ELECTRO INDUSTRIES PROTOCOL EMULATION

1.1 GENERAL DESCRIPTION

This section briefly describes the Electro Industries communication protocol for reference purposes only. The appropriate manufacturers documentation should be consulted for complete details of the protocol.

The Electro Industries protocol is an asynchronous byte oriented protocol. The protocol may be used either in a point-to-point or in a multi-drop configuration. The protocol can be used in either half or full-duplex operation. This protocol does not have any error detection fields.

All communications exchanges in the Electo Industries protocol are initiated by the host, in this case the Comm-Master. The remote meter cannot initiate any exchange with the host nor can the meter directly address or communicate with another meter. The meter will return a response to the host for all valid messages sent by the host that contain the meters ID number.

1.2 MESSAGE STRUCTURE

All messages to and from the Electro Industries meters consist of ASCII character strings.

All messages to the meter consist of a header character, the four (4) digit meter number, a data code and a function code. The first character is the sync character. This character will always be the capital letter R for messages from the master to the meter and an = sign or $ sign for meter responses. The meter number follows the R and is always a four (4) digit number. The meter number is unique for each meter on the communications channel. Valid addresses are 1-9999. Following the meter number is a single character data code and a single character function code. The meter will respond after it sees all seven (7) characters. The meter response will be one of three formats depending on the function and data codes in the request. The meter responses are:

- **an = sign followed a sign character (+ or -), a four (4) digit value and a carriage return**
- **an = sign followed by a 9 or 13 character value and a chariage return**
- **a $ sign followed by a length character then multiple value fields, and a checksum.**

Figures F-1 and F-2 detail the Electro Industries Data Codes and Function Codes that are supported by the Comm-Master.

Data Code	Description	**Implemented**
S = 53	Meter Setup	N
D = 44	Instantaneous	Y-Poll
A = 41	Running Average	Y-Poll
E = 45	Excess HI	N
F = 46	Excess LOW	N
X = 58	+ Maximum	Y-Poll
N = 4E	+ Minimum	Y-Poll
K = 4B	+ Total Hour	N
U = 55	-Maximum	Y-Poll
V = 56	-Minimum	Y-Poll
L = 4C	Total Hour.	N
x = 78	Reset + Maximum	Y-Message
n = 6E	Reset + Minimum	Y-Message
u = 75	Reset - Maximum	Y-Message
v = 76	Reset - Minimum	Y-Message

Figure F-1 Electro Industries Data Codes

Function Code	Description	**Implemented**
A = 41	Volt AN	Y
B = 42	Volt BN	Y
C = 43	Volt CN	Y
D = 44	Volt AB	Y
E = 45	Volt BC	Y
F = 46	Volt CA	Y
G = 47	Amp A	Y
H = 48	Amp B	Y
I = 49	Amp C	Y
J = 4A	Amp N	Y
K = 4B	KW	Y
L = 4C	KVAR	Y
M = 4D	KVA	Y
N = 4E	P.F.	Y
O = 4F	Frequency	Y
P = 50	Watt-Hour	Y
Q = 51	VA-Hour	Y
W = 57	Whole Group	N
_ (space) = 20	Single Function	Y

Figure F-2 Electro Industries Function Codes

1.2 Message Types

Electro Industries protocol communications exchanges can be divided into two types: data requests and control requests. In data requests (poll requests), the Comm-Master transmits a message requesting data values from the meter. The meter responds by transmitting the requested data value. The meter value is converted from ASCII string to a signed integer prior to storing it in the PLC.

Control requests are defined as any message from the master PLC that will reset the spedified maximum or minimum values in the meter.

R	Meter Number	Data Code	Function Code

=	sign	Data (ASCII) MSB	Data (ASCII)	Data (ASCII)	Data (ASCII) LSB	Carriage Return

Figure F-3 Comm-Master/Meter Message Exchange

1.4 COMM-MASTER ELECTRO INDUSTRIES CONFIGURATION TABLE

The following paragraphs detail the organization of the configuration table for a Comm-Master with Electro Industries communication protocol installed.

