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Installation Guide

Digi EPC/X (AccelePort)
Cluster Controller System

EPC/CON-16 Concentrator

90027400 Rev E

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Approvals and Notices

Federal Communications Commission (FCC) Statement

Radio Frequency Interference (RFI) **(FCC 15.105)**

This equipment has been tested and found to comply with the limits for Class A digital devices pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential 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. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Labeling Requirements **(FCC 15.19)**

This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Modifications **(FCC 15.21)**

Changes or modifications to this equipment not expressly approved by Digi may void the user's authority to operate this equipment.

Cables **(FCC 15.27)**

Shielded cables *must* be used to remain within the Class A limitations.

Industry Canada Compliance Statement

This Class A digital apparatus meets the 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.

European Union EMC Directive

This product has been tested and found to comply with the following European Union standards:

- EN 55022 Class A
- EN 50082-1

Safety

This product complies with the following safety standards:

- UL 1950
- CSA 22.2 No. 950
- EN 60950

Notes

Introduction

The Digi EPC/X System

The Digi EPC/X system is a cluster controller system consisting of two major subsystems: the EPC/X host adapter, which plugs into a slot in your computer's interface bus, and one or more EPC/CON-16 or C/CON-16 concentrators, which are connected to the host adapter via a high-speed EIA-422 synchronous serial interface. Each host adapter has two EIA-422 synchronous serial ports, and each concentrator is equipped with sixteen EIA-232 asynchronous serial ports. Depending upon the operating system and device driver software, up to fourteen concentrators can be connected to each host adapter (eight on one synchronous line and six on the other, or seven on each), and up to seven host adapters can be installed in a system.

The Digi EPC/X system is also known as the Digi AccelePort EPC/X system. In AccelePort systems, the concentrators are known as AccelePort EPC/CON-16. The EPC/X system and AccelePort EPC/X systems are functionally identical.

Accessories

EPC/CON concentrators are shipped with these accessories:

- Daisy chain cable (see pages 11 and 55)
- Terminator plug (see pages 8 and 55)
- Diagnostic loopback plug (see pages 43 and 55)

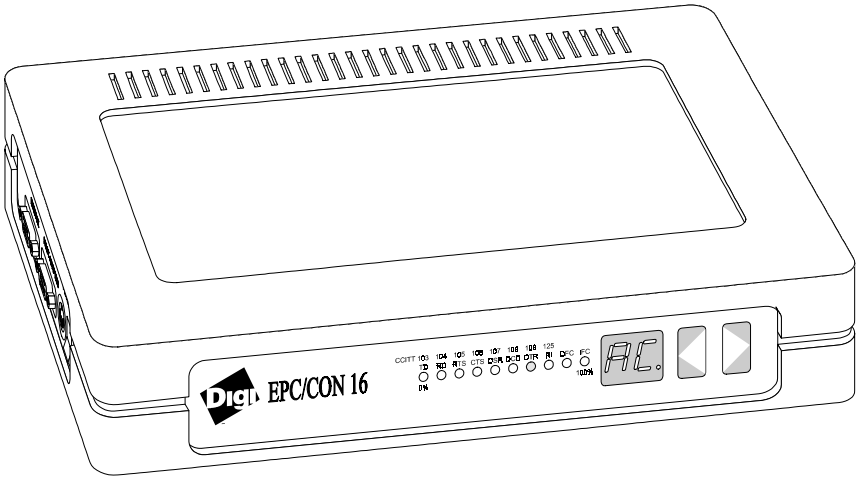
EPC/CON-16 Concentrators

The Digi EPC/CON-16 concentrator is a complete subsystem with its own 20 MHz R3051 RISC microprocessor, 1 megabyte of RAM and 128K bytes of EPROM (expandable to 256K), sixteen 16C550-compatible UARTs for the sixteen EIA-232 asynchronous serial ports, and a high-speed synchronous EIA-422 port for communication with the host adapter and other concentrators. The EPC/CON-16 also features an External Bus Interface (EBI) port to allow up to three Digi PORTS/16em, PORTS/8em or PORTS/8emp modules to be attached to the EPC/CON-16, expanding the number of ports to as many as 64. The concentrators receive packets of data from the host adapter at data rates of up to 10 megabaud, then distribute the data, as appropriate, to the asynchronous EIA-232 ports. Data received by the EIA-232 ports is similarly packetized and sent to the host adapter over the high-speed synchronous line. The EIA-232 ports operate at data rates of up to 115,200 baud. Multiple concentrators may be daisy chained together, and with standard wiring, concentrators may range up to 300 meters (1000 feet) from the host adapter .

By using high-speed synchronous modems, remote concentrators may be located virtually anywhere in the world.

The EPC/CON-16 concentrator features a front panel which is comprised of two push-button switches, ten LED indicators and two seven-segment LED displays. The LED indicators can be used to reflect the activity of each of the EIA-232 lines and flow control status for a given channel. They can also be set to act as a bar-graph to show CPU utilization and the activity level of the EIA-422 synchronous channel. The seven-segment LED displays indicate which channel is currently selected, the various operating modes, or diagnostic information.

Figure 1 EPC/CON-16 Concentrator


EPC/CON 16

Surge Protection

Digi concentrators are equipped with surge protection circuitry to prevent damage to the concentrators in the case of transients or other fluctuations on the serial interface lines.

In extreme cases (for example, where a ground loop is experienced), the synchronous lines can be totally isolated by the use of the Digi C/X-FL fiber optic link option. Optical fiber is impervious to electrical noise, ground loops, etc. The C/X-FL option also permits synchronous cable runs of up to 2000 meters (1.2 miles). Note that the C/X-FL supports only data rates of 1.2 megabaud and 10 megabaud, and is therefore not recommended for use with remote concentrators connected to the host adapter via synchronous modems.

Fault Tolerance

EPC/CON-16 concentrators are assigned *physical* node numbers (set by the operator during installation—see page 20). The node number is used by the host adapter to route data to and from a specific concentrator. If a particular concentrator is turned off or removed from the daisy chain, the sixteen channels on that concentrator become unavailable to the system, but the rest of the system remains unaffected. Since the EPC/CON-16 concentrator's "Host Adapter" and "Remote" ports are of opposite gender, a concentrator can be removed from the middle of a daisy chain by plugging the cables together so that the chain remains unbroken. To remove the last concentrator, simply plug the terminator plug into the end of the daisy chain cable.

Mixing C/CON and EPC/CON Concentrators

C/CON-16 and/or C/CON-8 concentrators may be installed on the same synchronous line with EPC/CON-16 concentrators. It should be noted, however, that when combining C/CON and EPC/CON concentrators, the maximum synchronous data rate is 1.2 megabaud (the C/CON concentrator's top speed) for all concentrators on that synchronous line, including any EPC/CON-16 concentrators.

It should also be noted that there are two versions of the C/CON-16 concentrator—newer versions have a plastic case and feature surge protection and fault tolerance circuitry like that in the EPC/CON-16. C/CON-8 concentrators and the newer C/CON-16 concentrators also use *physical* node numbers, as do EPC/CON-16 concentrators.

Earlier versions of the C/CON-16 concentrator (identifiable by their metal case) are assigned sequential *logical* node numbers (beginning with Node 1) by the operating software each time the system is booted up. Removal of an older concentrator from the daisy chain changes the node numbers of the remaining concentrators (and consequently their port names).

If an older version of the C/CON-16 concentrator is turned off or fails, the daisy chain is broken, and the entire system fails. Newer concentrators can be turned off, and data will still pass through to other concentrators. C/CON-8 and newer C/CON-16 concentrators can also be removed from the daisy chain in the same way as EPC/CON-16 concentrators (see Fault Tolerance, on page 5).

Installation

Installation of the EPC/X system consists of installing and configuring the host adapter in your computer, connecting the EPC/CON-16 concentrator(s) and installing the device driver software. This manual covers the EPC/CON-16 concentrator installation—installation of the host adapter and device driver software are described in separate manuals.

The EPC/X host adapter has two identical EIA-422 synchronous serial interface ports to which a number of concentrators may be connected. Current versions of Digi's device driver software support up to eight concentrators per host adapter, which may be distributed in any combination between the two EIA-422 ports.

Multiple concentrators are connected to a single EIA-422 line in *daisy chain* fashion—that is, the first concentrator is connected directly to one of the host adapter's EIA-422 lines, the second concentrator is connected to the first, and so on.

EPC/CON-16 concentrators can be connected to the EPC/X host adapter, and to each other, in a variety of ways, including twisted pair cable, fiber optics, synchronous modems, and combinations of these methods.

For local applications, where the work groups will not be located more than 300 meters (1000 feet) from the host computer, EPC/CON-16 concentrators can be connected to a host adapter via four or eight-conductor twisted pair cable. With the eight-conductor cable, data is transferred between concentrators and the host adapter at rates of up to 10 megabaud. With four-wire cable, the maximum synchronous data rate is 1.8 megabaud. In most cases, when the concentrators are used to connect terminals and printers, the reduced synchronous data rate on a four-wire cable will not affect the performance of the system. For moderate to heavy loads, however, the eight-wire connection is recommended.

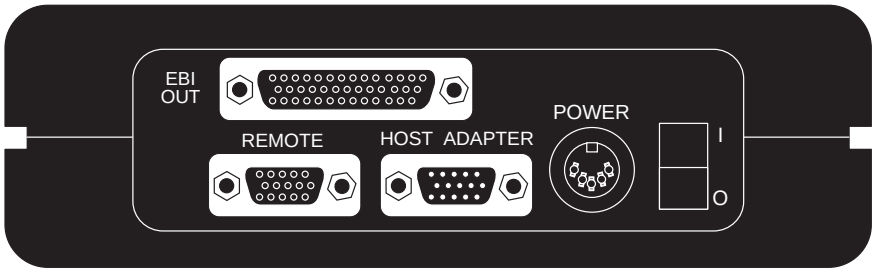
See *Restrictions on Cable Lengths*, on page 15, for information on maximum data rates for various cable lengths.

When concentrators must be located more than 1000 feet from the host adapter, a fiber optic link option, the Digi C/X-FL option, is available. With the C/X-FL option, concentrators may be located up to 2000 meters (1.2 miles) from the host adapter or other concentrators. Note that the C/X-FL supports only the 1.2 and

10 megabaud rates, and is therefore not recommended for use with remote concentrators connected to the host adapter via synchronous modems.

Still greater distances can be achieved by using high-speed synchronous modems between the host adapter and concentrators. By using modems, a remote concentrator can be located anywhere in the world where there is phone service.

Figure 2 EPC/CON-16 EIA-422, EBI and Power Connectors



Termination

Concentrators always receive input data via their "Host Adapter" ports, and always transmit output data from their "Remote" ports. When multiple concentrators are daisy chained together, data travels in a circular fashion—thus, if there are four concentrators connected to a Host Adapter synchronous port, data from the Host Adapter to concentrator #4 must pass through concentrators #1, #2 and #3 before reaching concentrator #4. At the same time, data from concentrator #1 to the host adapter must travel the full circle through concentrators #2, #3 and #4 before being returned to the host adapter (see the flow diagram in Figure 3, on page 9).

