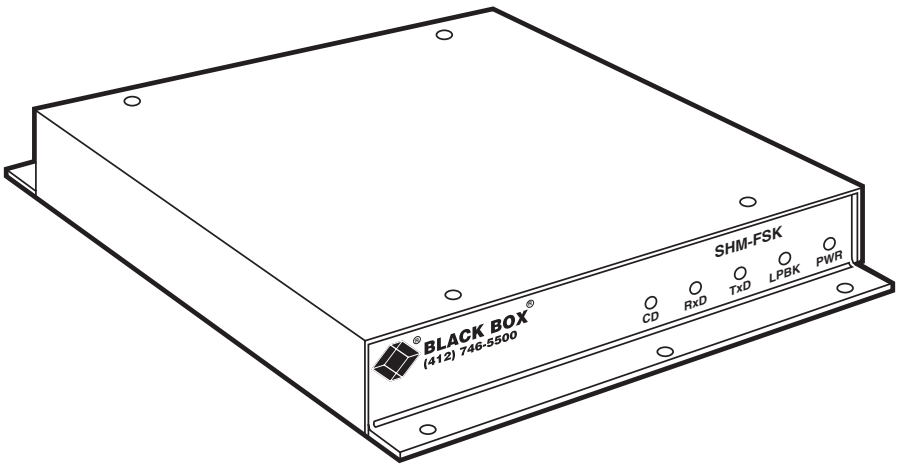




## Short-Haul Modem-FSK RS-485 Modules



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RADIO FREQUENCY INTERFERENCE STATEMENTS**

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

*This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.*

*Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.*

### NORMAS OFICIALES MEXICANAS (NOM) ELECTRICAL SAFETY STATEMENT

#### INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.

11. El aparato eléctrico deberá ser conectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.
12. Precaución debe ser tomada de tal manera que la tierra física y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las líneas de energía.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objetos líquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
  - A: El cable de poder o el contacto ha sido dañado; u
  - B: Objetos han caído o líquido ha sido derramado dentro del aparato; o
  - C: El aparato ha sido expuesto a la lluvia; o
  - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
  - E: El aparato ha sido tirado o su cubierta ha sido dañada.

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# 1. Specifications

**Data Format** — RS-232C (RS-422/485 optional)

**Operation** — Full-duplex or half-duplex controlled carrier, serial asynchronous data

**Mode** — Point-to-point or multipoint

**Data Transmission Speed** — Up to 9600 baud

**Modulation** — Frequency shift key; carrier signal inductively and capacitively isolated

**Distance** — Up to 48,000 feet (9.1 miles or 14.6 km) on single twisted pair

**Operating Temperature** — 32 to 140 °F (0 to 60 °C)

**Enclosure** — All-metal enclosure, 16 gauge steel; polyurethane paint

**Interface** — DTE/DCE jumper selectable; Female DB25 connector for RS-232C; green two-position pluggable terminal block for carrier; black two-position pluggable terminal block for power

**LED Indicators** — Carrier Detect, Receive Data, Transmit Data, Power

**Power Requirements** — 120 VAC 50/60 Hz at 9.6 watts or 24 VDC at 10 watts

**Size** — 1.75" H x 7.5" W x 10.5" D (4.45 x 19.1 x 26.7 cm)

**Weight** — 4.5 lb. (2 kg)

## 2. Introduction

The Short Haul Modem (SHM-FSK) is a private-line modem that allows half- and full-duplex RS-232 data communications at 9600 bps over a single dedicated wire pair and across sliding contacts. The SHM-FSK operates using pure Frequency Shift Key (FSK) at high carrier frequencies (100KHz, 106.5KHz to 150KHz, 156.5KHz). These high frequencies make the SHM-FSK particularly immune to crosstalk and outside noise interference, providing highly reliable, continuous data transmission over distances of several miles in harsh industrial environments.

The SHM-FSK converts digital signals to modulated high-frequency sine-wave carrier signals that can be transmitted much longer distances, with greater noise immunity, than square-wave digital signals. The digital Space and Mark (or 0 and 1) are converted in the transmitter to carrier signals having two slightly different frequencies that are identified by the receiver and reconverted to the digital signals. The SHM-FSKs are configured as either Master or Remote units and can be used for either point-to-point or multi-drop data communications.

The SHM-FSKs send data asynchronously. They are transparent to protocol, and to data rate from DC to 9600 baud.

The SHM-FSK can be configured as a master unit or as a slave unit. See **page 13** for more information.

### 2.1 SHM-FSK Master Units (part number ME840A-M)

The SHM-FSK Master unit transmits at 106.5/100 KHz (Space/Mark) and receives at 156.5/150 KHz. A green pluggable two-position terminal block at the back of the unit is used for connection to the data line. There is no polarity to the data-line connection.

