

ST-8000A FSK MODEM

OPERATOR'S MANUAL

CHAPTER 1 INTRODUCTION

1.1 PURPOSE

The purpose of this manual is to provide operating and field maintenance instructions for the Model ST-8000A Modem. Individual chapters describe installation, operation, remote control, theory of operation, and field maintenance.

1.2 GENERAL DESCRIPTION

The ST-8000A is a modulator-demodulator (MODEM) device that is an interface between digital data signals and radio or wire-line transmission systems. The modulator section of the ST-8000A converts digital data pulses into audio tones. The frequency of the output tone is shifted according to the MARK or SPACE state of the data pulses. The Modulator FSK output signal is used to drive data transmission lines or as an audio input to a radio transmitter. The ST-8000A demodulator section converts FSK audio tone data into digital pulses that are then used to drive a data terminal device. The ST-8000A FSK MODEM is shown in Figure 1.1.

Modulator and demodulator parameters of the ST-8000A are set by front panel keypad entry or by using remote control commands issued by a computer or controlling data terminal. Microprocessor control circuitry within the ST-8000A interprets these user inputs and generates the required control signals to the modulator and demodulator sections of the modem. The modem may be operated in either "full-duplex" (FDX) or "half-duplex" (HDX) modes.

The ST-8000A front panel includes a 27-key keypad for parameter entry, numerical digital displays, and LED mode indicators. The MARK, SPACE, and CENTER frequencies are displayed to 0.5 Hz resolution and may be set in 0.5 Hz increments from 300 to 3000 Hz. Baud rate is displayed to 1.0 baud resolution and may be set in 1.0 baud increments over the range of 30 to 1200 baud. LED indicators show currently selected operating modes. Two 20-segment Bar Graph displays show the amplitude of the MARK and

SPACE signals of both the modulator output and demodulator input audio signals.

The ST-8000A remote control input port may be used with either an RS-232 or MIL-188 compatible terminal or computer at data rates from 110 to 38,400 baud. Remote control commands include HELP messages and summary output features.

The ST-8000A is housed in a rack-mountable aluminum cabinet. The cabinet is 3.5 inches high by 19 inches wide by 18 inches deep. The FSK Modem may be operated from power line sources of 115 VAC $\pm 10\%$ or 230 VAC $\pm 10\%$ at frequencies from 47 to 440 Hz. The modem requires a total of 30 Watts of AC power.

The ST-8000A meets U.S.A., German, and United Kingdom (Host Nation) approval for Safety, Telecommunications, and RFI suppression. The design Mean-Time-Between-Failure (MTBF) of the ST-8000A is greater than 30,000 hours. The ST-8000A may be operated over the temperature range of 0 to 50 degrees C, up to 95% humidity (non-condensing), and up to 10,000 ft. elevation.

1.3 SPECIFICATIONS

1.3.1 Demodulator

Input Impedance: 600 ohm or 10,000 ohm, $\pm 10\%$, Balanced; impedance set by internal jumper option.

Input Level: -45 dBm to +6 dBm into 600 ohm.

Data Rate: 30 to 1200 baud, in 1.0 baud increments.

Frequency: 300 to 3000 Hz, in 0.5 Hz increments.

Frequencies Set: MARK and SPACE or CENTER and SHIFT.

Shift: 30 to 2700 Hz, 30 to 600 baud, 1 Hz incr. 850 to 1200 Hz, 601 to 1200 baud, 1 Hz incr.

Filter Bandwidth: 16 MARK and 16 SPACE bandwidths automatically selected according to data rate selected.

Detection: MARK Only, SPACE Only, or
MARK/SPACE (M/S) differential detection.

Auto Mark Hold: Automatic MARK Hold (AMH)
returns output RXD to MARK state when signal
is not present (LOS). AMH Threshold = -42 to
0 dBm, 6 dB incr. AMH Delay = 1.0 to 5.0
seconds, 0.5 sec. incr. AMH Threshold & Delay
set via internal option switch.

Low/High Speed: Two separate demodulators
and detectors;

Low-Speed = 30 to 600
baud;

High-Speed = 601 to 1200
baud.

Automatically selected
according to data rate.

Receive Data Out: RS-232C (MARK = -V) and
MIL-188 (MARK = +V) on separate output pins.

Data Sense: Selectable NORMAL or
REVERSE.

Carrier Detect: RS-232/MIL-188 output;
LOS = -V or +V, set via internal option
jumper.

Receive Clock: RS-232 Mid-Bit Regenerated
Clock, 30 to 1200 baud. Synchronizer tracking
range of $\pm 5\%$ of selected baud rate.

Synchronous Mode: RS-232 and MIL-188, 30 to
1200 baud.

Asynchronous Mode: RS-232 and MIL-188 for 5,
6, 7, and 8 bit data word length; set via
front panel or Remote Control command.

BIT Loop-back: Internal Built-In-Test
(BIT) loop-back of Modulator signal into
Demodulator input; BIT levels = 0 dBm, -20
dBm, and -45 dBm.