To make the loop complete, a *terminator plug* must be installed on the "Remote" port of the *last* concentrator in the daisy chain (see Figures 3 and 4, on page 9). This plug ties all of the "Remote" port's output signals back to their corresponding input signals (TxD to RxD, TxC to RxC, RTS to CTS, etc). The concentrator's "Remote" port *input* signals are hard-wired to its "Host Adapter" port *output* signals, so once any concentrator's output data reaches the terminator plug on the last concentrator, it is passed back through all of the concentrators until it is ultimately received by the host adapter. Note that if only one concentrator is installed, it is by default the last one, and needs to have a terminator plug installed.

Figure 3 Data Flow Between Host Adapter and Concentrators

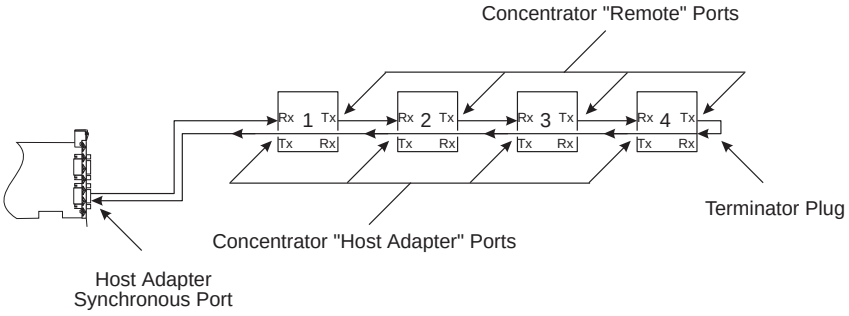
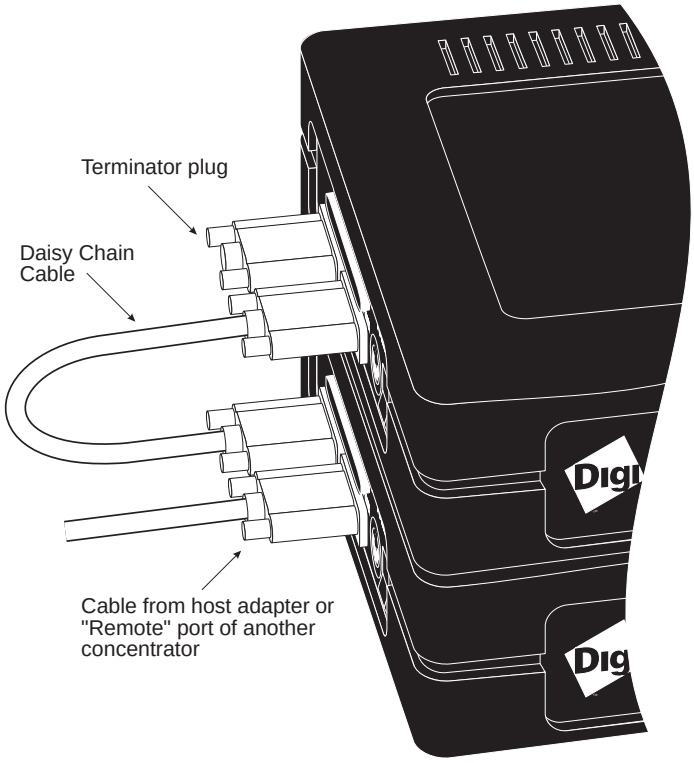


Figure 4 Terminator Plug Installed

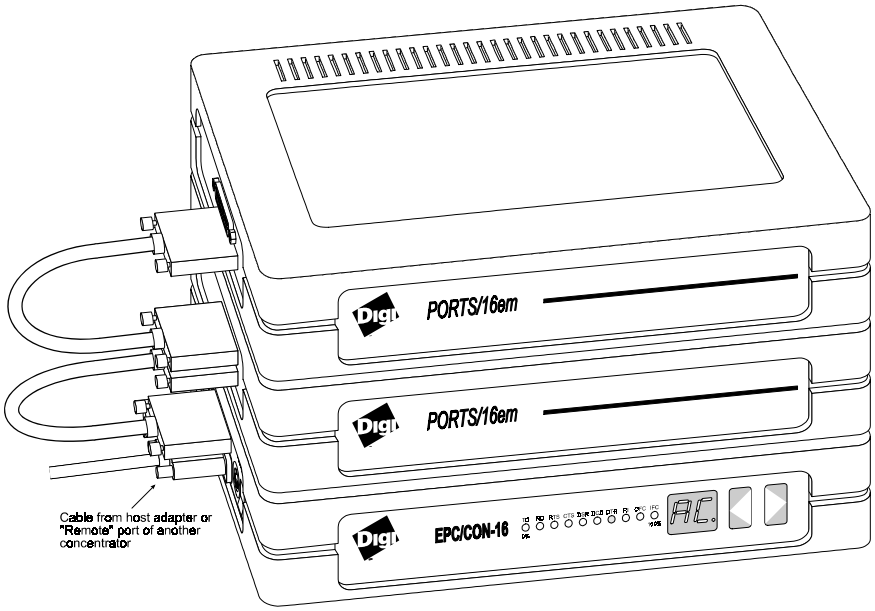


The EBI (External Bus Interface) Port

The EPC/CON-16 concentrator features an External Bus Interface port (labeled "EBI Out") which permits up to three PORTS/16em, PORTS/8em or PORTS/8emp modules to be connected to the concentrator. With three PORTS/16em modules installed, the EPC/CON-16 effectively becomes a 64-port concentrator.

To connect PORTS modules to the EPC/CON-16 concentrator, connect the "EBI Out" port of the concentrator to the "EBI In" port of the PORTS module (use the short cable provided with the PORTS module). Additional PORTS modules can be connected in the same way, as shown in Figure 5, below:

Figure 5 EPC/CON-16 Concentrator with Two PORTS/16em Modules



Important! Power must be OFF when connecting or disconnecting PORTS modules.

Connecting the Concentrators to the Host Adapter

A single EPC/X host adapter can have up to fourteen concentrators (including PORTS modules) attached to it, and most Digi device driver software supports up to seven host adapters per system.

To connect an EPC/CON-16 concentrator to the host adapter, use the daisy chain cable furnished with the concentrator, or build your own custom cable. The cable should be a shielded twisted pair cable, terminated with HD-15 (high-density DB-15) connectors, one male and one female, and wired as shown in Figures 8 or 9 on the following pages. The shield should be connected to the connector shell at both ends.

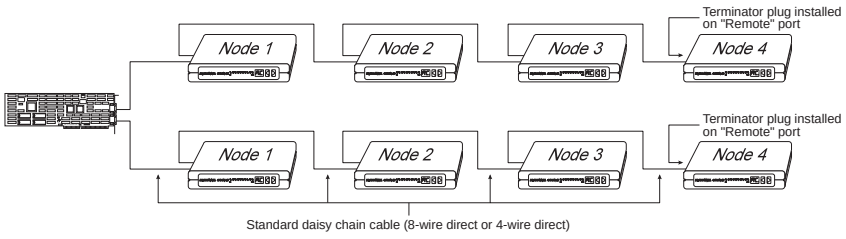
Important! Do not connect wires to pins 12 or 13 in a standard daisy chain cable—serious damage could result.

Never use VGA extension cables or any other cable that has all 15 pins wired.

Connect the male end of the cable to one of the Host Adapter synchronous line connectors (if only one Host Adapter synchronous line is to be used, it must be Line 1—the bottom connector), and connect the female end of the cable to the concentrator port marked “Host Adapter”.

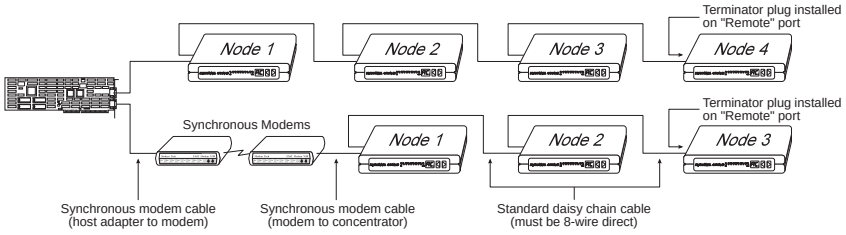
The same cable configuration should be used for interconnecting (daisy chaining) multiple concentrators. Connect the male end of the cable to the port marked “Remote” on the first concentrator and the female end to the “Host Adapter” port on the second, and so on (up to eight concentrators can be daisy chained in this fashion). Be sure to install a terminator plug on the “Remote” port of the last concentrator in the chain (see *Termination*, on page 8).

Figure 6 Eight Concentrators Connected Locally



To connect a concentrator to the host adapter via modems, use the cables shown in Figures 10 or 11 (pages 16 and 17), depending upon your modem type (EIA-232 or EIA-422). Connect additional concentrators with Eight-Wire Direct cables (or the standard daisy chain cables shipped with the unit). Be sure to install the terminator plug on the "Remote" port of the last concentrator.

Figure 7 Local and Remote Concentrators

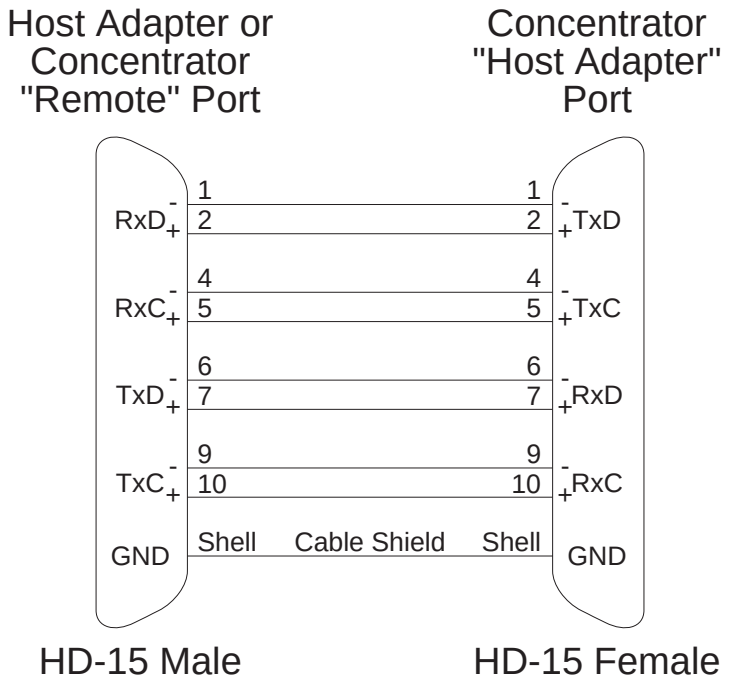


There are three basic wiring modes for connecting concentrators to a host adapter or to each other: Eight-Wire Direct; Four-Wire Direct (also called Four-Wire Self-Clocking) and Eight-Wire Synchronous Modem (or Eight-Wire Externally Clocked).

