

**Monitoring and Control Network
Extender Module (EXB)
User Documentation**

S2-60596-115

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Manual Revisions

Rev.	Date	Description
110		Original Release
115	10/12/2002	Added extended baud rate table, Option B switch description (RS232 Handshake Control), User supplied DC Power Supply information, and Custom Engineered System operation.

1. Introduction

The Extender Module (EXB) is used in pairs to connect multiple MCN modules in real-time, spanning distances from building-wide to worldwide. Two types of EXB modules are available, supporting different communication channels that connect the remote networks. The EXB-TELCO module supports any analog or digitized analog channel that is capable of carrying V.32 terbo standard modem signaling, including 2-wire or 4-wire leased lines or microwave channels. **The EXB-TELCO Module does not provide any dialing capability, therefore it cannot be used over dial-up lines.** Figure 1 shows an example system that using the EXB-TELCO modules to connect networks in two remote buildings.

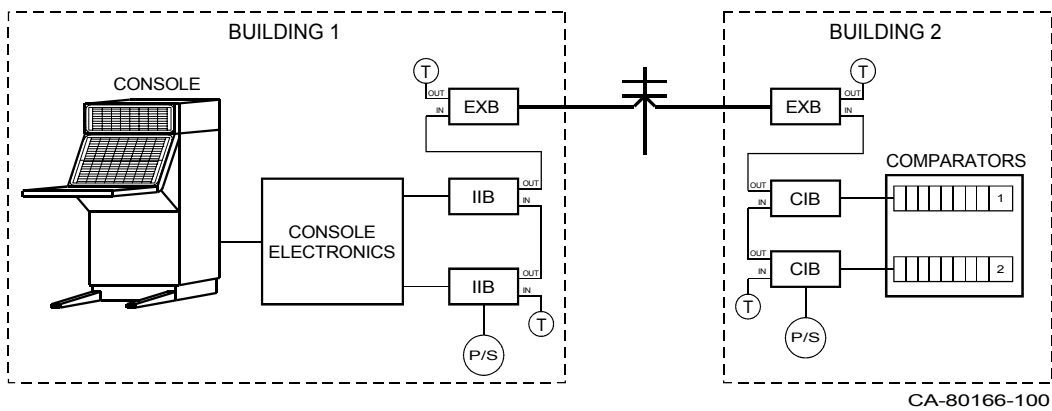


Figure 1 MCN module in two buildings connected with EXB-TELCO Modules

The second type of EXB module is the **EXB-Serial Module**. This module interfaces with a virtual RS-232 communications channel (such as a high speed fractional T1 circuit). Figure 2 shows an example system using the EXB-Serial modules to connect networks in two remote buildings.

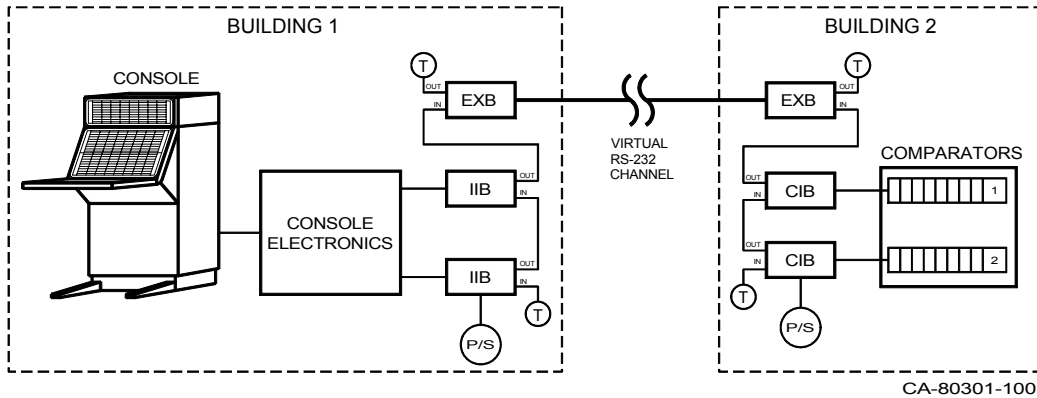


Figure 2 MCN modules in two buildings connected with EXB-Serial Modules

EXB modules are used when two multi-node MCN networks are separated by a distance beyond the reach of conventional wired media (typically 4000 feet). This distance could be across a large building, business campus, city, etc. Additional networks can be added to this unified network by simply adding an EXB module pair per network.

The EXB module is identified by the model number found on the rear panel of the module. The table below shows the model numbers and the type of EXB it represents.

Model Number	EXB Type
S1-60603	EXB-TELCO 1.25 Mbps Network
S1-60602	EXB-TELCO 78 Kbps Network
S1-60656	EXB-Serial 1.25 Mbps Network
S1-60655	EXB-Serial 78 Kbps Network

Throughout this manual, any reference to an EXB module includes both the EXB-TELCO and the EXB-Serial modules.

1.1 Reference Documents

1. Monitoring and Control Network Comparator Display System Manual
Part Number S2-60425

1.2 EXB Communication Channel Interfaces

This section describes the communication channel interface of the EXB-TELCO module and the EXB-Serial module. This interface provides the network connection between the remote MCN networks.

1.2.1 EXB-TELCO Communication Channel Interface

The internal modem in the EXB-TELCO module uses proven V.32 terbo modulation, transferring data at 19,200 bits per second. This modem is unique, however, in its ability to transfer voice simultaneous to data using only a single voice-grade circuit between two EXB-TELCO modules. This bidirectional voice channel exists between each EXB-TELCO module pair and is accessible via the AUDIO connector on the EXB-TELCO module. This live voice feature can be used in any application that requires live data as well as voice communication between personnel or equipment at separate sites.

1.2.2 EXB-Serial Communication Channel Interface

PORT 1 and PORT 2 are standard asynchronous serial ports with individually configurable baud rates from 1200 to 115.200 BPS. An RS-232 communication channel can be connected to each port. PORT 1 and PORT 2 pinouts are configured for DTE operation and allow direct connection to an RS-232 communication channel via a standard 9 pin to 25 pin cable, provided the RS-232 communication channel is configured for DCE operation. Data format is Asynchronous, 8 Data Bits, No Parity Bits, 1 Stop Bit (8N1).

NOTE: When the RS-232 communication channel is transmitting data to the EXB-Serial module, the EXB-Serial module requires that the character to character gap be less than 500 milliseconds.

