# ARCNET Interface Cards from Contemporary Controls for the PA10 Robot Arm from Mitsubishi Heavy Industries

We have received many similar enquiries concerning the potential use of ARCNET cards from Contemporary Controls (CC) to interface with the PA10 Robot Arm from Mitsubishi Heavy Industries (MHI). Therefore, CC thought it would be useful to summarize our information regarding this issue.

As we understand it, the PA10 Robot Arm is supplied with an ARCNET interface that uses either the COM20020 or COM20022 ARCNET controller chip, plus the HYC4000 line driver. The HYC4000 is an eight-pin device that converts the ARCNET data-stream into an AC-coupled 'backplane-mode' EIA 485 waveform for transmission over twisted-pair cable at data rates from 10 Mbps down to 156.25 kbps. The COM20020 can operate as high as 2.5 Mbps, the COM20022 as high as 10 Mbps.

MHI offers an optional Optical Conversion Board (OCB) designed to replace the HYC4000 line driver on the PA10 Control Board — thus, using fiber-optic cable as the network medium instead of twisted-pair. It is supplied with an 8-pin header as a direct pin-for-pin replacement for the HYC4000. However, because the OCB requires ***PLASTIC*** optical fiber, it ***cannot*** communicate to fiber ports on CC ARCNET cards.

CC offers a wide range of ARCNET interface cards with various connectors and line drivers to support coaxial, twisted-pair, and fiber-optic cabling. These accommodate different computer bus types including PCI, ISA and PC/104.

CC cards that employ the COM20020 chip (2.5 Mbps max. data rate) are:

| | |
|---|---|
| ISA Bus: | PCX20 Series |
| PC/104 Bus: | PC10420 Series |

CC cards that employ the COM20022 controller chip (10 Mbps max. data rate) are:

| | |
|---|---|
| PCI Bus: | PCI20U Series |
| PC/104 Bus | PC10422 Series |

Data sheets, software (including drivers) and other information for these products can be found at:

www.ccontrols.com/arccontrol/nims.htm

Currently the HYC4000 transceiver is offered in the PCI20U-4000 and the PC10422-4000 models. The transceivers on these cards can be simply replaced by the OCB with proper signal polarity and pin identity achieved automatically.

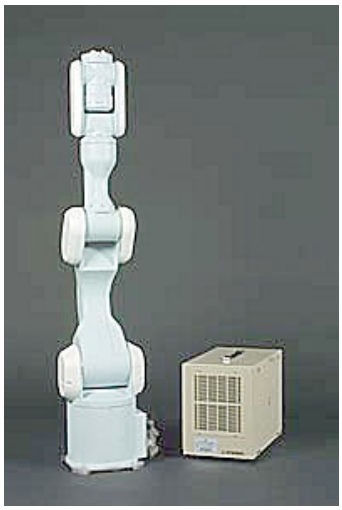
However, other CC ARCNET cards use daughterboard transceivers that vary with network cabling but are always mounted via 20-pin headers. On these cards, the OCB is not a simple plug-in replacement. It should be a simple task, though, to remove the header from the OCB and the transceiver from the CC card, and then connect the OCB flying leads directly to the CC card. (But doing this voids the warranty.)

The OCB uses 4 connections that can be “mapped” to 4 of the 20 pins on CC transceivers in the following manner (position 1 of the CC card is indicated by a square PCB soldering pad):

Pin 2 of the OCB (+5V) connects to position 6 of the CC card.
Pin 3 of the OCB (RXIN) connects to position 7 of the CC card.
Pin 6 of the OCB (GND) connects to any of positions 4, 13, 14 or 17 of the CC card.
Pin 8 of the OCB (PULSE1) connects to position 20 of the CC card.

A suitable method of securing the OCB must be devised but is not addressed here.