### 2.2 SHM-FSK Remote Units (part number ME840A-S)

The SHM-FSK Remote unit transmits at 156.5/150 KHz and receives at 106.5/100 KHz. It has the same data-line connector as the Master unit.

Both the Master and Remote SHM-FSKs are powered by nominal 24 volts DC, which is supplied to a black two-position pluggable terminal block (+ on the left, if you're facing the pins) on the rear panel. The units are delivered from the factory with 120VAC to 24VDC wall transformers which have a black plug attached. An external 24VDC supply can also be used to power up the MDLs. The current draw is 250mA.



### 2.3 Operating Mode

The SHM-FSKs can be operated in either point-to-point or multipoint polling mode.

For multi-drop data communications, the SHM-FSK can be operated with one Master and typically up to eight Remote units. The transmitter in each Remote unit is controlled by the intelligent device it is connected to. The Master unit's transmitter remains on all the time. The green two-position pluggable terminal block at the receptacle marked "LINE" on the back of the SHM-FSK unit is used with any two-wire cable (does not need to be twisted). Since the FSK signal is AC, there is no polarity required on any of the data-line connections.

### 2.4 Diagrams

Figure 2-1 shows the location of the LEDs on the front of the SHM-FSK.

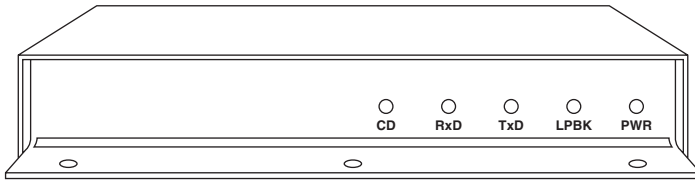
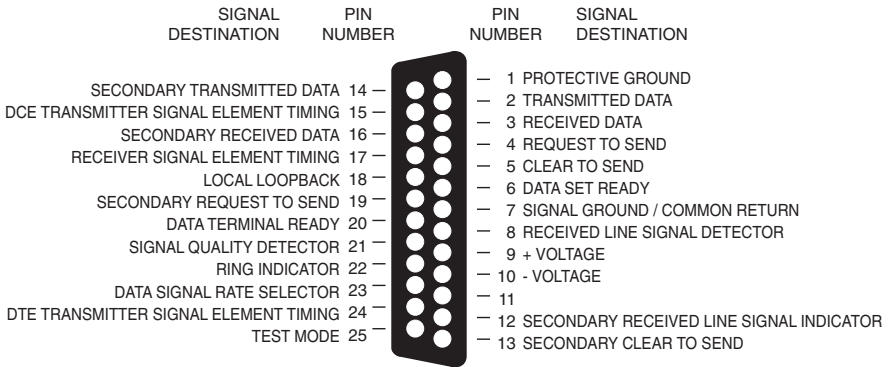


Figure 2-1. Location of LEDs on the SHM-FSK.

Figure 2-2 is a pinout of the RS-232 port.



**Figure 2-2. Pinout of the RS-232 Port.**

## SHORT HAUL MODEM (SHM-FSK)

Figure 2-3 is an illustration of a typical full-duplex or half-duplex, point-to-point application.

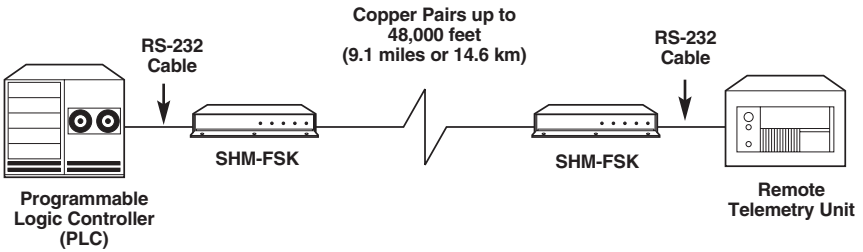


Figure 2-3. Typical Application Connections.

## 3. Installation

The SHM-FSK units are shipped ready for either full-duplex or half-duplex multi-drop operation. The jumpers have been factory-set in full-duplex mode.

The Master and Remote units are both factory-configured as DCEs (Data Communications Equipment) with the jumpers on headers P1 and P2 in the B-C position. Data into the DB25 is on pin 2 and data out is on pin 3. (Also see **Chapter 5, Jumper Settings.**)

Before installing the SHM-FSK units, make sure that the digital devices to be connected to the SHM-FSK units are capable of communicating with each other if connected with a conventional three-wire RS-232 data cable. Once this has been established, the devices can be connected to the SHM-FSK units and RS-232 data communications will take place transparently.

