Honeywell

UMC800 Controller
Modbus® RTU Serial Communications
User Manual

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Revision A – 2/01

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Sensing and Control
Honeywell
11 West Spring Street
Freeport, IL 61032

Reference: Modicon Modbus Protocol Reference Guide - PI-MBUS-300 Rev. G

About This Document

Abstract

This document provides information specific to Honeywell's UMC800 Controller implementing the Modbus RTU Serial Communications protocol. It includes a summary of all UMC800 data available (primarily floating point) for Modbus RTU access, read and write including methods for access.

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Contents

Tables

Figures

1. Introduction

1.1 Modbus RTU Implementation

Overview

This implementation is designed to provide a popular data exchange format connecting the UMC800 Slave Port (COM A) to both Honeywell and foreign master devices. The Modbus RTU allows the instrument to be a citizen on a data link shared with other devices which subscribe to the Modbus RTU RS-485 specification.

These instruments DO NOT emulate any MODICON type device. The Modbus RTU specification is respected in the physical and data link layers. The message structure of the Modbus RTU function codes are employed and standard IEEE 32-bit floating point and integer formats are used. Data register mapping is unique to these instruments. The definition in Table 6-1 is the register mapping for the UMC800 and the corresponding parameter value.

Function Codes 20 and 21

Also included in this manual is information concerning function codes 20 and 21 in Section 7. They provide additional functionality not available using the function codes described in Section 4. The additional functionality includes:

- read/write function block dynamic data that is not part of the function code 03 register set
- read function block inputs and outputs that are not part of the function code 03 register set
- read detail of an alarm point
- read the event summary buffer
- acknowledge alarms and events
- upload historical data for alarms and events

ATTENTION

To access the controller you must have a current Control Builder configuration file available. Data is referenced relative to function block number and the index number of the desired parameter. It is suggested that you upload the controller configuration using the Control Builder configuration tool to assure that you have a current configuration. The Control Builder tool can provide a printout of all function blocks used, their number and detail. You will also need to use the Control Builder Function Block Reference Guide as a reference for the function block index numbers for contained parameters.

2. Wiring

2.1 COMM A Connector

The CPU module equipped with the optional communication board provides an RS 485 communications ports with Modbus RTU protocol support. COMM A port allows the UMC800 controller to network with up to 31 other slave UMC800 controllers and devices on a Modbus RTU link. This manual describes the communications for the COM A Port only. COM B is a master port described in other product literature.

Figure 2-1 shows the COMM A connector wiring when using either a shielded twisted pair or 4-wire shielded cable.

NOTE: When using the RS 485 communications, it is recommended that an RS 485 to RS 232 converter (such as Black Box model IC901A) be used to interface with the host PC. Also, be certain that the Half Duplex Turnaround Delay parameter for the converter set to 1 millisecond or less.

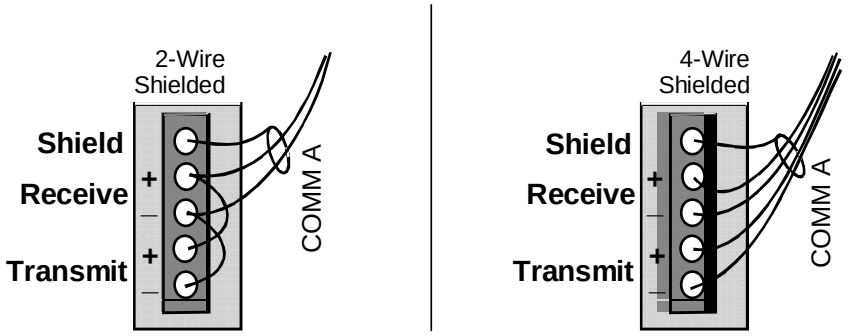


Figure 2-1 COMM A port wiring (2-wire and 4-wire)

2.2 RS 485 serial communications

When connecting the controller to an RS 485 communication link (see Figure 2-2), you must use termination resistors at each end of the link. The following cables with the listed resistor values can be used for connecting the controller.

RS 485 Cables: Belden #9271 (or equivalent) with 120 ohm termination resistors (2,000 ft. maximum)

Belden #9182 (or equivalent) with 150 ohm termination resistors (4,000 ft. maximum)

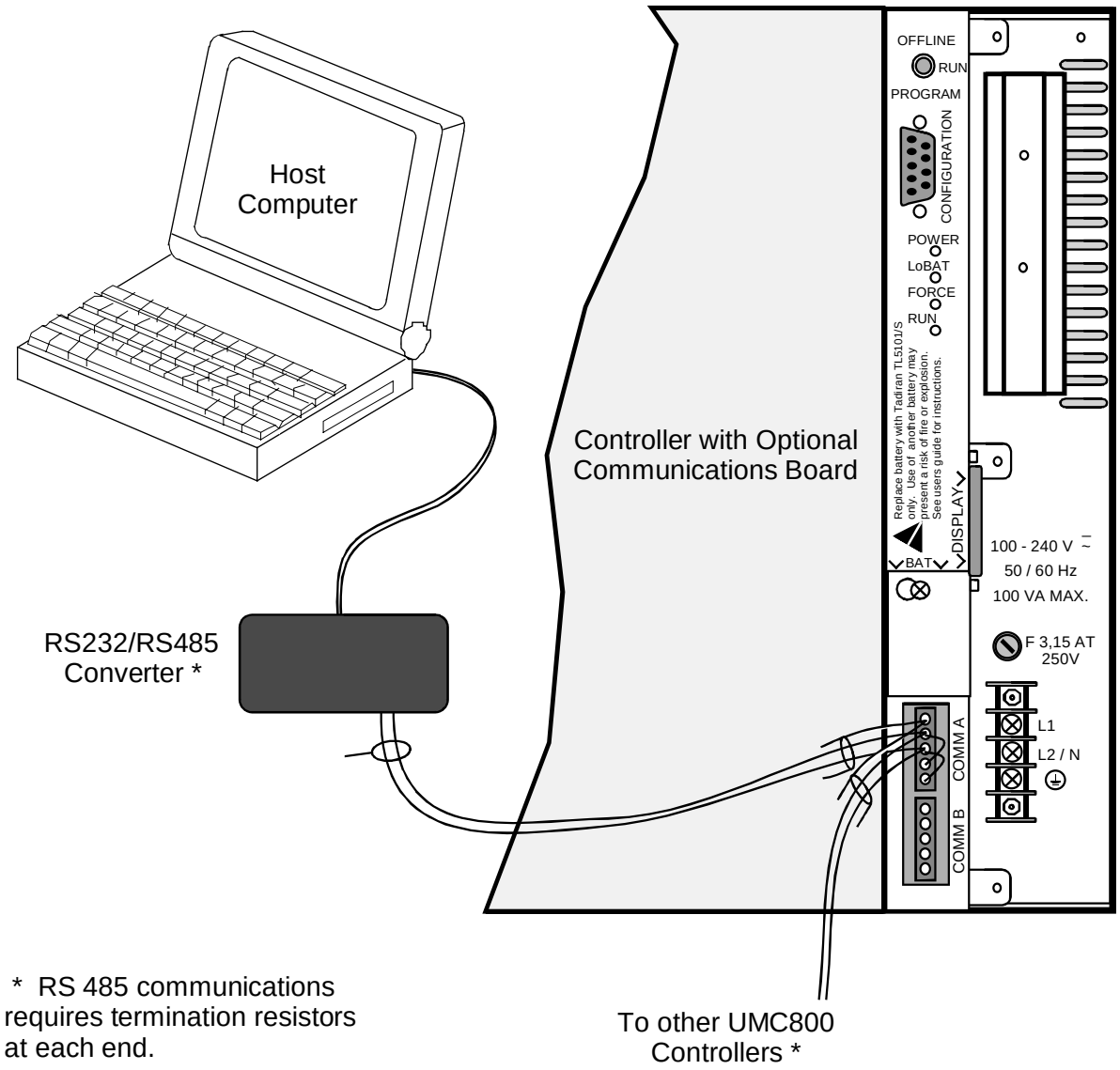


Figure 2-2 RS 485 port wiring (2 wire)

3. Modbus RTU Message Format

Table 3-1 Modbus RTU Message Formats

Coding system	8 bit binary
Number of data bits per character	10 Bits start bits - 1 data bits - 8 parity bits - 0 stop bits - 1
Parity	Not used
Bit transfer rate	9600, 19200, 38400 Selectable
Duplex	Half duplex Transceiver
Error checking	CRC (cyclic redundancy check)
Polynomial	(CRC-16 10100000000001)
Bit transfer order	LSB first
End of message	Idle line for 3.5 or more characters (>1.82 msec for 19200).

