Async Short-Haul Modem MP

Power   TD   RD   Control   Control   Loopback
                    IN   OUT   Test

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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 the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par le ministère des Communications du 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 connectado 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 fisica 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 lineas de energia.

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 objectos liquidos 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: Objectos 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.

Contents

1. Specifications

Transmission Format—	Asynchronous
Transmission Line—	19 to 26 AWG twisted pair
Range—	See table in **Appendix A**
Serial Interface—	EIA RS-232 (CCITT V.24), DB25 female
Twisted-Pair Interface—	Terminal blocks, RJ-11 jack
Data Rates—	Up to 115,200 bps
Applications—	Point-to-point, multipoint
Indicators—	Tri-state for transmit data, receive data, control in, control out; dual-state for power, loopback test
Diagnostics—	Local Analog Loopback (LAL), Remote Analog Loopback (RAL)
Optical Isolation—	2500V RMS minimum
Surge Suppression—	Over-voltage protection for opto-isolators via Silicon Avalanche Diodes
Temperature Range—	32 to 140°F (0 to 60°C)
Humidity Tolerance—	5 to 95%, noncondensing
Maximum Altitude Range—	Up to 15,000 feet (4572 m)
Power Supply—	Wallmount, outputs 10 VAC, 700 ma
Size—	1.5"H x 4.1"W x 5"D (3.8 x 10.4 x 12.7 cm)
Weight—	13.2 oz. (374.2 g) without transformer

2. Introduction

2.1 Overview

The Async Short-Haul Modem MP is equipped with a virtual wish list of "bells and whistles." Point-to-point or multipoint applications are supported. Two separate control signals may be passed (one each way), each with switch-selectable pin assignments. Data lines are protected from ground loops and electrically volatile environments by optical isolation and Silicon Avalanche Diodes. System integrity can be evaluated using two built-in test modes: local analog loopback and remote analog loopback. Tri-state LEDs monitor transmit data, receive data, and control signals. Finally, 4-wire connections may be made using either RJ-11 jack or terminal blocks—both are included.

In addition, the Async Short-Haul Modem MP is perfect for low-power RS-232 environments. The Modem is AC powered, and therefore is the recommended solution for RS-232 environments whose interface voltages are below RS-232 specifications. The Modem supports data rates to 115.2 kbps and extends RS-232 transmission distances up to 14 miles (22.5 km) over two twisted pairs.

The Modem is housed in a sturdy metal case and comes with either 115 or 220V external transformers.

2.2 Features

- Data rates to 115.2 kbps.

- Built-in optical isolation and high-speed surge protection.

- Distances up to 14 miles (19 AWG TWP @ 1200 bps).

- Tri-state LED indicators.

- Point-to-point or multipoint applications.

- Local and remote loopback test modes.

- DCE/DTE switch-selectable.

- Hardware and software flow control support.

- Externally powered.

3. Configuration

The Async Short-Haul Modem MP features externally accessible configuration switches (two DCE/DTE switches and a DIP-switch set), located on the underside of the unit; there is no need to open the case to configure the Modem.

3.1 Quick Set-Up Instructions

In the majority of applications, you won't need an in-depth knowledge of the Modem's capabilities to get up and running. The following quick-setup DIP-switch configurations cover most Modem operating environments. (Note that DIP-switch 8 is not used.)

3.1.1 POINT-TO-POINT CONFIGURATION

If you are installing these Modems in a point-to-point application with a computer, printer, or terminal, configure the DIP switches on both Modems as follows:

Switch Number	1	2	3	4	5	6	7
Positions	OFF	OFF	OFF	ON	ON	ON	OFF

3.1.2 MULTIPOINT CONFIGURATION

The Modem supports multipoint operation in either daisychain or star configurations.

In a multipoint topology, you must configure the master Async Short-Haul Modem MP's DIP switches differently than those of the slave Modems. These are the proper DIP-switch settings for a daisychain topology:

Switch Number	1	2	3	4	5	6	7
Master Positions	ON	ON	ON	OFF	OFF	OFF	OFF
Slave Positions	ON	ON	ON	OFF	OFF	OFF	ON

3.2 DCE/DTE Switch Settings

Correct setting of the DCE/DTE switches eliminates the need for RS-232 crossover cables. If the RS-232 device you are connecting to the Modem is a PC, terminal, or host (or is wired like one), set both of the DCE/DTE switches to DCE. If the RS-232 device you are connecting to the Async Short-Haul Modem MP is a modem or multiplexor, or is wired like one, set both of the DCE/DTE switches to DTE.

