PCX20

ARCNET® Network Interface Modules

INSTALLATION GUIDE

INTRODUCTION

The PCX20 series of ARCNET network interface modules (NIMs) links PC/XT/AT (ISA) compatible computers with the ARCNET local area network (LAN).

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 PCX20 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 PCX20 module has two LEDs on the board. The green LED indicates that the module is receiving data on the network and the yellow LED indicates host bus access to the module. The PCX20 also has a piano-style DIP switch so that node addresses can be easily reassigned without removing the module.

There are several versions of the PCX20 ARCNET NIM. The PCX20-CXS supports coaxial star configurations requiring external active or passive hubs. The PCX20-CXB supports coaxial bus configuration usually requiring no hubs. Other versions include the PCX20-FOG which supports fiber optic cable with either ST or SMA connectors. The PCX20-TPB supports twisted-pair bus cabling using RJ-11 and screw terminal connectors. There are various versions that support EIA-485 communication each using RJ-11 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
PCX20* 2.5 Mbps, 1.25 Mbps, 625 kbps, 312.5 kbps, 156.25 kbps
PCX20/5* 5.0 Mbps, 2.5 Mbps, 1.25 Mbps, 625 kbps, 312.5 kbps

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

Dimensions
3.9" x 4.3"
(99 mm x 109 mm)

Shipping Weight
1 lb. (.45 kg)

I/O Mapping
Supports I/O Mapping on any 16-byte boundary

Interrupt Lines
Supports strapping of IRQ 2/9, 3, 4, 5, 6, or 7

Compatibility
PCX20 series NIMs are compliant with all of Contemporary Controls' (CC) ARCNET products and PC/XT/AT computers.

Regulatory Compliance
CE Mark
CFR 47 Part 15, Class A

Power Requirements

Model	**+5 V**	**–12 V**
PCX20-CXS	200 mA	20 mA
PCX20-CXB	200 mA	50 mA
PCX20-FOG-SMA	300 mA	N/A
PCX20-FOG-ST	300 mA	N/A
PCX20-TPB	200 mA	50 mA
PCX20-485	200 mA	N/A
PCX20-485D	200 mA	N/A
PCX20-485X	200 mA	N/A
PCX20/5-485	200 mA	N/A
PCX20/5-485D	200 mA	N/A
PCX20/5-485X	200 mA	N/A
PCX20/5-FOG-ST	300 mA	N/A

INSTALLATION

The PCX20 can be installed in any XT-compatible, 8-bit, ISA computer bus. To install the PCX20, remove the cover of the computer exposing the motherboard and expansion slots (connectors). Care should be taken when installing the PCX20 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 PCX20 from its protective ESD package. Remove the backplate of the computer adjacent to the desired slot (connector). The PCX20 can then be inserted into this slot by applying a downward even pressure until it stops and is firmly seated into the connector. The PCX20 backplate can be secured to the computer by installing the small screw used to attach the original backplate. Installation is completed by replacing the computer cover.

Register Map

The PCX20 requires 16 contiguous I/O address locations in order to access the COM20020 register and node ID switch. Because several locations are reserved, it is important not to address another device to these locations. The register map is shown in Table 1.

I/O Address	Read Register	Write Register
Base + 0	Status	Interrupt Mark
Base + 1	Diagnostic Status	Command
Base + 2	Address Pointer High	Address Pointer High
Base + 3	Address Pointer Low	Address Pointer Low
Base + 4	Data	Data
Base + 5	Reserved	Reserved
Base + 6	Configuration	Configuration
Base + 7	Test ID/..../Next ID	Test ID/..../Next ID
Base + 8	Node ID Switch	Reserved
Base + 9	Node ID Switch	Reserved
Base + A	Reserved	Reserved
Base + B	Reserved	Reserved
Base + C	Reserved	Reserved
Base + D	Reserved	Reserved
Base + E	Reserved	Reserved
Base + F	Reserved	Reserved

Table 1—Register Map

I/O Base Addressing

The I/O base address for the register map can be set with jumpers. The PCX20 does not require any memory address space, simplifying installation. See Table 2 for details.

A9	A8	A7	A6	A5	A4	I/O ADDRESS
■		■	■	■	■	100
■		■	■	■		110
■		■	■		■	120
■		■	■			130
■		■		■	■	140
■		■		■		150
■		■			■	160
■		■				170
■			■	■	■	180
■			■	■		190
■			■		■	1A0
■			■			1B0
■				■	■	1C0
■				■		1D0
■					■	1E0
■						1F0
	■	■	■	■	■	200
	■	■	■	■		210
	■	■	■		■	220
	■	■	■			230
	■	■		■	■	240
	■	■		■		250
	■	■			■	260
	■	■				270
	■		■	■	■	280
	■		■	■		290
	■		■		■	2A0
	■		■			2B0
	■			■	■	2C0
	■			■		2D0
	■				■	2E0

