PanelMate ControlNet Communication Driver Manual

Eaton Corporation
Cutler-Hammer Group
811 Greencrest Drive
Columbus, OH 43081

EATON | Cutler-Hammer

RESTRICTED RIGHTS LEGEND

TRADEMARKS

Printed in the United States of America.

P/N 01-00484-00

Table of Contents

Preface

Welcome to Cutler-Hammer's PanelMate ControlNet Communication Driver Manual. This chapter gives a brief overview of this manual, and provides information on Support Services.

About this Manual

Purpose

This manual describes how to use your Operator Station with ControlNet.

What's Inside

This manual is organized in the following way:

Preface	
Chapter 1:	*Introduction*, describes the ControlNet driver installation.
Chapter 2:	*ControlNet Interface Module*, describes the hardware layout of the ControlNet Module, as well as a description of the LED indicators and their behaviors.
Chapter 3:	*Connectivity*, describes supported messaging, how the ControlNet module connects to the network, the connectivity options, how to configure the PLC Name and Port Table in PanelMate software, and wiring guidelines.
Chapter 4:	*Memory Addressing and Communications to the Allen-Bradley PLC-5 Using DF1 (PCCC) Messaging*, describes PCCC references, memory addressing for the PLC-5, and monitored I/O.
Chapter 5	*Memory Addressing and Communications to the Allen-Bradley ControlLogix Using Control Information Protocol (CIP) Messaging*, describes CIP references and memory addressing for ControlLogix PLCs.
Appendix A:	*Error Codes*, describes ControlNet Peer Error Codes.
Index	Alphabetical listing of important names, subjects, and titles found within this manual, with their page numbers.

Support Services

It is Cutler-Hammer's goal to ensure your greatest possible satisfaction with the operation of our products. We are dedicated to providing fast, friendly, and accurate assistance. That is why we offer you so many ways to get the support you need. Whether it's by phone, fax, modem, or mail, you can access Cutler-Hammer support information **24 hours a day, seven days a week**. Our wide range of services include:

Technical Support **VOICE 1-800-809-2772**
FAX 614-882-0417
EMAIL chatechsupport@ch.etn.com

If you are in the U.S. or Canada, you can take advantage of our toll-free line for technical assistance with hardware and software product selection, system design and installation, and system debugging and diagnostics. Technical support engineers are available for calls during regular business hours (8 am - 5:30 pm EST) by calling 1-800-809-2772. International calls can be made to either the Tech Line at 1-800-809-2772 (toll call) or the Cutler-Hammer main business line at 614-882-3282. You can contact our technical support engineers by faxing your support requests directly to the Advanced Product Support Center (APSC) located in Columbus, Ohio at 614-882-0417. You can also contact our technical support engineers by emailing your support requests to chatechsupport@ch.etn.com.

Emergency Technical Support **VOICE 1-800-809-2772**

Because machines do not run on a nine-to-five schedule, we offer emergency after-hours technical support. A technical support engineer can be paged for emergencies involving plant down situations or safety issues. Emergency support calls are automatically routed directly to our answering service after-hours (5:30 pm - 8 am EST) and weekends. For emergency technical support, call 1-800-809-2772.

Note that the Emergency Technical Support phone number does not currently support product repairs or shipping outside normal business hours.

Information Fax-Back Service **FAX 614-899-5323**

The latest Cutler-Hammer product information, specifications, technical notes and company news is available to you via fax through our direct document request service at 614-899-5323. Using a touch-tone phone, you can select any of the info faxes from our automated product literature and technical document library, punch in a fax number and receive the information immediately.

If you have Internet capabilities, you also have access to technical support via our website at http://www.cutlerhammer.eaton.com/automation. The website includes technical notes, frequently asked questions, release notes, and other technical documentation. This direct technical support connection also offers you the ability to request assistance and exchange software files electronically.

Bulletin Board Service **MODEM 614-899-5209**

Parameters: 8 data bits, 1 stop bit, parity none, 9600-28.8K baud

If you have modem access, you can dial in directly to our electronic bulletin board service for the latest product and company information. File sharing, product software downloads and our user message service are just a few of the things you will find online at 614-899-5209.

Software Registration

FAX 614-899-4141
EMAIL aus@ch.etn.com

Register your software and receive free information updates regarding Cutler-Hammer products. Information will include details of software modificatioins, product enhancements, and reduced-price software upgrades. Registering your software also gives you access to Technical Support. You can register your software by using the registration form included with the software kit.

If you have Internet capabilities, you can register your software via our website at http://www.cutlerhammer.eaton.com/automation. Select “Tech Support” then “Automation Update Service”. Go to the Software Registration Form, fill it in and then submit the form.

Repair and Upgrade Service

VOICE 614-882-3282 ext. 7601
FAX 614-882-3414

Our well-equipped Customer Service department is ready to assist you with repairs, upgrades, and spare parts services. If a situation arises where one of these services is needed, just call 614-882-3282 x7601 or fax 614-882-3414.

Customer Support Center

VOICE 1-800-356-1243
FAX 1-800-752-8602

Authorized Cutler-Hammer distributors and Cutler-Hammer sales offices can get assistance for Cutler-Hammer standard and component product lines through the Customer Support Center. Call the Customer Support Center for the following assistance:

1. To place an order.
2. Stock availability, proof of shipment.
3. Expedite an existing order.
4. Product assistance and product price information.
5. Product returns other than warranty returns.
6. Information on local distributors or sales offices.

Address

Eaton Corporation
Cutler-Hammer Group
811 Greencrest Drive
Columbus, OH 43081

Introduction

1

This chapter discusses:

- *Driver installation*

Driver Installation

The Driver Software Kit contains a CD-ROM.

Caution: Before installing the drivers, make sure that the PanelMate Configuration software is not already running.