Eight-Wire Direct Wiring

Eight-Wire Direct is the standard method for connecting concentrators to Host Adapter synchronous lines, and to other concentrators. It provides transmit and receive data signals plus discrete clock signals for transmit and receive data. This permits synchronous data rates of up to 10 megabaud (see Table 1 on page 15 for restrictions on cable lengths), which results in the maximum data throughput under moderate to heavy loads. The synchronous cables provided with the concentrators are Eight-Wire Direct cables. The Eight-Wire Direct cable is a twisted pair cable with a male HD-15 (high-density DB-15) connector at one end and a female HD-15 at the other end. The cable should be shielded, and the shield must be connected to the HD-15 connector shell at both ends.

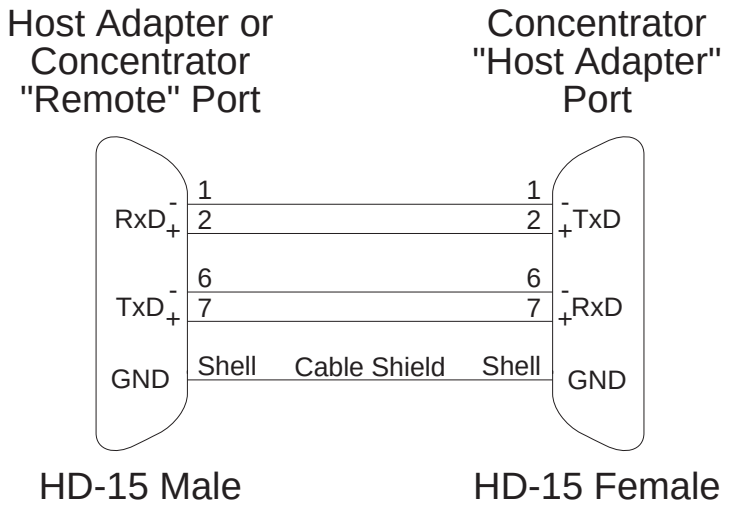
Figure 8 Eight-Wire Direct Daisy Chain Cable Wiring



Four-Wire Direct Wiring

Four-Wire Direct wiring can be used to connect concentrators where longer synchronous cable runs are necessary. While not as fast as Eight-Wire connections (the maximum data transfer rate is 1.8 megabaud—see Table 1 on page 15 for restrictions on cable lengths), this wiring method is more economical, and is sufficient in all but the most demanding high-performance applications (terminal users should see no degradation in performance). In the Four-Wire Direct wiring mode, the clock signals are encoded with the receive and transmit data signals, so only two twisted pairs are required. The Four-Wire Direct cable is a twisted pair cable with a male HD-15 (high-density DB-15) connector at one end and a female HD-15 at the other end. The cable should be shielded, and the shield must be connected to the HD-15 connector shell at both ends.

Figure 9 Four-Wire Direct Daisy Chain Cable Wiring



Restrictions on Daisy Chain Cable Lengths

The maximum length of a daisy chain is dependent upon the synchronous data rate. Table 1, below, lists the maximum *cumulative* daisy chain cable lengths for various baud rates. For example, to run a synchronous line at 10 megabaud, the total length of all daisy chain cables for that synchronous line may not exceed 30 feet. Thus, a single concentrator could be placed 30 feet from the host adapter, or six concentrators could be spaced at 5 foot intervals and still operate at 10 megabaud.

Table 1 Daisy Chain Cable Length vs. Baud Rate

Baud Rate	**Maximum Cable Length** (24AWG Twisted Pair, 12 pF/foot)
0 - 460K	2000 feet
0 - 1.2M	1000 feet
0 - 2.5M	300 feet
0 - 5M	120 feet
0 - 10M	30 feet

These figures represent our maximum *recommended* configurations, and are intended for general guidelines only. Configurations above our recommendations may be used, but be aware that loss of data integrity and possible hardware failures may occur, depending on your particular operating environment.

Eight-Wire Synchronous Modem Wiring

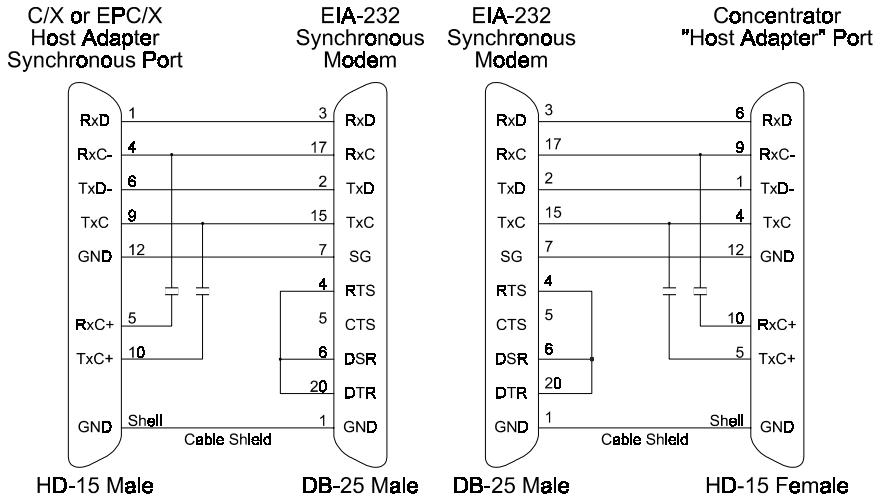
Eight-Wire Synchronous Modem wiring allows concentrators to be installed in remote locations and connected to the host adapter via EIA-232 or EIA-422 synchronous modems, DSUs/CSUs, frame relay adapters, fractional T1s or ISDN terminal adapters.

The EPC/X host adapter and the EPC/CON-16 concentrator have been designed so that the synchronous ports can support either EIA-422 or EIA-232 line levels. To connect host adapters and concentrators to EIA-232 synchronous modems, use the special cables shown in the diagram below.

Note that only the negative lead for each EIA-422 signal is used in this configuration. The positive lead is left “floating”.

Four 2200 pF capacitors (X7R 50V type) are required—two for the host adapter, and two for the concentrator. Install the capacitors between the positive and negative leads of the TxC and RxC signals on the back of the HD-15 connectors, as shown below.

Figure 10 EIA-232 Synchronous Modem Cables

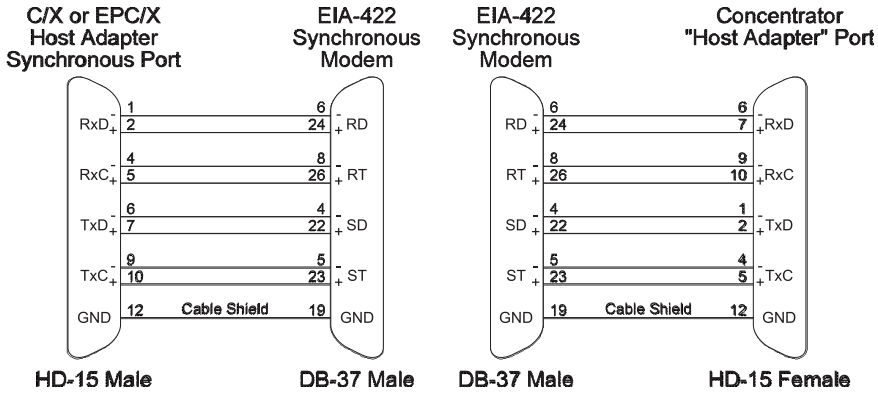


These cables may be purchased ready-made from your Digi supplier. The part numbers are 76000211 for the host adapter to EIA-232 modem cable, and 76000212 for the EIA-232 modem to concentrator cable.

Note: The EIA-232 wiring feature is not supported by device driver software released prior to 9/1/92. Older releases support only EIA-422 wiring.

EIA-422 synchronous modems can also be used with the EPC/X system. The required cables are shown below.

Figure 11 EIA-422 Synchronous Modem Cables



The EIA-422 Synchronous Modem cables are twisted pair cables, each having an HD-15 (high-density DB-15) connector at one end and a DB-37 connector at the other end. The cable should be shielded, and the shield must be connected as shown in the above diagram.

These cables may be purchased ready-made from your Digi supplier. The part numbers are 76000213 for the host adapter to EIA-422 modem cable, and 76000214 for the EIA-422 modem to concentrator cable.

V.35 Wiring

V.35 wiring allows concentrators to be installed in remote locations and connected to the host adapter via V.35 DSUs/CSUs, frame relay adapters, fractional T1s or ISDN terminal adapters.

To connect host adapters and concentrators to V.35 devices, use the special cables shown in the diagram below.

Figure 12 V.35 Synchronous Cables (Winchester Connectors)

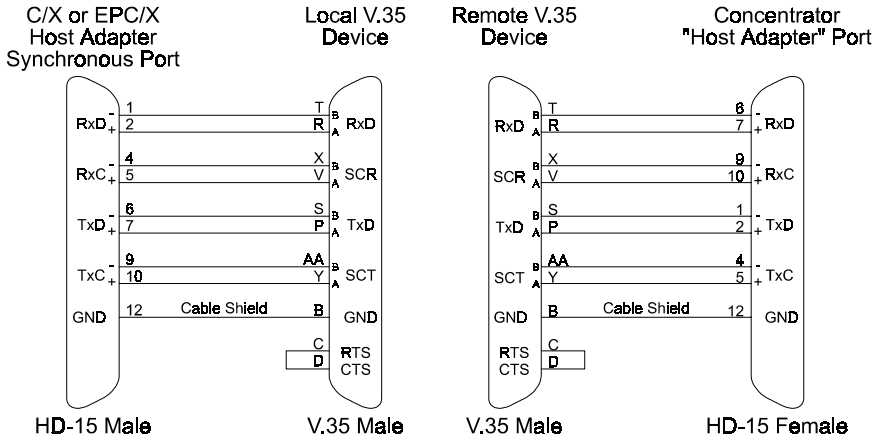
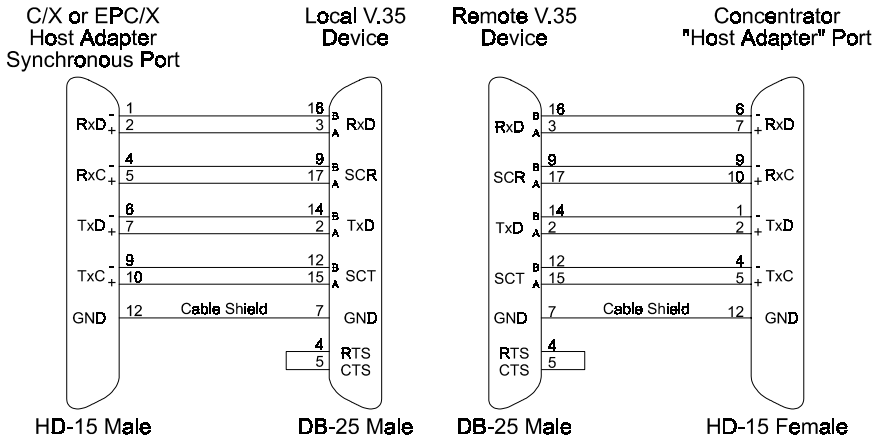


Figure 13 V.35 Synchronous Cables (DB-25 Connectors)



Connecting the Power Supply

The EPC/CON-16 concentrator requires an external power supply. A universal 50/60 Hz, 90 to 270 volt switching power supply (Digi part number 10000985) is provided.