A9	A8	A7	A6	A5	A4	I/O ADDRESS
	■					2F0
		■	■	■	■	300 **Default**
		■	■	■		310
		■	■		■	320
		■	■			330
		■		■	■	340
		■		■		350
		■			■	360
		■				370
			■	■	■	380
			■	■		390
			■		■	3A0
			■			3B0
				■	■	3C0
				■		3D0
					■	3E0
						3F0

Key: ■ = Install Jumper

Table 2—I/O Base Address

Interrupts

Interrupts can be invoked at jumper location E1 which consists of a series of rows of two posts each. Each row is labeled an interrupt line corresponding to the PC bus interrupt designators. To enable an interrupt, insert a jumper across a pair of posts corresponding to the desired interrupt. Only one interrupt can be selected; therefore, only one jumper is supplied. If no interrupt is desired, remove the jumper at E1. The default interrupt setting is INT 2.

Indicator Lights

A dual LED is located at the PCX20 front plane. The yellow LED indicates that the PCX20 is being accessed via its I/O address. The green LED indicates the PCX20 is receiving ARCNET traffic from the network.

Node ID Switch

Although not always necessary with the COM20020, the PCX20 provides a separate input port that reads an 8-bit DIP switch (SW1) located near the board edge. 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.

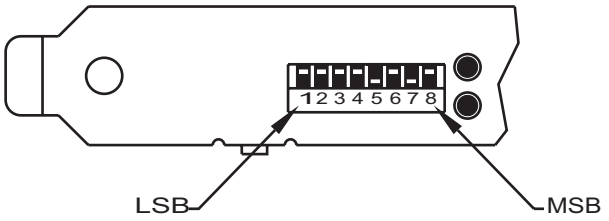

Figure 1—Node ID Switch

FIELD CONNECTIONS

The PCX20 is available in several transceiver options. Each transceiver is matched to a particular cable type and identified by a three-character 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 an 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.

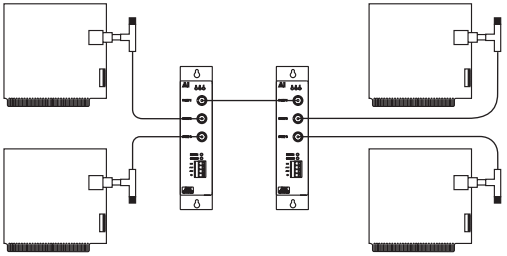

Figure 2—Active hubs can be cascaded for greater distances.

-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 the hub port 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 cable where it attaches to the hub port since a -CXS port effectively terminates the end of a bus segment. Simply attach the cable directly to the hub port without using a BNC Tee connector or a terminator. The opposite end of the segment still requires termination if no hub connection is being made.

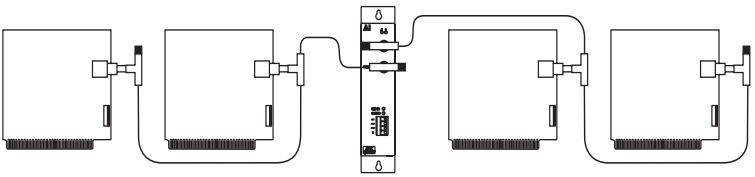

Figure 3—Bus segments can be extended through active hubs.

-FOG Fiber Optic (-ST, -SMA)

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

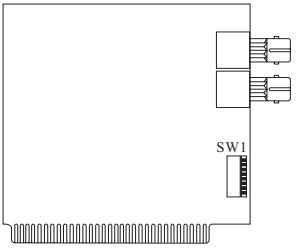

Figure 4—Fiber Optic Option (-FOG)

Fiber optic connections require a duplex cable arrangement. Only star and distributed star topologies are supported. Two unidirectional cable paths provide the duplex link. Two connectors exist on each NIM. One, colored light gray, is the transmitter and the other, colored 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 2 km of 62.5 µm 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 3—The power budget varies with the fiber core size.

-TPB 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 -TPB and it supports shielded or unshielded twisted-pair cable such as Category 5. Dual RJ-11 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 4 and 5 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-11 socket which is to hold the RJ-11 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 so 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 RJ-11 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 -TPB 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 -TPB interface.

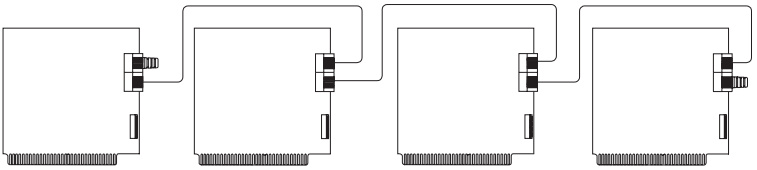

Figure 5—TPB NIMs are connected in a daisy-chain fashion with terminators inserted at both end NIMs.

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

The PCX20-485D 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 Standard Microsystems Corporations application note and data sheet since 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 PCX20 without modification.