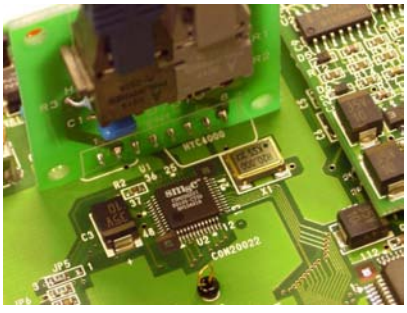
# Modification of a Contemporary Controls ARCNET Card to Control a Mitsubishi Heavy Industries, Inc. PA10 Robot Arm

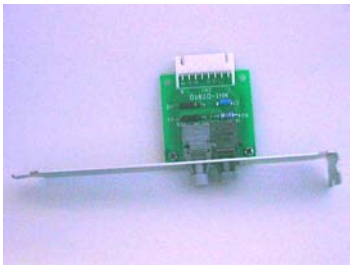


The manipulators of the PA10 series by Mitsubishi Heavy Industries can be controlled via ARCNET in addition to the Motion Control Board shipped with the PA10 by default. The image to the left shows a PA10-6C and its controller.

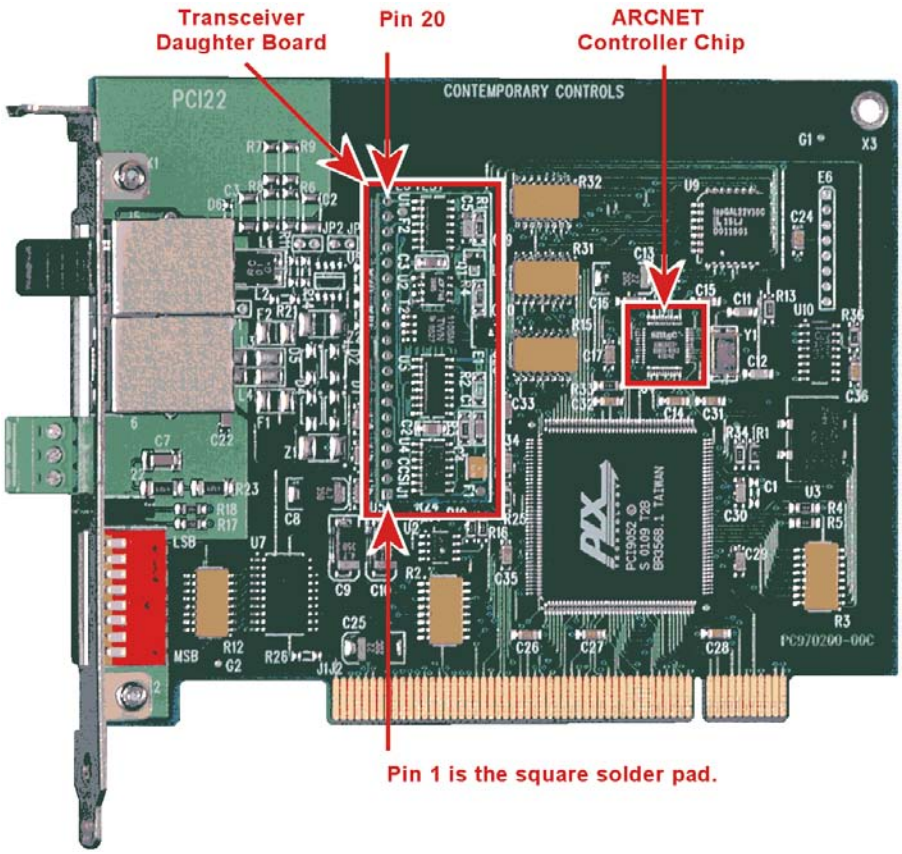
To create an ARCNET connection between the manipulator's controller and your computer you will need an appropriate ARCNET card. Such a card is not available from Mitsubishi, but the text below explains how a PCI22-485X ARCNET card from Contemporary Controls was modified to work with the PA10. This procedure was done by Daniel Westhoff while a student at the University of Hamburg and he also supplied the photographs. Mr. Peter Jefferson furnished support from Contemporary Controls, UK. NOTE: Because the PCI22-485X is no longer available, the following discussion is only useful if you plan to modify an older ARCNET card that is already in your possession.

The PA10 controller board has two parts relevant to ARCNET communication. The first element is the ARCNET chip. On newer PA10 manipulators the COM20022 (with data rates up to 10 Mbps) from is used. Older PA10 models use the COM20020 with data rates up to 5 Mbps. The second element is the media transceiver (the small vertical board in the left image below). Newer PA10 manipulators also have a transceiver that converts from electrical to optical signals for use with fiber optic cable. Mitsubishi calls this the Optical Conversion Board (OCB). A solution for the older PA10 with EIA-485 interface is **not** covered by this procedure.