1. Make sure the Power switch on the concentrator is in the OFF ("O") position.
2. Plug the AC connector of the power supply into a standard wall outlet. Plug the DIN connector into the receptacle labeled "Power" on the concentrator.
3. Turn the concentrator's Power switch to the ON ("I") position. The lights on the front panel should flash as the concentrator executes its Power-On Self Test (POST) sequence, and the seven-segment LED display will eventually display "**P1**" to indicate that the POST sequence passed.

   (If you have already connected the concentrator to a host adapter and installed the device driver software, the display will show "**AC**" to indicate that it is on-line and has received instructions from the host adapter.)

Important! DO NOT stack power supplies on top of each other! This can lead to thermal damage to the power supply. Place power supply at least 4 inches from other power supplies or heat sources. In a forced cooling environment (30 CFM minimum), power supplies may be placed 2 inches apart.

Configuration

Node Numbers

The host adapter identifies EPC/CON-16 concentrators by their *node numbers*. Each concentrator in a daisy chain must have a unique node number, which must be set during installation. The node numbers must be assigned in ascending order with the lowest number assigned to the concentrator closest to the host adapter. It is permissible to skip node numbers (to facilitate insertion of additional concentrators at a later date), as long as the ascending sequence is maintained.

Setting the Node Number

Turn the concentrator on and wait for the POST (Power On Self Test) sequence to complete. This will take about 30 seconds. When "**P1**" is displayed on the front panel 7-segment LED display, press the right-hand button once. The current node number will be displayed ("**1n**", for Node 1, if the concentrator has just been unpacked). Press the left-hand button to advance the node number through the eight possible settings (**1n-8n**). Once "**8n**" has been reached, the numbers start over at "**1n**". When the desired node number is displayed, press the right-hand button again to select the number. The display should now read "**Pn**" (indicating a "pass" condition). If there was an error, the display will read "**Fn**".

If you are adding concentrators to an existing system which has an older version of the EPC/CON-16 (these have a metal case), the node numbers of the new concentrators must begin with a number that is greater than the total number of older concentrators connected to that EIA-422 synchronous line.

In the case of duplicate node numbers, the concentrator farther from the host adapter will display "**En**", instead of "**AC**" when the system is booted up.

Important!

Remote Concentrators

When setting up remote concentrators, the node number of the *last* concentrator on a sync line must be the same as the total number of concentrators that will be configured in the device driver software for that line. This is because the clocking mode for the last concentrator is set by the device driver software for synchronous modem clocking. If the device driver has been configured for six concentrators on a sync line, the node number of the last concentrator must be set to 6, regardless of the actual number of concentrators that are physically present on that line.

Similarly, fault tolerance is not effective if the last concentrator of a remote string fails, because the software only programs that concentrator, by its node number, for synchronous modem clocking. The other concentrators are all set for regular (8-wire direct) clocking. If the last concentrator in a remote string fails or is removed for any reason, you must either reconfigure the device driver software for one less concentrator, or change the node number of the next to last concentrator to the number of the concentrator that was removed. If you change a concentrator's node number, be sure to reboot the concentrator (power off and then on) so that the host system can reinitialize it properly.

Remote concentrators must all be of one type: either all older (metal case) or all newer (plastic case) concentrators.

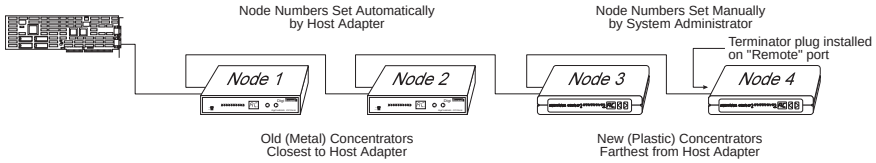
Adding Concentrators to an Existing C/X System

While EPC/CON-16 concentrators perform best when attached to the EPC/X host adapter, they can also be installed in existing C/X systems with the standard C/X host adapter. When connected to a standard C/X host adapter, their performance is equivalent to the C/CON-16 concentrator.

EPC/CON-16 concentrators can be installed in systems comprised of older C/CON-16 concentrators (which have a metal case). When mixing old and new concentrators the old concentrators must be electrically closest to the host adapter, and the new concentrators must follow the old ones. This is because the old concentrators are assigned node numbers by the host, each time the software is booted. The first concentrator in the daisy chain is always Node 1, the second is always Node 2, etc. EPC/CON-16 and newer C/CON-16 concentrators' node numbers are assigned during installation (see page 20), and remain fixed until changed via the front panel.

Also remember to remove the terminating jumpers (or set the "LAST/INLINE" switch to "INLINE") from the last old-style concentrator when installing additional concentrators in a daisy chain.

Figure 14 Mixed Older and Newer Concentrators



Note: When connecting concentrators to the host adapter via synchronous modems, all concentrators must be of one type—either all newer or all older concentrators.

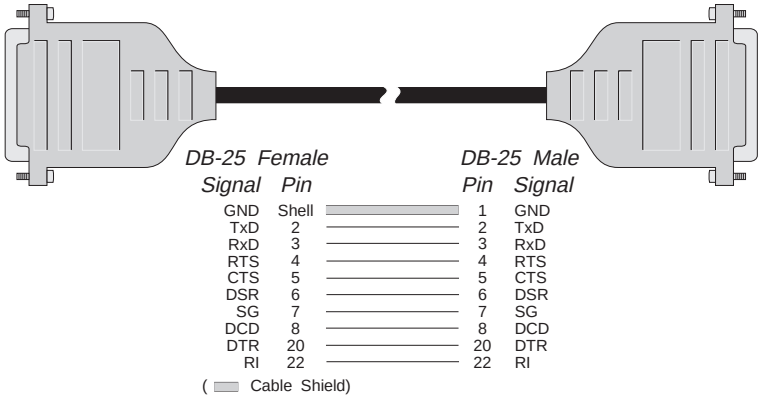
Important! The last EPC/CON-16 concentrator in a daisy chain must have a terminator plug installed on its "Remote" port. Individual concentrators are not shipped with terminator plugs (terminator plugs are shipped with EPC/X host adapters only). To obtain a terminator plug, free of charge, contact Digi Technical Support. See the Support Services section in the back of this book for phone numbers.

Connecting Peripherals

Connecting to a Modem

DB-25 Equipped Concentrators

Figure 15 **DB-25 to DB-25 Modem Cable**



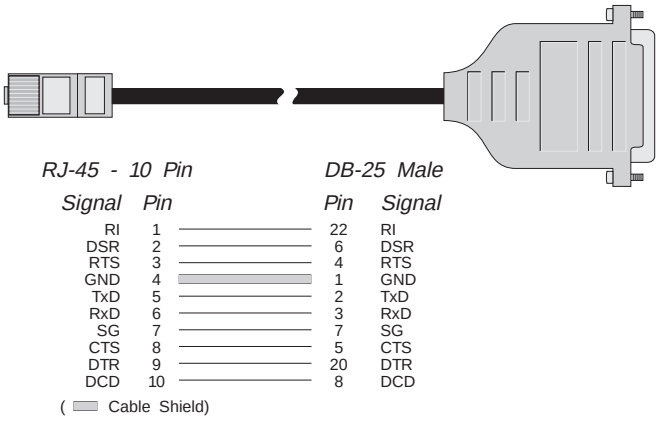
To connect a DB-25 equipped concentrator to a modem, use a standard "straight-through" cable (see Figure 15) to connect the modem to one of the DB-25 connectors on the rear of the concentrator.

Important! Shielded cable must be used to remain in compliance with Part 15 of FCC rules.

RJ-45 Equipped Concentrators

The simplest way to connect a modem to a concentrator with RJ-45 connectors is to use RJ-45 to DB-25 “Cable Legs”, available from Digi (see page 41 for a description and part numbers). These adapters use 10-pin RJ-45 plugs, and therefore provide full modem support (Ring Indicator and Data Carrier Detect are only available on 10-pin RJ-45 connectors).

Figure 16 RJ-45 to DB-25 Modem Cable (10 Wire)



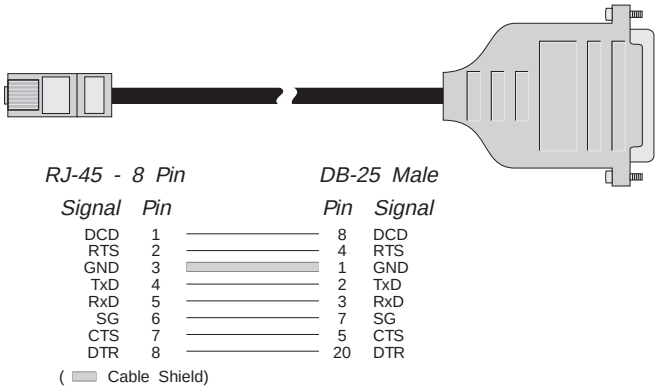
If you wish to build your own modem cable, follow the diagram in Figure 16.

Important! Shielded cable must be used to remain in compliance with Part 15 of FCC rules.

ALTPIN Modem Wiring (RJ-45 Versions)

10-pin RJ-45 plugs may be difficult to obtain in the retail market; therefore, most Digi device driver software incorporates an optional feature called ALTPIN, which swaps the logical functions of DSR (Data Set Ready) with DCD (Data Carrier Detect). When ALTPIN is enabled (see your device driver software reference manual for instructions), DCD becomes available on pin 1 of an 8-pin RJ-45 connector (equivalent to pin 2 of a 10-pin connector).

Figure 17 8-Wire Modem Cable for use with ALTPIN Configuration



If you wish to build an 8-wire modem cable for an RJ-45 equipped board, use an 8-pin RJ-45 plug wired as shown in Figure 17.

Important! Shielded cable must be used to remain in compliance with Part 15 of FCC rules.

Connecting to a DTE Device

A DTE device is a terminal, serial printer, another computer's serial port, etc. To connect the EPC/CON-16 concentrator (which is also a DTE device) to another DTE device, you need a *null modem* cable or adapter.