3.1 Modbus RTU Link Layer

The link layer includes the following properties/behaviors:

- Slave address recognition,
- Start / End of Frame detection,
- CRC-16 generation / checking,
- Transmit / receive message time-out,
- Buffer overflow detection,
- Framing error detection,
- Idle line detection.

Errors detected by the physical layer in messages received by the slave are ignored and the physical layer automatically restarts by initiating a new receive on the next idle line detection.

General Modbus RTU message format

Query message format
[Slave Address, Function Code, Function code dependent data, CRC 16]

Response message format
[Slave Address, Function Code*, Function code dependent data, CRC 16]

* If an error is detected in a valid message the response function code is modified by adding 80 (hex) and the function code dependent data is replaced by an exception response code as described in *Section 5 - Modbus RTU Exception Codes.*

Between messages, the RS-485 link is in a high impedance state. During this time receiving devices are more susceptible to noise generated false start of messages. Although noise-generated messages are rejected due to address, framing, and CRC checking, they can cause the loss of a good message when they are included in the message stream. In the slave the transmitting device enables its transmitter line diver and forces an idle line state onto the link for three character time slots prior to transmitting. This forces termination of any noise generated messages and improves message frame synchronization.

3.2 Modbus RTU Data Layer

The data layer includes:

- Diagnostic loopback,
- Function code recognition / rejection,
- Busy / repoll,
- Data error code generation

Errors detected by the data layer are rejected and the slave responds to the polling device with a Modbus-type status exception error. A summary of the Modbus status exception codes is listed in *Section 5 - Modbus RTU Exception Codes.*

3.3 IEEE 32-bit Floating Point Register Information

The Modbus applications support IEEE 32-bit floating point information for several of the function codes.

3.3.1 IEEE Floating Point Data Format

The formula for calculating the floating point number is:

$$\text{mantissa} \times 2^{(\text{exponent} - 127)}$$

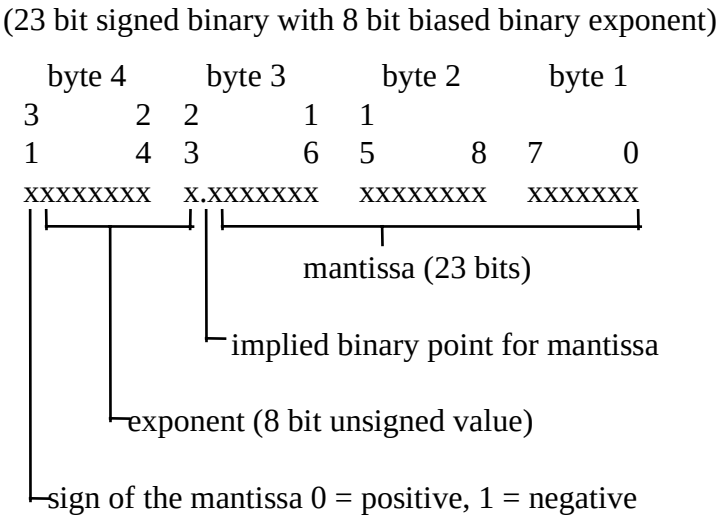


Figure 3-1 IEEE Floating Point Data format

Mantissa and Sign

The mantissa is defined by a sign bit (31) and a 23-bit binary fraction. This binary fraction is combined with an "implied" value of 1 to create a mantissa value, which is greater than or equal to 1.0 and less than 2.0.

The mantissa is positive if the sign bit is zero (reset), and negative if the sign bit is one (set). For example:

DECIMAL	HEXADECIMAL	BINARY
100	42C80000	01000010 11001000 00000000 00000000

The sign bit (31) is zero, indicating a positive mantissa. Removing the sign bits and exponent bits, the mantissa becomes:

HEXADECIMAL	BINARY
480000	xxxxxxxx x1001000 00000000 00000000

Add an "implied" value of one to the left of the binary point:

BINARY
1.1001000 00000000 00000000

Using positioned notation, this binary number is equal to:

$$1.0 + (1x2^{-1}) + (0x2^{-2}) + (0x2^{-3}) + (1x2^{-4}) = 1.0 + 0.5 + 0.0 + 0.0 + 0.0625 = 1.5625$$

Exponent

The exponent is defined by an unsigned 8-bit binary value (bits 23 through 30). The value of the exponent is derived by performing a signed subtraction of 127 (decimal) from the 8-bit exponent value.

DECIMAL	HEXADECIMAL	BINARY
100	42C80000	01000010 11001000 00000000 00000000

Removing the sign and mantissa bits, the exponent becomes:

DECIMAL	HEXADECIMAL	BINARY
133	85	x1000010 1xxxxxxx xxxxxxxx xxxxxxxx

or:

$$1x2^7 + 0x2^6 + 0x2^5 + 0x2^4 + 0x2^3 + 1x2^2 + 0x2^1 + 1x2^0$$

Subtract a bias of 127 (decimal) from the exponent to determine its value: 133 – 127 = 6.

Mantissa and Exponent Combination

Combining the mantissa and exponent from the two previous examples:

$$\text{float number} = \text{mantissa} \times 2^{\text{exponent}}$$

$$\text{float number} = 1.5625 \times 2^6 = 1.5625 \times 64 = 100.0$$

Below is a list of sample float values in IEEE format:

DECIMAL	HEXADECIMAL
100.0	42C80000
-100.0	C2C80000
0.5	3F000000
-1.75	BFE00000
0.0625	3D800000
1	3F800000
0	00000000

Reserved Operands

Per the Standard certain exceptional forms of floating point operands are excluded from the numbering system. These are as follows:

EXCEPTION	EXPONENT	MANTISSA
+/- Infinity	All 1's	All 0's
Not-a-Number (NAN)	All 1's	Other than 0's
Denormalized Number	All 0's	Other than 0's
Zero	All 0's	All 0's

3.3.2 Modbus Double Register Format

Each IEEE 32-bit floating point number requires two consecutive registers (four bytes) starting with the register defined as the starting register for the information. The stuffing order of the bytes into the two registers differs among Modbus hosts. To provide compatibility, the UMC800 Double register format is configurable. To set the controller's double register byte order, go to the "Set Controller Comm A Port" dialog box in the User Utility/Control Builder and configure "Modbus Double Register Format".

