PCI20

ARCNET® Network Interface Modules for PCI Bus Computers

INSTALLATION GUIDE

INTRODUCTION

The PCI20 series of ARCNET network interface modules (NIMs) links PCI compatible computers with the ARCNET local area network (LAN). The high performance PCI bus allows for jumperless configuration or plug and play operation.

ARCNET is classified as a token-bus LAN operating at a nominal 2.5 Mbps while supporting 255 nodes. Interfacing ARCNET to a host computer usually requires a NIM which plugs into the host computer's bus.

The PCI20 incorporates the newer COM20020 ARCNET controller chip with enhanced features over the earlier generation ARCNET chips. New performance and integration enhancements include command chaining operation and an internal 2K x 8 RAM buffer. There is no requirement for wait-state arbitration.

Each PCI20 module has two LEDs on the board. The green LED indicates that the module is transmitting data on the network and the yellow LED indicates bus access to the module. The PCI20 also has an external DIP switch so that node addresses can be easily reassigned without removing the module.

There are several versions of the PCI20 ARCNET NIM. The PCI20-CXS supports coaxial star configurations requiring external active or passive hubs. The PCI20-CXB supports coaxial bus configuration usually requiring no hubs. Other versions include the PCI20-FOG which supports fiber optic cable with either ST or SMA connectors. The PCI20-TB5 supports twisted-pair bus cabling using RJ-45 connectors. There are some versions that support EIA-485 communication each using RJ-45 and screw terminal connectors.

On some models, operation up to 5.0 Mbps is possible. These models are identified with a /5 designation.

CONTEMPORARY CONTROLS®

SPECIFICATIONS

Environmental
Operating temperature: 0°C to +60°C
Storage temperature: -40°C to +85°C

Data Rates
PCI20*   2.5 Mbps, 1.25 Mbps, 625 kbps, 312.5 kbps, 156.25 kbps
PCI20/5* 5.0 Mbps, 2.5 Mbps, 1.25 Mbps, 625 kbps, 312.5 kbps

*   The -CXS, -CXB and -TB5 models can only operate at 2.5 Mbps.
     The -485X model can only operate at 1.25, 2.5 or 5.0 Mbps.

Dimensions
4.20" x 5.5"
(107mm x 140mm)

Shipping Weight
1 lb. (.45kg)

I/O Mapping
Requires 16 bytes of I/O space for COM20020 controller

Interrupt Lines
Supports PCI INTA

Compatibility
PCI20 series NIMs are compliant with ANSI/ATA 878.1 and PCI bus
computers.

Regulatory Compliance
CE Mark
FCC Part 15 Class A

Power Requirements

Model	+5V	-12V
PCI20-CXS	400mA	20mA
PCI20-CXB	400mA	50mA
PCI20-FOG-SMA	500mA	N/A
PCI20-FOG-ST	500mA	N/A
PCI20-TB5	400mA	50mA
PCI20-485	400mA	N/A
PCI20-485D	400mA	N/A
PCI20-485X	400mA	N/A
PCI20/5-485	400mA	N/A
PCI20/5-485D	400mA	N/A
PCI20/5-485X	400mA	N/A
PCI20/5-FOG-ST	500mA	N/A
PCI20/5-FOG-SMA	500mA	N/A

INSTALLATION

The PCI20 can be installed in any PCI bus compatible computer bus. With the power removed from the computer, remove the cover of the computer exposing the motherboard and expansion slots (connectors). Care should be taken when installing the PCI20 because both it and the exposed computer motherboard are sensitive to electrostatic discharge. To prevent inadvertent damage, touch the metal case of the internal power supply to discharge yourself then proceed to remove the PCI20 from its protective ESD package. Remove the backplate of the computer adjacent to the desired slot (connector). The PCI20 can then be inserted into this slot by applying a downward even pressure until it stops and is firmly seated into the connector. The PCI20 backplate can be secured to the computer by installing the small screw used to attach the original backplate. Hardware installation is completed by replacing the computer's cover.