To install the drivers from the CD-ROM, select the **Install Software** option and then **Install Drivers**. From the dialog box, select the ControlNet driver you wish to install and then press the **OK** button.

ControlNet Interface Module

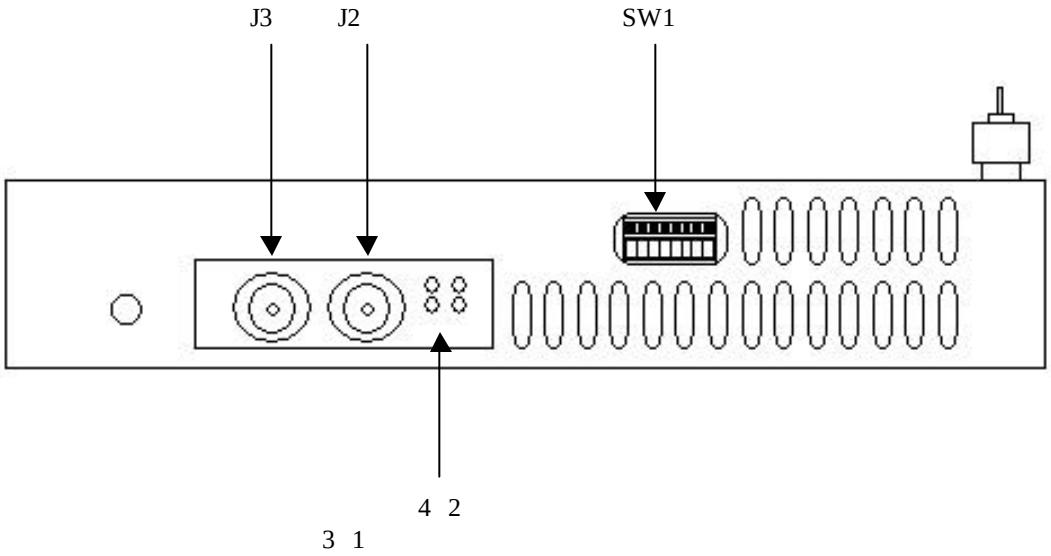
2

This chapter discusses:

- *The Hardware Layout*
- *Address Settings*
- *LED Indicators*

Hardware Layout

Below is a graphic representation of the end view of the ControlNet interface card.



The top set of stacked LED's are used to monitor UCS and network specific status. The bottom set of stacked LED's are used to monitor redundant ControlNet channel status. See the table below for a more detailed description of each component.

Item	Description
1	ControlNet Interface Status
2	Network Specific Status
3	Channel B Status
4	Channel A Status
J2	ControlNet Channel A BNC Connector
J3	ControlNet Channel B BNC Connector
SW1	ControlNet Addressing Switches

See following table for address settings.

Address Settings

Address	Switch Position								Address	Switch Position							
	1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0	50	0	0	1	1	0	0	1	0
1	0	0	0	0	0	0	0	1	51	0	0	1	1	0	0	1	1
2	0	0	0	0	0	0	1	0	52	0	0	1	1	0	1	0	0
3	0	0	0	0	0	0	1	1	53	0	0	1	1	0	1	0	1
4	0	0	0	0	0	1	0	0	54	0	0	1	1	0	1	1	0
5	0	0	0	0	0	1	0	1	55	0	0	1	1	0	1	1	1
6	0	0	0	0	0	1	1	0	56	0	0	1	1	1	0	0	0
7	0	0	0	0	0	1	1	1	57	0	0	1	1	1	0	0	1
8	0	0	0	0	1	0	0	0	58	0	0	1	1	1	0	1	0
9	0	0	0	0	1	0	0	1	59	0	0	1	1	1	0	1	1
10	0	0	0	0	1	0	1	0	60	0	0	1	1	1	1	0	0
11	0	0	0	0	1	0	1	1	61	0	0	1	1	1	1	0	1
12	0	0	0	0	1	1	0	0	62	0	0	1	1	1	1	1	0
13	0	0	0	0	1	1	0	1	63	0	0	1	1	1	1	1	1
14	0	0	0	0	1	1	1	0	64	0	1	0	0	0	0	0	0
15	0	0	0	0	1	1	1	1	65	0	1	0	0	0	0	0	1
16	0	0	0	1	0	0	0	0	66	0	1	0	0	0	0	1	0
17	0	0	0	1	0	0	0	1	67	0	1	0	0	0	0	1	1
18	0	0	0	1	0	0	1	0	68	0	1	0	0	0	1	0	0
19	0	0	0	1	0	0	1	1	69	0	1	0	0	0	1	0	1
20	0	0	0	1	0	1	0	0	70	0	1	0	0	0	1	1	0
21	0	0	0	1	0	1	0	1	71	0	1	0	0	0	1	1	1
22	0	0	0	1	0	1	1	0	72	0	1	0	0	1	0	0	0
23	0	0	0	1	0	1	1	1	73	0	1	0	0	1	0	0	1
24	0	0	0	1	1	0	0	0	74	0	1	0	0	1	0	1	0
25	0	0	0	1	1	0	0	1	75	0	1	0	0	1	0	1	1
26	0	0	0	1	1	0	1	0	76	0	1	0	0	1	1	0	0
27	0	0	0	1	1	0	1	1	77	0	1	0	0	1	1	0	1
28	0	0	0	1	1	1	0	0	78	0	1	0	0	1	1	1	0
29	0	0	0	1	1	1	0	1	79	0	1	0	0	1	1	1	1
30	0	0	0	1	1	1	1	0	80	0	1	0	1	0	0	0	0
31	0	0	0	1	1	1	1	1	81	0	1	0	1	0	0	0	1
32	0	0	1	0	0	0	0	0	82	0	1	0	1	0	0	1	0
33	0	0	1	0	0	0	0	1	83	0	1	0	1	0	0	1	1
34	0	0	1	0	0	0	1	0	84	0	1	0	1	0	1	0	0
35	0	0	1	0	0	0	1	1	85	0	1	0	1	0	1	0	1
36	0	0	1	0	0	1	0	0	86	0	1	0	1	0	1	1	0
37	0	0	1	0	0	1	0	1	87	0	1	0	1	0	1	1	1
38	0	0	1	0	0	1	1	0	88	0	1	0	1	1	0	0	0
39	0	0	1	0	0	1	1	1	89	0	1	0	1	1	0	0	1
40	0	0	1	0	1	0	0	0	90	0	1	0	1	1	0	1	0
41	0	0	1	0	1	0	0	1	91	0	1	0	1	1	0	1	1
42	0	0	1	0	1	0	1	0	92	0	1	0	1	1	1	0	0
43	0	0	1	0	1	0	1	1	93	0	1	0	1	1	1	0	1
44	0	0	1	0	1	1	0	0	94	0	1	0	1	1	1	1	0
45	0	0	1	0	1	1	0	1	95	0	1	0	1	1	1	1	1
46	0	0	1	0	1	1	1	0	96	0	1	1	0	0	0	0	0
47	0	0	1	0	1	1	1	1	97	0	1	1	0	0	0	0	1
48	0	0	1	1	0	0	0	0	98	0	1	1	0	0	0	1	0
49	0	0	1	1	0	0	0	1	99	0	1	1	0	0	0	1	1