To complement the OCB mounted on the PA10 controller, an additional OCB was provided by Mitsubishi. It is a small board with a slot bracket (right image above). The remaining text describes how this board can be connected to a PCI22-485X. (The PA10 manual *Instruction Manual for Servo Driver* describes a similar retro-fitting for ARCNET cards equipped with an HYC4000 transceiver.)

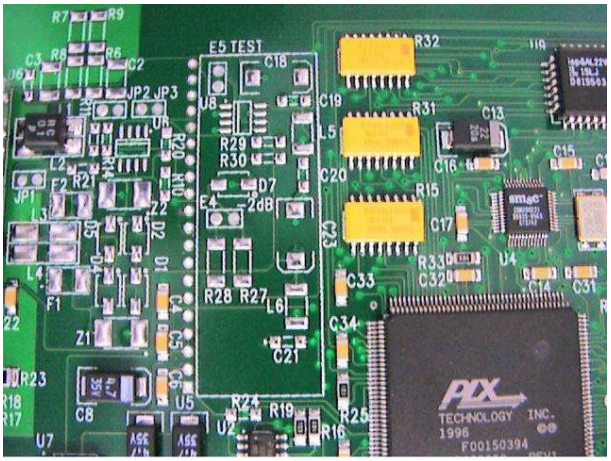



**Contemporary Controls PCI22-485X**

The cards of the PCI22 Series (above image) form the basis of this description. These cards are equipped with the COM20022 chip. Use the PCI20 Series if your PA10 has the COM20020 chip. The following steps apply regardless of the type of interface card being used.

**NOTE: MODIFICATIONS MADE TO A CARD WILL VOID ITS WARRANTY!**

Transceiver Daughter Board



PCI22 with Transceiver Removed

As with the PA10, ARCNET cards also have two relevant parts, the ARCNET chip and the transceiver (preceding image, left). The transceiver is built on a small circuit board (daughter board) mounted on the primary card. The various ARCNET interface cards differ mainly by virtue of the transceiver circuitry and its associated port connector. Most transceiver daughter boards are soldered onto the main board, but a few are pressed-fitted to a 20-pin connector that is itself soldered in place. A press-fitted transceiver can be removed cautiously with a screwdriver or similar prying tool and its 20-pin connector then unsoldered from the main board. After cleanly unsoldering the transceiver (or its 20-pin connector, if applicable), a new connector can be soldered into the same position on the board (preceding image, right). (Some users may wish to skip the connector and solder cable wires directly to the main board.)

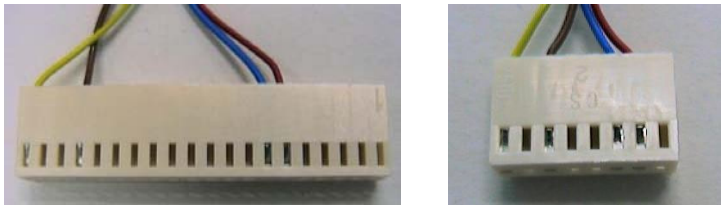
A new connector allows a detachable cable between the ARCNET card and the OCB, but a keyed connector is recommended to prevent polarity mis-match. The original 20-pin transceiver pin numbering (the square solder pad is pin 1) provided the following connections: Pin 6 ties to +5V. Ground is available on pins 4, 13, 14 and 17. For the ARCNET controller chip signals, pin 7 connects to RXIN and pin 20 to PULSE1.

A 4-wire cable must connect the ARCNET card to the OCB. The 8-pin connector of the OCB may be retained, if the user has a plug that fits it. Alternatively, the cable can be hard-wired at both the ARCNET card and the OCB. Take care that you connect the pins correctly. For ease of assembly, some users prefer to replace the OCB 8-pin connector with one that includes a header for soldering wires as shown below.


**OCB: old connector (left) and new connector (right)**

To help in terminating your cable, use the following table. The listed wiring color scheme matches that of the sample connector photographs displayed below the table:

| ARCNET card connection points | Function | Color | OCB (D-7810) Connector Pins |
|---|---|---|---|
| PIN 6 | +5V | red | PIN 2 |
| PIN 7 | RXIN | blue | PIN 3 |
| PIN 4, 13, 14 or 17 | GND | brown | PIN 6 |
| PIN 20 | PULSE1 | yellow | PIN 8 |



**Sample connectors: ARCNET card (left) and OCB (right)**