3.3 Special Configuration

If your Modem requires special configuration, use Table 3-1 as a guide. This table shows all of the possible Modem switch settings. Following the table are brief descriptions of the Control Input, Control Output, +Voltage Output and Carrier Controlled by (C_{in}) parameters shown in the table.

Table 3-1. All possible switch settings for the Modem

Mode (DCE/DTE)	Control Input (C_{In})	Control Output (C_{Out})	+Voltage Output (V_{Out})	Carrier Controlled by (C_{In})	Switch Settings						
					1	2	3	4	5	6	7
DCE	4	8	6	Disabled	ON	ON	ON	OFF	OFF	OFF	OFF
DCE	4	8	6	Enabled	ON	ON	ON	OFF	OFF	OFF	ON
DCE	4,11,20*	8	6	Disabled	OFF	ON	ON	ON	OFF	OFF	OFF
DCE	4,11,20*	8	6	Enabled	OFF	ON	ON	ON	OFF	OFF	ON
DCE	4	6	8	Disabled	ON	OFF	OFF	OFF	ON	ON	OFF
DCE	4	6	8	Enabled	ON	OFF	OFF	OFF	ON	ON	ON
DCE	4,11,20*	6	8	Disabled	OFF	OFF	OFF	ON	ON	ON	OFF
DCE	4,11,20*	6	8	Enabled	OFF	OFF	OFF	ON	ON	ON	ON
DTE	8	4	11,20**	Disabled	ON	ON	ON	OFF	OFF	OFF	OFF
DTE	8	4	11,20**	Enabled	ON	ON	ON	OFF	OFF	OFF	ON
DTE	5,6,8*	4	11,20**	Disabled	OFF	ON	ON	ON	OFF	OFF	OFF
DTE	5,6,8*	4	11,20**	Enabled	OFF	ON	ON	ON	OFF	OFF	ON
DTE	8	11,20**	4	Disabled	ON	OFF	OFF	OFF	ON	ON	OFF
DTE	8	11,20**	4	Enabled	ON	OFF	OFF	OFF	ON	ON	ON
DTE	5,6,8*	11,20**	4	Disabled	OFF	OFF	OFF	ON	ON	ON	OFF
DTE	5,6,8*	11,20**	4	Enabled	OFF	OFF	OFF	ON	ON	ON	ON

*Multiple input pins are "or-tied"—if any input goes low, carrier is dropped.

**Multiple output pins generate the same signal simultaneously.

Control Input (C_{in}):

The Control Input signal is used by the local Async Short-Haul Modem MP as an input signal to activate its transmitter (Enabled settings) and allow data transmission to the remote device. This is required for half-duplex/switched-carrier environments as well as in hardware flow-control applications. In the Disabled settings, the Modem is always "turned on" and sends a continuous carrier to the remote Modem.

Control Output (C_{out}):

The Control Output signal is transmitted by the local Modem to its attached DTE device. This signal should be the same logic state as the Control Input signal on the remote Modem. This signal is required in half-duplex/switched-carrier environments or in hardware flow-control applications.

+Voltage Output ($+V_{out}$):

The +Voltage Output signal is a constant positive voltage that is sent from the Modem to its attached DTE device.

Carrier Controlled by (C_{in}):

When Carrier Controlled by Control Input is Enabled, the Modem's transmitter is activated by the corresponding C_{in} Signal from the DTE. In effect, the Control Input signal on the local Modem controls the presence of carrier and the Control Output signal on the remote Modem. This setting is required in half-duplex/switched-carrier environments or in hardware-flow-control applications. When Carrier Control by Control Input is Disabled, the Modem sends a continuous carrier and is always "turned on."