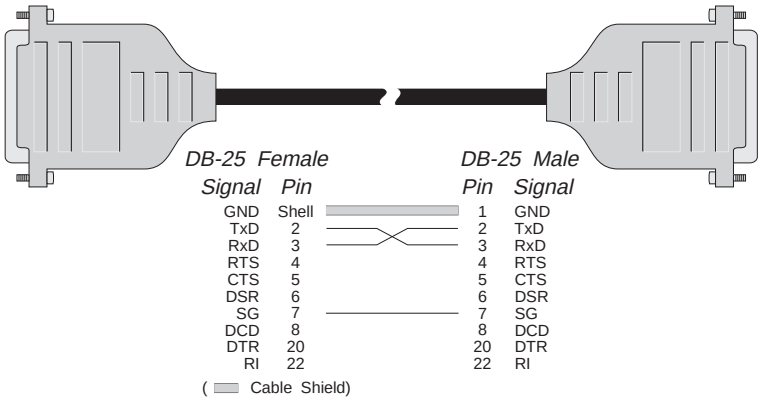
DB-25 Equipped Concentrators

Software Handshaking (XON/XOFF)

In most cases, serial terminals and printers need only a "three-wire" connection to the concentrator. Digi device driver software supports XON/XOFF (software) handshaking, so the only signal lines necessary are Transmitted Data (TxD), Received Data (RxD) and Signal Ground (SG). It may be necessary to disable DCD (Data Carrier Detect) sensing through a software command—see the Digi device driver manual for instructions. Cables must be shielded to remain in compliance with FCC certification requirements, and the shield should be connected to Chassis Ground (GND) at both ends of the cable run.

A simple cable for connecting a terminal or a printer to a DB-25 equipped concentrator is shown in Figure 18.

Figure 18 Simple Terminal/Printer Cable (DB-25)

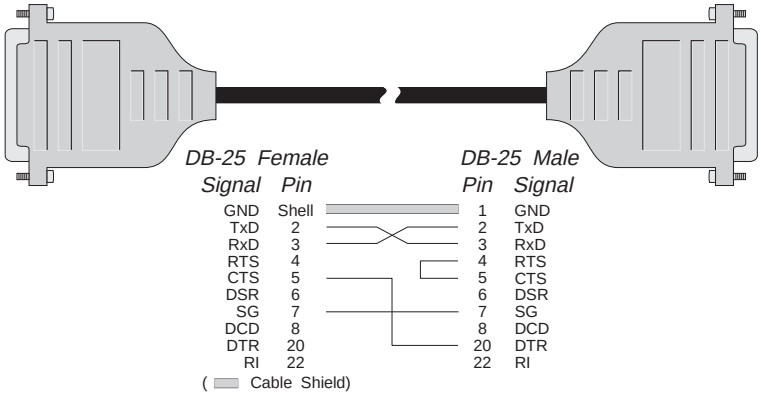


Important! Shielded cable must be used to remain in compliance with Part 15 of FCC rules.

The cable shown in Figure 18 is a three-wire null modem cable—that is, Transmitted Data on one end of the cable is connected to Received Data at the other end, and vice versa.

The male DB-25 end can be plugged directly into most serial terminals and printers without any adapters. The female DB-25 end plugs directly into one of the DB-25 connectors on the rear of the concentrator.

Figure 19 Terminal/Printer Cable with DTR Handshaking (DB-25)



Most terminals and printers use Data Terminal Ready (DTR) for Ready/Busy hardware handshaking. The cable shown in Figure 19 supports this method.

Important! Shielded cable must be used to remain in compliance with Part 15 of FCC rules.

Note: Some Okidata printers use a control signal on pin 11, called Supervisory Send Data (SSD) instead of DTR. In this case, simply connect CTS on the female DB-25 side to pin 11 of the male DB-25, instead of pin 20.

Other printer manufacturers may use different methods of flow control. Consult your printer's documentation for specific wiring requirements.

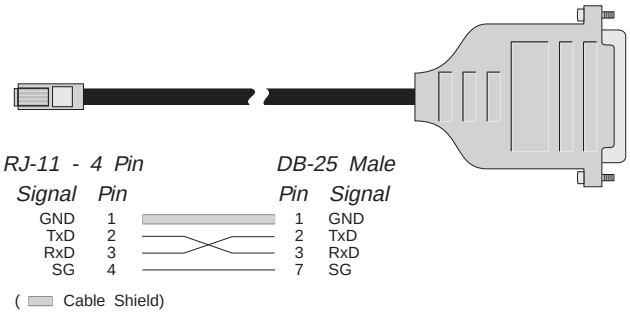
RJ-45 Equipped Concentrators

Software Handshaking (XON/XOFF)

In most cases, serial terminals and printers need only a "three-wire" connection to the concentrator. All Digi device driver software supports XON/XOFF (software) handshaking, so the only signal lines necessary are Transmitted Data (TxD), Received Data (RxD) and Signal Ground (SG). It may be necessary to disable DCD (Data Carrier Detect) sensing through a software command—see your Digi device driver software manual for instructions. Cables must be shielded to remain in compliance with FCC certification requirements, and the shield should be connected to Chassis Ground (GND) at both ends of the cable run.

A simple cable for connecting a terminal or a printer to an RJ-45 equipped concentrator is shown in Figure 20.

Figure 20 Simple Terminal/Printer Cable (RJ-45)

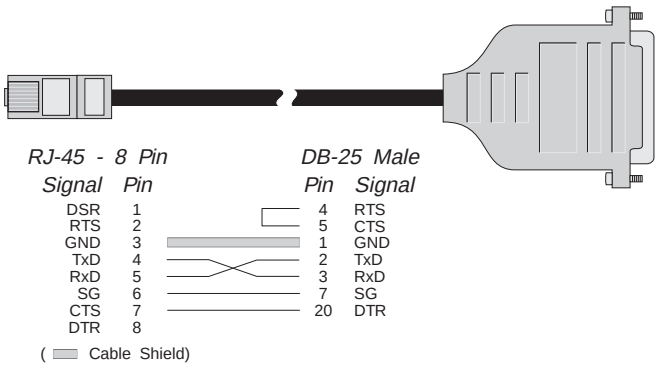


The cable shown is a three-wire null modem cable—that is, Transmitted Data on one end of the cable is connected to Received Data at the other end, and vice versa.

The male DB-25 end can be plugged directly into most serial terminals and printers without any adapters. The RJ-11 plug fits into the center of the RJ-45 jack.

Important! Shielded cable must be used to remain in compliance with Part 15 of FCC rules.

Figure 21 Terminal/Printer Cable with DTR Handshaking (RJ-45)



Most terminals and printers use Data Terminal Ready (DTR) for Ready/Busy hardware handshaking. The cable shown in Figure 21 supports this method.

Important! Shielded cable must be used to remain in compliance with Part 15 of FCC rules.

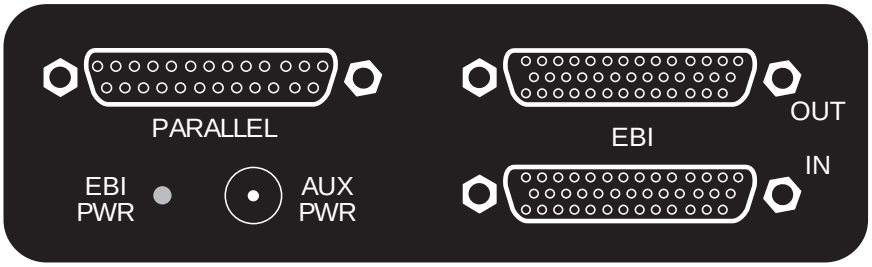
Note: Some Okidata printers use a control signal on pin 11, called Supervisory Send Data (SSD) instead of DTR. In this case, simply connect CTS on the RJ-45 side to pin 11 of the DB-25, instead of pin 20.

Other printer manufacturers may use different methods of flow control. Consult your printer's documentation for specific wiring requirements.

Parallel Printers

The PORTS/8emp EBI module includes a parallel printer port, which is located on the left-hand side of the module (see Figure 22). To connect a parallel printer to the PORTS/8emp module, use a standard PC printer cable with a DB-25 male connector at one end, and a 36 pin Centronics connector at the other end. Printer cables of this type are readily obtainable from any computer store. The recommended maximum cable length is 10 feet; longer cables (up to 25 feet) may work, but are not supported.

Figure 22 PORTS/8emp Parallel Printer Port



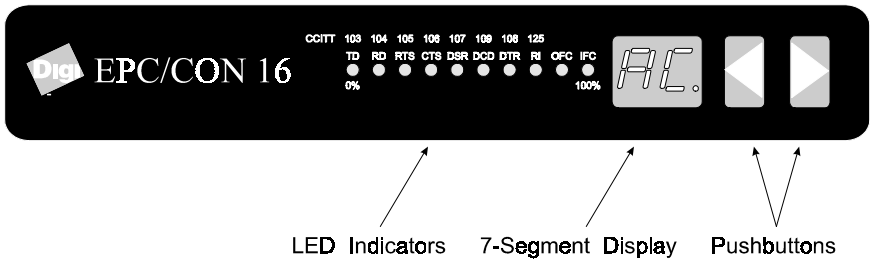
(Left side of PORTS module)

Operation

The EPC/CON-16 control panel is equipped with ten LED indicators, a two-digit 7-segment LED display and two pushbuttons which can be used to monitor various functions of the concentrator.

Normal operation of the EPC/CON-16 involves nothing more than turning on the power. First, "**P0**" is displayed and the POST (Power On Self Test) sequence is run. This takes about 30 seconds. Next, "**P1**" is displayed and the concentrator begins scanning for a ping packet from the host adapter. The DTR, RI and OFC LEDs on the front panel will each be momentarily illuminated as the three different clocking modes (NRZ, NRZI and FM0, respectively) are tried. Once communications have been established with the host adapter, the 7-segment display shows the node number of the concentrator (e.g. "**1n**" if the concentrator is node #1). If a ping packet is not detected within 15 minutes, the concentrator is reset and the above sequence is repeated, except that the OFC LED will remain lit to indicate that the 15 minute timeout occurred.

Figure 23 EPC/CON-16 Front Panel



Display Modes

The EPC/CON-16 concentrator front panel has 22 different display modes. Push the right or left arrow pushbuttons to cycle sequentially through the modes.

Table 2 EPC/CON-16 Display Modes

Mode/Display	Description
AC	**Activity.** "**AC**" appears on the 7-segment display. The ten LEDs turn on sequentially from left to right. The speed of this "chase light" display increases with the overall activity level of the concentrator.
1 - 64	Modes 1 through 64 correspond to channels 1 through 64 (channels 1-16 are on the EPC/CON-16 concentrator; channels 17-64 are on attached EBI modules, if present). Press the right or left pushbuttons until the desired channel number appears in the 7-segment display. The LEDs now become a "line monitor" for the selected channel. The first eight LED indicators show the activity of each of the eight EIA-232 signals (**TD**, **RD**, **RTS**, **CTS**, **DSR**, **DCD**, **DTR** and **RI**). The last two LED indicators show when output flow control (**OFC**) and input flow control (**IFC**) are active. Pressing both pushbuttons simultaneously will release software flow control: If **OFC** is ON, it will be cleared; if **IFC** is OFF, a start character (e.g. XON) will be transmitted. Note: If you are viewing the ninth (parallel) port of a PORTS/8emp module, some of the LEDs have different meanings: **TD** and **RD** still signify transmitted and received data; **CTS**, **DCD** and **RI** correspond to parallel input signals IP0 (ERROR), IP1 (SELECT) and IP2 (FAULT), respectively; **DTR** corresponds to SELECTIN; **OFC** corresponds to OP2 (BUSY).
PC	**Packet Count.** "**PC**" appears on the 7-segment display, and the ten LEDs show a binary representation of the total number of packets transmitted or received. Pressing both pushbuttons simultaneously resets the count to 0.