Diversity Option: OPTIONAL FEATURE:
Connects two ST-8000A FSK Modems for
two-receiver combination diversity. Requires
OPTION 01.

1.3.2 Modulator

Output Impedance: 600 ohm $\pm 10\%$, balanced.

Output Level: -35 dBm to 0 dBm into 600
ohm; set via Front Panel adjustment.

Data Rate: 30 to 1200 baud in 1.0
baud increments.

Modulation: FSK as defined in
MIL-STD-188C (2.347 & 4.5.15) and MIL-188-110A
(5.2.1, 5.2.2, & 5.3.1.3).

Harmonics: All harmonics less than
-40 dBm, referenced to 0 dBm output signal.

Spurious Signals: All non-harmonic spurious
outputs less than -60 dBm.

Frequency: 300 to 3000 Hz in 0.5 Hz
increments.

Shift: 30 to 2700 Hz in 1.0 Hz
increments.

Frequencies Set: MARK and SPACE or CENTER
and SHIFT.

TXD Mute: Turns Modulator output
tones OFF. Mute selected via Front Panel
keypad or remote control command. AUTO MUTE
may be selected by internal option jumper to
turn output tones OFF a delay period after
input TXD has ceased. AUTO MUTE Delay: 0.000
to 9.999 seconds in 1.0 msec. increments; set
via internal option switches.

Transmit Data In: 30 to 1200 baud; RS-232 (MARK = -V) or MIL-188 (MARK = +V); selected via internal option jumper.

Transmit Clock: Provides synchronous transmit clock for data terminal devices. RS-232, 30 to 1200 baud; clock frequency = selected data rate.

Data Sense: NORMAL or REVERSE.

Keyline Output: Isolated relay contact output for control of transmit/receive function (PTT). Keyline Delay is controlled by Auto-MUTE delay setting.

DRTS/DCTS: Data I/O connections used to immediately activate Modulator Output tones and Keyline (to transmit condition). Signal input to DRTS enables Modulator output and Keyline. Signal output DCTS is delayed 200 msec. from DRTS activation and may be used to control data flow of the transmit data device.

1.3.3 Modem Control

Control Input: Set parameters using Front panel keypad and/or rear panel REMOTE port.

Selection: Front Panel REMOTE keypad switch or via REMOTE Port command (R0/R1).

Memory: All previously set parameters and conditions are stored and saved. When AC power is interrupted, previously set parameters are restored on power-ON.

Current Parameters: Front Panel LED

annunciators and frequency displays reflect current operating conditions for "Local" (Front Panel) or "Remote" (REMOTE port) control.

1.3.4 Front Panel

Data Entry: 27 Key keypad.

Keys: 0.5, 0 through 9, ENTER, M/S - CENT, BIT, 2nd, FSK, MARK ONLY, SPACE ONLY, DIV, MUTE, REMOTE, AMH HOLD, NORM REV, SYNCH REGEN, CHAN, BAUD RATE, CLEAR.

Indicators: All indicators are visible on front panel; Keypad annunciators on ENTER, DIV, MUTE, and REMOTE keys. Separate LED annunciators for DEMOD, MOD, MARK, CENTER, SPACE, SHIFT, SYNCH, FSK, REGEN, MK ONLY, SP ONLY, AMH, HOLD, and REV.

Frequencies: 5-Digit RED LED display for MARK/CENTER;
5-Digit RED LED display for SPACE/SHIFT;
4-Digit RED LED display for BAUD;
1-Digit RED LED display for CHANNEL.

Signal Level: Two 20-segment RED LED Bar Graphs, calibrated from -42 dBm to +6 dBm (600 ohm reference). CH = 1 (Modulator): Bars show MODULATOR MARK and SPACE output levels. CH = 2 (Demodulator): Bars show signal input levels to demodulator.

Other Controls: POWER - Controls AC power to ST-8000A, OUTPUT LEVEL - Continuous

adjustment of Modulator output level.

1.3.5 Remote Control

Data Format: RS-232 (MARK = -V) or MIL-188 (MARK = +V), selected by internal option jumpers; compatible with VT-100 and other data terminal devices. Data format: 1 Start bit, 8 data bits (bit 8 = SPACE), 2 stop bits.

Data Rate: 110, 300, 600, 1200, 2400, 4800, 9600, 19,200, or 38,400 baud selected by internal switch.

Unit Address: Selected by internal option switch to Unit 1 through Unit 9 (Channel select C01 - C18).

Multi-Modem: Up to nine ST-8000A Modems may have REMOTE ports "daisy-chain" connected for control by one data terminal. Each modem responds only when addressed.

Commands: All Front Panel features of the ST-8000A may be set via REMOTE port commands (except Modulator Output Level and POWER ON). Commands may be set for "long" or "short" command format. Command echo to controlling terminal may be set ON or OFF. Once given unit is selected (Channel command), further commands may be issued to that unit without repeating Channel number.