### NOTE

**Make sure that the wire pair to be used for data communications between SHM-FSK units is connected only to those units; has no branches; has no attached inductance, capacitance, or resistance; and has no loading coils, filters or any other load; and that all connections are clean and solid. Since the data line is transformer-isolated from the rest of the circuit, neither leg of the data-carrying twisted pair should be grounded.**

The installation procedure is as follows:

1. Remove the unit's cover by taking out the four screws on top of the modem.
2. Set the Remote units for either full- or half-duplex operation by positioning the jumper on header P4, located behind the DB25 connector. For full-duplex operation, the jumper should be in the B-C position; for half-duplex, multi-drop operation using RTS line carrier control, the jumper should be in the A-B position.

## SHORT HAUL MODEM (SHM-FSK)

3. Confirm that the jumpers on positions P1 and P2 are in the B-C position.
4. Replace the cover.
5. Connect the RS-232 communications port of the digital data device (PC, PLC, etc.) to the SHM-FSK unit with an appropriate cable.
6. Connect the transmission line to the unit at the green pluggable terminal block. There is no polarity requirement.
7. Connect the unit's power cord at the black two-position pluggable terminal block marked "PWR" (facing receptacle, + is on the left and - on the right) and plug the modular transformer into a convenient 120-VAC outlet. Plugging the power in will power up the units; there is no "On-Off" switch.

## 4. Operation

Point-to-point, full- or half-duplex operation is usually conducted with the both the Master and Remote SHM-FSK carriers on all the time. This is achieved by placing the P4 jumper in the B-C position and either not connecting the RTS line (DB25 pin 4) to the SHM-FSKs or making sure that the RTS line supplied by the devices connected to the SHM-FSK is either floating or logic high.

In half duplex, multi-drop operating mode, with the P4 jumper in the A-B position, the RTS line of the intelligent device that a Remote SHM-FSK is connected to (PC, PLC, or RTU) is used to control the the SHM-FSK's transmitted carrier. When logic is low, the carrier is turned off; when logic is high, the carrier is turned on. If the RS-232 cable is disconnected, the RTS connection on the SHM-FSK is biased low and the carrier remains off. (If the P4 jumper is in the B-C position, the RTS connection is biased high and the carrier will stay on.)

When properly configured, the SHM-FSK is capable of half- or full-duplex data transmission at rates up to 9600 baud. The SHM-FSKs require no settings for data rate and will operate transparently as data is fed to them. They will begin communicating data as soon as connections are made and they are powered up.

## 5. Jumper Settings

There are several configuration options that can be selected by jumpers as described below. The jumper pins are internal and are identified by lettering on the circuit board. They are accessed by removing the four retaining screws on the top cover of the enclosure and removing the cover. Be sure that the unit is disconnected from power before removing the cover.

### 5.1 DCE and DTE Settings

Both the SHM-FSK Master and Remote units are configured at the factory as DCE (Data Communication Equipment) for connection to DTE (Data Terminal Equipment). A PC, PLC, or multiplexor is usually configured as DTE. If either the Master or Remote must be changed from DCE to DTE, move the jumpers on blocks "P1" and "P2," which are located directly behind the DB25 RS-232 connector on the rear panel.

### 5.2 Transmitter Output Level

The SHM-FSK allows the selection of either normal or high-power (HP) transmitter output. The high-power output has six times greater peak-to-peak transmitted signal and provides correspondingly greater signal-to-noise ratio. High-power transmitter operation is generally best in applications involving sliding contacts or in very noisy EMI environments. However, caution is advised in some cases since high power carrier signals will result in more crosstalk to adjacent conductors.

The jumper to select normal or high power is located at position TP2. High power is selected when the jumper is positioned center to left (marked "H"); normal output is selected with center to right (marked "N"). When using the HP setting, the receiver gain should be set to low for data-line lengths under 5000 feet. (see **Section 5.3**). The factory setting is normal (center to right, "N").

### 5.3 Receiver Gain

The SHM-FSK incorporates a receiver amplifier on the circuit board. This amplifier has low, normal, and high gain settings configured by a “T” shaped pin block near the center of the circuit board with pins marked “G1/H,” “G2,” “G3/L,” and “N” (the leg of the “T”). G1/H-G2 is the high-gain setting; G2-N, the normal medium gain; and G3/L-G2, the low gain. The units are delivered from the factory set at normal gain because the transmitter has been factory-set at normal output. If the data line is under 5000 feet long, the low-gain setting should be used whenever the high- power transmitter option is selected.