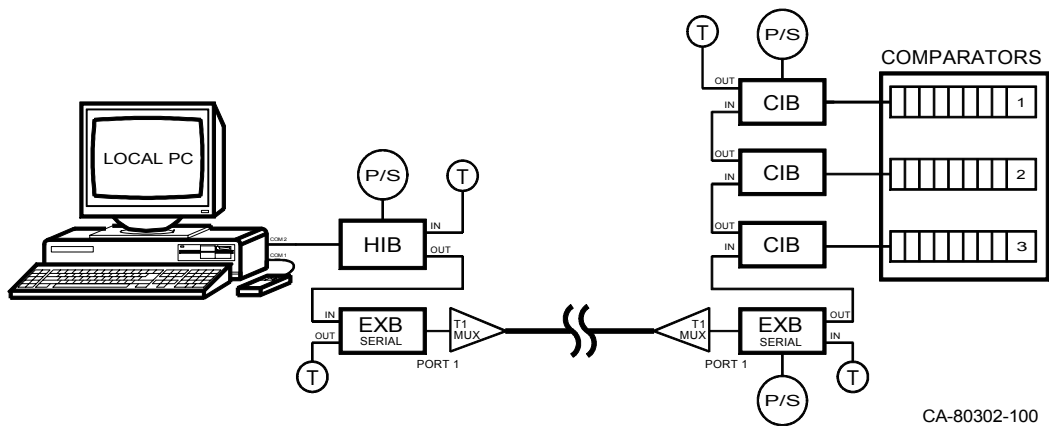


Figure 3 - EXB-Serial System Example

The system shown in Figure 3 uses the EXB-Serial modules to connect two MCN networks through a high speed fractional T1 circuit. For both EXB-Serial modules, PORT 1 is configured to match the baud rate of the T1 MUX. PORT 2 on both EXB-Serial modules is disabled.

NOTE: The EXB-Serial module is configured as a DTE device. In order to use standard RS-232 cables to connect the module with the RS-232 communication channel (in this case, the T1 MUX), the RS-232 communication channel must be configured as a DCE device.

A single EXB-Serial module can interface two RS-232 communication channels to one MCN network by enabling both PORT 1 and PORT 2. If both PORT 1 and PORT 2 are enabled, then any data received on one port is transmitted on the other port, as well as on the Network port. Also, any data received on the Network port will be transmitted on both PORT 1 and PORT 2. Figure 4 shows a system configured in this way.

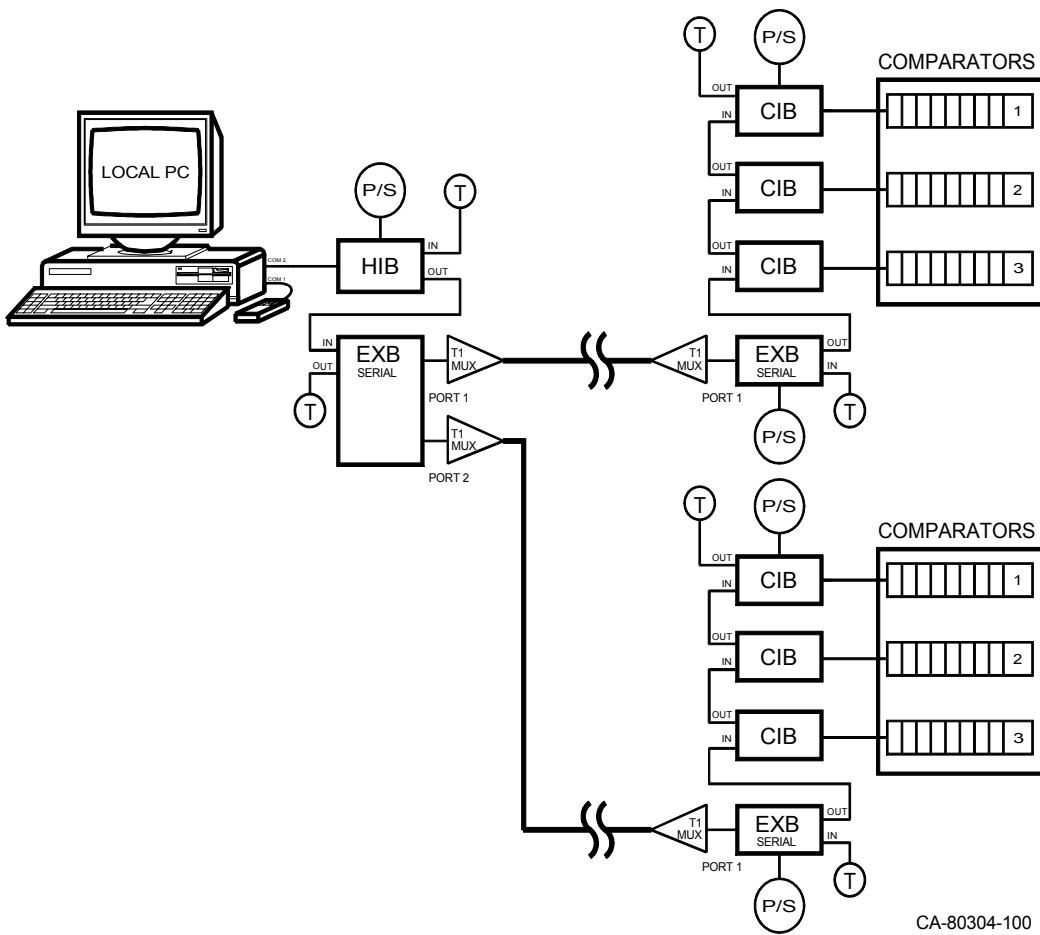


Figure 4 - Two Port EXB-Serial Module System Example

The system in Figure 4 shows how a single EXB-Serial module is connected to two remote networks. The EXB-Serial module at the PC side of the network has both PORT 1 and PORT 2 connected to high speed fractional T1 circuits to allow simultaneous monitoring of two remote comparator sites. Both PORT 1 and PORT 2 of this EXB-Serial module are configured to match the baud rate of the T1 MUXes. The EXB-Serial modules at the comparator sites are both configured with PORT 2 disabled and PORT 1's baud rate matching the baud rate of the T1 MUXes.

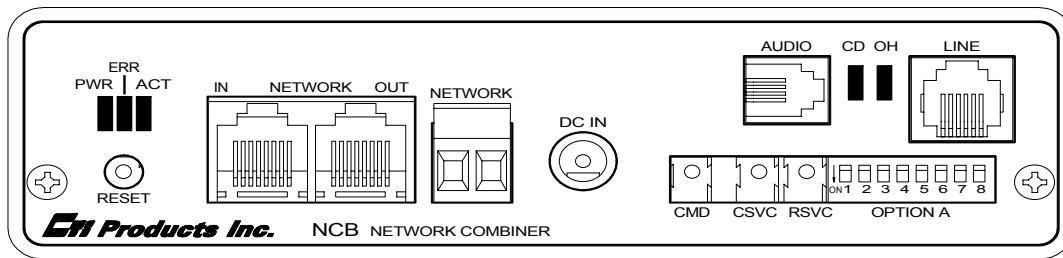
NOTE: The EXB-Serial module is configured as a DTE device. In order to use standard RS-232 cables to connect the module with the RS-232 communication channel (in this case, the T1 MUX), the RS-232 communication channel must be configured as a DCE device.

