both units to 10K ohms (jumper A1J6).

ST-8000A Modems may be operated in either Full Duplex (FDX) or Half Duplex (HDX) modes with the following considerations.

To operate Full Duplex (FDX), a different set of MARK and SPACE tone frequencies must be used for each direction of data flow. For example, a 300 baud FDX system may be operated on 2-wire lines by setting 1070 and 1270 Hz as the MARK and SPACE frequencies of Unit 1 modulator and Unit 2 demodulator. Set 2025 and 2225 Hz as the MARK and SPACE frequencies of Unit 2 modulator and Unit 1 demodulator. Different frequencies and a separation between the MARK/SPACE frequency pairs must be maintained. This technique should be used only for data rates up to 300 baud.

The 2-wire line connection may also be used in Half Duplex (HDX) mode. This mode operates much like the radio system previously described. In this case, all MARK and SPACE frequencies may be set to be the same. The modulator AUTO MUTE feature must be enabled and A1J8 must be set as described in Section 2.5.4. AUTO MUTE automatically turns the modulator output tones OFF when there is no more transmit data to be sent by a station. This allows the other station to send data.

In many half-duplex systems, Carrier Detect (DCD or CD, J1 pin 10) is used to determine if the channel (wire line) is busy. RTS (Request To Send) is used to turn on the modulator audio output signal. Transmit data is then started 200 ms later. This operation requires that AMH be turned ON. These connections are discussed in detail in Section 2.6.2.

NOTE: The ST-8000A cannot be directly connected to the public switched telephone network.

2.6.2 Data Terminal Connections

Data I/O connections to the ST-8000A are made via rear panel connector J1. Signal connections and ratings for J1 are shown in Table 2.4.

TABLE 2.4
DATA I/O CONNECTOR J1

PIN	SIGNAL	RATINGS	NOTES
1	No Connection (N.C.)	-----	
6			
7	DEMOD UNDETECTED MARK	0 dBm MARK	Audio Output 1
8	Jumper wire to J2, Pin 8	200V, 5A Maximum	
9	DEMOD UNDETECTED SPACE	0 dBm SPACE	Audio Output 1
10	CARRIER DETECT OUTPUT	± 6 VDC, Polarity via A1J9	
11	No Connection (N.C.)	-----	
12	DEMODULATOR ANALOG GROUND	GROUND	
13	GROUND	GROUND	
14	GROUND	GROUND	
15	KEYLINE RELAY CONTACTS	± 50 V, 0.2A Maximum	2
16	KEYLINE RELAY CONTACTS	± 50 V, 0.2A Maximum	2
17	DATA I/O RTS INPUT	± 18 VDC, RS-232	3
18	DATA I/O CTS OUTPUT	± 6 VDC, RS-232	3
19	TRANSMIT CLOCK OUTPUT	± 6 VDC	4
20	MODULATOR DIGITAL DATA INPUT	± 18 VDC, RS-232/MIL-188	5
21	DEMOD MID-BIT CLOCK OUTPUT	± 6 VDC, RS-232	
22	DEMOD DIGITAL DATA OUT (RS)	± 6 VDC, RS-232	6
23	DEMOD DIGITAL DATA OUT (MIL)	± 6 VDC, MIL-188	6
24	MODULATOR ANALOG GROUND	GROUND	
25	GROUND	GROUND	
26	GROUND	GROUND	
27			
	No Connection (N.C.)	-----	
35			
36	MODULATOR ANALOG GROUND	GROUND	
37	SHIELD (Ground)	GROUND	

NOTES:

1. DEMOD Undetected Outputs (pins 7 and 9) are 0 dBm audio output signals.
2. Keyline connections (Pins 15 & 16) are paralleled by connections to J2 (Pins 5 & 6).
3. DRTS (Pin 17) and DCTS (Pin 18) are available for external transmit/receive and data flow control.
4. Transmit Clock at Modulator Data Rate (CH2).
5. Modulator data input RS-232/MIL-188 selection set by Option Jumper A2J2 on Control Board.
6. Demodulator RS-232 (Pin 22) and MIL-188 (Pin 23) data outputs available simultaneously.
7. Rear panel connector J1 is type MS27508E14F35SB.
8. The mating cable connector is type MS27473E14F35PB.

Typical connections between the ST-8000A and an RS-232 data terminal device are shown in Figure 2.19. Connections to the standard DB-25 style connector are shown, but connector type and sex may vary among terminal devices. Consult the manual of the intended data terminal and confirm these connections before preparing a cable. A shielded cable for Data I/O connections is highly recommended.

NOTE: Connector J1 provides data input and output (I/O) only for data passed via the audio modulator and demodulator sections -- radio or wire-line data. Connector J4 (REMOTE CONTROL) is used for connection of a different data terminal device to control parameters of the ST-8000A.

Typical minimum connections between the ST-8000A and the data terminal device are shown as solid lines in Figure 2.19. Additional signals that may be used in some data terminal connections are shown as dashed lines. These signals are not required in many applications. If the ST-8000A is used in a receive-only connection, only receive data (pin 22 or 23), signal ground (pin 13) and cable shield (pin 37) need be connected.

The Carrier Detect signal (J1 Pin 10) has RS-232 and MIL-188 compatible levels and may be set for either polarity (LOS = -V (factory default) or LOS = +V) via Option Jumper A1J9.

The transmitter clock output (J1 Pin 19) is compatible with RS-232 and MIL-188 levels ($\pm 6V$) and may be used to synchronize external devices to the ST-8000A transmit data clock.