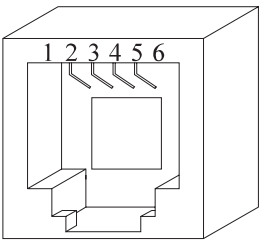

Figure 6—Modular Jack Numbering Orientation

Modular Connector Pin Assignments	
6-Contacts	
Pin	Usage
1	Not Available
2	Not Used
3	Line+
4	Line–
5	Not Used
6	Not Available

Table 4—Modular Connector Pin Assignments for -TPB

One three-position screw terminal (see Figure 7) and two RJ-11 connectors are supplied on each NIM. These are bussed together to allow a convenient daisy-chain implementation for connecting multiple nodes onto one segment. This segment can be up to 900 feet of Category 5 unshielded twisted-pair cable, and as many as 17 nodes can occupy the segment. Make sure the phase integrity of the wiring remains intact. Pins 3 of the modular jack on each NIM must be connected together. The same applies to pins 4. Most modular (satin cable) telephone wiring flips the phase of the wiring thereby reversing the connections to pins 3 and 4 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 4 and 5 for connector pin assignments.

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

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

Table 5—Screw Terminal Connector Pin Assignments for -485, -485D -485X and -TPB

twisted-pair. With the jumper removed, no termination is applied. If external termination is desired, remove this jumper and insert an RJ-11 style terminator in the unused RJ-11 modular jack or install a 120 ohm 1/4 watt resistor across pins 1 and 2 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

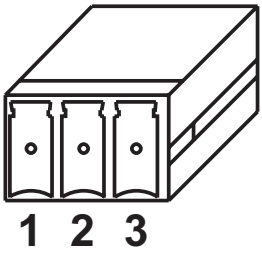

Figure 7—Screw Terminal Connector Numbering Orientation

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 invalid logic state. There are two precision bias resistors (Rb) of equal value on each daughters board. One resistor is tied to the +5 V line and the other is tied to ground. Each resistor has a jumper associated with it. If the two jumpers are installed, the resistor tied to +5 V is connected to the (+) signal line and 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.

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, remove 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 model compatible with DC-coupled EIA-485 signaling. 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 PCX20-485 version. This version does not use the daughterboard approach. Instead, you will find three sets of jumpers labeled E3, E4 and E5 which replace the three jumper functionality of E1 found in the -485D model. Operation is similar to that of the -485D version but the bias is distributed among all the nodes. If bias is required, place jumpers in locations E3 and E4 according to Table 6. If termination is required, place a jumper at E5 on pins 1 and 2. If termination is not required, simply move the E5 jumper to pins 2 and 3. Cabling and expansion rules are the same for the -485 and -485D options.

Jumper E3/E3	# of Nodes
1-2, 3-4, 5-6	2-5
3-4, 5-6	6-15
5-6	16-30

Table 6—Backplane Mode, DC Coupled EIA-485 Option (-485)

Note: When all jumpers are left open, minimal bias is provided by a pair of 10 kohm resistors.

-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 distance is 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-11 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-11 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-11 style passive terminators in each of the two vacant RJ-11 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 4 and 5 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.

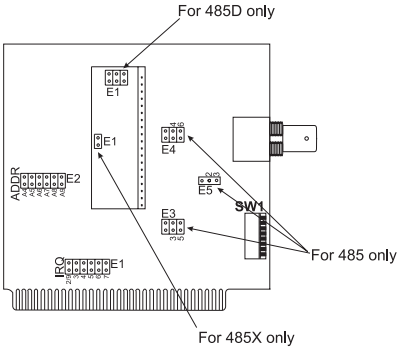

Figure 8—Jumper settings for EIA-485 models.

Electromagnetic Compatibility

The PCX20 series complies with Class A radiated and conducted emissions as defined by CFR 47 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 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 on-line technical manuals, downloadable software drivers and utility programs that can test the product. When contacting us, just ask for technical support.

Warranty

Contemporary Controls (CC) warrants its new product to the original purchaser for two years from the product shipping date. Product returned to CC for repair is warranted for one year from the date that the repaired product is shipped back to the purchaser or for the remainder of the original warranty period, whichever is longer.

If a CC product fails to operate in compliance with its specification during the warranty 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.

CC's limited warranty covers products only as delivered and does not cover repair of products that have been damaged by abuse, accident, disaster, misuse, or incorrect installation. User modification may void the warranty if the product is damaged by the modification, 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. IN NO EVENT WILL CC BE LIABLE FOR ANY DAMAGES INCLUDING LOST PROFITS, LOST SAVINGS, OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT EVEN IF CC HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, OR FOR ANY CLAIM BY ANY PARTY OTHER THAN THE PURCHASER.

THE ABOVE WARRANTY IS IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED OR STATUTORY, INCLUDING THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE OR USE, TITLE AND NONINFRINGEMENT.

Returning Products for Repair

Return the product to the location from which it was purchased by following the instructions at the URL below:

www.ccontrols.com/rma.htm

DECLARATION OF CONFORMITY

Additional compliance documentation can be found on our website.

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