LED Indicators

Net Status (Item 2)

The Network Specific LED is the upper-right LED on the ControlNet interface card. See page 2 for a side view of the card. The following table describes the behavior of the Network Specific LED:

LED State	Network Status
Off	Network interface offline/No network power
Flashing Red	I/O Connection(s) in timed-out state or other Recoverable Fault.
Flashing Green	Device is online, but has no running connections
Solid Red	Unrecoverable Fault
Solid Green	Online with established connections
Flashing Green/Red	Self-test for A-B devices

ControlNet Interface Status (Item 1)

The ControlNet Interface status LED is the lower-right LED on the ControlNet interface card. See page 2 for a side view of the card. The following table describes the behavior of the UCS status LED.

LED State	Status
Off	No power
Solid Red	Hardware error
Flashing Red	Recoverable configuration fault (Invalid firmware, OEM data, or Personality Block)
Flashing Green	No errors
Solid Green	No errors
Amber	Configuration mode

Channel Status

The Channel Status LEDs are the left-most stacked set of LEDs on the on the ControlNet interface card. See page 2 for a side view of the card. They are read together when their states change synchronously to one another.

States	Network Status
Off	Network interface offline.
Solid Red	Network faulted state or other recoverable fault
Alternating Red/Green	Network ASIC self test
Alternating Red/Off	Incorrect node configuration. Check ControlNet parameters or node address.

The Channel Status LEDs are read independently when their states change asynchronous to one another:

States	Network Status
Off	Network channel disabled. Redundant Cable operation disabled.
Solid Green	Online normal operation.
Flashing Red/Off	Media fault or no other nodes present. Check for broken cables, bad connectors, etc.
Flashing Green/Off	Device is online, but is encountering temporary errors. Check termination and cables.
Flashing Green/Red	Incorrect network configuration.

Connectors

The Channel A and Channel B connectors (J2 and J3 respectively,) on the ControlNet interface card, provide redundant coax media connections to ControlNet using standard BNC female connectors. See page 2 for a side view of the card.

Connectivity

3

This chapter discusses:

- *Supported Messaging*
- *Network Connection*
- *Connectivity Options*
- *PLC Modules*
- *Wiring Guidelines*

Supported Messaging

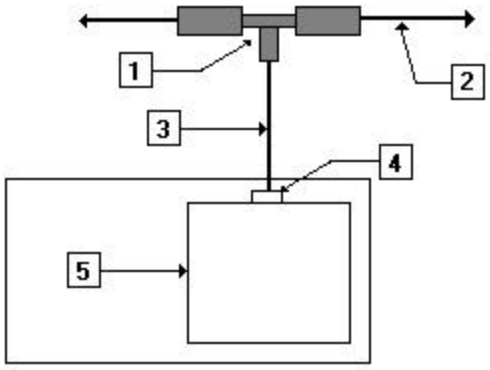
The Operator Station with the ControlNet Interface Module supports PCCC and CIP unscheduled messaging.

Note: PanelMate does not support scheduled messaging.

Network Connection

The figure below shows the rear of a PanelMate Power Pro Series unit. To connect the operator station to the ControlNet network:

1. Install a "passive Tee" (Tee and drop cable are combined,) connector [1] on the network cable [2].
2. Run a drop cable [3] from the Tee connector to the BNC connector [4] on the ControlNet Module [5].



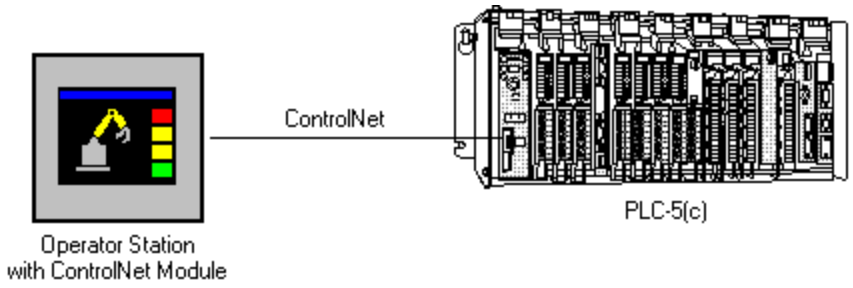
Network Termination

If the Operator Station is the last node (at the end of) the network, install a 75 Ω terminating resistor in the unused plug of the Tee connector.