Mode/Display	Description
EC	**Error Count.** "**EC**" appears on the 7-segment display, and the ten LEDs show a binary representation of the total number of errors counted in the data. Pressing both pushbuttons simultaneously resets the count to 0.
PU	**Processor Utilization.** "**PU**" appears on the 7-segment display, and the ten LEDs become a bar graph indicating the percentage (0-100%) of the time the concentrator's microprocessor is being used.
LU	**Line Utilization.** "**LU**" appears on the 7-segment display, and the ten LEDs become a bar graph indicating the percentage (0-100%) of the time the synchronous communications line is being used.
1n, 2n, 3n ... 8n	**Node Number.** The 7-segment display shows the node number of the concentrator. NOTE—if this concentrator is being run with an older version of the device driver and FEP/OS software, this display mode may not be available. In this case, the node number can still be obtained via the EPC/CON-16 diagnostics (see page 44). The 10 LEDs behave as in the "**AC**" display mode.

Front panel functions are controlled by the downloaded FEP/OS software. Using device driver software released prior to 9/1/92 will result in minor variations in the display—namely, the node number display will not be present, and the "clear" functions in "**EC**", "**PC**" and the channel monitoring modes will not be present.

EIA-232 Cables and Connector Options

The Digi EPC/CON-16 concentrator's sixteen EIA-232 asynchronous serial interface ports are provided via either sixteen DTE-wired male DB-25 connectors (see Figure 24, on page 37), or sixteen RJ-45 modular jacks (see Figure 25, on page 39), located on the rear of the unit.

Note: The information in this section also applies to the serial interfaces on PORTS/16em, PORTS/8em and PORTS/8emp modules.

Cables

EIA-232 serial interface cables should be shielded, low-capacitance cables, ideally designed specifically for serial data transmission.

Grounding

The shield should be grounded at both ends of the cable. Chassis Ground, available on pin 4 of the 10-pin RJ-45 connector, and on pin 1 or the metal shell of the DB-25 connector, is ideal for this purpose.

Environment

While good shielding provides reasonable protection against "noise" (Electro-Magnetic Interference, or EMI), cables should still be routed away from noise sources wherever possible. Avoid laying cables in close proximity to transformers, generators, motors, fluorescent lights, etc.

Capacitance vs. Length of Run

The total capacitance of a cable affects the integrity of transmitted data. As a rule of thumb, the *total* capacitance of a cable (including the connectors) should not exceed 2500 pF. Serial interface cable is usually rated in picofarads per foot. Therefore, if a cable has a capacitance of 50 pF/ft, and the connectors are 100 pF each, the maximum recommended cable length is 46 feet. If the cable is rated at 12.5 pF/ft, the maximum recommended cable length is 184 feet, and 5 pF/ft cable can be run up to 460 feet.

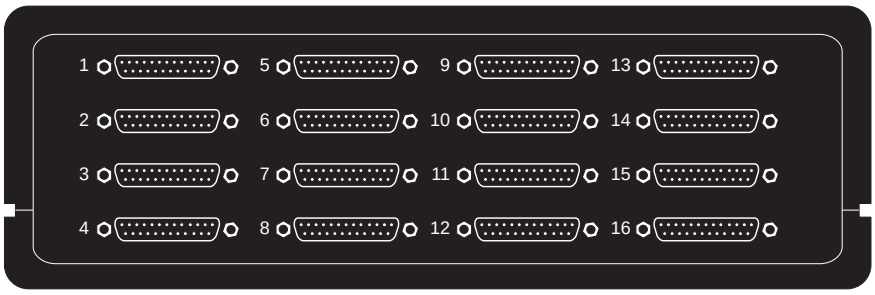
In situations where low-capacitance cable is unavailable, or very long cable runs are required, "short-haul" modems, available from suppliers such as Black Box, can be used to increase the effective range of the EIA-232 interface. Short-haul modems are similar to standard modems, except that they are connected directly to each other via a cable instead of going through a telephone circuit. *NOTE—Externally-powered short-haul modems are recommended.*

Connector Options

The Digi EPC/CON-16 concentrator is available with either DB-25 connectors or 10-pin RJ-45 “modular” connectors.

DB-25 Connectors

Figure 24 EPC/CON-16 Asynchronous Connectors (DB-25 Version)



The DB-25 version of the EPC/CON-16 concentrator is equipped with sixteen male DTE-wired DB-25 connectors. The pin assignments for the DB-25 connectors follow the usual conventions for DTE EIA-232 wiring. See Table 3, on the following page, for the pin assignments.

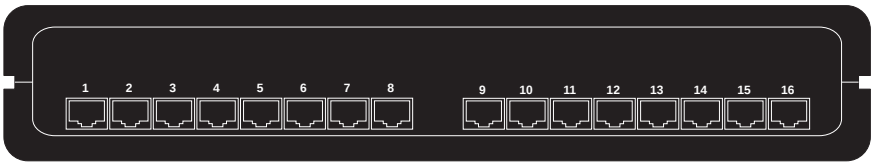
Table 3 DB-25 Connector Pin Assignments

Signal	Description	Pin
GND	Chassis Ground	1*
TxD	Transmitted Data	2
RxD	Received Data	3
RTS	Request to Send	4
CTS	Clear to Send	5
DSR	Data Set Ready	6
SG	Signal Ground	7
DCD	Data Carrier Detect	8
DTR	Data Terminal Ready	20
RI	Ring Indicator	22

*Chassis Ground is also available on the connector shell.

RJ-45 Connectors

Figure 25 EPC/CON-16 Asynchronous Connectors (RJ-45 Version)



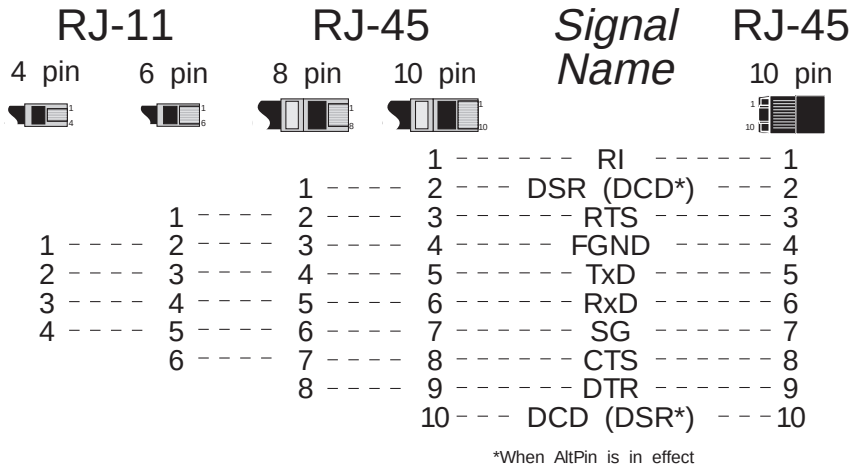
There are four types of modular plugs that can be used with the concentrator's RJ-45 10-pin jack. These are the 4 or 6-pin RJ-11 plugs, and the 8 or 10-pin RJ-45 plugs.

The 8 and 10-pin RJ-45 plugs are the same physical size, but the 10-pin version has one additional wire at each end of the row of contacts. Thus pins 1-8 of an 8-pin RJ-45 directly correspond to pins 2-9 of a 10-pin RJ-45 connector.

Similarly, the two RJ-11 plugs have the same physical dimensions, but the 6-pin version has an extra pin at each end. The RJ-11 plugs are physically smaller than RJ-45 plugs, but are designed so that they fit into the *center* of an RJ-45 jack. In this way, the four pins closest to the center of any size connector will always carry the same signals as the middle four pins of any other connector. The contacts of a 6-pin RJ-11 connector correspond directly to the middle six pins of an 8 or 10-pin RJ-45 connector, and so on.

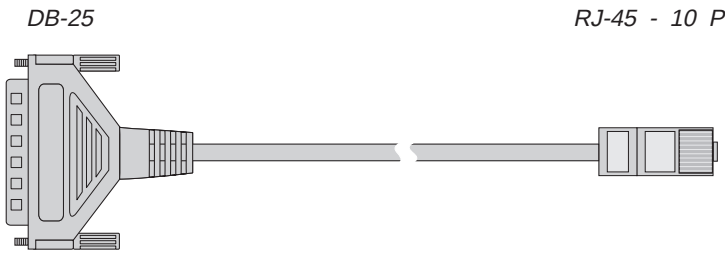
The diagram below illustrates the relationship of the various modular plug configurations to Digi's standard 10-pin RJ-45 jack, and show which EIA-232 signals are available in each configuration.

Figure 26 Correspondence of Different RJ Plugs to RJ-45 Jack



RJ-45 to DB-25 Conversion

Figure 27 **RJ-45 to DB-25 “Cable Leg”**



Pin	*Signal*
Shell	Chassis Ground
2	TxD
3	RxD
4	RTS
5	CTS
6	DSR
7	Signal Ground
8	DCD
20	DTR
22	RI

Pin	*Signal*
1	RI
2	DSR
3	RTS
4	Chassis Ground
5	TxD
6	RxD
7	Signal Ground
8	CTS
9	DTR
10	DCD

Table 4 **Cable Leg Options and Part Numbers**

	DB-25 Male	DB-25 Female	DB-9 Male
24 Inch Cables	61020024	61030024	61070024
48 Inch Cables	61020048	61030048	N/A

Since most EIA-232 devices are equipped with DB-25 connectors, it is necessary to buy or build an adapter to transfer the signals to a DB-25 plug. The most simple and direct approach is to purchase ready-made “Cable Legs” from a Digi dealer or distributor. These are made with a full 10-pin RJ-45 plug (which can be difficult to obtain in the retail market), connected via a two or four foot cable to a DTE-configured DB-25 plug.

The pin configuration of the DB-25 connector on the Cable Leg is identical to that of the DB-25 connectors on the standard Digi DTE octa cable, and provides full modem control.

If you don’t need full modem control, you can use one of the many commercially available RJ-45 to DB-25 adapters. These have both an 8-pin RJ-45 jack and a DB-25 plug in a housing no larger than that found on a standard DB-25 plug. The plug and jack are connected within the housing by jumpers which may be installed by the user in any desired configuration.