Software Drivers

Unlike ISA bus computers, PCI bus computers frequently have their resources assigned by the operating system. The PCI20 requires a 16 byte I/O range for the COM20020 ARCNET controller and one interrupt line. Depending upon the sophistication of the software driver, the PCI20 assignment may be done automatically by the driver with little concern on the part of the user. This is called Plug and Play operation. Some software drivers, especially those originally written for ISA bus computers, may not verify resource allocation automatically requiring the user to accomplish this task. This is called jumperless operation. It is important that the user appreciate the type of software driver being used since it is sometimes difficult to remove software drivers once they are installed.

Included with this product is a driver disk which contains enabler software that will assist in the installation of non-Plug and Play software drivers under Windows 95 or 98. Only use this enabler software if instructed to do so. Also included on the disk are several utility programs.

OEM Software Driver

If the PCI20 has been specified by an Original Equipment Manufacturer (OEM) for use with their equipment, follow the instructions of the OEM and utilize their driver disk. They may also require you to use the enabler software from our driver disk. Do so if instructed.

Microsoft Networking

If your intention is to use Microsoft Networking with either Windows 95, 98 or NT, you will require an NDIS 4.0 driver. Obtain this driver from our web site and follow the instructions on its use. This is a Plug and Play driver so it is unnecessary to use our enabler software or verify resources. With this driver you can operate with the various transport layers supported by Microsoft including TCP/IP.

Legacy ISA Software Driver

The PCI20 is register compatible with our PCX20 ISA adapter, PC10420 PC/104 adapter, PCM20 PC card adapter, as well as SMSC's COM20020 Evaluation Board. If the software driver was originally written for the ISA or PC104 versions of these adapters and the intent is to operate this same driver using the PCI20 under Windows 95 or 98, then enabler software is required in order to map the system resources to the I/O and interrupt requirements of the legacy driver. The driver disk with the required enabler software has been provided for this task. Only use this software when a Plug and Play driver does not exist. Follow the instructions on the README.TXT file, which can be found on the driver disk, before attempting an installation of this software.

Other Operating Systems

With Windows NT, you will be required to have a Plug and Play driver. The enabler software cannot be used. For other operating systems such as Linux and QNX, view our web site for the latest support on these operating systems.

Node ID Switch

Although not always necessary with the COM20020, the PCI20 provides a separate input port that reads an 8-bit DIP switch (SW1) located at the backplate. This switch is intended to serve as a node ID switch, although it can serve as a general purpose switch if desired. The node ID switch has no connection to the COM20020 ARCNET controller chip.

The most significant bit (MSB) is switch position 8, and the least significant bit (LSB) is switch position 1. A switch in the open position (off position or away from the printed circuit board) introduces a logic "1." Figure 1 shows the node ID switch. In this example, the switch is set to hexadecimal address AF.
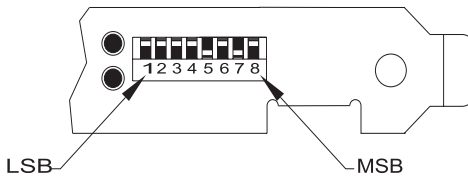

Figure 1-Node ID Switch and Indicator Lights

Indicator Lights

There is a dual LED located at the PCI20 backplate. The yellow LED indicates that the PCI20 is being accessed via its I/O address. The green LED indicates that the PCI20 is transmitting ARCNET traffic to the network.

FIELD CONNECTIONS

The PCI20 is available in several transceiver options. Each transceiver, which is matched to a particular cable type, is identified by a three-digit suffix appended to the model numbers. The capabilities of each transceiver differs.

-CXS Coaxial Star

In a coaxial star system, NIMs and hubs are interconnected in a point-to-point fashion using coaxial cable. A NIM can connect to one other NIM or can connect to a unused port on a hub. Hub-to-hub connections are allowed.

In a two node system, simply connect the two -CXS NIMs together using RG-62/u coaxial cable. The length of cable cannot exceed 2000 feet.

If more than two NIMs are used on a network, either an active or passive hub is required. With passive hubs, a maximum of four NIMs can be interconnected. Unused ports on the passive hub must be terminated with a 93 ohm (nominal) resistor. The maximum length between a passive hub port and a NIM is 100 feet.