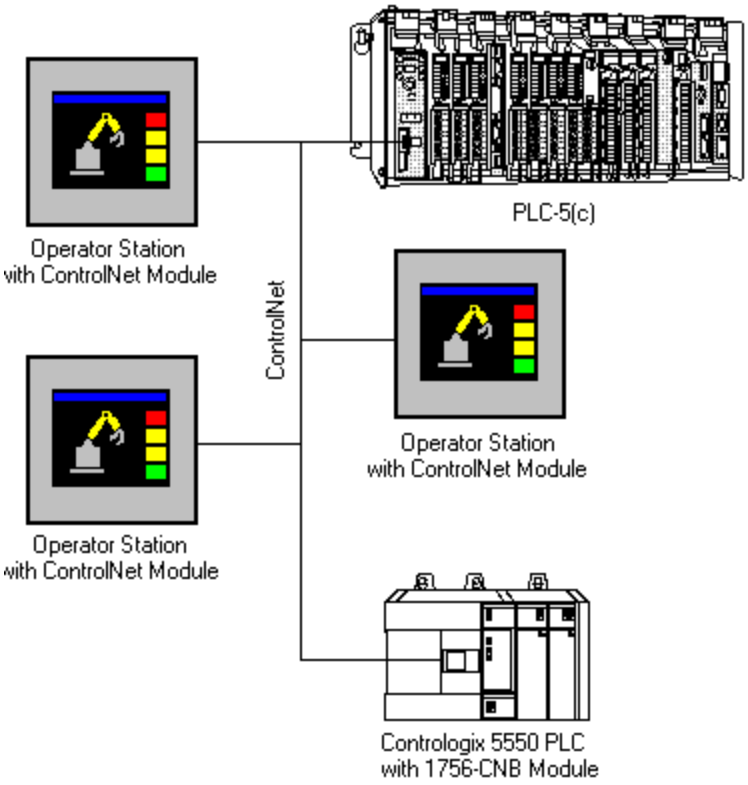
Connectivity Options

One Operator Station to One PLC

Connecting to ControlNet using the ControlNet Interface Card



Multiple Stations to Multiple PLCs



PLC Modules

Operator Station Connection to ControlNet using the ControlNet Interface Module

Configure the following setup in the **PLC Name and Port Table**.

Field	Selection	Comments
Port	I/O	Selects communications card.
Device Use	ControlNet	ControlNet Peer
Local ID		N/A
Data Bits		N/A
Stop Bits		N/A
Parity		N/A
Baud Rate		N/A
Electrical		N/A
Name		Use a six-character name. (alphanumeric or underscore)
Port	I/O	Name assigned to the PLC by the user
Model		Set to match the A-B PLC model type. (Used for range checking in addressing)
Remote ID		Must match the Processor ControlNet Node Number.

Notes:

- Do not duplicate node numbers on the network.
- The Operator Station ID must not match another used number on the network.

Wiring Guidelines

Consult the Allen-Bradley ControlNet publications for details on wiring guidelines.

Memory Addressing and Communications to the Allen-Bradley PLC-5 Using DF1 (PCCC) Messaging

4

This chapter discusses:

- *PCCC Memory Addressing*
- *I/O Format*
- *Status Format*
- *Memory Addressing Examples*

PCCC Memory Addressing

General Format

The Allen-Bradley PLC-5 uses decimal word addresses. The Operator Station default format is S16. The following word and bit addressing descriptions apply to the PLC-5 Command Set.

[xf:e.s/b] - (/b is an optional field.)

x File Type

B	Bit (Signed 16)
BT	Block Transfer
C	Counter***** (Signed 16)
F	Floating point (IEEE single precision floating point)
N	Integer (Signed 16)
PD	PID
R	Control***** (Signed 16)
T	Timer* (Signed 16)
*****	For Control, Timer, and Counter files; word 0 is read only, and words 1 and 2 are read/write.

F File Number

0-2	Reserved
3	Bit
4	Timer
5	Counter
6	Control
7	Integer
8	Floating Point
9-999	Additional File Storage
:	Element Delimiter

E Element Number (0 to 999, decimal)

. Subelement Delimiter

S Subelement mnemonic (used with **C**ounter, **T**imer, and Cont**r**ol files).

Timer (T):

PRE: Preset Value (word 1)

ACC: Accumulated Value (word 2)

Counter (C):

PRE: Preset Value (word 1)

ACC: Accumulated Value (word 2)

Cont**r**ol (R):

LEN: Length (word 1)

POS: Position (word 2)

/ Bit Delimiter

B Bit Number (not used in word preferences)

0 - 15999 Decimal for Bit type files when the element number is not specified (optional).

0 - 15 Decimal for all other files types, including Bit type files which specify the element number.

Note: Access to bits directly within a complex structure such as timers and counters are not supported.

Certain file types allow mnemonics to be used instead of the actual bit number. The mnemonic should be placed after the "." and the "/" is not used in this case. The following is a list of mnemonics that can be used.