1.4.1 Comm-Master Electro Industries Configuration Header

Word offset 0 is used for 2 functions: Byte # 0 is used to define the Allen-Bradley Data Highway address of the interface module that is connected to the Comm-Master. This address is typically 11_8 but may be assigned to other values depending on the final system configuration. The address of the data highway interface module is used as the file address when reading or writing data to a PLC-5 system. The interface module can be assigned any address from 1 through $77_{8.;}$ Byte # 1 is used to define the number of RTU Polling Tables that are defined in the system. The Comm-Master will use this number to determine the number of Polling Table Entries to read.

Word offset 1 through 11 are used by the Comm-Master to define options for the protocol used on port 1 (top port). The Electro Industries protocol uses port P3 (bottom port). Words 1 through 12 must be set as defined i the appendix describing the protocol to be used on the master side.

Word offset 12 is used for two functions. Byte # 0 is used to select the Auxiliary (slave) port Baud Rate. Valid settings for this byte are: $0B_H$= 110 baud, $0F_H$= 150 baud, $1E_H$= 300 baud 78_H= 1200 baud or $F0_H$= 2400 baud. Byte 1 is used to select the Auxiliary Port Number of Data Bits option. Valid selections are: 07_H and 08_H, corresponding to seven and eight data bits respectively.

Word offset 13 is used for two options. Byte 0 is used to select the Auxiliary Port Parity option and byte 1 is used to select the number of stop bits to use. Valid selections for byte 0 are 00_H= no parity, 01_H= odd parity and 02_H= even parity. Valid selections for byte 1 are 01_H and 02_H, corresponding to one or 2 stop bits.

Word offset 14 is used to specify an RTS ON delay for the Auxiliary port (slave side) The delay will be 10ms times the value set in word 14

Word offset 15 is used to specify an RTS OFF delay for the Auxiliary port. The delay will be 10ms times the value set in word 15.

Word offsets 16 through 19 are reserved for future use. Set to zero.

Word	Byte Numbers	Function
0	00,01	Comm-Master Address; Number of Polling Tables
1	02,03	Radio turn-on Delay (x 10 msec)
2	04,05	Radio turnoff Delay (x 10 msec)
3	06,07	RTS/CTS Delay (x 10 msec-starts after Radio turn-on delay)
4	08,09	Remote Baud Rate; # Data Bits
5	10,11	Remote Parity; # Stop Bits
6	12,13	Reserved-set to 0000_H
7	14,15	Reserved-set to 0000_H
8	16,17	Reserved-set to 00_H; RTU Enable (ASCII= 00, RTU= 01)
9	18,19	Daniel Enable (Gould= 00, Daniel= 01); Reserved set to 00_H
10	20,21	Radio Key Address
11	22,23	Poll Timer Multiplier Factor
12	24,25	Aux. Port Baud; Aux. Port # Data Bits
13	26,27	Aux. Port Parity; Aux. Port # Stop Bits
14	28,29	Aux. Port RTS ON Delay (X10ms per count)
15	30,31	Aux. Port RTS OFF Delay (X10ms per count)
16-19	24-39	Reserved-set to 0000_H

Figure F-4 Comm-Master Configuration Header

1.4.2 Polling Table Entry for Electro Industries Protocol

The Polling tables start immediately following the end of the configuration table header section. The polling tables are contiguous, one immediately following the other. Each Polling table is 20 words long. There is a polling table for each poll message that the Comm-Master is required to send. The number of polling tables to read is specified in the Configuration header word 0 byte 1 entry as described above.

Word offset 0 is not used for the Electro Industries protocol. Set to 0.

Word offset 1 is not used for the Electro Industries protocol. Set to 0.