EXB-Serial devices can operate with external modems. If dial-up operation is required, the modems must be capable of being manually dialed.

2. The EXB Unit

The EXB unit contains user accessible connectors, indicators and controls to allow efficient use of the EXB module. This section describes the function of each item. More detail of the use of each is in section 3. See Appendix A for connector specifications and pinouts.

2.1 The EXB-TELCO Unit



CA-80080-105

Figure 5 EXB-TELCO Module Front Panel

"DC IN" connector -- The primary power entry point for the EXB-TELCO module. See Appendix B for electrical specifications.

"LINE" connector -- connection point for the 2/4 wire leased-line.

"AUDIO" connector -- connection point for a telephone style handset or other audio device to make use of the simultaneous voice/data feature of the EXB-TELCO module.

"NETWORK" connector -- connection point for the MCN network. The dual RJ45 connector designated "IN" and "OUT". These designations apply only to DC power that is passed down unused pairs of the 4 pair network cable. The two pins carrying the network pair are straight-through. **NOTE:** Previous versions of the EXB-TELCO module do not have both RJ45 and terminal strip connectors mounted simultaneously, rather were provided with only a dual RJ45. The two pin terminal strip connector is not used with the MCN family products.

"PWR" LED (Green) -- Indicates when power is present to the EXB-TELCO module. Flashes if DC input to module is below minimum required voltage.

"ERR" LED (Red) -- Indicates a diagnostic error has occurred or insufficient configuration information is present in the EXB-TELCO module.

"ACT" LED (Yellow) -- Indicates a packet has been passed by the EXB-TELCO router.

"OH" LED (Green) -- Indicates the modem is Off Hook.

"CD" LED (Yellow) -- Indicates the modem has detected carrier and completed the training sequence with the distant modem.

"RESET" pushbutton -- Hardware reset for the entire EXB-TELCO module. Non-volatile information is retained.

"CMD" pushbutton -- currently not used.

"CSVC" pushbutton -- reserved. Used during configuration of custom engineered systems. See the custom configuration documents for your system.

"RSVC" pushbutton -- reserved -- Used during configuration of custom engineered systems. See the custom configuration documents for your system.

"OPTION A" switches -- This eight position DIP switch is read by the EXB-TELCO module at power-up or after the RESET button is pressed and is used to set the following options:

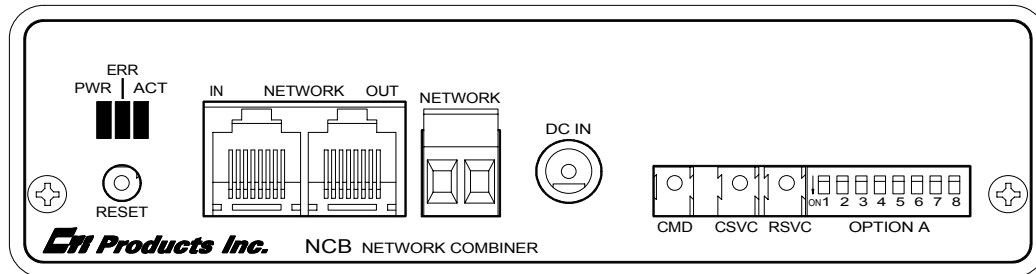
OPTION A

<u>Position</u>	<u>Function</u>
1	Up: Leased-Line Answer Mode Dn: Leased-Line Originate Mode
2	Reserved, leave Dn
3	Not Used, leave Up
4	Not Used, leave Up
5	Normal Systems leave Up Custom Engineered Systems, set as indicated in Custom Documentation
6	Dn: EXB #1, use for Originate Up: EXB #2, use for Answer
7	Up: -10 dBm Modem Tx Level (normal) Dn: -16 dBm Modem Tx Level (for back-to-back leased-line connection)
8	Leased-Line Mode 2wire/4wire Select Up: 2 wire Dn: 4 wire

2.2 The EXB-Serial Unit

The EXB-Serial unit contains user accessible connectors, indicators and controls to allow efficient use of the module. This section describes the function of each item. More detail of the use of each is in section 3. See Appendix A for connector specifications and pinouts.

EXB Serial Front Panel



CA-80283-105

Figure 3 EXB-Serial Module Front Panel

"DC IN" connector -- The primary power entry point for the EXB-Serial module.

"NETWORK" connectors -- connection point for the MCN network. Pins 1 and 2 of both RJ45 connectors are wired in parallel. The dual RJ45 connector designates "IN" and "OUT". These designations apply only to DC power that is passed down unused pairs of the 4 pair network cable. The two pins carrying the network pair are straight-through. **NOTE:** Previous versions of the EXB-Serial module do not have both RJ45 and terminal strip connectors mounted simultaneously, rather were provided with only a dual RJ45. The two pin terminal strip connector is not used with the MCN family products.

"PWR" LED (Green) -- Indicates when power is present to the EXB-Serial module. Flashes if DC input to module is below minimum required voltage.

"ERR" LED (Red) -- Indicates either:

- Always On: a diagnostic error has occurred.
- Slow Flash or Always On: insufficient configuration information is present.
- Quick Flash: the DSR handshake signal of a serial port configured for use (BAUD switch set other than 0) is inactive.

"ACT" LED (Yellow) -- Indicates a packet has been passed by the EXB-Serial router.

"RESET" button-- Hardware reset for the entire EXB-Serial module.

"CSVC" pushbutton -- reserved -- Used during configuration of custom engineered systems. See the custom configuration documents for your system.

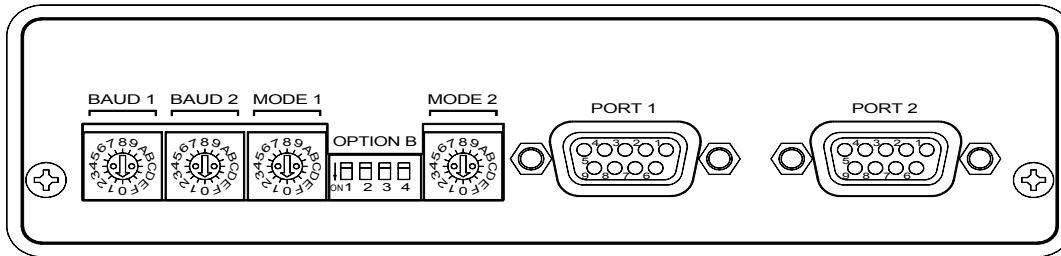
"RSVC" pushbutton -- reserved -- Used during configuration of custom engineered systems. See the custom configuration documents for your system.