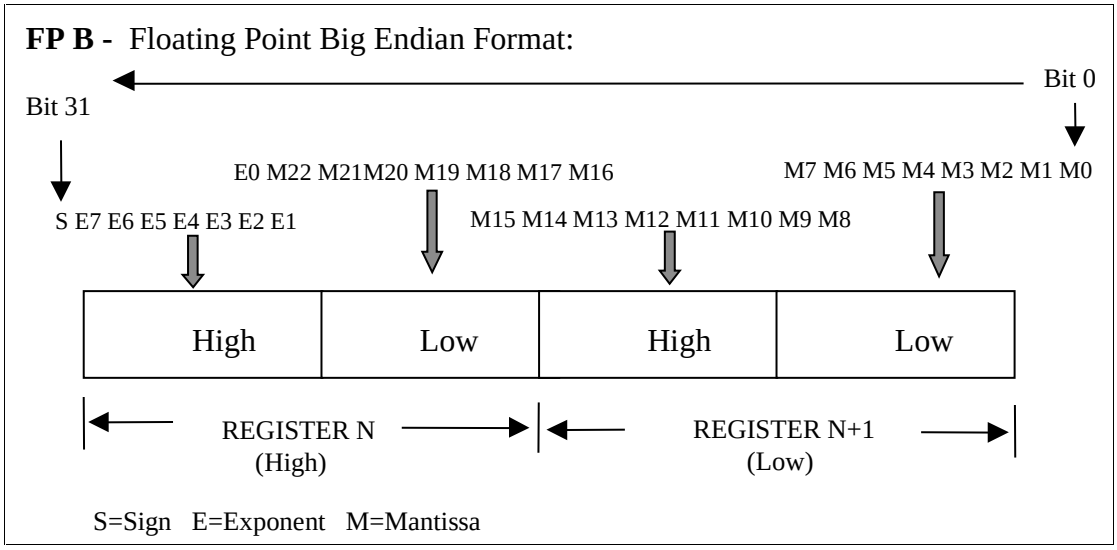
The selections are:

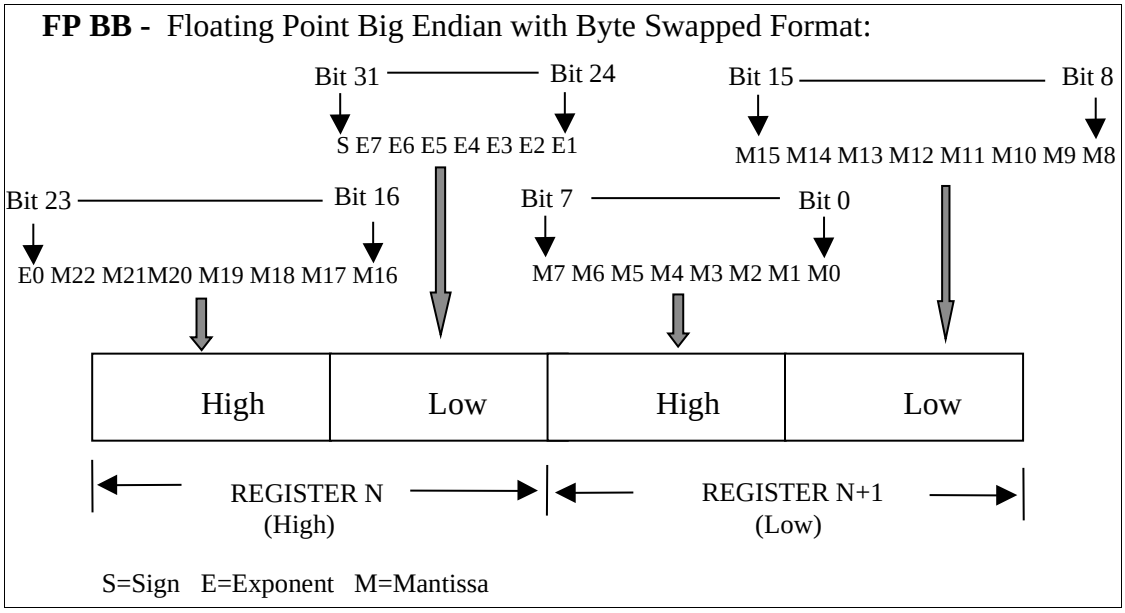
Selection	Description	Byte order (See Figure 3-1)	Notes
FP B	Floating Point Big Endian Format	4, 3, 2, 1	UMC800 default
FP BB	Floating Point Big Endian with byte-swapped	3, 4, 1, 2	
FP L	Floating Point Little Endian Format	1, 2, 3, 4	
FP LB	Floating Point Little Endian with byte-swapped	2, 1, 4, 3	Modicon and Wonderware standard

See IEEE Formats starting on next page.

NOTE: Byte Swapping only applies to Function Codes 3, 4, and 16. Function Codes 20 and 21 DO NOT support byte swapping. They always use FP B.

IEEE Floating Point Formats





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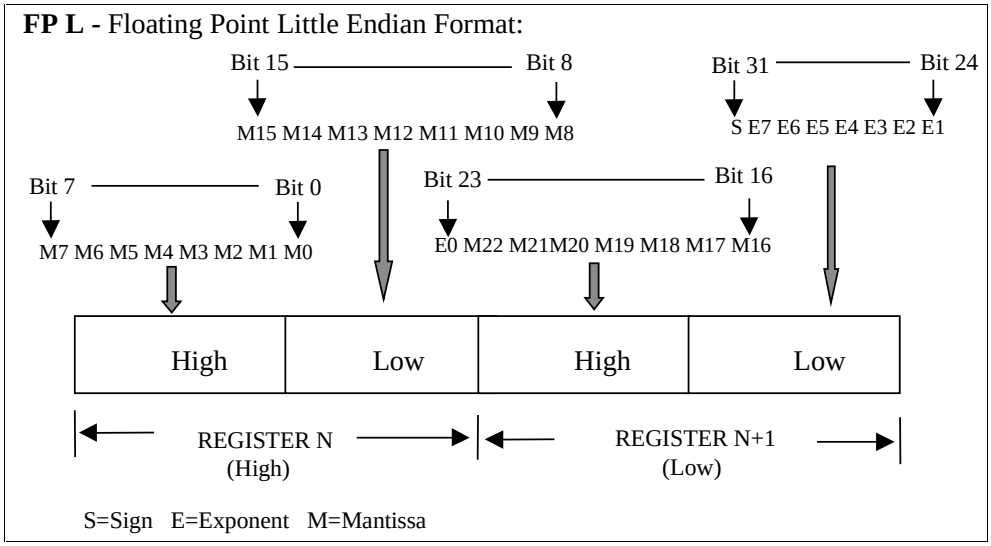


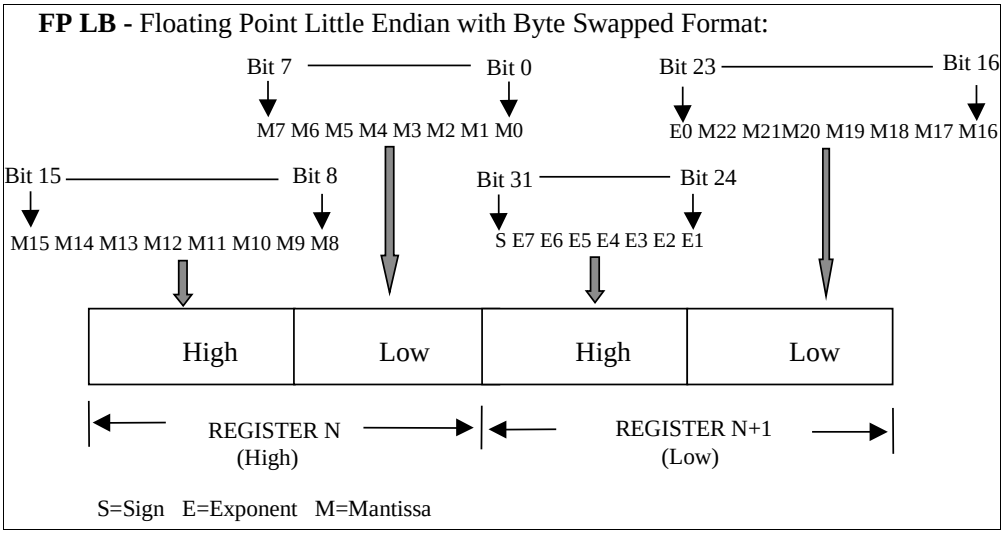


Figure 3-2 IEEE Floating Point Formats

Table 3-2 IEEE Floating Point Number Examples in FP B Format

Value (decimal)	IEEE FP B	Register N		Register N+1	
	MSB LSB	high	low	high	low
100.0	42C80000h	42h	C8h	00h	00h
55.32	425D47AEh	42h	5Dh	47h	AEh
2.0	40000000h	40h	00h	00h	00h
1.0	3F800000h	3Fh	80h	00h	00h
-1.0	BF800000h	BFh	80h	00h	00h

4. Modbus RTU Function Codes

The Honeywell Universal Modbus RTU protocol uses a subset of the standard Modbus RTU function codes to provide access to process-related information. These standard function codes provide basic support for IEEE 32-bit floating point numbers and 16-bit integer register representation of instrument's process data.