Bit	Block Transfer (BT)
	EN enable
	ST
	DN done
	ER
	CO
	EW
	NR
	TO
	RW
	RLEN
	DLEN
	File
	Elem
	R
	G
	S

Bit	Counter (C)
15	**CU** up enable
14	**CD** down enable
13	**DN** done
12	**OV** overflow
11	**UN** underflow
0-10	**INVALID**

Bit	PID
	EN
	CT
	CL
	PVT
	DO
	SWM
	CA
	MO
	PE
	INI
	SPOR
	OLL
	OLH
	EWD
	DVNA
	DVPA
	PVLA
	PVHA
	SP
	KP
	KI
	KD
	BIAS
	MAXS
	MINS
	DB
	SO
	MAXO
	MINO
	UPD
	PV
	ERR

OUT
PVH
PVL
DVP
DVN
PVDB
DVDB
MAXI
MINI
TIE

Bit	Control (R)
15	**EN** enable
14	**EU** unload enable
13	**DN** done
12	**EM** empty
11	**ER** error
10	**UL** unload
9	**IN** inhibit
8	**FD** found
0-7	**INVALID**

Bit	Timer (T)
15	**EN** enable
14	**TT** timing
13	**DN** done
0-12	**INVALID**

I/O Format

When using the Operator Station to access I/O file types in the Allen-Bradley PLC-5, the following format must be used. The following word and bit addressing descriptions apply to the PLC-5 Command Set.

[I:rg/b] or **[O:rg/b]** - (/b is an optional field.)

- **I** Input
- **O** Output
- **:** Rack delimiter
- **r** Assigned rack number
  - 0-3 for PLC-5/12 and PLC-5/15
  - 0-7 for PLC-5/25
- **g** I/O group number
  - 0-7 for all PLC-5 models
- **/** Bit delimiter
- **b** Terminal (bit) number
  - 0-17 for all PLC-5 models

Note: To address an I/O word, do not include the /b field.

Status Format

The following word and bit addressing descriptions apply to the PLC-5 Command Set.

[S:e/b] - (/b is an optional field.)

- **S** Status
- **:** Element delimiter
- **e** Element number (0-31)
- **/** Bit delimiter
- **b** Bit number (0-15)

Note: To address a status word, do not include the /b field.

Memory Addressing Examples

Word References

Reference	Description
[B321:100]	Element 100 of Bit file 321
[N22:15]	Element 15 of Integer file 22
[I:02]	Group 2 in rack 0 of reserved Input file 1
[o:27]	Group 7 in rack 2 of reserved Ouput file 0
[S:22]	Element 22 in reserved Status file 2
[C222:444]	Control value in element 444 of Counter file 222
[C15:29.ACC]	Accumulated value in element 29 of Counter file 15
[c354:2.PRE]	Preset value in element 2 of Counter file 354
[T31:999]	Control value in element 999 of Timer file 31
[t9:52.aCC]	Accumulated value in element 52 of Timer file 9
[T354:2.pre]	Preset value in element 2 of Timer file 354
[r119:272]	Status value in element 272 of Control file 119
[R53:52.len]	Length value in element 52 of Control file 53
[R111:721.PoS]	Position value in element 721 of Control file 111
[b041:581]	Element 581 of Bit file 41
[n421:008]	Element 8 of Integer file 421
[F8:23]	Element 23 of Floating point file 8.

Bit References

Reference	Description
[B34/17]	Bit 17 of Bit file 34 (bit 1 of element 1)
[b4:091/10]	Bit 10 of element 91 of Bit file 4
[N007:25/06]	Bit 6 of element 25 of Integer file 7
[I:15/7]	Bit 7 in group 5 of rack 1 of Input file 1
[O:32/1]	Bit 11 in group 2 of rack 3 in Output file 0
[s:06/8]	Bit 8 in element 6 of Status file 2
[T9:71.eN]	Enable bit (15) in control word of element 71 of Timer file 9
[t4:1.DN]	Done bit (13) in control word of element 1 of Timer file 4
[C005:28.UN]	Underflow bit (11) in control word of element 28 of Counter file 5
[c163:08/14]	Down Enable bit (14) in control word of element 8 of Counter file 163
[R6:954.fd]	Found bit (8) in status word of element 954 in Control file 6
[r46:83/09]	Inhibit bit (9) in status word of element 83 in Control file 46

Memory Addressing and Communications to the Allen-Bradley ControlLogix Using Control Information Protocol (CIP) Messaging

5

This chapter discusses:

- *CIP References*
- *ControlNet Messaging*
- *ControlLogix Addressing*
- *ControlLogix Addressing Using PLC-5 or SLC Address Syntax*
- *Controller Tags versus Program Tags*
- *CIP Memory Addressing*

CIP References

These types of references are used to access message tags that represent data within the PLC. References to these message tags are created and sent using CIP message protocol. This protocol requires the message tag name, the data type, the offset, and the request length. All of this information is entered by the user except the data type. A new reference is validated against a PLC's .csv file. Once the reference message tag is found, the data type can be extracted.

Reference format

<Tag Name>[Dimension1, Dimension2, Dimension3]{Request Length}

Field	Description
Tag Name	This is the case sensitive name of the message tag found within the PLC.
Dimensions	The dimensions are separated by commas. There can be 0,1,2,or 3 dimensions defined in a single reference. All dimensions are delimited by the '[' and']' characters. Range of each dimension is limited by 16 bits (0 – 0xFFFF) and define the offset of the first requested data element. This value may not be greater than the dimensions defined within the message tag found within the referenced node.
Request Length	Not applicable in PanelMate.

Example

Message Tag = Fred[5]

Fred

Fred[2]

BOOLEAN References

Boolean references may not cross DWORD boundaries. For example, if you have an array of BOOL[128], references may not cross multiples of 32.

Example

BOOL[28]{5} crosses a boundary and will not work

BOOL[28]{2} does not cross a boundary

Note: The description and data type fields are delimited by commas and quotes

Tag Names:

First character must be an alpha character

All characters must be alphanumeric, an underscore, or a dot. All other characters are invalid.

Names must be at least one character.