Active hubs provide overall better performance than passive hubs since greater distances can be achieved along with a degree of isolation. Connect each NIM to a port on the hub using RG-62/u coaxial cable. This length of cable cannot exceed 2000 feet nor can the length of cable between two cascaded hubs exceed 2000 feet. However, up to ten hubs can be cascaded thereby providing an overall cable length of 22,000 feet. Unused ports on active hubs need not be terminated.
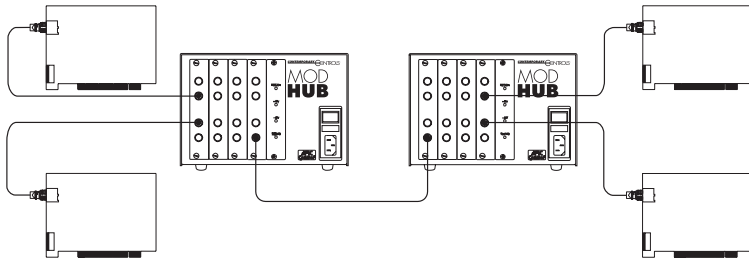
*Figure 2-Point-to-point connections
are required between -CXS NIMs and hubs.*

-CXB Coaxial Bus

For hubless systems, the -CXB transceiver can be used. NIMs are interconnected with RG-62/u cables and BNC Tee connectors. Each -CXB NIM represents a high impedance connection in both the powered and

unpowered states. Therefore, passive termination must be applied to both ends of a bus segment. Use BNC style 93 (nominal) ohm resistors at each end. The maximum segment length is 1000 feet and the maximum number of NIMs that can be connected to a segment is eight.

To extend a bus segment beyond 1000 feet, an active hub is required. If the hub port is of the -CXS type, connection can be made if a few simple rules are followed. Only connect this bus segment at the end of a segment. Do not connect the hub to the middle of a segment since the hub port is not of the high impedance type. Do not terminate the end which attaches to the hub port since a -CXS port effectively terminates the end of a bus segment. Simply remove the BNC Tee connector and terminator from the segment end and attach the cable directly to the hub port. The opposite segment end still requires termination if no hub connection is being made.
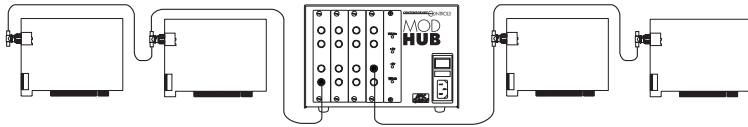
Figure 3-A hub is required to extend bus segments.

-FOG Fiber Optic (-ST, -SMA)

The fiber optic option is designated -FOG; however, a further designation is required in order to specify the type of connector. The -FOG-ST uses the ST style connector while the -FOG-SMA uses the SMA style connector. Cable sizes of 50, 62.5 or 100 micron duplex cable can be used with either connector.

Fiber optic connections require a duplex cable arrangement. Only star and distributed star topologies are supported. Two unidirectional cable paths provide the duplex link. There are two devices on each NIM. One device, colored light gray, is the transmitter and the other, dark gray, is the receiver. Remember that "light goes out of the light (gray)." To establish a working link between a NIM and another NIM or a hub to a NIM, the transmitter of point A must be connected to a receiver at point B. Correspondingly, the receiver at point A must be connected to a transmitter at point B. This establishes the duplex link.

Optical Power Budget

The optical power budget is the ratio of the light source strength divided by the light receiver sensitivity expressed in dB. The link loss budget, which includes losses due to cable and connectors, must be less than the power budget. Assuming cable attenuation of 3.5 dB/km, up to 2km of 62.5μm fiber optic cable can be used per segment.

OPTICAL POWER BUDGET			
Fiber Size (μm)	Transmit Pwr (dBm)	Receiver Pwr (dBm)	Power Budget (dB)
100/140	-9.5	-25.4	15.9
62.5/125	-15.0	-25.4	10.4
50/125	-18.8	-25.4	6.6

*Table 1-The power budget varies with the fiber core size.*
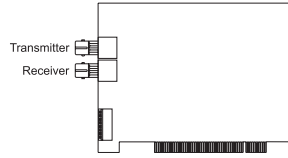
Figure 4-A duplex link is required with the -FOG option.