Table 4-1, Table 4-2, and Table 4-3 list the Modbus RTU Function Code definitions, the maximum number of Object Addresses and maximum number of registers allowed per request.

Repolling of data is not supported by this instrument.

Table 4-1 Modbus RTU Function Codes Definitions

Function Code	Name	Usage
01	Read Coil Status	Read the state of a digital output
02	Read Input Status	Read the state of a digital input
03 04	Read Holding Registers / Read Input Registers	Read Data in 16 bit Register Format (high/low). Used to read integer or floating point process data. Registers are consecutive and are imaged from the instrument to the host.
05	Force Single Coil	Write data to force a digital output ON/OFF Values of FF 00 forces digital output ON Values of 00 00 forces digital output OFF Values of FF FF releases the force of the digital output All other values are illegal and will not effect the digital output.
06	Preset Single Register	Write Data in 16-bit Integer Format (high/low) ONLY.
08	Loopback Test	Used for diagnostic testing of the communications port.
16 (10h)	Preset Multiple Registers	Write Data in 16-bit Format (high/low). Used to write integer and floating point override data. Registers are consecutive and are imaged from the host to the instrument.
17 (11h)	Report Device ID	Read instrument ID and connection information, ROM version, etc.
20 (14h)	Read General Reference	Used to Read or upload the instrument's configuration into the host device. See *Section 7.2.*
21 (15h)	Write General Reference	Used to Write or download an instrument's configuration into the instrument from a host device. See *Section 7.3.*

Table 4-2 Maximum Number of Object Addresses

Object Name	Max. No. of Addresses	Object Name	Max. No. of Addresses
Alarms Status	120	Variable Value	150
Analog Input	64	Set Point Programmer Value	4
Analog Output	16	Segments per Set Point Programmer	50
Discrete Input	96	Tagged Signals	500
Discrete Output/Coil	96	Scheduler Value	1
Loop	16	Segments per Scheduler Schedule	50

Table 4-3 Maximum Number of Registers Allowable per Request

Function Code	Max. No. of Registers
1, 2	12 Bytes
3, 4	127 Registers 63 Floats
5	1 Digital Output
6	1 Register
10h	127 Registers 63 Floats

4.1 Function Code 01 – Read Digital Output Status

Description

Function code 01 (0X references) is used to read a digital output's ON/OFF status of the UMC800 in a binary data format. All binary data transferred using function code 01is mapped into bytes.

Broadcast is not supported.

Query

The query message specifies the starting Digital Output (DO) and the quantity of DOs to read. The DO address in the message is based on the slot and channel number of the digital output being read. Table 4-4 shows the Modbus Comm Digital I/O Channel to Address Mapping.

Query message format for function code 01

Slave Address	Function Code	Starting Address High	Starting Address Low	Number DO High	Number DO Low	CRC	CRC

Example: Read DO channels 1 to 6, located in slot 1, from slave at address 02.

02 01 00 00 00 06 CRC CRC

Response

The DO status in the response message is packed as one DO per bit of the data field. Status is indicated as: 1 = ON; 0 = OFF. The LSB of the first data byte contains the DO addressed in the query. The other DOs follow toward the high order end of this byte, and from low order to high order in subsequent bytes.

If the returned DO quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte). The byte count field specifies the quantity of data bytes returned.

Response message format for function code 01

Slave Address	Function Code	Byte Count	Data	Data	...	CRC	CRC

Example: DO channels 2 through 6 located in slot 1 are on, all others are off.

02 01 01 22 CRC CRC

In the response the status of DOs 1 - 6 is shown as the byte value 22 hex, or 0010 0010 binary. DO 8 is the MSB of this byte, and DO 1 is the LSB. Left to right, the status of DO 6 through 1 is: ON-OFF-OFF-OFF-ON-OFF. DO #8 and #7 were not requested and so bit #7 or the MSB and bit #6 were padded with a 0.

Table 4-4 Modbus Comm Digital I/O Channel to Address Mapping

Slot 1		
CH#	Address	
	Dec	Hex
16	15	15
15	14	14
14	13	13
13	12	12
12	11	11
11	10	10
10	9	9
9	8	8
8	7	7
7	6	6
6	5	5
5	4	4
4	3	3
3	2	2
2	1	1
1	0	0

Slot 2		
CH#	Address	
	Dec	Hex
16	31	1F
15	30	1E
14	29	1D
13	28	1C
12	27	1B
11	26	1A
10	25	19
9	24	18
8	23	17
7	22	16
6	21	15
5	20	14
4	19	13
3	18	12
2	17	11
1	16	10

Slot 3		
CH#	Address	
	Dec	Hex
16	47	2F
15	46	2E
14	45	2D
13	44	2C
12	43	2B
11	42	2A
10	41	29
9	40	28
8	39	27
7	38	26
6	37	25
5	36	24
4	35	23
3	34	22
2	33	21
1	32	20

Slot 4		
CH#	Address	
	Dec	Hex
16	63	3F
15	62	3E
14	61	3D
13	60	3C
12	59	3B
11	58	3A
10	57	39
9	56	38
8	55	37
7	54	36
6	53	35
5	52	34
4	51	33
3	50	32
2	49	31
1	48	30

Slot 5		
CH#	Address	
	Dec	Hex
16	79	4F
15	78	4E
14	77	4D
13	76	4C
12	75	4B
11	74	4A
10	73	49
9	72	48
8	71	47
7	70	46
6	69	45
5	68	44
4	67	43
3	66	42
2	65	41
1	64	40

Slot 6		
CH#	Address	
	Dec	Hex
16	95	5F
15	94	5E
14	93	5D
13	92	5C
12	91	5B
11	90	5A
10	89	59
9	88	58
8	87	57
7	86	56
6	85	55
5	84	54
4	83	53
3	82	52
2	81	51
1	80	50

Slot 7		
CH#	Address	
	Dec	Hex
16	111	6F
15	110	6E
14	109	6D
13	108	6C
12	107	6B
11	106	6A
10	105	69
9	104	68
8	103	67
7	102	66
6	101	65
5	100	64
4	99	63
3	98	62
2	97	61
1	96	60

Slot 8		
CH#	Address	
	Dec	Hex
16	127	7F
15	126	7E
14	125	7D
13	124	7C
12	123	7B
11	122	7A
10	121	79
9	120	78
8	119	77
7	118	76
6	117	75
5	116	74
4	115	73
3	114	72
2	113	71
1	112	70

Slots 9 through 16 on next page

Slot 9		
CH#	Address	
	Dec	Hex
16	143	8F
15	142	8E
14	141	8D
13	140	8C
12	139	8B
11	138	8A
10	137	89
9	136	88
8	135	87
7	134	86
6	133	85
5	132	84
4	131	83
3	130	82
2	129	81
1	128	80