ControlNet Messaging

The PanelMate Power Pro ControlNet driver communicates on ControlNet using the unscheduled portion of network bandwidth. ControlNet can be characterized as having both the older Remote I/O and Data Highway Plus communications capabilities combined onto a single network. In ControlNet terminology this means that there are "scheduled" messages that are used by the ControlNet Master to read its slave's inputs and updates its slave's outputs with every update of the network (Network Update Time or ***NUT***). The time for the ControlNet Master to read and write to all of its configured slaves can be calculated from the ControlNet configuration tool. The configuration tool requires that the ***NUT*** be set to a number larger than the calculated slave messaging time to allow "unscheduled" requests of data from non-slave devices. These "unscheduled" requests are analogous to Data Highway like polls from peers on the ControlNet network.

For unscheduled messaging ControlNet offers two different methods of communicating. One is "unconnected" messaging, which means that the device initiating the unscheduled communication opens a socket, or "connects" to the requested device, sends a message, receives a response, and then closes the sockets, or "disconnects". The second method is "connected" messaging, whereby the initiating device opens a socket ("connects") to the requested device, sends a message, receives a response, then leaves the socket open so that another message can be sent without re-opening a connection. The PanelMate Power Pro ControlNet driver communicates using connected messaging. The connection is left open until the block of data being read from the PLC is no longer needed, which can happen when a page change takes place and a different block of data is needed for the new page. In this case the old connection(s) is/are terminated and new ones established. Background reads for alarming, trending, and message display are established at startup and left open until the PanelMate is taken offline. Connected messaging is a more efficient method of communicating on ControlNet but it does mean that the PLC's on the network must support all the active connections of those devices communicating to it using unscheduled messaging. In the case of ControlLogix PLC's, the CNB (Control Net Bridge) modules have a maximum number of connections that can be supported at one time (initial versions supported a maximum of 64). If more connections are required additional CNB modules must be added to a ControlLogix rack to handle the communications load.

ControlLogix Addressing

The ControlLogix addressing structure is different from that of all other Allen-Bradley PLC's. Whereas PLC-5's and SLC-500's use a File Type-File Number:Word/Bit nomenclature the ControlLogix uses an open, alphanumeric tag name format. For instance the user can create a tag called "Machine_speed" and the data type of that variable is established when the controller tag is defined in the RSLogix 5000 software. The data types supported within ControlLogix are extensive and broken into two categories, atomic types and structures. Atomic data types include Bool (single bit - Boolean), INT (16-bit signed integers), DINT (32-bit signed integers), SINT (8-bit signed integers), and REAL (32-bit IEEE floating point). These atomic types are all available as array data types with 1, 2, or 3 dimensions. Structure data types include pre-defined types for TIMER, COUNTER, PID, AXIS, CONTROL, MESSAGE, MOTION INSTRUCTION, and MOTION GROUP instructions. The ControlLogix also supports user defined structures. See section XXX of this manual to view the data types that are supported by our ControlNet driver.

This powerful flexibility can be confusing to traditional Allen-Bradley PLC users who didn't have as many decisions to make when defining the memory layout of their PLC. At first glance it would seem to

make sense to define all user created variables as single controller tags with descriptive alphanumeric names. This would serve the same purpose of assigning symbolic names within a PLC-5 or SLC program so that the user doesn't have to memorize or look up cryptic addresses. The problem with using all individual controller tags has to do with being able to read the ControlLogix data table efficiently using unscheduled messaging. The ControlNet protocol (CIP) is less efficient when asking for multiple individual tags within a single ControlNet message than when asking for an array of tags or a structure. Even on a high bandwidth network such as ControlNet, reading many individual tags can significantly bog down communications throughput. However, the protocol is very efficient when requesting large blocks of data if that data is in an array or a large pre-defined or user-defined structure. The problem with using arrays is that the user gives up the easy memorization of variables. If you name an array "**Machine_Integers**" and the array has 500 elements, then an individual piece of data is referenced as Machine_Integers[0], Machine_Integers[1], Machine_Integers[2], ……, Machine_Integers[499], or a bit within one of those integer values would be referenced as Machine_Integers[44].0, Machine_Integers[44].1, Machine_Integers[44].2, ……, Machine_Integers[44].16. The RSLogix 5000 logic editor has a solution for this problem in that it allows the user to create a tag that is an "alias" for another tag. For example the user can create a tag named "tension" that is an alias for "Machine_Integers[77]", or a tag named "gate_open" that is an alias for "Machine_Integers[32].8. In the logic editor this is no more work than creating individual tags, and satisfies the ease-of-use issue of unique alphanumeric tags while allowing optimized communications on ControlNet for Operator Interface performance.

The ControlNet driver requires that the user export the tags from their RSLogix 5000 program when communicating to a ControlLogix PLC, and then use that tag cross-reference file (.CSV) within the PanelMate Power Pro editor. To export with the RSLogix 5000 editor, select "Export Tags" from the "Tools" pull-down menu. The tag and reference columns must both be set to the column labeled "NAME" (column 3) and the line number (Tag Start Line) must be the line following the column header "TYPE, SCOPE, NAME, DESCRIPTION, DATATYPE, SPECIFIER" (line 8). If you extensively use aliases in your database for values to display on PanelMate, and because the tag export from RSLogix doesn't sort between the raw tag names and the aliases for those tags, it may be helpful to open the exported file with Excel and sort the file so that all the tags are at the beginning and all the aliases at the end. Then when opening the cross-reference file within the PLC Name and Port Table of PanelMate you can select the tag start line to be the first alias so that the raw tags are not displayed intermixed with the aliases when editing.

Raw tag arrays and built-in structures such as TIMERS, COUNTERS, and PID can be accessed efficiently using unscheduled ControlNet messaging. The only problem is that the exported tag file from RSLogix 5000 does not show the structure elements or array indexes of each of these data types. For example, if a variable named Timer1 is created and assigned a TIMER structure data type, the tag cross reference file will only show the base tag of Timer1 and not the individual elements, such as the preset (Timer1.PRE) or accumulator (Timer1.ACC). This makes editing using the provided cross-reference file more cumbersome. However, RSLogix 5000 allows assigning aliases to individual structure elements so that the user can create an alias for the Timer1.ACC called timer1_acc or some other name that will allow the tag feature of PanelMate to easily access structure elements directly without resorting to typing the structure elements or array indices in the PanelMate editor.

