2.6 CABLE CONNECTIONS

This section will describe 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 2.6.1.

TABLE 2.6.1
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 thru 36	No Connection (N.C.)	-----	
37	SHIELD (Ground)	GROUND	

NOTES:

1. Pins 1 & 3 (Modulator Output) are balanced audio output 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

A typical radio system connection to the ST-8000A is shown in Figure C1440. A total of 6 wires and the cable shield must be connected.

USE OF SHIELDED CABLE IS HIGHLY 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 C1440. 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).

If the transmitter does not have a special audio line input, the ST-8000A may be connected to the transmitter's "Microphone Input", but with the following precautionary notes:

a. HF SSB transmitter microphone input circuits usually have an input impedance much greater than 600 ohms. The ST-8000A will drive any load impedance greater than 600 ohms and an additional load resistor is not required.

b. HF SSB transmitter microphone inputs typically use high-gain amplifiers and require input low-voltages to produce full transmitter RF power output. The ST-8000A OUTPUT LEVEL control must therefore bet set to a relatively low level to avoid over-driving the transmitter. A typical OUTPUT LEVEL setting under these conditions is approximately -30 dBm (24.5 mV rms).

c. Microphone inputs are usually unbalanced which means that one input terminal is connected to ground. Run separate wires from pins 1 and 3 of ST-8000A connector J2 and ground the pin 3 wire at the transmitter input connector to avoid hum and noise that may be caused by "ground-loops".

d. Some transmitter microphone input circuits have a DC bias that is used to power "Electet" microphones and/or in-microphone pre-amplifiers. An isolating capacitor must be connected in series with the ST-8000A Modulator Output connection to such transmitters. Install a tantalum capacitor (1.0 to 2.2 uF, 25V) in series with the pin 1 ST-8000A modulator output. Place the capacitor inside the transmitter microphone connector plug. CONSULT THE TRANSMITTER MANUAL TO DETERMINE IF THIS CAPACITOR IS REQUIRED.

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 2.6.1 (50V, 0.2 Amperes).

The ST-8000A Keyline is driven by the MUTE circuit. The keyline is therefore controlled by the MUTE ON/OFF and KEYLINE DELAY parameters. Consult Sections xxx (ON/OFF) and yyy (KEYLINE DELAY) to set these parameters.

The ST-8000A also includes a "Phantom" keyline feature. When Jumper A1J7 on the MODEM board (See Section xx) is set in the "Phantom" position the relay contact connected to J2, pin 6 is also connected to the center-tap of the modulator output transformer. Some radio transmitters require grounding of the transmitter audio line input to switch from receive to transmit. In these cases, install Jumper A1J7 in the "Phantom" position and ground Pin 5 of J2. The transmitter line input circuit will then be connected to DC ground when transmitting.

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 between -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 (MODEM board), 600 ohms or 10,000 ohms (10K). The audio input may be either balanced or unbalanced. Ground the wire connected to pin 12 at the receiver for unbalanced audio input connections.

Receiver audio output connections vary greatly between different receivers. A constant level, 600 ohm receiver output is the most useful and should be used if available. If not, receiver audio may be obtained from "speaker", "headphone", or "recorder" audio output connectors. Either 600 or 10K ohm ST-8000A input impedances may be used with "speaker output" connections. The 10K

ohm impedance setting may be best for "headphone" and "recorder" receiver audio output connections.

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 FSK Modems may be connected to dedicated 4-wire transmission lines as shown in Figure C1441. Note that 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 and set each OUTPUT LEVEL control to "0 dBm" (775 mV - full Clock-wise rotation).

Care should be taken to ensure that modulator output tone frequencies match the demodulator tone frequencies of the other unit. For example, in Figure C1441, set CH2 (Modulator) MARK and SPACE frequencies on Unit 1 to be the same as the CH1 (Demodulator) MARK and SPACE frequencies on Unit 2 and vice versa. Data may 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 C1441 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 C1442. In this case, set the demodulator input impedance of both units to 10K ohms (Jumper A1J6).