"CMD" button -- currently not used.

"OPTION A" switches --

- 1-4 Reserved. All switches must be UP.
- 5 Normal Systems: leave Up
Custom Engineered Systems, set as indicated in Custom Documentation
- 6-8 Reserved. All switches must be UP.

EXB Serial Rear Panel



CA-80286-105

Figure 4 EXB-Serial Module Rear Panel

"PORT 1" and "PORT 2" connectors -- Provide for connecting up to two external RS-232 devices to the EXB-Serial module.


"BAUD 1" and "BAUD 2" switches -- Correspond to PORT 1 and PORT 2 connectors and allow either disabling the port for use or enabling it at a specific baud rate.

BAUD Switch Position	Selected Baud Rate
0	port disabled
1	1200
2	2400
3	4800
4	9600
5	19.2 K
6	38.4 K
7	57.6 K
8	115.2 K

"MODE 1" and "MODE 2" switches -- Reserved. These switches must be set to 0.

2.2.1 OPTION B Switches

OPTION B switches set the *Serial Port Handshaking* options.

	DOWN	UP
1. PORT 1 CTS sense.....	Disabled	Enabled (Normal)
2. PORT 1 DSR sense.....	Disabled	Enabled (Normal)
3. PORT 2 CTS sense.....	Disabled	Enabled (Normal)
4. PORT 2 DSR sense.....	Disabled	Enabled (Normal)

CTS/RTS flow control can be used to pace the transmission of individual bytes between the EXB and a connected device.

DSR/DTR handshaking informs the EXB that a connected device is active. If the channel does not directly support DSR/DTR handshaking, you must either:

1. Strap DSR back to the (always active) DTR output signal, or
2. Set the Port 1 or 2 DSR Sense Switch Down to disable sending of the DSR..

When enabled, the operation of CTS/RTS and DSR/DTR is as follows:

Signal	Direction	Function
CTS	Input to EXB	Active when the connected device is ready to accept characters from EXB. This signal is driven by the RTS signal of the connected device.
RTS	Output from EXB	Active when EXB is ready to accept characters from the connected device. This signal is received by the CTS signal of the connected device.
DSR	Input to EXB	Active when a connected device is functioning. This signal is driven by the DTR signal of the connected device. If driven inactive, EXB front panel “ERR” LED will flash quickly, and EXB will not communicate with this device. If DSR signal is not available from connected device, strap to DTR output.
DTR	Output from EXB	Always driven active by EXB.

If DSR Sense is disabled, the EXB will ignore the DSR line. It will not blink the Error LED if it does not sense an active DSR.

If the CTS Sense is disabled, the EXB will ignore the CTS line and will transmit characters as fast as it can.

3. EXB Module Setup

The EXB module requires minimal setup for ease of installation. This section details setup requirements for mounting, connection, and controls.

3.1 Physical

Non-slip rubber feet are included on all EXB modules to allow them to conveniently rest on any horizontal surface. Four 6-32 threaded holes are also available on the bottom of the module to allow bolting of the module in any convenient orientation. **WARNING: Care should be taken to limit protrusion of the screw into the module to no more than 0.125 inch from the module bottom surface!**

Mounting kits are available as options to allow wall or rack mounting of the EXB module. Installation details using these kits are contained in Appendix C.

3.2 Electrical Connections

3.2.1 Network Connections

The local MCN network must be attached to the EXB module via the NETWORK connector following standard MCN guidelines as to cable type, cable length, and termination as specified in reference 1, the MCN System Manual.

3.2.2 Power Connection

DC power must be attached to the EXB module via the DC IN connector (see Appendix B for electrical specifications and Appendix A for connector specifications). **Apply DC power to the EXB module only after all other connections have been made.** A wall plug-in style power supply designed for the EXB module is available from CTI Products, Inc.

DC power can also be distributed over the MCN network cables. Power is distributed through the NETWORK OUT connector to provide power to the NETWORK IN connector of the MCN unit it is connected to. Each power supply can power up to four units total. See reference 1, the MCN System Manual, for complete details of connections to the network and DC IN connectors.

3.2.3 EXB-TELCO Telephone Line Connection

The telephone circuit connection must be made using the LINE connector (see Appendix A for connector type and pinout). Leased-Line connection can use either a 2 wire or 4 wire scheme to a dedicated leased-line circuit. In 2 wire leased-line mode, the audio circuit must pass audio in both directions simultaneously. See text in section 3.3 covering OPTION A switch position 7 for important information when connecting two EXB-TELCO units “back-to-back” in leased line mode with a short phone cable. Certain leased-line audio circuits (most notably microwave RF channels) provide a 4-wire circuit made up of a Transmit pair and a Receive pair. Use the 4 wire mode in these situations. Be sure to provide proper wiring in 4 wire mode (see Appendix A for details).

3.2.4 EXB-TELCO Handset Connection

A standard telephone handset or other audio input and output device may be connected to the "AUDIO" connector to allow use of the simultaneous voice/data feature of the EXB-TELCO module. Audio directly from the telephone circuit is routed to this connector during training to permit monitoring of call establishment (as typical modems provide via an internal speaker). After training is completed (when the "CD" LED turns on), bidirectional audio from the simultaneous voice/data system is available at this connector. The audio on this connector is digitized and transferred across the modem link by utilizing a portion of the connection bandwidth. This utilization is dynamic and only consumes bandwidth when audio is detected into the AUDIO connector.

Therefore, to avoid unnecessary consumption of bandwidth normally allotted to data transfer, be sure to either disconnect the audio source when not in use or minimize background noise.

3.2.5 EXB-Serial RS-232 Communication Channel Connection

Connect the RS-232 communication channel(s) to PORT 1 (and PORT 2 if two RS-232 communication channels are being used) on the rear of the EXB-Serial unit.. See Appendix A for pinouts and cable diagrams (this is a standard 9 pin to 25 pin modem cable).

Be sure to set the "BAUD 1", "BAUD 2", "MODE 1", "MODE 2", and Option B switches according to information in section 3.3.2 **BEFORE** powering up the EXB-Serial module.

3.3 Controls

3.3.1 EXB-TELCO Controls

The 8 position DIP switch labeled "OPTION A" provides for EXB module static configuration. Section 2.1 of this manual lists the function of each switch position. This section details how to set the switches for each type of intended use. The OPTION A switch is read by the internal EXB circuits at module power up or after pressing the RESET pushbutton on the EXB module front panel.

OPTION A switch positions 1 and 2 control the connection operation of the EXB module modem. Use the following table to select the proper settings of these two switch positions:

<u>Operational Mode</u>	<u>Switch Settings</u>
Leased-Line (Answer)	1 up, 2 dn
Leased-Line (Originate)	1 dn, 2 dn

In order for two EXB modules to communicate via the telephone circuit, one must be set to ORIGINATE mode and the other to ANSWER mode. It does not matter which EXB module is in which mode, only that one is Leased-Line (Originate) and the other Leased-Line (Answer).