ControlLogix Addressing Using PLC-5 or SLC Address Syntax

An alternate addressing convention available when communicating with ControlLogix PLC's uses the traditional PLC-5 and SLC addressing format *FileTypeFileNumber:Word/bit*, (Eg. N7:55, or B3:12/02, or

F8:15). This allows PLC-5 and SLC users who migrate applications to ControlLogix PLC's to minimize reprogramming efforts. This requires the user to associate tags and tag arrays with PLC-5 or SLC file numbers. For example, if a 16-bit integer single-dimensional array of 1000 elements is named **Machine_Integers**, and it is given a PLC-5 file number of 24 in the RSLogix 5000 editor then the following table shows the alternate addressing syntax for referencing words or bits in that array.

Machine_Integers [0]	N24:0
Machine_Integers [1]	N24:1
Machine_Integers [2]	N24:2
Machine_Integers [999]	N24:999
Machine_Integers [26].12	N24:26/12

If the array data type is Boolean, then the file type specifier would be **B, D** for double-precision integer, and **F** for IEEE floating point. To associate an array with a PLC-5 or SLC file number in RSLogix 5000, go to the pull down menu for "Logic" and select "Map PLC/SLC Messages". The "PLC2, 3, 5 / SLC Mapping" dialog box lets the user establish the assignment of file number to array tag name.

Note that this PLC-5 or SLC file assignment is not shown in the exported tag cross-reference file so the addresses must be entered by typing them in the PanelMate editor, or the .CSV file must be modified manually every time tags are added or deleted in the ControlLogix program. This addressing methodology is recommended only for users who are trying to quickly migrate existing configurations that communicated to PLC-5's or SLC 500's to communicate over ControlNet with ControlLogix PLC's.

Controller Tags versus Program Tags

ControlLogix programs can contain both Controller Tags and Program Tags. Controller Tags can be considered as being global to all programs running on the logic processor and are unique. Program Tags are local to a single program and are unique within the program but cannot be accessed by other programs. The ControlNet driver supports both Controller Tags and Program Tags.

CIP Memory Addressing

General Formats

Controller Tags:

Tagname
Tagname.nn
Tagname.subelement
Tagname.subelement.nn
Tagname[mmm]
Tagname[mmm].nn
Tagname[mmm].subelement
Tagname[mmm].subelement.nn
Alias

Program Tags:

ProgramName:Tagname
ProgramName:Tagname.nn
ProgramName:Tagname.subelement
ProgramName:Tagname.subelement.nn
ProgramName:Tagname[mmm]
ProgramName:Tagname[mmm].nn
ProgramName:Tagname[mmm].subelement
ProgramName:Tagname[mmm].subelement.nn
ProgramName:Alias

Where:

ProgramName is the name of the program where the tag is located
Tagname is any legal tagname within ControlLogix
subelement is a subelement within structure
nn is a bit within an integer data type
INT – nn = 0 through 15
DINT – nn = 0 through 31
SINT – nn = 0 through 7
mmm is an array element in a one dimensional (1-D) array
mmm = 0 to 65535
Alias is an alias, or pointer, to another tag. An alias can be configured as a pointer to any tag, structure element, array element, or bit.

Supported Data Types

Data types that are supported in the ControlNet driver include:

BOOL	Boolean or bit (single tag or 1-D array)
CONTROL	Control (structure)
COUNTER	Counter (structure)
DINT	Double Integer (signed 32: single tag or 1-D array)
INT	Integer (signed 16: single tag or 1-D array)
MESSAGE	Message (structure)
PID	PID (structure)
REAL	Floating Point (IEEE single precision: single tag or 1-D array)
SINT	Short Integer (signed 8: single tag or 1-D array)
TIMER	Timer (structure)

Addressing Examples

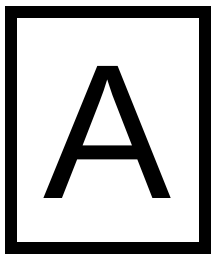
The following are examples of legal addressing syntax (note that all tag names shown here are just examples of legal tag names in the ControlLogix PLC family)

Tag Name		Data Type
Machine_Speed		BOOL, INT, DINT, SINT, REAL
Tank_22_Parameters[25]		BOOL, INT, DINT, SINT, REAL
Tank_3_Parameters[244].07		INT, DINT, SINT
Tank_3_Parameters[522].14		INT, DINT
Tank_3_Parameters[18].25	DINT	
Limit_switch_status		Alias for any legal data type
Box_sensor		Alias for any legal data type
Part_count_machine1_shift3.ACC		COUNTER or TIMER
Zone3_Extruder5_Temp.PV		PID
Zone3_Extruder5_Temp.CTL		PID
Controller1.POS		CONTROL
message31.REQ_LEN		MESSAGE
Main_program:Counter.pre		COUNTER within a Program tag
First_Floor:Tank[0].0		INT within a Program tag

The following are examples of illegal addressing syntax (here again all tag names are just examples). We recommend mapping these data types to supported data types within the processor.

Tag Name	Illegal Reason
Machine Speed	spaces in tag name are not allowed in ControlLogix
Tank_22_Parameters[25][33]	only single-dimension arrays are supported in PanelMate's ControlNet interface
Machine1.motor_amps	User-defined data types are not supported in PanelMate's ControlNet interface
drive14.MotionStatus.7	AXIS data type is not supported in PanelMate's ControlNet interface
Local:3:I.Fault	Local I/O cannot be accessed directly.
Motor_Speed[0].acc.0	Bits within a structure like the accumulator in a timer cannot be accessed directly.