Word offset 2 is used to specify the Meter number to poll. Valid meter numbers are from 1 through 9999. Enter the number in decimal.

Word offset 3 is used to specify the Electro Industries "Data Code" to be sent. Refer to Figure F1 for valid data codes. Enter the ASCII code as shown in the table.

Word offset 4 is used to specify the Electro Industries "Function Code" to be sent to the meter. Refer to Figure F2 for valid function codes. Enter the ASCII codes as shown in the table.

Word offset 5 is not used for the Electro Industries protocol; set to 0.

Word offsets 6 through 9 are used to specify the data destination PLC type, Data Highway Address, Logical Processor, File Type, File Number and Element. The Destination PLC is the location that the Comm-Master will use to store the data returned from an RTU poll. The first word of the address field is used to define the PLC type and data highway address. The second word is used to define the Logical Processor (PLC5/250 only) in byte 0 and the file type in byte 1. Use the hexadecimal equivalent of

Word	Byte Numbers	Function
0	00,01	Reserved set to 0
1	02,03	Reserved set to 0
2	04,05	Electro Industries Meter Number
3	06,07	Reserved; Data Code
4	08,09	Reserved; Function Code
5	10,11	Reserved set to 0
6	12,13	Destination PLC Type; Highway Address
7	14,15	Destination PLC L.P.; File Type
8	16,17	Destination PLC File Number
9	18,19	Destination PLC Starting File Element
10	20,21	Scan Update Frequency (x 10 msec)
11	22,23	Scan Error Timeout (x 10 msec)
12	24,25	Port Select (0= P1, 1= P3)
13-15	26-31	Reserved
16	32,33	Error PLC Type; Highway Address
17	34,35	Error PLC L.P.; File Type
18	36,37	Error PLC File Number

Figure F-5 Comm-Master Polling Table Entry

the ASCII logical processor number and the file type. For example, if the file to be used is an integer file (file type N) then enter a 4EH in byte 1. If the destination PLC is a PLC-2 then these fields are not used for addressing. Set this word to 0000H. The next word is used to specify the file number. Enter the hexadecimal equivalent of the file number. If the destination file is to be N10 then enter a hex 0A in this word. The file number word is not used for PLC-2 addressing. The last word is used to specify the file element that marks the start of the data to be returned. Enter the hexadecimal equivalent of the address.

Word	PLC2	PLC5	PLC5/250
0	02; Address	05; Address	FA;Address
1	00;00	00; File Type	L.P.; File Type
2	00; 00	File Number	File Number
3	Memory Address	Element	Element

Figure F-6 PLC Address Fields

Word offset 10 is used to specify the interval between polls. Polls will be issued by the Comm-Master at the rate specified by the contents of this word. The polling interval can be specified in 10 ms increments. For example, an entry of 200 (decimal) would result in the Comm-Master polling for the data specified in this table entry once every 2 seconds (200 X 10ms per count = 2000 ms = 2 sec). Note that the timer increment is multiplied by the number stored in word 11 of the header in order to achieve longer polling intervals.

Word offset 11 is used to specify the message time-out time. The message time out will be set to the number stored in this word times 10ms.

Word offset 12 is used to specify the port to use for the poll. Setting word 12 to 0 will direct the poll to connector P1 (top connector). Future Comm-Master modules will support other protocols from the bottom port. Set word 12 to 1 to select the bottom port.

Word offsets 13 through 15 are reserved for future use. Set to 0000H.

Word offsets 16 through 19 are used to specify a Poll Message Error Address. This address will be updated by the Comm-Master at the conclusion of the poll request if an error occurs. The poll request is ended whenever either the RTU responds with the requested data or an error occurs.