OPTION A switch position 5 should be set Up for normal systems.
For Custom Engineered Systems, set as indicated in Custom Documentation

OPTION A switch position 6 should be set to match OPTION A switch position 1.

OPTION A switch position 7 is used to set the transmit level from the modem. It should be normally left in the UP position for telephone lines. If two EXB units are to be connected "back-to-back" in leased line mode (with only a short cable between the "LINE" connector on each unit, in lab test situations, for instance) or are connected standard Starplex multiplex equipment, switch position 7 must be set to the DOWN position in order for the two modems to connect properly.

OPTION A switch position 8 controls the selection of 2 wire or 4 wire mode for leased-line operation.

3.3.2 EXB-Serial Controls

The front panel "OPTION A" switches as well as the rear panel "OPTION B", "BAUDn" and "MODEn" switches provide for EXB module static configuration. Section 2.2 of this manual lists the function of each switch position. This section details how to set the switches for each type of intended use. The switches are read by the internal EXB circuits at module power up or after pressing the RESET pushbutton on the EXB module front panel.

OPTION A

OPTION A switch positions 1 through 8 are not used on the EXB-Serial Module and should be left in the UP position.

OPTION B

OPTION B switch positions 1 through 4 control the RS-232 handshaking. They are normally in the UP position. See sections 2.2.1 for more details.

MODE 1 and MODE 2

Switches MODE 1 and MODE 2 are present only on the EXB-Serial Module and must be set to 0. On previous versions of EXB-Serial modules, the MODE 1 switch is labeled simply MODE and the MODE 2 switch is not present.

BAUD 1 & BAUD 2

The rear panel BAUD 1 and BAUD 2 switches control the baud rate of serial PORT 1 and serial PORT 2, respectively. See section 2.2 for more details. Set them as required.

Although baud rates down to 1200 are shown, the lower baud rates may introduce unacceptable delays in the overall system. It is recommended that you use the highest baud rate supported by your connecting channel.

NOTE: Set the BAUD n switch to 0 if the respective port will not be used. This is important, as the front panel ERR LED will flash continuously if a serial port BAUD switch is non-zero and no RS-232 communication channel is connected.

Alternately, the appropriate switches of Option B could be set Down for an unused port.

RS-232 Hardware Handshake Controls

The EXB-Serial module uses the hardware handshake control lines to control the flow of data to and from the RS-232 communication channel. These control signals are listed below.

Control Signal	Direction
RTS	Output
CTS	Input
DSR	Input
DTR	Output

The control signals DCD and RI are not used by the EXB-Serial module.

The RTS and CTS lines control the flow of characters to and from the EXB-Serial module. The EXB-Serial module asserts the RTS output TRUE when it is ready to receive incoming RS-232 data and asserts the RTS output FALSE to signal the RS-232 communication channel to stop sending data. The CTS signal must be TRUE for the EXB-Serial module to send RS-232 data. If the EXB-Serial module is sending characters too fast for the RS-232 communication channel, the CTS signal can be set FALSE by the RS-232 communication channel to hold off the EXB-Serial module from sending more characters.

The DSR and DTR lines control the channel link between the EXB-Serial module and the RS-232 communication channel. The DSR input must be TRUE for the EXB-Serial module to begin sending and receiving RS-232 data (the ERR LED will blink fast if DSR is FALSE). The EXB-Serial module always asserts the DTR output TRUE.

If the RS-232 communication channel being used does not support these hardware handshake control signals, you must strap the DTR signal to the DSR and CTS inputs in order for the EXB-Serial module to operate.

You can also use the Option B switches to disable DSR and/or CTS sensing. See section 2.2.1 for details.

3.4 Standard Systems and Custom Configured Systems

The EXB units pass traffic to and from the MCN modules in both directions.

Standard Systems are defined as systems having 20 or fewer comparator and I/O modules (CIBs, AIBs, IOBs). **Custom Engineered Systems** are systems that have greater than 20 of these modules or systems that require a 1.25 Mb network.

EXB modules in standard systems are programmed as repeaters to pass all messages in both directions. EXB modules in Custom Engineered Systems are custom configured to pass certain traffic in certain directions only. This reduces the bandwidth required over the Telco or RS-232 link. If you have a Custom Engineered system, see your custom system documentation for details on re-programming the custom-configured EXB modules after repairing or replacing.

4. EXB Module Usage

Once properly connected and configured for use, the EXB module is simple to operate. Run-time operation of the EXB module is completely automatic.

4.1 EXB-TELCO Usage

After power up or reset, an EXB module set to Leased-Line Originate mode will immediately go off hook and emit a cyclic calling tone to the telephone circuit. An EXB module set to Leased-Line Answer mode will go off hook and wait for detection of the calling tone from the distant end. When this calling tone is detected, the modem training sequence begins. This training sequence determines telephone circuit characteristics, sets appropriately equalization parameters and other housekeeping items, and concludes with the "CD" (carrier detect) LED illuminating. Within 2 seconds after this LED lights, data packets can flow across the modem connection and the simultaneous voice/data facility is enabled to the AUDIO port.

The elapsed time between training sequence start and end (carrier detect) is tracked by a timer inside each EXB unit. If the time reaches 20 seconds and training has not concluded, the EXB units will automatically restart the calling tone sequence. Once a connection is established between the two EXB modems, any loss of carrier will be detected by both EXB modules and cause them to automatically restart the calling tone sequence. Data entering the EXB module while the modem is in the calling tone or training sequence is not buffered.

4.2 EXB-Serial Usage

After power up or reset, the EXB-Serial module is ready to begin transferring data over the asynchronous RS-232 port(s). Data received on the Network port is immediately transmitted on the RS-232 ports. Data received on the RS-232-ports is transmitted on the Network port. If both RS-232 ports are enabled, any data received on one port is transmitted on the other RS-232 port, as well as the Network port.

Appendix A EXB Module Connectors

DC IN Connector

Connector type: 2.5 x 5.5 mm coaxial

Mating Connector: Switchcraft 760 or equivalent

Connector pinout: CTI Products, Inc. standard power supply wired with center pin positive, EXB module can accept either pin positive, polarity routing is provided internal.