-TB5 Twisted-Pair Bus

The -CXB transceiver can be modified to drive a balanced cable system with the addition of some parts. This configuration is called -TB5 and it supports shielded or unshielded twisted-pair cable such as category 5. Dual RJ-45 connectors replace the single BNC connector in order to support the popular modular plug connectors. For convenience, a three-position screw terminal connector is also provided (see figure 7). Follow the connector pin assignments in Tables 2 and 3 when using this connector or when mixing cable types. Wiring between NIMs is accomplished in a daisy-chain fashion with point-to-point cables connecting the various NIMs to create a bus segment. The end NIMs will have one vacant RJ-45 socket which is to hold the RJ-45 style 100 ohm terminator required to terminate the end points of the bus segment. When terminating the screw terminal connector, install a 100 ohm, 1/4 watt resistor across terminals 1 and 2. Use twisted-pair cable and observe polarity. Modular plugs must be installed on this cable such that they do not invert the signals. Most satin cable does not twist the pairs nor maintain signal polarity. Do not use this cable. To test for the proper cable connections, hold both ends of the cable side by side with the retaining clips facing the same direction. The color of the wire in the right-most position of each plug must be the same if there is no inversion of the cable. If this is not the case, the cable is inverted. Up to eight -TB5 NIMs can be connected to one segment which cannot exceed 400 feet in length.

The overall distance of a twisted-pair network can be expanded beyond 400 feet if hubs are used. Use a hub port that supports the same -TB5 interface.
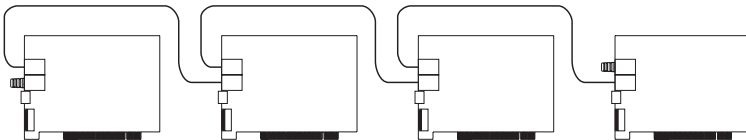
Figure 5-TB5 NIMs are connected in a daisy-chain fashion.

-485D DC Coupled EIA-485 (Non Backplane Mode)

The PCI20-485D supports DC coupled EIA-485 communication via a daughter board which replaces the coaxial hybrid transceiver. This daughter board receives the conventional P1 and P2 pulses intended for the coaxial hybrid transceiver and converts them to an elongated P1 pulse (the width is equal to P1 and P2) suitable for the EIA-485 differential driver. Therefore, do not set the COM20020 to backplane mode for EIA-485 communication as recommended in SMSC's application note and data sheet since Contemporary Controls (CC) implements the same signaling on this daughter board. With our approach, the same software driver used for coaxial networks will function with the EIA-485 version of the PCI20 without modification.

Figure 6-Modular Jack Numbering Orientation

One three-position screw terminal (see figure 7) and two RJ-45 connectors are supplied on each NIM which are bussed together so as to provide a convenient daisy-chain connection for connecting multiple nodes onto one segment. This segment can be up to 900 feet long of category 5 shielded or unshielded twisted-pair cable, and as many as 17 nodes can occupy the segment. Make sure that the phase integrity of the wiring remains intact. Pin 4 of the modular jack on each NIM must be connected together. The same applies to pin 5. Most modular (satin cable) telephone wiring flips the phase of the wiring thereby reversing the connections to pins 4 and 5 at each end. Do not use this type of cable. Some modular cable is not even twisted. Be sure to use the proper cable. Refer to Tables 2 and 3 for connector pin assignments.
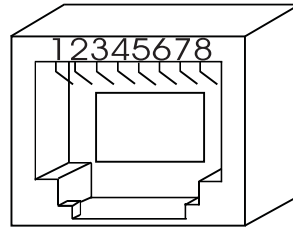
Modular Connector Pin Assignments	
8-Contacts	
Pin	Usage
1	Not Used
2	Not Used
3	Not Used
4	Line- (Phase B)
5	Line+ (Phase A)
6	Not Used
7	Not Used
8	Not Used