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

If Full Duplex (FDX) operation is required (pass data in both directions simultaneously), 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 and 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 in which data is sent by each station in turn, but not simultaneously. This mode operates much like the radio system previously described. In this case, all modulator and demodulator MARK and SPACE frequencies may be set to be the same, but the modulator AUTO MUTE feature must be enabled (see Section xxxx). AUTO MUTE automatically turns the modulator output tones OFF when there is no more transmit data to be sent by a station, thereby allowing the other station to send data. In this connection, the AUTO-MUTE feature should be set ON via option jumper A1J8.

In many half-duplex systems, Carrier Detect (DCD or CD, J1 pin 10) is used to determine if the channel (wire line) is busy. In this case RTS (Request To Send) is also used to turn on the Modulator Audio Output signal. Transmit data is then started 200 ms later. This operation also requires that AMH is 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 J2 are shown in Table 2.6.2.

TABLE 2.6.2
DATA I/O CONNECTOR J1

PIN	SIGNAL	RATINGS	NOTES
1 thru 6	No Connection (N.C.)	------	
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	±50V, 0.2A Maximum	2
16	KEYLINE RELAY CONTACTS	±50V, 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 thru 35	No Connection (N.C.)	------	
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 MS27508E14F35SA.
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 C1443. Connections to a 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 C1443. These connections are: (1) ST-8000A receive data output (J1 Pin 22 for RS-232 or Pin 23 for MIL-188), (2) ST-8000A modulator data input (J1 Pin 20 for RS-232 or MIL-188), (3) Signal Ground (J1 Pins 13, 14, 25, or 26), and (4) Cable Shield (J1 Pin 37). 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.

Additional signals that may be used in some data terminal connections are shown as dashed lines. These signals are not required in many applications.

The Carrier Detect signal (J1 Pin 10) has RS-232 and MIL-188 compatible levels ($\pm$6V) and may be set for either polarity (LOS = +6V or LOS = -6V) 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 ($\pm$6V) 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 signals have RS-232 compatible levels. Data RTS may be used to

externally force transmit condition (Modulator tones ON, MUTE defeated, keyline closed). Setting RTS "high" (V > 2.5V) sets transmit condition. The Data CTS signal is driven by the Data RTS signal, producing a +6V output approximately 200 ms after RTS is pulled "high". Data CTS may be used to control transmit data flow out of the data terminal device, preventing 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 2.6.3.

TABLE 2.6.3
REMOTE CONTROL 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 thru 13	No Connection (N.C.)	-----

NOTES:

1. Select RS-232 or MIL-188 via Option Jumper A2J7 on Control Board.
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.

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 C1444. 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 highly recommended.

Note that the Remote Control data rate of the ST-8000A must be set via option switch A2SW3 (on Control circuit board). The ST-8000A remote control data rate must match that of the Remote Terminal.

Figure C1444 also 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 flow-control.

Some date terminals or data terminal software requires connection to the Carrier Detect (DCD) input. Alternate connections for use with these terminals are shown in drawing C1459.

Multiple ST-8000A FSK Modems may be connected in a "Daisy-Chain" network in which up to eight (8) modems are controlled by a single Remote Control Terminal device. This connection is shown in Figure C1445.

When multiple modems are connected in this fashion, they must all use the same data format (RS-232 or MIL-188) and all must operate at the same data rate as the Remote Control Terminal. 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. Also, 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 also contains one or more 1280A/M FSK Modems. However, the 1280A/M remote port is compatible only with RS-232 data levels and therefore the entire mixed-modem network must use RS-232 data.

Each ST-8000A (or 1280A/M) connected in the network must have a unique Address, set via option switch A2SW4 (on the Control circuit board). As shown in Figure C1445, each modem remote control channel address is then unique. For example, "C01xxxxx" commands set Unit 1

Demodulator parameters, "C02xxxx" commands set Unit 1 Modulator parameters, "C03xxxx" sets Unit 2 Demodulator, and so on to "C16xxxxx" commands which set Unit 8'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.