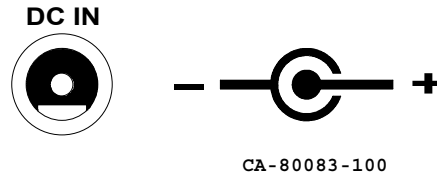


Figure 6 DC Power Connector

NETWORK Connectors

Connector Type: standard RJ45 telephone connector, 8 position 8 contact

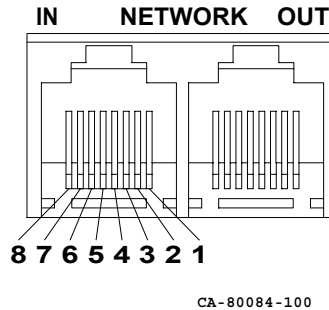


Figure 7 RJ-45 Network Connectors

Pin	Function	Notes
1	Network	Network connection is NOT polarity sensitive
2	Network	Pins 1,2 of IN and OUT connectors tied parallel
3	+ DC Power	In on IN connector, Out on OUT connector
4	No Connection	
5	No Connection	
6	- DC Power	In on IN connector, Out on OUT connector
7	- DC Power	In on IN connector, Out on OUT connector
8	+ DC Power	In on IN connector, Out on OUT connector

Because the EXB module has higher power requirements than other MCN modules, a single EXB module counts as two module loads if DC power is being distributed over the RJ-45 Network Connectors. For the system shown in Figure 1, the power supplies in each building are connected to their load limit (four modules total). The power supply for the MCN system in

building 1 is powering 2 module loads for each IIB plus 2 module loads for the EXB for a total of 4 module loads on the power supply. If another MCN module is added to the MCN network in either building, an additional power supply would have to be added to the system for the additional module.

Powering the EXB unit from a customer-supplied DC source

When powering the unit from a customer-furnished power supply, the supply must be current limited or fused at 1A.

It is recommended that 18-30 VDC be used as power input, although lower voltages can be used. Since a switching regulator is used in the EXB units, they will draw lower current at the higher voltages.

At the lower input voltages, the number of modules that can be driven in series is limited. When an MCN module powers a unit downstream from it, it adds approximately 1.4 V drop from its power input to the power output on the network connector. Thus, a 12VDC input would only power two modules before reaching the lower limit of 10V input to the last module. Additional modules could be powered from the 12VDC input, but you must power the additional groups of modules through the round DC power connector.

EXB-TELCO Module LINE Connector

Connector type: standard RJ11 telephone style, 6 position 4 contact.

For 2 wire leased-line operation, connect pins 3 and 4 from each EXB module to each end of the bidirectional leased-line circuit.

For 4 wire leased-line operation:

- connect pins 3 and 4 of EXB module 1 to the circuit carrying audio from EXB1 to EXB2, terminate this circuit to pins 2 and 5 of EXB2.
- connect pins 2 and 5 of EXB module 1 to the circuit carrying audio from EXB2 to EXB1, terminate this circuit to pins 3 and 4 of EXB2.

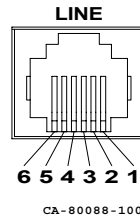


Figure 8 Line Connector

Pin	Function	Notes
1	No Connection	
2	4 wire receive tip	Used for 4 wire channels only
3	2 wire tip / 4 wire transmit tip	
4	2 wire ring / 4 wire transmit ring	
5	4 wire receive ring	Used for 4 wire channels only
6	No Connection	

EXB-TELCO Module AUDIO Connector

Connector type: standard RJ11 telephone type, 4 position 4 contact

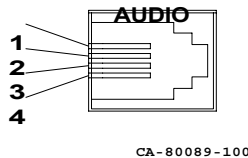


Figure 9 Audio (Handset) Connector

Pin	Function	Notes
1	audio in	inactive during training, simultaneous voice audio in after training
2	audio out	line audio during training, simultaneous voice audio out after training
3	audio ground	
4	audio ground	

EXB-Serial Module PORT 1 and PORT 2 Connectors

Connector type: standard DE9 male

Pinout as DTE (PC-AT pinout)

In general, all signals (except RI and DCD) must be connected for proper operation.

EXB Pin	Function	Direction
1	DCD	Input
2	RXD	Input
3	TXD	Output
4	DTR	Output
5	ground	---
6	DSR	Input
7	RTS	Output
8	CTS	Input
9	RI	Input

The table below shows the wiring list for back to back connections of two EXB-Serial modules:

EXB 1 Signal Name	EXB 1 Pin	EXB 2 Pin	EXB 2 Signal Name
TXD	3	2	RXD
RXD	2	3	TXD
DTR	4	6	DSR
DSR	6	4	DTR
CTS	8	7	RTS
RTS	7	8	CTS
ground	5	5	ground

Appendix B EXB Module Specifications

DC Power Input: 10 to 30 VDC, unregulated

Input Power: 5 watts maximum - this counts as two MCN module loads when using network cable power distribution.

DC Drop: 1.4 VDC drop from Power input (or Network In) connector to Network Output connector.

Size: 7.5" D x 5.6" W x 1.6" H

Operating Temperature: 0 to 60 °C

Humidity: 10-95% non-condensing

Mounting: Desktop with integral non-slip feet
Wallmount or 19" rack mount with optional adapters

Modem: (EXB-TELCO Only)
V.32 terbo 19200 BPS, 2/4 wire leased line
Simultaneous voice plus data

Serial Data: (EXB-SERIAL Only)
RS-232C
9-Pin Male, DTE (PC-AT pinout)
Asynchronous, 1 Start, 8 Data, No Parity, 1 Stop Bit
Baud rates: 1200, 2400, 4800, 9600, 19.2K 38.4K, 57.6K, 115.2K

Approvals:

Safety:	UL 1950 CSA 1950 EN 60950-1992
Listings:	CSA C22.2 (EXB-TELCO only) FCC Part 68 (EXB-TELCO only)
Emissions:	FCC Part 15 Class B DOC Class B EN55022
Susceptibility:	IEC 801-2 IEC 801-3 IEC 801-4 EN50082-1

Appendix C EXB Mounting Options

Wall mount and EIA 19" rack mount kits are available as options for the EXB from CTI Products, Inc. The wall mount kit includes brackets to allow a single EXB module to be mounted to any flat surface. The rack mount kit includes an adapter allowing up to three EXB modules to be mounted in a single rack unit height.

Wall Mount Option

The wall mount option allows an EXB module to be mounted to any flat surface. The EXB module has four screw holes on the bottom. Simply attach the two mounting plates to the bottom of the module using the four flat-head screws provided with the wall mount kit. This assembly is then attached to the flat surface with user-provided fasteners. Figure 12 shows an exploded view of the wall mount installation.