Slot 10		
CH#	Address	
	Dec	Hex
16	159	9F
15	158	9E
14	157	9D
13	156	9C
12	155	9B
11	154	9A
10	153	99
9	152	98
8	151	97
7	150	96
6	149	95
5	148	94
4	147	93
3	146	92
2	145	91
1	144	90

Slot 11		
CH#	Address	
	Dec	Hex
16	175	AF
15	174	AE
14	173	AD
13	172	AC
12	171	AB
11	170	AA
10	169	A9
9	168	A8
8	167	A7
7	166	A6
6	165	A5
5	164	A4
4	163	A3
3	162	A2
2	161	A1
1	160	A0

Slot 12		
CH#	Address	
	Dec	Hex
16	191	BF
15	190	BE
14	189	BD
13	188	BC
12	187	BB
11	186	BA
10	185	B9
9	184	B8
8	183	B7
7	182	B6
6	181	B5
5	180	B4
4	179	B3
3	178	B2
2	177	B1
1	176	B0

Slot 13		
CH#	Address	
	Dec	Hex
16	207	CF
15	206	CE
14	205	CD
13	204	CC
12	203	CB
11	202	CA
10	201	C9
9	200	C8
8	199	C7
7	198	C6
6	197	C5
5	196	C4
4	195	C3
3	194	C2
2	193	C1
1	192	C0

Slot 14		
CH#	Address	
	Dec	Hex
16	223	DF
15	222	DE
14	221	DD
13	220	DC
12	219	DB
11	218	DA
10	217	D9
9	216	D8
8	215	D7
7	214	D6
6	213	D5
5	212	D4
4	211	D3
3	210	D2
2	209	D1
1	208	D0

Slot 15		
CH#	Address	
	Dec	Hex
16	239	EF
15	238	EE
14	237	ED
13	236	EC
12	235	EB
11	234	EA
10	233	E9
9	232	E8
8	231	E7
7	230	E6
6	229	E5
5	228	E4
4	227	E3
3	226	E2
2	225	E1
1	224	E0

Slot 16		
CH#	Address	
	Dec	Hex
16	255	FF
15	254	FE
14	253	FD
13	252	FC
12	251	FB
11	250	FA
10	249	F9
9	248	F8
8	247	F7
7	246	F6
6	245	F5
5	244	F4
4	243	F3
3	242	F2
2	241	F1
1	240	F0

4.2 Function Code 02 - Read Digital Input Status

Description

Function code 02 (1X references) is used to read a digital input's ON/OFF status of the UMC800 in a binary data format. All binary data transferred using function code 02 is mapped into bytes.

Broadcast is not supported.

Query

The query message specifies the starting input and the quantity of inputs to read. The DI address in the message is based on the slot and channel number of the digital input being read.

Query message format for function code 02

Slave Address	Function Code	Starting Address High	Starting Address Low	Number Inputs High	Number Inputs Low	CRC	CRC

Example: Read inputs for channels 1 to 6 in slot 1, from slave at address 02.

02 02 00 00 00 06 CRC CRC

Response

The input status in the response message is packed as one input per bit of the data field. Status is indicated as: 1 = ON; 0 = OFF. The LSB of the first data byte contains the input addressed in the query. The other inputs follow toward the high order end of this byte, and from low order to high order in subsequent bytes.

If the returned input quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte). The byte count field specifies the quantity of data bytes returned. Table 4-4 shows the Modbus Comm Digital I/O Channel to Address Mapping.

Response message format for function code 02

Slave Address	Function Code	Byte Count	Data	Data	...	CRC	CRC

Example: Inputs for channels 2 and 6 in slot 1 are on, all others are off.

02 02 01 22 CRC CRC

In the response the status of inputs 1 - 6 is shown as the byte value 22 hex, or 0010 0010 binary. Input 8 is the MSB of this byte, and input 1 is the LSB. Left to right, the status of input 6 through 1 is: ON-OFF-OFF-OFF-ON-OFF. Input #8and #7 were not requested and so bit #7or the MSB and bit #6 were padded with a 0.

4.3 Function Codes 03/04 - Read Data Registers

Description

Function code 03 (4X references) or Function code 04 (3X references) is used to read the binary contents of input registers in the slave referenced in Section 5. Function codes 3 and 4 are not restricted to inputs. They may transmit alarm status, control parameters, etc.

If a request is made to an address that does not exist in the map in Section 6, the controller will honor that request and return zeros for that address. This behavior will greatly enhance the bandwidth on the link vs. making several different requests for non-contiguous data elements. (i.e. Consider a controller that is configured for AI #1 and AI #3 and for some reason AI #2 is an invalid request.) The contiguous method would allow the read of AI #1 through AI #3 and the data location for AI #2 would be zeros.

Broadcast is not supported.

Query

The query message specifies the starting register and quantity of registers to be read. Registers are addressed starting at zero: registers 1-16 are addressed as 0-15.

Query message format for function code 03/04

Slave Address	Function Code	Starting Address High	Starting Address Low	Number Addresses High	Number Addresses Low	CRC	CRC

Example: Read analog inputs #1 and #2 in addresses 1800-1803 as floating point values from a slave at address 02.

02 04 18 00 00 04 CRC CRC

Response

The register data in the response message are packed as two bytes per register. For each register, the first byte contains the high order bits and the second contains the low order bits.

The floating point values require two consecutive registers. A request for a single floating point value must be for two registers. The byte order of the floating point number is determined by the setting of the byte swap configuration value. In this example, and the examples that follow, the byte swap order is FP B. Refer to subsection 3.3. The first 16 bits of the response contain the IEEE MSB of the float value. The second 16 bits of the response contain the IEEE LSB of the float value. If the master station requests only one register at an address of a floating point value, a zero will be returned.

The Modbus RTU protocol has a single byte count for function codes 03 and 04, therefore the Modbus RTU protocol can only process up to 64 floating point and 127 integer values in a single request.

Response message format for function codes 03/04

Slave Address	Function Code	Byte Count	Data	Data	...	CRC	CRC

Example: Analog inputs #1 and #2 as floating point values where AI #1 = 100.0 and AI #2 = 55.32

02 04 08 42 C8 00 00 42 5D 47 AE CRC CRC

4.4 Function Code 05 - Force Single Digital Output

Description

Force a single digital output (0X reference) to either ON or OFF. These are the same digital outputs (DO) used in Function Code 01.
The Modbus Comm Digital I/O Channel to address mapping is shown in Table 4-4.

The UMC800 does not support broadcast, and forcing can only be done in the Run mode.

Query

The query message specifies the DO to be forced. Registers are addressed starting at zero:
DO 1 is address 0.

The requested ON/OFF state is specified by a constant in the query data field.
A value of FF 00 hex requests it to be ON.
A value of 00 00 hex requests it to be OFF.

A value of FF FF releases the force.

ATTENTION: Any query (ON or OFF) causes a force mode of this point in the UMC800 controller. The Green force LED goes ON. While in this mode, internal control of function blocks cannot communicate to this point. **DON'T FORGET** to send a query to release this force.

Query message format for function code 05

Slave Address	Function Code	DO Address High	DO Address Low	Force Data High	Force Data Low	CRC	CRC

Example: Force DO Card Slot 1, Channel 6 ON in a slave at address 02.

02 05 00 05 FF 00 CRC CRC

Response

The normal response is an echo of the query, returned after the DO state has been forced.

Response message format for function code 05

Slave Address	Function Code	DO Address High	DO Address Low	Force Data High	Force Data Low	CRC	CRC

Example: Force DO Card Slot 1, Channel 6 ON in a slave at address 02.

02 05 00 05 FF 00 CRC CRC

Table 4-4 shows the Modbus Comm Digital I/O Channel to Address Mapping.

4.5 Function Codes 06 - Preset Single Register

Description

Presets integer value into a single register (4X references).