4. Installation

The Async Short-Haul Modem MP is easy to install. After configuring the DIP switches and DCE/DTE switches, connect the two twisted pairs using either terminal blocks or the RJ-11 jack. Figure 4-1 shows the location of the terminal blocks and RJ-11 jack, as well as the female DB25 connector.
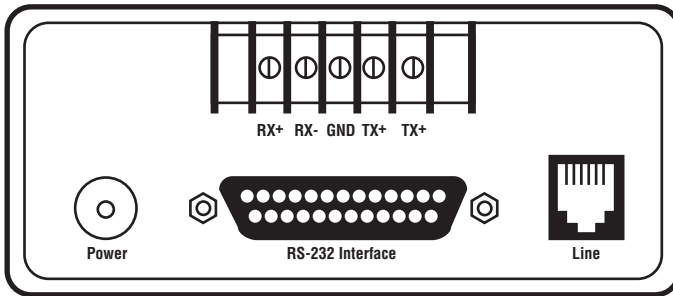

RX+ RX- GND TX+ TX+

Power   RS-232 Interface   Line

Figure 4-1. Rear view of Modem showing interface connectors.

4.1 Twisted-Pair Wiring Overview

These short-range modems are designed to work in pairs. You will need one at each end of a 4-wire twisted-pair circuit. The pairs must be "dry" (unconditioned) metallic wire, 19 to 26 AWG. The smaller gauges limit distance somewhat compared with larger gauges. When you have completed wiring for your data circuit, the pin connections should be as shown below:

```
XMT +  ----------------------------------------  RCV +  ⎫
XMT -  ----------------------------------------  RCV -  ⎬ One Pair
G          ----------To Shield (optional)        G
RCV -  ----------------------------------------  XMT -  ⎫
RCV +  ----------------------------------------  XMT +  ⎬ One Pair
```

4.1.1 TWISTED-PAIR CONNECTION USING TERMINAL BLOCKS

If your two-twisted-pair line terminates in bare wires, strip the ends and connect the individual leads to each Modem's terminal block. Be sure the end-to-end connections follow the diagram on page 11.

### 4.1.2 TWISTED-PAIR CONNECTION USING RJ-11

If your two-pair cable is terminated in an RJ-11 plug, you may use the RJ-11 jack in the back of the Modem to make the connection. The RJ-11 jack on the Modem is prewired for a standard telco wiring environment. To be sure you have the right wiring, use the pinout below as a guide.

RJ-11	SIGNAL
1	GND[†]
2	RCV-
3	XMT+
4	XMT-
5	RCV+
6	GND[†]

For proper signal crossing between two Modems using RJ-11 connectors, wire the twisted-pair cable according to the pinout below.

SIGNAL	PIN#	PIN#	SIGNAL
GND[†]	1	6	GND[†]
RCV-	2	4	XMT-
XMT+	3	5	RCV+
XMT-	4	2	RCV-
RCV+	5	3	XMT+
GND[†]	6	1	GND[†]

[†]Connection to ground is optional
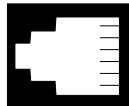
1 - Blue
2 - Yellow
3 - Green
4 - Red
5 - Black
6 - White

AT&T® standard modular color codes.
(These are standard color codes—yours may be different.)

4.2 Wiring For Multipoint Circuits

The Modem supports multipoint applications using either a star or daisychain topology. Both topologies require special wiring, as well as specific DIP-switch settings for master and slave units.

4.2.1 DAISYCHAIN TOPOLOGY

Using a daisychain topology, you may connect as many as 10 Async Short-Haul Modem MPs together in a master/slave arrangement. Maximum distance between the units will vary based upon the number of drops, data rate, wire gauge, etc. Call Technical Support for specific distance estimates.

Figure 4-2 shows how to wire the two-pair cables properly for an Async Short-Haul Modem MP daisychain topology. Note that the ground connection is not needed.

Figure 4-2. Daisychain wiring.

HOST	FIRST SLAVE	OTHER SLAVE(S)
XMT+	RCV+	RCV+
XMT-	RCV-	RCV-
RCV+	XMT+	XMT+
RCV-	XMT-	XMT-

In a multipoint topology, you must configure the master Async Short-Haul Modem MP's DIP switches differently than those of the slave Modems. These are the proper DIP-switch settings for a daisychain topology:
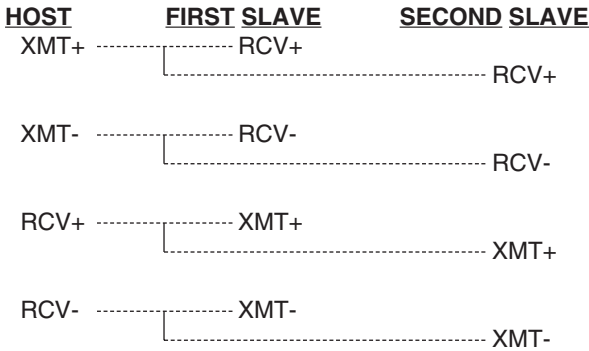
Switch Number	1	2	3	4	5	6	7
Master Positions	ON	ON	ON	OFF	OFF	OFF	OFF
Slave Positions	ON	ON	ON	OFF	OFF	OFF	ON