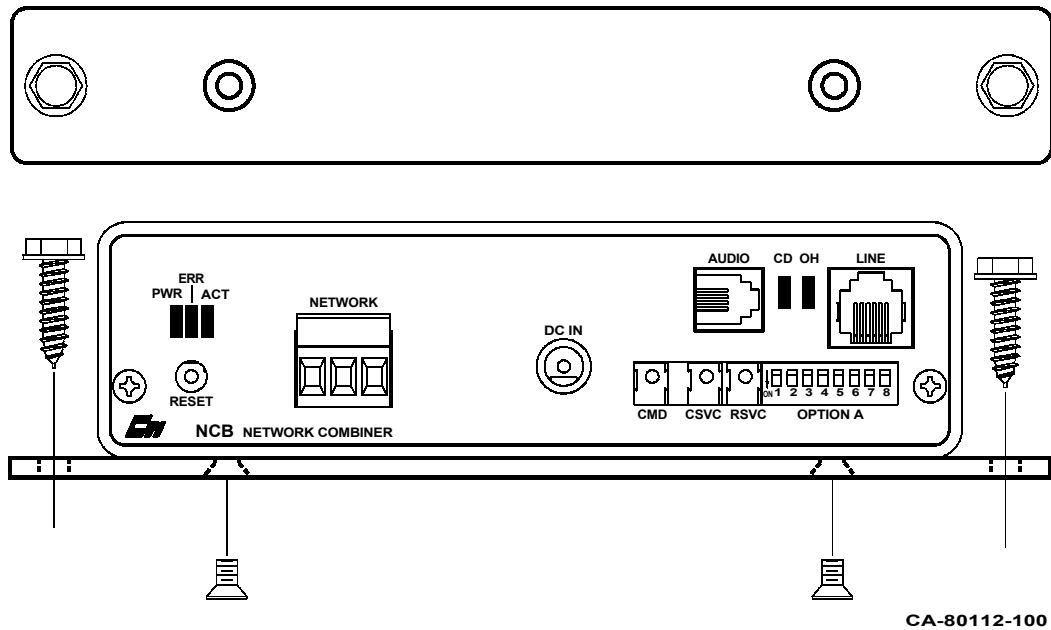


Figure 10 EXB Module Wall Mounting

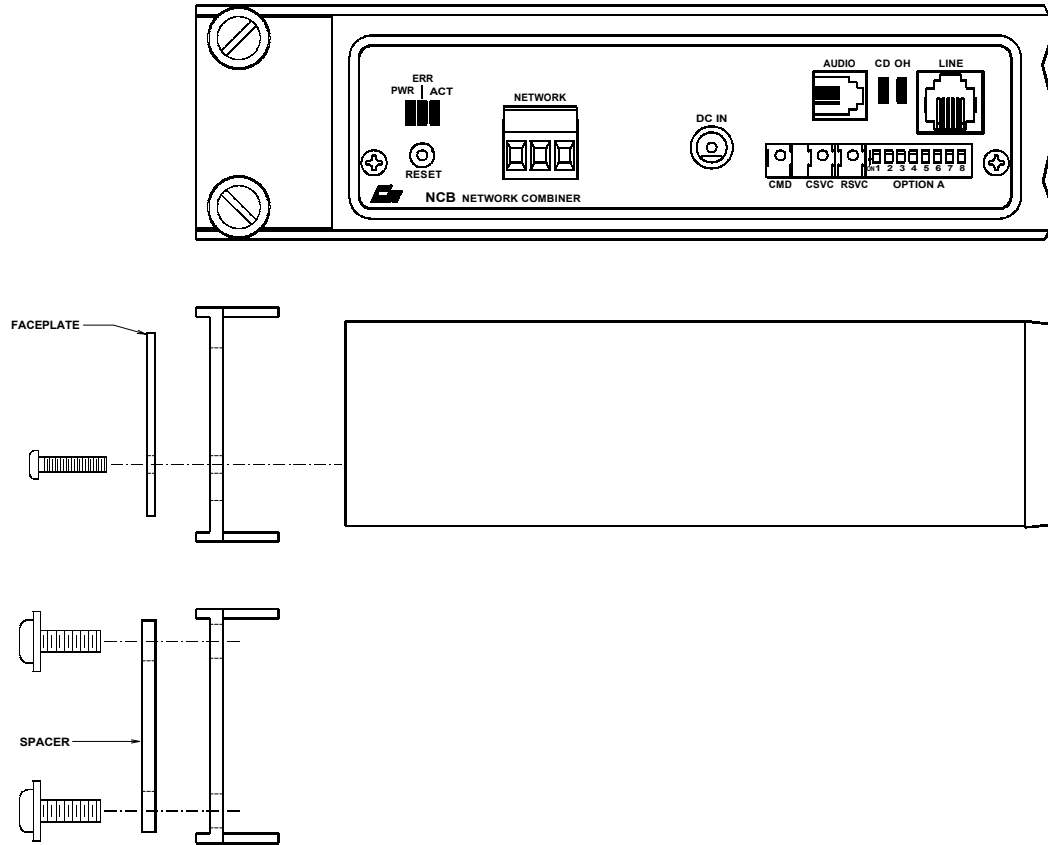
CAUTION

Be sure to use the flat head screws provided with the wall mount kit. If you are not using the wall mount kit from CTI Products, Inc., make sure that the screws do not protrude into the enclosure more than 0.125 inches from the bottom surface of the module.

Using a longer screw that touches the PC board inside the module may damage the module. Doing so will void the unit's warranty.

Rack Mount Option

The rack mount option allows up to three EXB modules to be mounted in a one rack unit height (1.75 inches) of a standard 19 inch rack. The modules are mounted in the rack plate by removing its' front bezel and remounting the module into the rack plate. Figure 13 shows an exploded view of the rack mount installation. The top diagram shows the front view of the bracket with one module installed. The bottom two diagrams show a side view of the module installation into the rack adapter and rack adapter installation into the rack, respectively.



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Figure 11 EXB Module Rack Mounting

To attach a module to the rack adapter, and then mount the rack adapter into the rack, follow the steps below.

WARNING

Do not allow the PC board to slide out of the housing when the front panel is removed. If it does, **DO NOT** slide the PC board back into the housing from the front of the module. Doing so may damage the unit, causing the unit to malfunction when powered on. Doing so will void the unit's warranty.

Rack Mounting Instructions

Step	Operation
1	Remove the front panel from the module, including the bezel, by removing the two Philips head screws in the faceplate. The bezel is not used when rack mounting the module.
2	Position the module behind the rack adapter, lining up the holes in the rack adapter with the front panel screw holes on the module.
3	Position the front panel in front of the rack adapter, lining up the front panel with the module.
4	Fasten the front panel and module to the rack adapter with the Philips head screws that were previously removed.
5	Position the rack adapter into your rack, lining up the four mounting holes of the rack adapter with mounting holes in the rack frame.
6	Position the two spacers in the front of the rack adapter, aligning the cutouts in the spacers with the holes of the adapter.
7	Install mounting screws (customer provided) into the rack.