The UMC800 does not support Broadcast.

The registers that are specified in Section 6 with an access type “W” and integer and bit packed data types, can be written to via Function Code 06.

Query

The query message specifies the register references to be preset. Registers are addressed starting at zero: Register 1 is addressed as 0.

Query message format for function code 06

Slave Address	Function Code	Address High	Address Low	Preset Data High	Preset Data Low	CRC	CRC

Example: Set Loop #1 to Auto (address 00FAh) to a slave at address 02.

02 06 00 FA 00 01 CRC CRC

Response

The normal response is an echo of the query returned after the register contents have been preset.

Response message format for function code 06

Slave Address	Function Code	Address High	Address Low	Preset Data High	Preset Data Low	CRC	CRC

Example: Set Loop #1 to Auto (address 00FAh) to a slave at address 02.

02 06 00 FA 00 01 CRC CRC

4.6 Function Code 08 - Loopback Message

Description

Echoes received query message.

Query

Message can be any length up to half the length of the data buffer minus 8 bytes.

Query message format for function code 08

Slave Address	Function Code	Any data, length limited to approximately half the length of the data buffer	CRC	CRC

Example:

02 08 01 02 03 04 CRC CRC

Response

Response message format for function code 08

Slave Address	Function Code	Data bytes received	CRC	CRC

Example:

02 08 01 02 03 04 CRC CRC

4.7 Function Codes 16 (10h) - Preset Multiple Registers

Description

Presets values into a sequence of holding registers (4X references).

The UMC800 does not support Broadcast.

The register assignments specified in Section 6 with an access type "W", can be written to via Function Code 16 (10h).

Query

The query message specifies the register references to be preset. Registers are addressed starting at zero: Register 1 is addressed as 0.

Query message format for function code 16 (10h)

Slave Address	Function Code	Starting Address High	Start Address Low	Number Addresses High	Number Addresses Low	Byte Count	Data	CRC	CRC

Example: Preset Variable #1 (address 18C0h) to 100.0 from a slave at address 02.

02 10 18 C0 00 02 04 42 C8 00 00 CRC CRC

Response

The normal response returns the slave address, function code, starting address and the quantity of registers preset.

The floating point values require two consecutive addresses. A request to preset a single floating point value must be for two addresses. The byte order of the floating point number is determined by the setting of the byte swap configuration value. In this example the byte swap order is FP B. Refer to subsection 3.3. The first 16 bits of the response contain the IEEE MSB of the float value. The second 16 bits of the response contain the IEEE LSB of the float value. The Byte order is configurable See Subsection 3.3. If the master station requests only one address at an address of a floating point value the slave will respond with an illegal data address exception (See Section 5) code.

Response message format for function code 16 (10h)

Slave Address	Function Code	Starting Address High	Start Address Low	Number Addresses High	Number Addresses Low	CRC	CRC

Example: Response from presetting Variable #1 (address 18C0h) to 100.0 from a slave at address 02.

02 10 18 C0 00 02 CRC CRC

4.8 Function Code 17 (11h) - Report UMC800 ID

Description

Function code 17 (11h) is used to report the device information which includes information like: Slave ID, device description, and firmware version.

Query

The query message specifies the function code only.

Query message format for function code 17 (11h)

Slave Address	Function Code	CRC	CRC

Example: Read Device ID from a slave at address 02.

02 11 CRC CRC

Response

The response is a record format describing the instrument.

Response message format for function code 17 (11h)

Slave Address	Function Code	Byte Count	Slave ID	Run Indicator Status	Device Specific Data	CRC	CRC

Slave ID - The Slave ID number for the UMC800 is 80 (hex)
(one byte) (byte 3)

Run Indicator Status:
(one byte) (byte 4)
00=OFF; FF=ON

Device Specific Data:

Device Description	Model ID	Device Class ID	Device Mapping

Device Description:
(bytes 5-20)
16 Character ASCII Message with the following format:

'U'	'M'	'C'	'8'	'0'	'0'	' '	*up to 9 character version number in floating point notation.*	*zeros are appended for the remaining bytes*

For example:

A UMC800 with version number 3.22 would have the following device description:

'U'	'M'	'C'	'8'	'0'	'0'	' '	*'3'*	*'.'*	*'2'*	*'2'*	*0*	*0*	*0*	*0*	*0*

Model ID:
00 (one byte) (byte 21)

continued

Device Class ID:
The Device Classification. (one byte) (byte 22)

Class ID	Class
00	Generic Class (Fixed Address Mapable)
01-FF	Future

Generic Class (00) Device Mapping:
Describes the I/O and feature mapping.

Number of Records	Record #1	Record #2	Record ...	Record #n

Number of Records:
1 Byte unsigned value 00-FFh (byte 23)

Record Description:

Byte	Description
00	Type of Data Element (See Data Element Values Table Below)
01	Starting Address of Data Element Record (High)
02	Starting Address of Data Element Record (Low)
03	Number of Data Elements (High)
04	Number of Data Elements (Low)

Data Element Values Table:

Value	Description
00	Analog Inputs
01	Not Applicable. Number of elements equals 0.
02	Discrete Inputs
03	Discrete Outputs
04	Control Loops
05	Set Point Programmers
06	Variables
07	Not applicable. Number of elements equals 0.
08	Not applicable. Number of elements equals 0.
09	Not applicable. Number of elements equals 0.
10	Schedulers
11	Tagged Signals

5. Modbus RTU Exception Codes

Introduction

When a master device sends a query to a slave device it expects a normal response. One of four possible events can occur from the master's query:

- *Slave device receives the query without a communication error and can handle the query normally.* It returns a normal response.
- *Slave does not receive the query due to a communication error.* No response is returned. The master program will eventually process a time-out condition for the query.
- *Slave receives the query but detects a communication error (parity, LRC or CRC).* No response is returned. The master program will eventually process a time-out condition for the query.
- *Slave receives the query without a communication error but cannot handle it (i.e., request is to a non-existent coil or register).* The slave will return with an exception response informing the master of the nature of the error (Illegal Data Address.)

The exception response message has two fields that differentiate it from a normal response:

Function Code Field:
In a normal response, the slave echoes the function code of the original query in the function code field of the response. All function codes have a most-significant bit (MSB) of 0 (their values are below 80 hex). In an exception response, the slave sets the MSB of the function code to 1. This makes the function code value in an exception response exactly 80 hex higher than the value would be for a normal response.

With the function code's MSB set, the master's application program can recognize the exception response and can examine the data field for the exception code.

Data Field:
In a normal response, the slave may return data or statistics in the data field. In an exception response, the slave returns an exception code in the data field. This defines the slave condition that caused the exception.

Query

Example: Internal slave error reading 2 registers starting at address 1820h from slave at slave address 02.

02 03 18 20 00 02 CRC CRC

Response

Example: Return MSB in Function Code byte set with Slave Device Failure (04) in the data field.

83 04 CRC CRC

Table 5-1 Modbus RTU Data Layer Status Exception Codes

Exception Code	Definition	Description
01	Illegal Function	The message received is not an allowable action for the addressed device.
02	Illegal Data Address	The address referenced in the function-dependent data section of the message is not valid in the addressed device.
03	Illegal Data Value	The value referenced at the addressed device location is no within range.
04	Slave Device Failure	The addressed device has not been able to process a valid message due to a bad device state.
06	Slave Device Busy	The addressed device has ejected a message due to a busy state. Retry later.
07	NAK, Negative Acknowledge	The addressed device cannot process the current message. Issue a PROGRAM POLL to obtain device-dependent error data.
09	Buffer Overflow	The data to be returned for the requested number of registers is greater than the available buffer space. *Function Code 20 only*.

6. Register Map for Process and Operation Type Variables

What's in this section?