Diagnostics

The EPC/CON-16 concentrator features two methods of running its on-board diagnostic programs: Front Panel mode, where the tests are selected and executed by pushing the buttons on the control panel and reading the results on the LED indicators, or Video mode, which permits running the diagnostics from a serial terminal connected to either port 1 or port 16 of the concentrator.

Running Diagnostics from the Front Panel

Note: Disconnect the concentrator from the host adapter and other concentrators before running diagnostic tests.

To run the internal diagnostic programs from the concentrator's front panel, turn the concentrator on and wait for the POST (Power On Self Test) to complete. While "**P1**" is displayed on the front panel, press either button on the control panel.

The first thing you should see is the concentrator's node number. This will be displayed in the form ***x*n**, where *x* is the node number (e.g. **1n**, **2n**, etc.).

If you do not wish to change the node number at this time, press the right-hand button again to proceed to Test 1 without rewriting the node number.

Pressing the right-hand button repeatedly will cycle through all of the test numbers without executing the tests. To execute a test, press the left-hand button while the desired test number is displayed. The left-hand decimal point of the 7-segment display will be turned on to indicate that a test is in progress.

Errors are counted on the ten LED indicators. The error count is a binary number, with the LSB (Least Significant Bit) on the left and the MSB (Most Significant Bit) on the right. Note that in tests 2, 4, 5, 6 and 7, when the test is stopped (by pressing the left-hand button), the error count is replaced by diagnostic information. Write down the status of the LED indicators so the information is available in case you need to contact Digi Technical Support.

To stop running a test in progress, push the left-hand button again. The test will terminate, and the 7-segment display will show the test number preceded by "**P**" (pass) or "**F**" (fail).

To exit diagnostic test mode and return to the initialized state, cycle the concentrator's power off, then on again.

Writing a New Node Number to EEPROM

The concentrator's node number can be changed while the current node number is displayed on the 7-segment display (e.g. **1n**, **2n**, etc.). If you wish to change the node number, press the left-hand button repeatedly until the desired node number appears on the display, then press the right-hand button to save it in EEPROM. If the new node number is successfully written to EEPROM, "**Pn**" will be displayed to indicate a "pass" condition. If the write operation failed, "**Fn**" will be displayed. See *Setting the Node Number* on page 20 for more information about node numbers.

Running Diagnostics from a Serial Terminal

Note: Disconnect the concentrator from the host adapter and other concentrators before running diagnostic tests.

To run the internal diagnostic programs from a serial terminal, turn off the EPC/CON-16 concentrator and connect the terminal to either port 1 or port 16. Set the terminal's communications parameters to 9600 baud, 8 data bits, no parity and 1 stop bit. Now turn the concentrator back on, and wait for the POST (Power On Self Test) to complete. While "**P1**" is displayed on the front panel, press the letter "**V**" (either upper or lower case) on your terminal.

Note: Some terminals (including the Wyse 60) will not transmit data if their CTS (Clear To Send) line is LOW. They will only transmit if CTS is HIGH or floating. When using a fully-configured null modem cable, the terminal's CTS line is connected to the concentrator's RTS (Request To Send) line, which is held LOW by the concentrator until "**AC**" is displayed. This can prevent the terminal from communicating with the concentrator when attempting to run diagnostics.

The solution to this problem is to use a cable that does not have CTS (pin 5 of a DTE-wired DB-25 connector) connected at the terminal's end. The basic terminal cable shown in Figure 20 on page 29 is suitable for this purpose.

You will see the following screen:

```
Digi EPC
  ROM revision: 0x1001
  ROM startup (cold boot)
Instruction cache size: 0x00001000
       Data cache size: 0x00000800
               RAM size: 0x00100000
CPU test............passed
Watchdog test.......passed
ROM checksum test...passed
RAM test............passed
Timer test..........passed
Sync test...........passed
Test EBI 0 UART-4...16 devices passed
EBI 1...............none
EBI 2...............none
EBI 3...............none
Node number.........1
Startup tests done
Press '?' for diagnostics menu
```

The results of the POST (Power On Self Test) sequence are displayed, and the concentrator begins listening for a ping packet from the host adapter. While listening for a ping packet, the EPC/CON-16 cycles through various baud rates and clocking modes as it tries to link up with the host adapter. The following messages will scroll continuously until you press "**?**" to get the diagnostic menu:

```
Listening mode gpp=0x038 mode 15 2400b NRZ ext
...no packet
Listening mode gpp=0x038 mode 60 115kb NRZI clk/16
...no packet
Listening mode gpp=0x038 mode 61 115kb FM0 clk/16
...no packet
Listening mode gpp=0x038 mode 15 2400b NRZ ext
...no packet
Listening mode gpp=0x038 mode 62 230kb NRZI clk/16
...no packet
Listening mode gpp=0x038 mode 63 230kb FM0 clk/16
...no packet
Listening mode gpp=0x038 mode 15 2400b NRZ ext
...no packet
Listening mode gpp=0x038 mode 64 460kb NRZI clk/16
...no packet
Listening mode gpp=0x038 mode 65 460kb FM0 clk/16
...no packet
Listening mode gpp=0x038 mode 15 2400b NRZ ext
...no packet
Listening mode gpp=0x038 mode 66 921kb NRZI clk/16
...no packet
Listening mode gpp=0x038 mode 67 921kb FM0 clk/16
...no packet
Listening mode gpp=0x038 mode 15 2400b NRZ ext
...no packet
Listening mode gpp=0x038 mode 68 1843kb NRZI clk/8
...no packet
Listening mode gpp=0x038 mode 69 1843kb FM0 clk/8
...no packet
```

Press "**?**" to see the diagnostic menu:

```
---DIAGNOSTIC MENU---
A = All tests (except 9)
1 = Front Panel light test
2 = RAM test
3 = Timer test
4 = EBI internal loopback test
5 = EBI external loopback test
6 = Sync internal loopback test
7 = Sync external loopback test
8 = EEPROM test
9 = Watchdog test

N = Set concentrator number (currently 1)
B = Reboot concentrator
d^DD)ump, r^RR)ead, w^WW)rite, f^FF)ill RAM
```

To run individual tests, enter the test number (**1**-**9**). To run all tests (except number 9), enter "**A**".

Tests run continuously. To stop a test, press any key during execution of the test. The current pass of the test will be completed and control will be returned to the terminal.

Pressing "**N**" allows you to change the concentrator's node number.

Pressing "**B**" reboots the concentrator (similar to a power-on reset, but the diagnostic port remains active).

Diagnostic Test Descriptions

Test 1: Front Panel Test

This test activates the ten LED indicators and the two 7-segment displays in four different patterns at 1-second intervals: the first pattern lights the RD, CTS, DCD, RI and IFC LEDs plus the horizontal elements of both 7-segment displays and the decimal point of the second 7-segment display; the second pattern lights all LEDs and display segments; the third pattern lights the TD, RTS, DSR, DTR and OFC LEDs plus the vertical elements of both 7-segment displays and the decimal point of the first 7-segment display; the fourth pattern turns all LEDs and 7-segment displays off. The cycle then repeats. Since the indicators are write only, the operator must visually verify success (or failure) of this test.

To begin the test in front panel mode, press the left-hand button while the number "**1**" is displayed in the 7-segment LED display. While the test is running, the 7-segment display shows the pass count. The test will be repeated until the left-hand button is pressed. At this point, "**P1**" will be displayed. Press the left-hand button again to restart the test or the right-hand button to advance to Test 2.

When run from a terminal, the test repeats until a key is pressed.

Test 2: RAM Test

The RAM test performs various walking bit and high bit tests.

RAM tests intermix cached & uncached RAM accesses.

To begin the test in front panel mode, press the left-hand button while the number "**2**" is displayed in the 7-segment LED display. While the test is running, the 7-segment display shows the pass count. Errors are counted on the ten LEDs, and the test is repeated until the left-hand button is pressed. At this point, either "**P2**" (pass) or "**F2**" (fail) will be displayed. Press the left-hand button again to restart the test or the right-hand button to advance to Test 3.

When run from a terminal, the test repeats until a key is pressed.

One complete cycle of this test takes about 1.5 minutes.

Test 3: Timer Test

The timer test runs the internal timer, and verifies that the timer can interrupt the CPU.

To begin the test in front panel mode, press the left-hand button while the number "**3**" is displayed in the 7-segment LED display.

When run from the front panel, the pass number is shown on the 7-segment display. Errors are counted on the ten LEDs, and the test is repeated until the left-hand button is pressed. The 7-segment display will then show "**P3**" or "**F3**" to indicate pass or fail status.

When run from a terminal, the test repeats until a key is pressed.

Test 4: EBI Internal Loopback Test

This test checks out the async ports on the concentrator and any attached PORTS/16em modules. The test puts the ports in local loopback mode. The four output signals (DTR, RTS, OUT1 and OUT2) are looped back (within the UART chip) to the four input signal lines (CTS, DSR, DCD and RI). These signals are checked for high and low conditions. Data is transmitted and received at the same port. Received data is compared to the transmitted data, and parity is checked. An interrupt is generated and checked for each port.

Front Panel Mode

In front panel mode, all async ports (including those on any attached PORTS/16em modules) are checked in each pass. To begin the test, press the left-hand button while the number "**4**" is displayed in the 7-segment LED display. While the test is running, the 7-segment display shows the pass count. Errors are counted on the ten LEDs, and the test is repeated until the left-hand button is pressed. At this point, either "**P4**" (pass) or "**F4**" (fail) will be displayed. Press the left-hand button again to restart the test or the right-hand button to advance to Test 5.

Video Mode

In video mode, you are first asked for the EBI number to test. Enter "**0**" to test the async ports on the EPC/CON-16 concentrator itself; "**1**", "**2**" or "**3**" to test the ports on individual attached PORTS/16em modules; or "**A**" to test all ports. When testing EBI 0, only 15 ports (2-16 if the terminal is connected to Port 1, or 1-15 if the terminal is connected to Port 16) are tested in each pass.

Test 5: EBI External Loopback Test

This test is used to check the async ports and their associated driver and receiver circuits. Loopback connectors are required. These connectors enable one async port to transmit and receive data. First, the two control signals, DTR and RTS, are used to test the four input signals (DSR, DCD, CTS and RI) on the same port. DTR is looped back to DCD and DSR, while RTS is looped back to CTS and RI. The port is then tested for transmit and receive data. Data is transmitted out of the port and received by the same port. Received data is compared to the transmitted data, and parity is checked.

This test can also be used to check communication between two ports on the same EBI module (EPC/CON-16 concentrator or attached PORTS/16em module). Use a null modem cable to connect the two ports to be tested. Note that in front panel mode, "**All**" must be selected for multiple port testing.

This test functions differently depending upon whether it is run in video mode or front panel mode.