Error Codes



This appendix includes ControlNet specific error messages.

ControlNet Interface Peer Error Codes

System Errors

Error	Description
Sys: 0 ControlNet Interface module hardware error	The ControlNet Interface module self-test has detected a hardware error.
Sys: 0 ControlNet Interface module startup error	The ControlNet Interface module cannot enter run mode due to a fatal error.
Sys: 0 ControlNet Interface module assertion error	The ControlNet Interface firmware has detected an unexpected condition.
Sys: 0 ControlNet Interface module abortion error	The ControlNet Interface firmware has terminated abnormally.
Sys: 0 ControlNet Interface module kernel error	The ControlNet Interface firmware kernel has detected a fatal error.
Sys: 0 ControlNet Interface module watchdog timer error	The ControlNet Interface hardware watchdog has expired.
Sys: 0 ControlNet Interface module not detected	The ControlNet Interface module could not be found.
Sys: 0 ControlNet Interface open data exchange interface error	The ControlNet Interface module data exchange interface could not be opened.
Sys: 0 ControlNet Interface open data exchange interface timeout	The ControlNet Interface module attempt to open the data exchange interface timed out.
Sys: 0 ControlNet Interface offline due to network fault	The ControlNet Interface network interface is offline due to a network fault.
Sys: 0 ControlNet Interface offline due to configuration fault	The ControlNet Interface network interface is offline due to a configuration fault.
Sys: 0 ControlNet Interface online but data service failed	The ControlNet Interface network interface in online but one or more data services have failed.
Sys: 0 ControlNet Interface online but data service idle	The ControlNet Interface network interface in online but one or more data services are idle.
Sys: 0 ControlNet Interface online but data service suspended	The ControlNet Interface network interface in online but one or more data services have been suspended.
Sys: 0 ControlNet Interface error reading OEM data	The ControlNet Interface module OEM data could not be read.
Sys: 0 ControlNet Interface OEM data is invalid	The ControlNet Interface module OEM data is invalid.

Local Errors

Error	Description
Loc: 0 on via ControlNet Interface is offline	The ControlNet Interface network interface is offline
Loc: 0 on via ControlNet Interface is offline due to network fault	The ControlNet Interface network interface is offline due to a network fault.
Loc: 0 on via ControlNet Interface is offline due to configuration fault.	The ControlNet Interface network interface is offline due to a configuration fault. i.e. invalid or duplicate station address, invalid baud rate, invalid DIP switch data, etc.
Loc: 0 on via ControlNet Interface is online but data service failed	The ControlNet Interface network interface in online but one or more data services have failed.
Loc: 0 on via ControlNet Interface is online but data service idle	The ControlNet Interface network interface in online but one or more data services are idle.
Loc: 0 on via ControlNet Interface is online but data service suspended	The ControlNet Interface network interface in online but one or more data services have been suspended.
Loc: 0 on plc1 via ControlNet Interface timeout waiting for interrupt n10:0	The ControlNet Interface module did not respond within the given amount of time.
Loc: 0 on plc1 via ControlNet Interface module busy timeout n10:0	The ControlNet Interface module is busy performing another operation or the module is not responding.
Loc: 0 on plc1 via ControlNet Interface error parsing reference n10:0	An error was encountered parsing the reference, the operation cannot be performed.
Loc: 0 on plc1 via ControlNet Interface unscheduled messaging not supported n10:0	The ControlNet Interface module does not support unscheduled messaging.
Loc: 0 on plc1 via ControlNet Interface data exchange interface is not open n10:0	The ControlNet Interface module data exchange interface is not open.
Loc: 0 on plc1 via ControlNet Interface reference is not updateable n10:0	The reference does not match an updateable item.
Loc: 0 on plc1 via ControlNet Interface reference is read only n10:0	The referenced item does not support write updates.
Loc: 0 on plc1 via ControlNet Interface communication fault updating n10:0	The update could not be performed due to a communication fault.
Loc: 0 on plc1 via ControlNet Interface error response received updating n10:0	The update attempt resulted in an error response.
Loc: 0 on plc1 via ControlNet Interface trigger ID not supported n10:0	An invalid trigger ID was sent. ControlNet Interface Slave modules do not support unscheduled messages.
Loc: 0 on plc1 via ControlNet Interface trigger contains invalid data n10:0	A trigger sent to the ControlNet Interface module contains invalid data.
Loc: 0 on plc1 via ControlNet Interface trigger contains invalid parameter n10:0	A trigger sent to the ControlNet Interface module contains an invalid parameter.
Loc: 0 on plc1 via ControlNet Interface trigger is missing a parameter n10:0	A trigger sent to the ControlNet Interface module is missing a parameter.

Index

Reader Comment Card

Cutler-Hammer strives to provide quality user guides and product manuals. Please take a moment to fill out this comment card.

Title: Online Operation User's Guide 01-00484-00

	Excellent	Good	Fair	Poor
Is the document easy to follow?	☐	☐	☐	☐
Does the product work as described in this document?	☐	☐	☐	☐
Are the instructions easy to follow?	☐	☐	☐	☐
Are the examples helpful/useful?	☐	☐	☐	☐
Are there enough examples?	☐	☐	☐	☐
Is the document organized logically?	☐	☐	☐	☐
Is it easy to find what you are looking for?	☐	☐	☐	☐
Are the illustrations clear and useful?	☐	☐	☐	☐

How would you improve this document?

Please list any errors found in this document:

Other comments:

Your name and address: (optional)

Thank you for your comments. Please fax this page to:

Cutler-Hammer Technical Publications Dept.

FAX : 614-899-4141