This section describes all paramters accessible by Function Code 03, 04, 06 and 10h. Section 5.1 gives a global overview of each function and its addresses/registers. Sections 5.2 through 5.17 contain the details on each function and each of its parameters.

Your particular controller may not contain all parameters shown. If you see a function that is not on your controller, either it is not available for that controller model or it is not in your configuration.

6.1 Register Map Overview

Table 6-1 describes the global register map for Function Code 03, 04, 06 and 10h. Details on each address are in sections 6.2 through 6.17.

Conversion of Address (Hex) Number to Register (Decimal) Number
To convert the address number to the register number, convert the address from hexidecimal to decimal and add 40001. Registers are addressed starting at zero: registers 1-16 are addressed as 0-15.

To convert the register number to the address number, subtract 40001 from the register and convert to hex.

Table 6-1 Global Register Map

Start Address (hex)	End Address (hex)	Description	See Subsection
0000	< 0040	Miscellaneous Parameters	6.2
0040	00FF	Loop #1 (floating point & bit packed)	6.3
0140	01FF	Loop #2 (floating point & bit packed)	
0240	02FF	Loop #3 (floating point & bit packed)	
0340	03FF	Loop #4 (floating point & bit packed)	
0440	04FF	Loop #5 (floating point & bit packed)	
0540	05FF	Loop #6 (floating point & bit packed)	
0640	06FF	Loop #7 (floating point & bit packed)	
0740	07FF	Loop #8 (floating point & bit packed)	
0840	08FF	Loop #9 (floating point & bit packed)	
0940	09FF	Loop #10 (floating point & bit packed)	
0A40	0AFF	Loop #11 (floating point & bit packed)	
0B40	0BFF	Loop #12 (floating point & bit packed)	
0C40	0CFF	Loop #13 (floating point & bit packed)	
0D40	0DFF	Loop #14 (floating point & bit packed)	
0E40	0EFF	Loop #15 (floating point & bit packed)	
0F40	0FFF	Loop #16 (floating point & bit packed)	
1800	187F	Analog Input Value (#1-#64)	6.5
18C0	19EB	Variable Value (#1 - #150)	6.6
1BE0	1BE6	Time	6.7
1E00	1E0F	Set Point Programmer #1	6.10
1E10	1E1F	Set Point Programmer #2	
1E20	1E2F	Set Point Programmer #3	
1E30	1E3F	Set Point Programmer #4	

Start Address (hex)	End Address (hex)	Description	See Subsection
1F00	1F3F	Set Point Programmer #1 Additional Values	6.12
1F40	1F7F	Set Point Programmer #2 Additional Values	
1F80	1FBF	Set Point Programmer #3 Additional Values	
1FC0	1FFF	Set Point Programmer #4 Additional Values	
2000	27CF	Tagged Signal (#1 - #1000)	6.9
2800	29FF	Set Point Programmer #1 Segments	6.13
2A00	2BFF	Set Point Programmer #2 Segments	
2C00	2DFF	Set Point Programmer #3 Segments	
2E00	2FFF	Set Point Programmer #4 Segments	
3000	304F	Scheduler #1 Value	6.15
3200	3DFF	Scheduler Segments	6.16
6600	6606	Hand Off Auto #1	6.18
6610	6616	Hand Off Auto #2	
6620	6626	Hand Off Auto #3	
6630	6636	Hand Off Auto #4	
6640	6646	Hand Off Auto #5	
6650	6656	Hand Off Auto #6	
6660	6666	Hand Off Auto #7	
6670	6676	Hand Off Auto #8	
6680	6686	Hand Off Auto #9	
6690	6696	Hand Off Auto #10	
66A0	66A6	Hand Off Auto #11	
66B0	66B6	Hand Off Auto #12	
66C0	66C6	Hand Off Auto #13	
66D0	66D6	Hand Off Auto #14	
66E0	66E6	Hand Off Auto #15	
66F0	66F6	Hand Off Auto #16	
6B00	6B08	Device Control #1	6.19
6B10	6B18	Device Control #2	
6B20	6B28	Device Control #3	
6B30	6B38	Device Control #4	
6B40	6B48	Device Control #5	
6B50	6B58	Device Control #6	
6B60	6B68	Device Control #7	
6B70	6B78	Device Control #8	
6B80	6B88	Device Control #9	
6B90	6B98	Device Control #10	
6BA0	6BA8	Device Control #11	
6BB0	6BB8	Device Control #12	
6BC0	6BC8	Device Control #13	
6BD0	6BD8	Device Control #14	
6BE0	6BE8	Device Control #15	
6BF0	6BF8	Device Control #16	

6.2 Miscellaneous Register Map

Table 6-2 Miscellaneous Register Map Addresses

Address (hex)	Register (decimal)	Parameter Name	Access	Notes
0000	40001	Instrument Mode	R/W	Bit Packed Indicators: Bit 0: 1:Diagnostic Bit 1: 1: unused Bit 2: 1:Maintenance/Offline mode Bit 3: 1:Program mode Bit 4: 1:Reset Unit/Force Cold Start (Write Only) Bit 5: 1:On-Line/Run mode Bit 6…15: Unused
0002	40003	Load Recipe	R/W	Floating Point Read: Returns zero Write: Loads the recipe, identified in the request, from the recipe pool.

6.3 Loop Value Register Map

This table contains addresses of Loop #1; see Table 6-1for addresses of other loops. Each successive control loop is offset by 256. The loop number corresponds to the PID block entry sequence during Control Builder configuration. The Modbus loop number address for a loop can also be obtained from the Control Builder printout of Tag Properties.

Function Code Support:

Reads – Function Codes 3/4

Writes – Function Code 16 (10 hex) for preset of multiple registers (e.g., for floating point)

Writes – Function Code 6 for presetting an integer value

Table 6-3 Loop Value Register Map Addresses

Address (hex)	Register (decimal)	Parameter Name	Access	Notes
0040	40065	PV	R	Floating Point in Engineering Units.
0042	40067	Remote Set Point; SP2	R/W	Floating Point in Engineering Units. When the remote setpoint source is configured as LSP2, the value can be written.
0044	40069	Working Set Point	R/W	Floating Point in Engineering Units. On a write to this register the instrument will update the proper set point according to the loop's currently selected set point.
0046	40071	Output	R/W	Floating Point in Engineering Units.
0048	40073	PV	R	Floating Point in Engineering Units.
004A	40075	Carbon Potential block temperature	R	Floating Point in Engineering Units
004C	40077	Gain #1 (Prop Band #1 *if active*)	R/W	Floating Point . (in units per what was configured in the UMC800: Gain or Proportional Band)
004E	40079	Direction	R	Floating Point 0.0=Direct; 1.0=Reverse
0050	40081	Reset #1	R/W	Floating Point in Repeats/Minute or Minutes/Repeat.
0052	40083	Rate #1	R/W	Floating Point in Minutes
0054	40085	Cycle Time for Analog Scan	R	Floating Point in Seconds
0056	40087	PV Low Range	R	Floating Point in Engineering Units.
0058	40089	PV High Range	R	Floating Point in Engineering Units.
005A	40091	Alarm #1 SP #1	R/W	Floating Point in Engineering Units.
005C	40093	Alarm #1 SP #2	R/W	Floating Point in Engineering Units.
0060	40097	Gain #2 (Prop Band #2 *if active*)	R/W	Floating Point