Control Commands: Status, Select Channel, Set MARK, Set SPACE, Set CENTER, Set SHIFT, Set BAUD, Select FSK mode, Select MARK ONLY mode, Select SPACE ONLY mode, Select Synchronous mode, Select Asynchronous mode and

set character length in bits, Select/disable +0.5 Hz frequency increment, Set NORMAL/REVERSE sense, Set Channel HOLD mode, Set/disable MUTE function, Select/disable Diversity (only with Diversity OPTION 01), Set/disable Automatic MARK Hold (AMH), Select/disable Regeneration function, Set/disable short REMOTE Control command format, Enable or disable LOCAL/REMOTE mode.

Control Signals: Input Data (RXD), Output Data (TXD), Status Input (CTS), Status Output (RTS) that is a continuous + voltage, Status Output (CTS).

1.3.6 Rear Panel Connections

DATA I/O: Rear panel connector J1 (MS27508E14F35SB); Signals include: Demodulator Undetected MARK output, Undetected SPACE output, Carrier Detect (CD) output, Demodulator analog ground, Keyline Relay (two isolated connections), Data Request to Send input (DRTS), Data Clear To Send output (DCTS), Transmit Clock output (TXC), Modulator Data input (TXD), Demodulator Mid-Bit Clock output (RXC), Demodulator RS-232 Data output (RS-RXD), Demodulator MIL-188 Data output (MIL-RXD), Modulator analog ground, Chassis ground (shield), and jumper to AUDIO I/O (J2).

AUDIO I/O: Rear panel connector J2 (MS27508E14F35SA): Signals include: Modulator FSK Audio output (two balanced connections), Keyline Relay output (two isolated connections), Demodulator FSK Audio input (two balanced connections), Chassis ground (shield), and jumper to DATA I/O (J1).

REMOTE: Rear Panel connector J4
(MS27508E10F35P): Signals include: Data input
(RXD), Status input (CTS), Data Output (TXD),
Status output, +V, (RTS), Status Output (CTS),
and Digital ground.

DIVERSITY: Rear Panel connector J5
(MS27508E10F35S): OPTIONAL, requires inclusion
of DIVERSITY OPTION-01.

AC POWER:

MULTI-NATIONAL Rear Panel connector J3
(IEC 320):
OPERATION: Signals include: AC Power
LINE, AC Power
NEUTRAL, and AC Power
SAFETY GROUND.

MIL OPERATIONS: Rear Panel Connector J3a (MS27472E12F98P): Adapter cable that plugs into IEC AC Power connector (J3). Signals include: AC Power LINE, AC Power NEUTRAL, and AC Power SAFETY GROUND.

GND Chassis Ground terminal for connection to system safety ground.

1.3.7 Other Rear Panel Devices

FUSE Field replaceable 0.5 Amp. slow-blow fuse.

ACV Switch to change between nominal 115 $\pm 10\%$ and 230 $\pm 10\%$ VAC power input.

FREQ Switch to change between low and high frequency AC power sources (50/60 Hz or 400 Hz).

1.3.8 Physical Data

Cabinet Finish: Front Panel: Light Gray
Cabinet: Natural aluminum
iridite finish.

Cabinet Style: 19" rack mounting; rack
handles included.

Size: 3.50" High x 18.0" Deep x
19.0" Wide (8.9 cm x 45.7 cm x 48.3 cm)

Weight: 16 lbs (7.3 kg) net, 28
lbs (12.8 kg) shipping.

AC Power: 115 VAC $\pm 10\%$ or 230 VAC
 $\pm 10\%$, 47 to 440 Hz; 30 Watts.

AC Protection: Rear panel fuse, 0.5 Amps,
slow-blow.

1.3.9 Compatibility

Interoperability: The ST-8000A is fully compatible and interoperable with the Model 1280A/M FSK Modem manufactured by the Frederick Electronics Corporation. Rear panel connectors and signal connections are completely compatible with cabling for the 1280A/M FSK Modem. The ST-8000A REMOTE port is completely compatible and will operate in a multi-unit connection of up to nine 1280A/M and ST-8000A FSK Modems.

Safety: UL1950, EN60950.

RFI: In accordance with FCC Part 15 (Class A), VDE/TUV (Germany) and BS (United Kingdom). Telecommunications: FCC Part 68, FTZ and ZZF, BABT and BSI.

Environment: 0 to 50 degrees C, 95% Relative Humidity (non-condensing); Sea level to 10,000 feet. Transport at up to 50,000 ft., unpressurized.

Reliability: Design
Mean-Time-Between-Failure $\geq$ 30,000 hrs.
(MIL-HDBK-217E, Method 5.1 (Stress Analysis),
at 25 Degrees C, G_B environment.

Maintenance: Depot repair at HAL Communications in Urbana, Illinois.
Built-In-Test (BIT) for field determination of failure. Mean-Time-To-Replace (MTTR) $\leq$ 10 minutes (determine unit failure, remove defective unit, replace with new unit, test

new unit). Factory repair time: 30 days.

Warranty: One year from date of
purchase.