Table 2-Modular Connector Pin Assignments for -TB5

Termination

Each end of the segment must be terminated in the characteristic impedance of the cable. A 120 ohm resistor can be invoked with a jumper which resides on the EIA-485 daughter board. With the middle jumper inserted at location E1 on the daughter board, 120 ohms of resistance is applied across the twisted-pair. With the jumper removed, no termination is applied. If it is desired to apply external termination instead, remove this jumper and insert an RJ-45 style terminator in the unused RJ-45 modular jack or install a 120 ohm 1/4 watt resistor across pins 1 and 2

TRANSCEIVER			
-485	-485D	-485X	-TB5
PIN			
1 LINE+	LINE+	LINE	LINE+
2 LINE-	LINE-	LINE	LINE-
3 SHIELD	SHIELD	SHIELD	SHIELD

Table 3-Screw Terminal Connector Pin Assignments for -485, -485D -485X and -TB5

on the screw terminal connector. Incorporating a resistance value less than 120 ohms is not recommended since it may excessively load the EIA-485 transceivers.

Bias

In addition to the termination, it is also necessary to apply bias to the twisted-pair network so that when the line is floated differential receivers will not assume an invalid logic state. There are two precision bias resistors (Rb) of equal value on each daughter board. One resistor is tied to the +5V line while the other is tied to ground. Each resistor has a jumper associated with it. If the two jumpers are installed, the resistor tied to +5V is connected to the (+) signal line while the grounded resistor is connected to the (-) line.

This voltage drop will bias the differential receivers into the "1" state when no differential drivers are enabled. Differential receivers typically switch at or near zero volts differential and are guaranteed to switch at +/-200 mv. Through the transition point, 70 mv of hysteresis will be experienced. Therefore, a positive bias of 200 mv or greater will ensure a defined state. We recommend that bias be applied to both ends of the wiring segment by installing the two end jumpers located at position E1 on the daughter board. This is to be done for only the two NIMs located at the end of the segment. All other NIMs will have their jumpers removed.
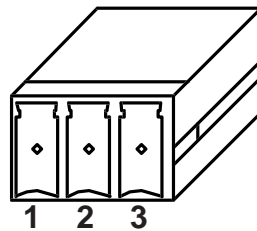
Figure 7- Screw Terminal Connector Numbering Orientation

The termination and bias rules are simple. If the NIM is located at the extreme ends of the segment, install all three jumpers at location E1 on the daughterboard. If the NIM is located between the two end NIMs, remove all three jumpers. If external termination is desired, removed the middle jumper at E1.

For EIA-485 DC operation, it is very important that all devices on the wiring segment be referenced to the same ground potential in order that the common mode voltage requirement (+/-7 Vdc) of the EIA-485 specification is achieved. This can be accomplished by running a separate ground wire between all PC computers or by relying upon the third wire ground of the power connector assuming that the DC power return is connected to chassis

ground on the PC computer. Another approach would be to connect the DC common of each PC computer to a cold water pipe. Connected systems, each with different elevated grounds, can cause unreliable communications or damage to the EIA-485 differential drivers. Therefore, it is important that an adequate grounding method be implemented. A ground connection can be found at pin 3 of the screw terminal connector.

Segments of -485D connected NIMs can be extended through the use of active hubs. Select a MOD HUB expansion module with a -485D compatible port. Connect one end of the segment to this port following the same termination rules as used for a NIM. This hub port counts as one NIM when cable loading is being calculated. The NIM electrically closest to the hub port should not have any termination or bias applied. Follow the same rules for other segments attached to different hub ports. Each hub effectively extends the segment another 900 feet. Maintain the same cabling polarity as the NIMs by using cable connections that do not invert the signals.

-485 DC Coupled EIA-485 (Backplane Mode)

If the software driver you intend to use sets the COM20020 into backplane mode, you will need the PCI20-485 version. This version does not utilize the daughterboard approach. Instead you will find three jumpers labeled JP1, JP2 and JP3 which replace the three jumper functionality of E1 found in the -485D model. Operation is identical to that of the -485D version. If bias is required, place jumpers in locations JP2 and JP3. If termination is required, place a jumper at JP1. Cabling and expansion rules are the same for the -485 and -485D options.