Front Panel Mode

To begin the test, press the left-hand button while "**5**" is displayed. In front panel mode, this test can check one port at a time, or all ports. Only one loopback connector is needed for single port testing. Pressing the right-hand button once will display the current port number to be tested. Pressing the right-hand button repeatedly causes the port number to be incremented through all async ports (64 ports if three PORTS/16em modules are attached). To test all ports, continue pressing the right-hand button until "**All**" is displayed. While the desired port number is displayed, press the left-hand button to begin execution of the test. The loopback connector must be installed on the selected port. If the port number is set to "**All**", the test scans for ports with loopback connectors, then only checks those ports (one error will be counted for each port that does not have a loopback connector installed, but this will not cause a test failure). Errors are counted on the ten LEDs, and the test is repeated until the left-hand button is pressed again. At this point, either "**P5**" (pass) or "**F5**" (fail) will be displayed. A binary error count will appear on the ten LED indicators, with the LSB (Least Significant Bit) on the leftmost LED, and the MSB (Most Significant Bit) on the rightmost LED. Once the test is halted, pressing the left-hand button once again displays the port number just tested. Press the right-hand button to increment the port number. To advance to Test 6, press the right-hand button while "**P5**" or "**F5**" is displayed.

Video Mode

In video mode, you are first asked for the EBI number to test. Enter "**0**" for the ports on the EPC/CON-16 concentrator, "**1**", "**2**" or "**3**" for individual attached PORTS/16em modules, or "**A**" for all ports. When testing EBI 0, only 15 ports (2-16 if the terminal is connected to Port 1, or 1-15 if the terminal is connected to Port 16) are tested in each pass. During the test, status information will be displayed on the terminal. You will see something like this:

```
EBI 0 ext. loopback: ? ? ? 4=5 ? ? 8 ? ? ? ? ? ? 15 16=debug
WARNING - Not all UARTS detected in loopback
Test EBI 0 UART-4...4 UARTs passed
```

In this example, ports 4 and 5 were connected together with a null modem cable (indicated by "**4=5**"), ports 8 and 15 had standard loopback connectors installed, and the terminal was connected to port 16 (indicated by "**16=debug**"). The question marks indicate ports that did not have loopback connectors installed.

The loopback plug for RJ-45 versions consists of a single 10-pin RJ-45 plug wired as follows:

Pin 3 connected to pins 1 and 8 (RTS to RI and CTS);
Pin 5 connected to pin 6 (TxD to RxD);
Pin 9 connected to pins 2 and 10 (DTR to DSR and DCD).

For DB-25 versions, the loopback plug consists of a female DB-25 connector wired as follows:

Pin 4 connected to pins 22 and 5 (RTS to RI and CTS);
Pin 2 connected to pin 3 (TxD to RxD);
Pin 20 connected to pins 6 and 8 (DTR to DSR and DCD).

Test 6: Sync Internal Loopback Test

This test places the high-speed synchronous channel in internal loopback mode. No loopback plug is required to run the test. The internal loopback test checks the 4-wire transmission modes (1, 2 and 60-69—see the appendix, beginning on page 56, for a list of the modes).

Front Panel Mode

While "6" is shown on the 7-segment LED display, press the left-hand button to begin the test. This test runs in internal mode, and checks the port in all 12 self-clocking modes (modes 1, 2 and 60-69) of synchronous transmission. All 256 8-bit character values (00h-FFh) are sent in each mode. Errors are counted on the ten LEDs, and the test is repeated until the left-hand button is pressed again. At this point, either "**P6**" (pass) or "**F6**" (fail) will be displayed. Pressing the left-hand button again restarts the test; pressing the right-hand button advances to Test 7.

Video Mode

When running this test in video mode, you are first asked for the transmission mode (0-74). Enter the mode number you wish to test, or press <Enter> to test all modes (note that only modes 1, 2 and 60-69 are checked by this test—see the appendix, beginning on page 56, for a list of the modes). Next, you are asked for the data to send (00h-FFh). Enter the hexadecimal value to send, or press <Enter> to use all 8-bit values.

Test 7: Sync External Loopback Test

This test places the high-speed synchronous channel in external loopback mode. In video mode, this test can be run with or without an external loopback cable. The external loopback test checks the internally clocked and self clocked transmission modes (0-2, 6-14, 27-29 and 60-74—see the appendix, beginning on page 56, for a list of the modes).

Front Panel Mode

While "7" is shown on the 7-segment LED display, press the left-hand button to begin the test. This test runs in external mode, and checks the port in all 12 self-clocking and internally clocked modes (0-2, 6-14, 27-29 and 60-74) of synchronous transmission. All 256 8-bit character values (00h-FFh) are sent in each mode. Errors are counted on the ten LEDs, and the test is repeated until the left-hand button is pressed again. At this point, either "**P7**" (pass) or "**F7**" (fail) will be displayed. Pressing the left-hand button again restarts the test; pressing the right-hand button advances to Test 8.

Video Mode

When running this test in video mode, you are first asked if you have an external loopback cable installed. If you answer "Yes", you need to install a standard daisy chain cable between the "Host Adapter" and "Remote" ports of the concentrator. If you answer "No", the signal lines are looped back via relays within the concentrator. Note that when running all tests (by selecting "All" from the menu), internal loopback is assumed, and the loopback cable is unnecessary.

You will then be asked for the transmission mode (0-74). Enter the mode number you wish to test, or press <Enter> to test all modes (note that only modes 0-2, 6-14, 27-29 and 60-74 are checked by this test—see the appendix, beginning on page 56, for a list of the modes). Next, you are asked for the data to send (00h-FFh). Enter the hexadecimal value to send, or press <Enter> to use all 8-bit values.

Test 8: EEPROM Test

This test generates a checksum of the EPROM contents, and compares it with the checksum stored in the EEPROM. If the checksums match, the test passes. This test does not write to the EEPROM (EEPROM write operations only occur when a new node number is set). To begin this test in front panel mode, press the left-hand button while "**8**" is displayed. Errors are counted on the ten LEDs, and the test is repeated until the left-hand button is pressed again. At this point, either "**P8**" (pass) or "**F8**" (fail) will be displayed. Pressing the left-hand button again restarts the test; pressing the right-hand button advances to Test 9.

Test 9: Watchdog Test

This test checks out the watchdog timer. This is a hardware feature that is used to ensure system reliability. When the watchdog timer is loaded and enabled, the timer begins counting down. It is up to the system to keep reloading the timer to prevent it from expiring. Normal test execution allows the timer to expire, then the test is repeated. The test fails if the timer has not expired after 1 second. To begin this test in front panel mode, press the left-hand button while "**9**" is displayed. Errors are counted on the ten LEDs, and the test is repeated until the left-hand button is pressed again. At this point, either "**P9**" (pass) or "**F9**" (fail) will be displayed. Pressing the left-hand button again restarts the test; pressing the right-hand button advances (wraps around) to the node number.

Specifications

Power Requirements

+5 volts ± 5%	0.760 amps typical
+12 volts ± 5%	0.180 amps typical
-12 volts ± 5%	0.050 amps typical

Environmental

Ambient temperature	5° C to 55° C
Relative humidity	20% to 80%

Serial Interface Surge Suppression

Threshold Voltage:	13 volts
Response Time:	Less than 10 nS

Dimensions

Length	12.0 inches
Width	7.0 inches
Height	2.25 inches
Weight	2.7 pounds

Daisy Chain Cables

Twisted pair, overall shield, 28 AWG. Capacitance 15.5 ±3 pF/ft. Impedance 100 Ω/ft. Belden 8-wire (4 twisted pair) #9806, or Belden 4-wire (2 twisted pair) #9804. HD-15 subminiature connectors, 1 male (AMP #748364-1 or equivalent; contacts: size 22 male AMP #748333-5 or equivalent), and 1 female (AMP #748565-1 or equivalent; contacts: size 22 female AMP #748610-2 or equivalent).

Digi part number 62110120 (10 feet).

Terminator Plug

HD-15 subminiature male plug (AMP #748364-1, or equivalent; contacts: size 22 male AMP #748333-5 or equivalent) with the following pairs of pins wired together:

1-6, 2-7, 3-15, 4-9, 5-10, 8-14.

Digi part number 60000388.

Loop Back Plugs

The diagnostic loopback plug for RJ-45 versions consists of a single 10-pin RJ-45 plug wired as follows:

Pin 3 connected to pins 1 and 8 (RTS to RI and CTS);
Pin 5 connected to pin 6 (TxD to RxD);
Pin 9 connected to pins 2 and 10 (DTR to DSR and DCD).

For DB-25 versions, the loopback plug consists of a female DB-25 connector wired as follows:

Pin 4 connected to pins 22 and 5 (RTS to RI and CTS);
Pin 2 connected to pin 3 (TxD to RxD);
Pin 20 connected to pins 6 and 8 (DTR to DSR and DCD).

Appendix—Transmission Modes

The EPC/X host adapter and the EPC/CON-16 concentrator transmit synchronous data in one of 75 *modes*. These modes are numbered 0 - 74, and each corresponds to a specific combination of wiring mode (4-Wire or 8-Wire), clocking method (internal, external or self-clocking) and baud rate. The 75 modes and their definitions are listed below:

8-Wire, Internally Clocked

Mode#	Mode	Baud Rate	Mode#	Mode	Baud Rate
0	NRZ	115K	13	NRZ	921K
3	NRZ	2400	14	NRZ	1229K
4	NRZ	4800	27	NRZ	1843K
5	NRZ	9600	28	NRZ	2458K
6	NRZ	19200	29	NRZ	3686K
7	NRZ	38400	70	NRZ	1843K
8	NRZ	57600	71	NRZ	2458K
9	NRZ	76800	72	NRZ	3686K
10	NRZ	115K	73	NRZ	7373K
11	NRZ	230K	74	NRZ	10M
12	NRZ	460K			

8-Wire Synchronous Modem (External Clock)

Mode#	Mode	Baud Rate	Mode#	Mode	Baud Rate
15	NRZ	2400	35*	NRZ	2400
16	NRZ	4800	36*	NRZ	4800
17	NRZ	9600	37*	NRZ	9600
18	NRZ	19200	38*	NRZ	14400
19	NRZ	38400	39*	NRZ	19200
20	NRZ	57600	40*	NRZ	38400
21	NRZ	76800	41*	NRZ	57600
22	NRZ	115K	42*	NRZ	64111
23	NRZ	230K	43*	NRZ	76800
24	NRZ	460K			
25	NRZ	921K			
26	NRZ	1229K			
30	NRZ	1843K			
31	NRZ	2458K			
32	NRZ	3686K			
33	NRZ	14400			
34	NRZ	115K			

* Modes 35-43 are for EIA-232 synchronous modems; modes 15-34 are for EIA-422 synchronous modems.

4-Wire, Self Clocked

Mode#	Mode	Baud Rate	Mode#	Mode	Baud Rate
1	NRZI	230K	64	NRZI	460K
2	FM	460K	65	FM	460K
60	NRZI	115K	66	NRZI	921K
61	FM	115K	67	FM	921K
62	NRZI	230K	68	NRZI	1843K
63	FM	230K	69	FM	1843K

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