The receiver mid-bit clock output (J1, Pin 21) is compatible with RS-232 and MIL-188 levels and may be used to synchronize external devices with timing recovered by the ST-8000A when the SYNC feature is used.

The Data RTS and CTS (DRTS and DCTS) signals have RS-232 compatible levels. Data RTS may

be used to externally force transmit condition (Modulator tones ON, MUTE OFF, keyline closed). Setting DRTS "high" ($V > 2.5V$) sets transmit condition. The DCTS signal is driven by the DRTS signal, producing a +V output approximately 200 ms after DRTS is pulled "high". DCTS may be used to control transmit data flow out of the data terminal device. This prevents data output until the transmitter RF output has stabilized.

The demodulator undetected output signals (MARK = Pin 7, SPACE = Pin 9) are usually not connected to data terminals. These are filtered audio signals recovered from the demodulator input signal. These signals may be used for further data processing or for connection to an external tuning display (oscilloscope). When connecting to Pin 7 or 9, use Pin 12 as the ground return and use shielded cable (Pin 37). The external load to ground on Pin 7 or 9 should be 10,000 (10K) ohms or higher.

2.6.3 Remote Control Terminal Connections

Remote Control connections to the ST-8000A are made via rear panel connector J4. Signal connections and ratings for J4 are shown in Table 2.5.

TABLE 2.5
REMOTE CONNECTOR J4

PIN	SIGNAL	RATINGS
1	DATA INPUT	+18 VDC Max, RS-232/MIL-188
2	BUSY INPUT (Status In: CTS)	+18 VDC Max, RS-232/MIL-188
3	DATA OUTPUT	+6 VDC, RS-232/MIL-188
4	+V OUTPUT	+6 VDC, 470 ohm impedance
5	BUSY OUTPUT (Status Out)	+6 VDC, RS-232/MIL-188
6	GROUND	GROUND
7		
13	No Connection (N.C.)	-----

NOTES:

1. Select RS-232 or MIL-188 via Option Jumper A2J7 on Control Board (see section 2.5.8)
2. In multi-modem "daisy-chain" connections, use Option Jumpers A2J4 and A2J8 to set terminating resistor on one unit and open on all other modems (see section 2.5.9).
3. Rear panel connector J4 is type MS27508E10F35P.
4. The mating cable connector is type MS27473E10F35S.

Typical connections of the ST-8000A to a remote control device are shown in Figure 2.20. Connections to a standard DB-25 style connector are shown, but connector type and sex may vary among terminal devices. Consult the manual of the intended remote control device before preparing the cable. A shielded cable for remote control connections is recommended.

The remote control data rate of the ST-8000A must be set via option switch A2SW3 (see section 2.5.5). The ST-8000A remote control data rate must match that of the remote terminal.

Figure 2.20 shows a simple 3-wire (plus shield) connection that may be used if "hardware handshaking" flow-control is not required. While this is a simpler circuit to install, hardware

flow-control is recommended, particularly if the remote control port is operated at high data rates (greater than 1200 Baud). Some data terminals may not support operation at high data rates without the use of hardware flow-control.

Some data terminals or terminal software require connection to the Carrier Detect (DCD) input. Alternate connections for use with these terminals are shown in Figure 2.21.

Multiple ST-8000A FSK Modems may be connected in a "Daisy-Chain" network in which up to nine (9) modems are controlled by a single Remote Control Terminal device. This connection is shown in Figure 2.22.

When multiple modems are connected in this fashion, they must all use the same data format (RS-232 or MIL-188, see section 2.5.8) and all must operate at the same data rate as the Remote Control Terminal (section 2.5.5). Further, the terminating resistors must be set "ON" in one ST-8000A and "OFF" in all other modems in the network. The terminating resistors are set using option jumpers A2J4 and A2J8 (see section 2.5.9). If echo of transmit data (TXD) is required by the terminal, it must be enabled in only one modem of the network. This one modem will then echo TXD commands sent to all modems in the network.

The ST-8000A will operate in a remote control network that contains one or more 1280A/M FSK Modems.

Each ST-8000A connected in the network must have a unique address, set via option switch A2SW4 (see 2.5.6). As shown in Figure 2.22, each modem remote control channel address is then unique. For example, "C01xxxx" commands set Unit 1 Demodulator parameters, "C02xxxx" commands set Unit 1 Modulator parameters, "C03xxxx" sets Unit 2 Demodulator, and so on to "C18xxxx" commands which set Unit 9's Modulator parameters. A given modem and modem channel will respond to commands only when it has been addressed. A given modem and channel remain selected until a new channel command is issued. A detailed description of REMOTE commands is provided in Chapter 4.

2.7 FACTORY DEFAULT PARAMETERS

The factory default parameters are set whenever there is a checksum error detected by the BIT in the EEPROM that stores the operational settings of the modem when power is OFF. These settings may be recalled during the Power-On Self Test (POST) by pressing the CLEAR key while the software version message is being displayed. The default settings are:

Display Channel is 1 (DEM0D)
Display Mode is MARK/SPACE
REMOTE is not selected/LOCAL mode is selected
Remote ECHO is ON
Remote format is LONG
MARK = 1575.0 SPACE = 2425.0 BAUD = 50
AMH is ON DIVERSITY is OFF HOLD is OFF
Polarity is NORMAL REGEN is OFF SYNCH is OFF

MUTE is OFF ASYNC character length is 5

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