-485X AC Coupled EIA-485

The AC coupled EIA-485 transceiver offers advantages over DC coupled EIA-485. No bias adjustments need to be made since each transceiver has its own fixed bias network isolated by a pulse transformer. Unlike the DC coupled EIA-485, wiring polarity is unimportant. Either inverted or straight through cable can be used or even mixed within one AC coupled network. Much higher common mode voltage levels can be achieved with AC coupling due to the transformer coupling which has a 1000 Vdc breakdown rating.

There are disadvantages to the AC coupled transceiver as compared to the DC coupled technology. The DC coupled distances are longer (900 feet) compared to the AC coupled distance (700 feet). The AC coupled transceiver will operate at 1.25, 2.5 and 5.0 Mbps while the DC coupled transceiver will operate over all six data rates.

The cabling rules of the -485X are similar to the -485D. Dual RJ-45 connectors and one three-position screw terminal connector are used in each NIM. Wire a maximum of 13 NIMs in a daisy-chain fashion leaving the end

NIMs with vacant RJ-45 connections. On these NIMs insert a jumper at E1 on both -485X daughter boards to invoke 120 ohm termination resistors or leave the jumpers open and insert RJ-45 style passive terminators in each of the two vacant RJ-45 jacks. Termination can also be accomplished by installing a 120 ohm, ¼ watt resistor across pins 1 and 2 of the screw terminals at each end of the bus segment. Refer to Tables 2 and 3 for connector pin assignments. Termination should not be applied to any of the NIMs located between the two end NIMs of the segment. Do not mix -485D and -485X NIMs together on one segment; however, bridging of the technologies is possible using active hubs with the appropriate transceivers. To extend -485X segments, use a hub as discussed under the -485D section. Make sure that the active hub transceivers are of the -485X type. Cable inversion is not of any consequence.
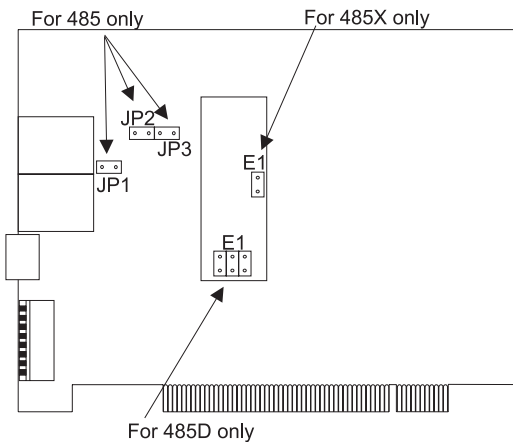

Figure 8-Jumper settings for EIA-485 models.

Electromagnetic Compatibility

The PCI20 series complies with class A radiated and conducted emissions as defined by FCC part 15 and EN55022. This equipment is intended for use in non-residential areas.

Warning

This is a Class A product as defined in EN55022. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

NEED MORE HELP INSTALLING THIS PRODUCT?

More comprehensive information can be found on our web site at www.ccontrols.com. Browse the Technical Support section of our site for a look at our interactive on-line technical manuals, downloadable software drivers and utility programs that can test the product. When contacting one of our offices, just ask for Technical Support.

Warranty

Contemporary Controls (CC) warrants its product to the original purchaser for one year from the product's shipping date. If a CC product fails to operate in compliance with its specification during this period, CC will, at its option, repair or replace the product at no charge. The customer is, however, responsible for shipping the product; CC assumes no responsibility for the product until it is received. This warranty does not cover repair of products that have been damaged by abuse, accident, disaster, misuse, or incorrect installation.

CC's limited warranty covers products only as delivered. User modification may void the warranty if the product is damaged during installation of the modifications, in which case this warranty does not cover repair or replacement.

This warranty in no way warrants suitability of the product for any specific application.

More warranty information can be found on our web site www.ccontrols.com.

Returning Products for Repair

Before returning a product for repair, contact Customer Service. A representative will instruct you on our return procedure.

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