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 +10% or 230 VAC +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,
+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 <u>Modem Control</u>

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 <u>Front Panel</u>

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 <u>Remote Control</u>

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, <u>requires inclusion
of DIVERSITY OPTION-01</u>.

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 +10% and 230 +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 +10% or 230 VAC
+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.