4.2.2 STAR TOPOLOGY

Using a star topology, you may connect several Modems together in a master/slave arrangement. Maximum distance between the units will vary based upon the number of drops, data rate, wire gauge, etc. Call Technical Support for specific distance estimates.

Figure 4-3 shows how to wire the two-pair cables properly for a Modem star topology. Note that the ground connection is not needed.

Figure 4-3. Modem star wiring.

```
HOST            FIRST SLAVE         SECOND SLAVE
 XMT+ --------------- RCV+
                  |--------------------------------------- RCV+

 XMT- --------------- RCV-
                  |--------------------------------------- RCV-

 RCV+ --------------- XMT+
                  |--------------------------------------- XMT+

 RCV- --------------- XMT-
                  |--------------------------------------- XMT-
```

In a multipoint topology, you must configure the master Modem's DIP switches differently than those of the slave Modems. Here are the proper DIP-switch settings for a star topology:

Switch Number	1	2	3	4	5	6	7
Master Positions	ON	ON	ON	OFF	OFF	OFF	OFF
Slave Positions	ON	ON	ON	OFF	OFF	OFF	ON

4.3 RS-232 Connection

To connect the Modem to a piece of data terminal or data communications hardware, use a straight-through RS-232 cable. Plug the cable directly into the DB25 port on the rear of the Modem.

The DCE/DTE switches eliminate the need for a crossover cable.

5. Operation

Once you have configured each Async Short-Haul Modem MP properly and connected it, simply plug in the AC power adapter to get it running; there is no power switch on the Modem. You can monitor the Modem's operation using the front-panel LED indicators and built-in loopback test modes.

5.1 LED Indicators

The Modem incorporates six front-panel LEDs that show status:

- The power LED lights when AC power is applied to the modem.

- The loopback test LED lights when the loopback test switch has been pressed and is in a test mode.

- The tri-state TD and RD indicators blink red and green with data activity. Solid red indicates a low RS-232 logic level and no color indicates no activity on the line. Note: RS-232 devices idle in a low state, so the LED will glow red if the connections are correct and the RS-232 device is in an idle state.

- The control in and control out indicators light red for a "low" signal and green for a "high" signal. The specific pin number associated with these indicators will vary according to the switch settings you have selected (see **Chapter 3**).

5.2 Loopback Test Modes

Select the test modes by pressing the Loopback Test switch. When the Modem is in loopback mode, the Loopback Test LED will glow red. Two tests are possible using this switch: Local Analog Loop (LAL) and Remote Analog Loop (RAL).

5.2.1 LOCAL ANALOG LOOP

The first test mode is Local Analog Loop (V.54 Loop 3). Any data sent to the local Modem in this mode will be echoed back (returned) to the user device. For example, characters typed on the keyboard of a terminal will appear on the terminal screen (see Figure 5-1 on the following page). If characters are not echoed back, check the connections between the user device and the Modem. Wire the units according to the instructions in **Chapter 4**.

5.2.2 REMOTE ANALOG LOOP

The second test mode is Remote Analog Loop. It causes any characters sent from the remote Modem to the local Modem to be returned to the remote device (see Figure 5-1).

Start the test by pressing the Test button on one of the Modems. Then send data from the other Modem (which must be in normal operating mode). If the data is echoed back to the Modem in normal mode (for example, if characters you type appear on your screen), the link to the Modem in loopback mode is working.

NOTE

Only the one Modem should be in test mode. The other Modem should be in "normal" operating mode or the test will not work.