### 5.4 Carrier Detect:

Carrier Detect to the RS-232 connector is enabled or disabled by Jumper Matrix P3. The SHM-FSK units are shipped with the Carrier Detect enabled (jumper on).

### 5.5 Chassis Ground

Chassis ground can be connected to signal ground via Jumper P5. This is generally not recommended. A separate chassis ground wire may be connected to the SHM-FSK’s metal enclosure by means of any of the cover mounting screws as desired to avoid a possible shock hazard.

### 5.6 Half-Duplex Operation/Carrier Control

The SHM-FSK can be operated in multi-drop/half-duplex mode by controlling the transmitter’s carrier on/off using external signals. The most common external carrier-control signal is through the RS-232 port RTS line (pin 4). This line are selected by Jumper P4, A-B. When an external RTS logic high is asserted, the SHM-FSK carrier is turned on; logic low or ground turns the carrier off. The SHM-FSK RTS line is biased low, so that if the RS-232 cable is disconnected or the external controlling device is turned off, the carrier will go off. A-B selects RTS and B-C selects DSR. Usually only the Remote units have their carriers controlled by the devices they are connected to. The Master unit’s carrier is left on all the time. (There is no interference, since the Master and Remote carrier frequencies are different.)

The factory setting for both SHM-FSK Masters and Remotes is P4, A-B, for full- or half-duplex point-to-point operation.

An alternative carrier-control method is to connect a cable to the SW1 header, which allows external contact closure or solid-state switch control of the transmitter. Please call technical support for special instructions.



## 6. LED Indications

There are four LEDs on the front panel of the SHM-FSK. From left to right they are:

<b>Marking</b>	<b>Function</b>
CD	Carrier Detect
RX	Data flowing out of the SHM's RS-232 port
TX	Data flowing into the SHM's RS-232 port
PWR	Power connected

The first diagnostic LED is Carrier Detect. In full-duplex mode, the CD LED must be ON on both units; in half-duplex, carrier-control mode, with RS-232 cables connected, the CD LED will be ON on all Remote SHMs and OFF on the Master SHM. (The Master CD LED will blink during operation as each Remote SHM turns on its carrier to answer back to the Master). If the correct CD LEDs are not ON, there is likely a carrier cable problem.

Assuming that the CD indication is correct, a loopback test is recommended as described in **Section 7.3**.

## 7. General Operating Notes

### 7.1 Tuned Circuits

The SHM-FSK uses tuned circuits to achieve its high performance. These circuits have been carefully adjusted at the factory to operate over several miles of transmission line. In order not to degrade performance, it is important not to disturb these adjustments. In particular, coils T1, T2, T3, T4, and T5 and potentiometers R18, R20, R31 and R57 should not be adjusted. If these adjustments have been inadvertently changed, call for technical support.

### 7.2 Proper Operation

Proper operation of SHM-FSK requires that the transmission line be non-loaded (free from inductors and capacitors on the line). The presence of inductors, capacitors or excessive resistance (from bad connections, for example), or shorts between the wires can seriously degrade performance or completely block data transmission.

### 7.3 Loopback Test

A loopback test is suggested to confirm the proper operation of SHM-FSKs in point-to-point operation, as follows:

A PC running a communication program in full duplex can be connected to one of the SHM-FSKs in a point-to-point configuration. A jumper wire (a bent paper clip works very well) is placed between pin sockets 2 and 3 of the DB25 on the other SHM-FSK. Data sent to the first SHM-FSK will be looped back from the second and appear on the PC screen. If the characters are correct, the SHM-FSKs are functioning.

## 8. RS-485 Interface

Optional RS-485 modules are available for connection to multiple remote devices. The following modules are available:

- RS-485 Module 2-Wire, part number MD3317
- RS-485 Module, 4-Wire, part number MD3318

All operating functions and instructions are the same as for the RS-232 full duplex version, except that the digital interface through the DB25 connector uses pin 12 as the -DO/RI connection and pin 13 as the +DO/RI connection. The RS-232 connections (pins 2, 3 and 7) are not functional.

### **CAUTION**

**Do not connect anything except an RS-485 signal to positions 12 and 13 on the DB25 or damage to the circuit could occur.**

The AE-485 (Auto Enable) circuit contains a special feature that eliminates the need for a separate enable signal or line to command the 485 transmit and receive functions. Data will pass through the SHM-FSK's RS-485 port transparently in either direction. The SHM-FSKs are operated in full-duplex point-to-point mode (no carrier control) when using the AE-485 interface. Up to 32 remote RS-485 devices can be multi-dropped off the SHM-FSK AE-485 port at distances of up to 4000 feet and at data rates of 9600 baud. A 100-ohm termination resistor should be connected at the ends of the 485 line.



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