1.4.3 COMMAND MESSAGE INSTRUCTION

Control commands are sent from the Comm-Master to an Electro Industries device using standard ladder logic MSG instructions. The MSG instruction must be a PLC2 Unprotected WRITE command addressed to the Comm-Master (the data highway address of the RS-232 interface module that is connected to the Comm-Master). The processor type must be set to PLC-2 and the Local/Remote mode set to LOCAL. The destination data table address is not used and can be set to any value. The MSG instruction references a data table address and length. The contents of the data table referenced by the MSG instruction will be sent to the Comm-Master. The Comm-Master interprets this data to form the actual command sent to the Electro Industries device. The following figure details the contents of the data block for a command MSG instruction.

Word	Byte Numbers	Function
0	00,01	Command Message Time-out (x10msec)
1	02,03	Linked Poll Number; Linked Poll Delay
2	04,05	Port Select 0= top port, 1= bottom port
3	06,07	Reserved-set to 0000H
4	08,09	Reserved-set to 0000H
5	10,11	Electro Industries meter number (0001 through 9999)

Figure F-7 Command Message Data

Word offset 0 is used to specify the time out value to be used for the command. The time out value is 10msec times the value stored in word 0.

Word 1 is used to optionally specify a "linked poll message". A linked poll message is a poll that is forced after the command is issued. This may be used for example to immediately read back a status line to confirm the control action specified in the control command did indeed occur. Byte 0 is used to specify the linked poll number. If no linked poll message is required set byte 0 to 00_H. Byte 1 is used to specify an optional delay time. The delay time is specified in 10 msec increments. The delay time is altered by the delay timer multiplier factor stored in the header. If no delay is required set the delay time byte to 00_H.

Words 2 is used to specify the port to use for the command. setting word 2 to 0 will instruct the Comm-Master to send the control out port 1 (the top port). Setting this word to 1 will send the command out the bottom port.

Word 3 and 4is reserved for future use. Set to 000H.

Word 5 is used to specify the meter number that will be used in the command message.

Word 6 is used to specify the Electro Industries "Data Code". Enter the ASCII value as specified in Figure F1.

Word 7 is used to specify the Electro Industries "Function Code". Enter the ASCII value as specified in Figure F2.

1.5 JUMPER SELECTIONS FOR ELECTRO INDUSTRIES PROTOCOL

The Comm-Master jumper settings and EPROM part numbers for Comm-Master Electr Industries protocol operation is detailed in the following figure.

JUMPER	POSITION	JUMPER	POSITION
J2	1-2	J10	NOT USED
J3	NOT USED	J11	1-2
J4	NOT USED	J12	1-2
J5	NOT USED	J13	NOT USED
J6	1-2	J14	NOT USED
J7	1-2	J15	1-2
J8	NOT USED	J16	NOT USED

MODBUS Protocol Communication is on Port P1 (top port), Allen-Bradley Communication is on Port P2 (center port), Electro Industries protocol is on Port P3 (bottom port)

U13 = # 166-002-11

U23 = # 166-001-11

U16 = # 252-001-0

Figure F-8 Jumper Settings

COMM-MASTER CONFIGURATION HEADER WORKSHEET FOR ELECTRO INDUSTRIES PROTOCOL

WORD	BYTE	ADDRESS	BYTE0	BYTE1	DESCRIPTION
00	00,01				Comm-Master address; number of Polling tables
01	02,03				Radio turn-on delay (x 10ms)
02	04,05				Radio turn-off delay (x 10ms)
03	06,07				RTS/CTS Delay (x 10ms)
04	08,09				Remote baud rate; # data bits
05	10,11				Remote parity; stop bits
06	12,13		00	00	Reserved
07	14,15		00	00	Reserved
08	16,17		00		Reserved; MODBUS ASCII= 0, RTU= 1
09	18,19			00	Gould= 0, Daniel= 1; Reserved
10	20,21				Radiokey Address
11	22,23				Poll Timer Multiplier Factor
12	24,25		00	00	Aux. Baud; Aux. # data bits
13	26,27		00	00	Aux. parity; Aux. # stop bits
14	28,29		00	00	Aux. RTS ON Delay (X10ms)
15	30,31		00	00	Aux. RTS OFF Delay (X10ms)
16	32,33		00	00	Spare
17	34,35		00	00	Spare
18	36,37		00	00	Spare
19	38,39		00	00	Spare