If no characters are echoed back, check the wiring between the two Modems. Wire the Modems according to the instructions in **Chapter 4**.
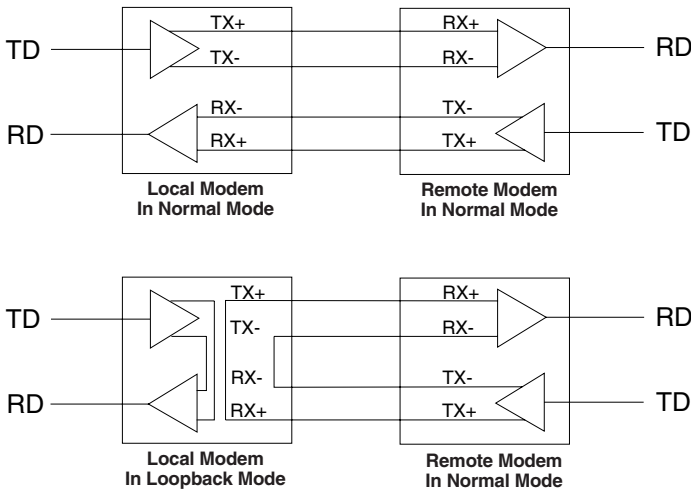
Figure 5-1. Loopback Test Modes.

6. Troubleshooting

Symptom: **TD and RD LEDs indicate activity, but units will not communicate or data is garbled.**

Problem 1: Improper RS-232 wiring.

Solution 1: Check wiring between the Modem and connected serial device—it should be straight through.

Problem 2: Improper twisted-pair wiring.

Solution 2: Compare your twisted-pair wiring with the diagram in **Chapter 4**.

Problem 3: Improper bit-rate setting.

Solution 3: Make sure the bit rates on all connected serial devices are the same.

Symptom: **TD and RD LEDs indicate activity, but CD LED is unlit or red (should be green).**

Problem 1: Defective twisted-pair line.

Solution 1: Test continuity of the twisted-pair line.

Problem 2: Poor twisted-pair connections to Modems.

Solution 2: Check screw terminal/RJ-11 connections to Modems; check integrity of plug RJ-11 terminations.

Symptom: **Occasional data errors.**

Problem 1: Distance/bit-rate capacity exceeded.

Solution 1: Check specifications in **Appendix A**.

Problem 2: Poor-quality twisted-pair circuit.

Solution 2: Use a different twisted-pair circuit if available.

Problem 3: Poor twisted-pair connections to Modems.

Solution 3: Check screw-terminal/RJ-11 connections to Modems; check integrity of plug RJ-11 terminations.

Symptom: **LEDs do not light when the AC power transformer is plugged into the wall outlet.**

Problem 1:   The AC transformer is not plugged into the Modem.

Solution 1:   Plug in the transformer.

Problem 2:   Loose power connection.

Solution 2:   Make sure the AC connection is flush.

Problem 3:   Outlet is defective.

Solution 3:   Try a different outlet.

Problem 4:   AC power adapter is defective.

Solution 4:   Call for a replacement adapter.

Symptom: **No data transfer in either or both directions.**

Problem 1:   Improper twisted-pair wiring.

Solution 1:   Compare your twisted-pair wiring with the diagram in **Section 4.1**.

Problem 2:   Improper DCE/DTE setting.

Solution 2:   Set both DCE/DTE switches alike, according to the instructions in **Section 3.2**.

Problem 3:   Improper bit-rate setting.

Solution 3:   Be sure all bit-rate settings on all connected serial ports are the same.

Problem 4:   Improper "control input" pin setting.

Solution 4:   The transmitter must be enabled by a specific "control input" pin (refer to Table 3-1 in **Section 3.3**).

Problem 5:   Distance specifications exceeded.

Solution 5:   Check specifications in **Appendix A**.

Appendix A. Cable Recommendations

The Async Short-Haul Modem MP is designed and tested to communicate over twisted-pair cable that has the following characteristics:

Wire Gauge	Capacitance	Resistance
19 AWG	83 nF/mi. or 15.72 pF/ft.	0.0163 Ω/ft.
22 AWG	83 nF/mi. or 15.72 pF/ft.	0.0326 Ω/ft.
24 AWG	83 nF/mi. or 15.72 pF/ft.	0.05165 Ω/ft.

Using the characteristics above as a baseline, we estimate the distance limitations for the Modem to be as follows.