When the module's front panel is removed, do not allow the PC board to slide out of the housing. If the PC board does slide out of the housing, you must follow the steps below to replace the PC board in the housing. **DO NOT RE-INSTALL THE PC BOARD FROM THE FRONT OF THE HOUSING !**

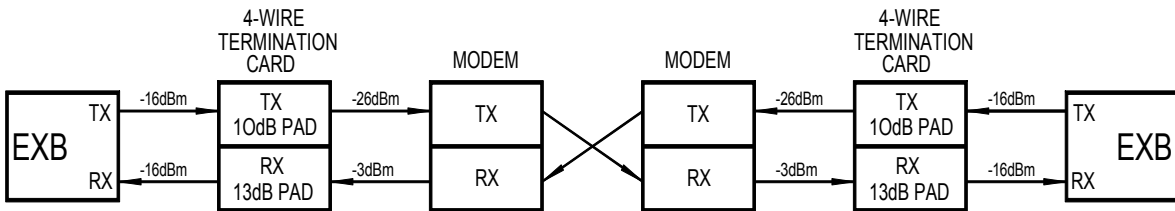
Re-Installing a PC Board in its housing

Step	Operation
1	From the front of the module, slide the PC board out of the housing.
2	Remove the back panel of the module.
3	From the rear of the module, slide the PC board back into the housing (there are markings on the PC board to indicate which edge to insert into the rear of the housing first).
4	Install the back panel of the module.

Appendix D Application Notes

Using the EXB-TELCO Module with Motorola STARPLEX Microwave System

This application note describes how Motorola's STARPLEX microwave system can be used to extend the range of an MCN network. The two MCN networks are connected to the STARPLEX system using a pair of MCN Extender (EXB) Modules as shown in the diagram below.



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Figure 12 EXB Modules used with Starplex Multiplex

Multiplex Level Considerations

The levels recommended in this application note are 10 dB below microwave test tone levels. Based upon the standard alignment for modems, the levels *into and out of the modem* are as shown below:

Modem	Test Tone	Operating Level
Transmit Input.	-16 dBm	-26 dBm
Receive Output	+7 dBm	-3 dBm

It is highly recommended that you keep your modems set to the standard alignment and make any required adjustments by changing the attenuator pads on the termination cards. This allows you to standardize on your modem settings and use common modems for spares, without having to re-set levels when changing modems.

Test Tone Level

The test tone level is the level used when the modems are aligned. Modems must not be operated at test tone level for any purpose other than testing. Operating at test tone level will cause distortion in the modems, cross-talk, and possibly microwave system over-deviation.

Operating Level

The operating level is set to 10 dB below test tone level to keep the signal out of distortion, prevent cross-talk and prevent over-deviation. Do not run the system at less than 10 dB below test tone level. Lower levels will result in degraded signal to noise ratio and will cause reduced performance.

EXB Module Phone Line Level Setting

Transmit: If you are using standard STARPLEX modems and terminations, set the transmit level on the EXB module to -16 dBm (Option A switch position 7 down). The standard TX attenuator pad in the STARPLEX termination board is 10 dB. This combination provides the standard -26 dBm level on the 4-wire TX input to the modem itself.

Receive: For optimum performance, the receive level at the 4-wire input to the EXB must be between -26 dBm and -16 dBm, with a -20 to -16 dBm level preferred. Using STARPLEX modems that have been set up for standard levels, you will need a 13 dB Receive attenuator pad in the termination card.

Warning:
Do not let the receive level into the EXB module exceed -16 dBm.
Receive levels higher than -16 dBm will result in improper operation.

The transmit and receive signal levels can be measured on the backplane of the STARPLEX system, where the EXB-TELCO module's 4-wire lines connect to the STARPLEX termination card's transmit and receive lines. Refer to Appendix A for a pinout of the EXB-TELCO module's 4-wire interface (on the line connector).

EXB Module Switch Settings

The EXB-TELCO modules are configured as follows:

Option A Switch	Originate EXB Module	Answer EXB Module
1	Down Originate	Up Answer
2	Down Leased Line	Down Leased Line
3	Up Reserved	Up Reserved
4	Up Reserved	Up Reserved
5	Up Reserved	Up Reserved
6	Down EXB #1 (Originate)	Up EXB #2 (Answer)
7	Down -16 dBm TX Level	Down -16 dBm TX Level
8	Down 4-Wire Mode	Down 4-Wire Mode

STARPLEX Termination Card Jumpering

Set the Transmit and Receive attenuator pads on the STARPLEX termination cards to the loss shown above. Make sure that the proper jumpers are installed in the termination cards to include the pads in the signal path and select the resistors for the proper attenuation. The termination card's user manual includes a list of attenuation values and the resistor values used to reach the attenuation.

Appendix E FCC Notices

1. The Federal Communications Commission (FCC) has established Rules which permit this device to be directly connected to the telephone network. Standardized jacks are used for these connections. This equipment should not be used on party lines or coin lines.
2. If this device is malfunctioning, it may also be causing harm to the telephone network; this device should be disconnected until the source of the problem can be determined and until repair has been made. If this is not done, the telephone company may temporarily disconnect service.
3. The telephone company may make changes in its technical operations and procedures; if such changes affect the compatibility or use of this device, the telephone company is required to give adequate notice of the changes. You will be advised of your right to file a complaint with the FCC.
4. If the telephone company requests information on what equipment is connected to their lines, inform them of:
 - a. The telephone number this unit is connected to
 - b. The ringer equivalence number
 - c. The USOC jack required
 - d. The FCC Registration number

Items 'b' and 'd' are indicated on the label.

The Ringer Equivalence Number (REN) is used to determine how many devices can be connected to your telephone line. In most areas, the sum of the RENs of all devices on any one line should not exceed five (5.0). If too many devices are attached, they may not ring properly.

WARNING: This device must only be attached to a private line using a JM8 connector

Service Requirements:

In the event of equipment malfunction, all repairs should be performed by CTI Products, Inc. It is the responsibility of users requiring service to report the need for service to CTI Products, Inc. Service can be obtained at:

CTI Products, Inc.
1211 W. Sharon Rd. Phone: (513) 595-5900
Cincinnati, Ohio 45240 Fax: (513) 595-5983

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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

Appendix F: Industry Canada (IC) Notices:

EQUIPMENT ATTACHMENT LIMITATIONS

- NOTICE: The Canadian Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.
- Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.
- Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.
- Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

The **Load Number (LN)** assigned to each terminal device denotes the percentage of the total load to be connected to a telephone loop which is used by the device, to prevent overloading. The termination on a loop may consist of any combination of devices subject only to the requirement that the total of the Load Numbers of all the devices does not exceed 100.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

CAUTIONS:

- Never install telephone wiring during a lightning storm.
- Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
- Never touch uninsulated telephone wiring or terminals unless the telephone line has been disconnected at the network interface.
- Use caution when installing or modifying telephone lines.