COMM-MASTER POLLING TABLE WORKSHEET FOR ELECTRO INDUSTRIES PROTOCOL

WORD	BYTE	ADDRESS	BYTE0	BYTE1	DESCRIPTION
00	00,01		00	00	Reserved
01	02,03			00	Reserved
02	04,05				**Data Source Address** -Meter Number
03	06,07		00		Reserved; Data Code
04	08,09		00		Reserved; Function Code
05	10,11		00	00	Reserved
06	12,13				**Data Destination Address**- PLC Type; Address
07	14,15				L.P.; File Type
08	16,17				File Number
09	18,19				Starting Element
10	20,21				Poll Update Frequency (x 10 ms)
11	22,23				Poll Timeout (x 10ms)
12	24,25		00		Port Select (0= P1, 1= P3)
13	26,27		00	00	Spare
14	28,29		00	00	Spare
15	30,31		00	00	Spare
16	32,33				**Error Address**-PLC Type; Address
17	34,35				L.P.; File Type
18	36,37				File Number
19	38,39				Starting Element

POLL TABLE

WORD	BYTE	ADDRESS	BYTE0	BYTE1	DESCRIPTION
00	00,01		00	00	Reserved
01	02,03		00	00	Reserved
02	04,05				**Data Source Address** -Meter Number
03	06,07		00		Reserved; Data Code
04	08,09		00		Reserved; Function Code
05	10,11		00	00	Reserved
06	12,13				**Data Destination Address**- PLC Type; Address
07	14,15				L.P.; File Type
08	16,17				File Number
09	18,19				Starting Element
10	20,21				Poll Update Frequency (x 10 ms)
11	22,23				Poll Timeout (x 10ms)
12	24,25		00		Port Select (o= P1, 1= P3)
13	26,27		00	00	Spare
14	28,29		00	00	Spare
15	30,31		00	00	Spare
16	32,33				**Error Address**-PLC Type; Address
17	34,35				L.P.; File Type
18	36,37				File Number
19	38,39				Starting Element

POLL TABLE

COMM-MASTER COMMAND WORKSHEET FOR ELECTRO INDUSTRIES PROTOCOL

WORD	BYTE	ADDRESS	BYTE0	BYTE1	DESCRIPTION
00	00,01				Message time out (x 10ms)
01	02,03				Linked Poll # ; Linked Poll delay (x 10ms)
02	04,05		00		Port Select (0= P1, 1= P3)
03	06,07		00	00	Reserved
04	08,09		00	00	Reserved
05	10,11				**Destination Address-**Meter Number
06	12,13		00		Reserved; Data Code
07	14,15		00		Reserved; Function Code

COMMAND

WORD	BYTE	ADDRESS	BYTE0	BYTE1	DESCRIPTION
00	00,01				Message time out (x 10ms)
01	02,03				Linked Poll # ; Linked Poll delay (x 10ms)
02	04,05		00		Port Select (0= P1,1= P3)
03	06,07		00	00	Reserved
04	08,09		00	00	Reserved
05	10,11				**Destination Address-**Meter Number
06	12,13		00		Reserved; Data Code
07	14,15		00		Reserved; Function Code

COMMAND

WORD	BYTE	ADDRESS	BYTE0	BYTE1	DESCRIPTION
00	00,01				Message time out (x 10ms)
01	02,03				Linked Poll # ; Linked Poll delay (x 10ms)
02	04,05		00		Port Select (0= P1, 1= P3)
03	06,07		00	00	Reserved
04	08,09		00	00	Reserved
05	10,11				**Destination Address-**Meter Number
06	12,13		00		Reserved; Data Code
07	14,15		00		Reserved; Function Code

COMMAND