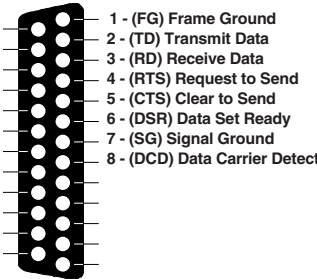| Async Short-Haul Modem MP Distance Table in Miles (km)			
Data Rate	**Wire Gauge**		
	19 (0.9 mm)	**22 (0.5 mm)**	**24 (0.4 mm)**
115,200	1.8 (2.9)	0.75 (1.2)	0.38 (0.6)
57,600	2.5 (4)	1.3 (2.1)	0.95 (1.5)
38,400	3.7 (6)	1.5 (2.4)	1.33 (2.1)
19,200	4.17 (6.7)	1.9 (3.1)	1.42 (2.3)
9600	5.41 (8.7)	2.6 (4.2)	2.08 (3.3)
4800	7.05 (11.3)	3.8 (6.1)	2.84 (4.6)
2400	11.5 (18.5)	7 (11.3)	4.83 (7.8)
1200	14 (22.5)	8.5 (13.7)	5.68 (9.1)

To reduce the potential of difficulties in the field, we recommend that the cable used to connect the Modem have a capacitance of *no greater than 20 pF/ft.*, and that the wire be *no thinner than 26 AWG.*
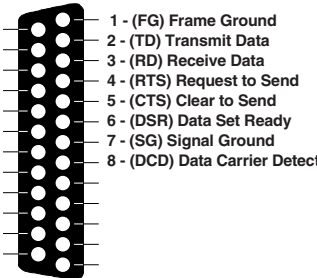
The Async Short-Haul Modem MP is designed to withstand normal environmental noise and conditions. However, other environmental factors too numerous to discuss may affect proper operation.
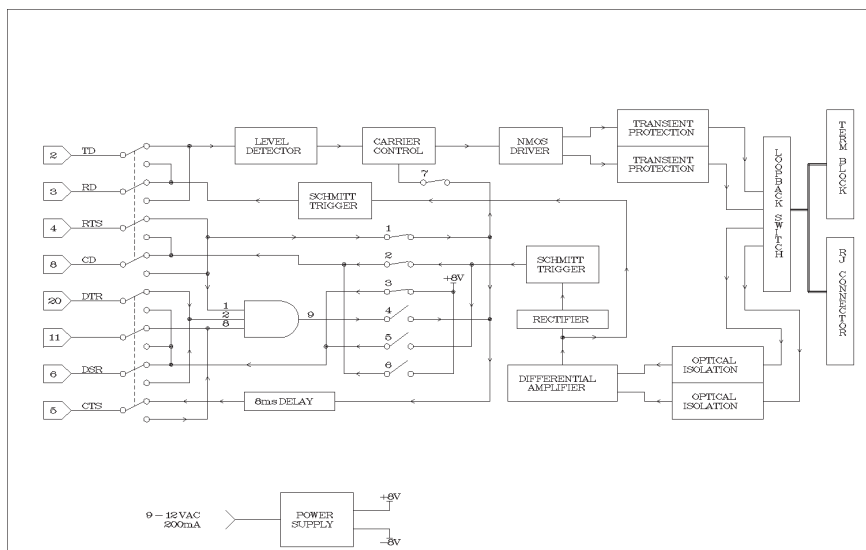
NOTE

The distance table above should be used as a general guideline only.

Appendix B. Interface Pin Assignments

DIRECTION	STANDARD DCE SETTING	DIRECTION
	1 - (FG) Frame Ground	
	2 - (TD) Transmit Data	To Modem
	3 - (RD) Receive Data	From Modem
	4 - (RTS) Request to Send	To Modem
	5 - (CTS) Clear to Send	From Modem
	6 - (DSR) Data Set Ready	From Modem
	7 - (SG) Signal Ground	
To Modem	Data Term. Ready (DTR) - 20 8 - (DCD) Data Carrier Detect	From Modem

DIRECTION	STANDARD DTE SETTING	DIRECTION
	1 - (FG) Frame Ground	
	2 - (TD) Transmit Data	From Modem
	3 - (RD) Receive Data	To Modem
	4 - (RTS) Request to Send	From Modem
	5 - (CTS) Clear to Send	To Modem
	6 - (DSR) Data Set Ready	To Modem
	7 - (SG) Signal Ground	
From Modem	Data Term. Ready (DTR) - 20 8 - (DCD) Data Carrier Detect	To Modem

Appendix C. Block Diagram

BLACK BOX
NETWORK SERVICES