Address (hex)	Register (decimal)	Parameter Name	Access	Notes
0062	40099	Three Position Step Motor Deadband	R/W	Floating Point in percent
0064	40101	Reset #2	R/W	Floating Point in Repeats/Minute or Minutes/Repeat as configured in the UMC800.
0066	40103	Rate #2	R/W	Floating Point in Minutes
0068	40105	Cycle Time for Analog Scan	R	Floating Point in Seconds
006A	40107	LSP #1	R/W	Floating Point in Engineering Units
006C	40109	LSP #2	R/W	Floating Point in Engineering Units.
006E	40111	Alarm #2 SP #1	R/W	Floating Point in Engineering Units.
0070	40113	Alarm #2 SP #2	R/W	Floating Point in Engineering Units.
0074	40117	SP Low Limit	R/W	Floating Point in Engineering Units. Operator Limit
0076	40119	SP High Limit	R/W	Floating Point in Engineering Units. Operator Limit
0078	40121	Working Set Point	R/W	Floating Point in Engineering Units. On a write to this register the instrument will update the proper set point according to the loop's currently selected set point.
007A	40123	Output Low Limit	R/W	Floating Point in Engineering Units.
007C	40125	Output High Limit	R/W	Floating Point in Engineering Units.
007E	40127	Output Working Value	R/W	Floating Point in Engineering Units.
0088	40137	Bias	R/W	Floating Point in Engineering Units. Auto/Man bias block, value is Read-Only
008A	40139	Deviation	R	Floating Point in Engineering Units. (SP-PV)
008E	40143	Manual Reset	R/W	Floating Point in Engineering Units.
0090	40145	Feed-forward Gain	R/W	Floating Point in Engineering Units.
0092	40147	Local Percent Carbon Monoxide	R/W	Floating Point in Engineering Units.
0094	40149	Furnace Factor	R/W	Floating Point in Engineering Units.
0096	40151	Percent Hydrogen	R/W	Floating Point in Engineering Units.
0098	40153	On/Off Output Hysterisis	R/W	Floating Point in percent of input span
009A	40155	Carbon Potential Dewpoint	R/W	Floating Point in Engineering Units
009C	40157	Three Position Step Motor Time	R/W	Floating Point in seconds
00F7	40248	Enable/Disable Fuzzy	R/W	Bit Packed Bit 0: 0:Disable; 1:Enable

Address (hex)	Register (decimal)	Parameter Name	Access	Notes
00F8	40249	Demand Tune Request	R/W	Bit Packed (one shot action, activates autotuning until autotuning completed) Bit 0: 0:Off; 1:On Bit 1-15: Unused
00F9	40250	Anti-soot set point limit enable	R/W	Bit Packed Bit 0: 0:Off; 1:On Bit 1-15: Unused
00FA	40251	Auto/Manual State	R/W	Bit Packed Bit 0: 0:Manual; 1:Auto Bit 1-15: Unused
00FB	40252	Set Point State	R/W	Bit Packed (selects either SP1 or SP2 as a local SP if the UMC800 is configured as such in PID setup) Bit 0: 0:SP1; 1:SP2 Bit 1-15: Unused
00FC	40253	Remote/Local Set Point State	R/W	Bit Packed Bit 0: 0:LSP; 1:RSP Bit 1-15: Unused
00FD	40254	Tune Set State	R/W	Bit Packed (selects tuning constant set) Bit 0: 0:Tune Set #1; 1:Tune Set #2 Bit 1-15: Unused
00FE	40255	Loop Status	R	Bit Packed Bit 0: Mode: 0:Manual; 1:Auto Bit 1: Set Point: 0:SP1; 1:SP2 Bit 2: Remote/Local: 0:LSP; 1:RSP Bit 3: Tune Set: 0:Set #1; 1:Set #2 Bit 4: IMAN: 0:Inactive; 1:Active Bit 5: LO: 0: Inactive; 1:Active Bit 6-15: Reserved

6.4 Example for queries using Function Codes 3, 6, 16

Example 1

Query: Read PV, Remote SP, Working SP, Output for Loop 1 from UMC800 at address 2 using Function Code 3 (hex codes). This will be accomplished by accessing contiguous registers.

02	03	00	40	00	08	CRC	CRC

Response: where PV=1000.0, Remote SP=1000.0, Working SP=1000.0, Output=50.0

02	**03**	**10**	**44**	**7A**	**00**	**00**	**44**	**7A**	**00**	**00**

.....

.....

44	**7A**	**00**	**00**	**42**	**48**	**00**	**00**	**CRC**	**CRC**

Example 2:

Query: Write a Local Setpoint , (address 006A) to 100.0 for loop 1 at UMC 800 address 1 using Function Code 16 (10 hex). Function code 16 is used for presetting multiple registers. Registers are addressed starting at zero: Register 1 is addressed as 0.

01	10	00	6A	00	02	04	42	C8	00	00	CRC	CRC

Response: from preset of LSP#1, address 006A to 100.0 at address 1.

01	10	00	6A	00	02	CRC	CRC

Example 3:

Query: Set Loop #1 to Auto (register 00FA hex) at controller address 1. This is a bit-packed single register data type. Registers are addressed starting at 0: Register 1 is addressed as 0.

01	06	00	FA	00	01	CRC	CRC

Response: from preset of LSP#1, address 006A to 100.0 at address 1.

01	06	00	FA	00	01	CRC	CRC

6.5 Analog Input, Frequency Input, Pulse Input Value Register Map

Summary

Used to access analog input, frequency input, or pulse input parameters.

Analog Input Example: AI1 through AI64. The mapping is with respect to card position starting with the first card slot position (numbered 1 through 16, starting at the lower left) with an analog input card. Since each card has 4 inputs, the first card position with analog inputs (I/O card Type 1) would be AI1 thru AI4. As an example, if the first AI card is in the Slot 1, this would represent AI1 through AI4. If the next AI card is in slot 2 this would be AI5 thru AI 8 and so on.

The Frequency Inputs and Pulse Inputs map the same as the Analog Inputs..

Function Code Support:

Reads – Function Codes 3 and 4

Table 6-4 Analog Input, Frequency Input, Pulse Input Value Register Map Addresses

Address (hex)	Register (decimal)	Channel Number	Access	Notes
1800	46145	Analog Input, Frequency Input, or Pulse Input #1	R	Floating Point in Engineering Units.
1802	46147	Analog Input, Frequency Input, or Pulse Input #2	R	
1804	46149	Analog Input, Frequency Input, or Pulse Input #3	R	
1806	46151	Analog Input, Frequency Input, or Pulse Input #4	R	
1808	46153	Analog Input, Frequency Input, or Pulse Input #5	R	
180A	46155	Analog Input, Frequency Input, or Pulse Input #6	R	
180C	46157	Analog Input, Frequency Input, or Pulse Input #7	R	
180E	46159	Analog Input, Frequency Input, or Pulse Input #8	R	
1810	46161	Analog Input, Frequency Input, or Pulse Input #9	R	
1812	46163	Analog Input, Frequency Input, or Pulse Input #10	R	
1814	46165	Analog Input, Frequency Input, or Pulse Input #11	R	
1816	46167	Analog Input, Frequency Input, or Pulse Input #12	R	
:	:	:		
187E	46271	Analog Input, Frequency Input, or Pulse Input #64	R	

Example

Read Analog Inputs 1 and 2 from UMC800 at address 2 using Function Code 3.

02	03	18	00	00	04	CRC	CRC

Response from UMC800 where AI1 = 100.0 and AI 2 = 55.32

02	03	08	42	C8	00	00	42	5D	47	AE	CRC	CRC

6.6 Variable Register Map

Summary

Variables (analog or digital) are writeable parameters in UMC 800 attached to input pins of function blocks. Digital Variable status is 0.0 for OFF or logic 0 and 1.0 for ON or logic 1. The Variable number in the table corresponds to the Variable number in the UMC 800 configuration. You will need to access the UMC 800 Control Builder configuration or corresponding configuration printout of Tag Properties to identify the Variable numbers desired.

Function Code Support:

Read – Function Code 3

Write – Function Code 16 (10 Hex)

Table 6-5 Variable Register Map Addresses

Address (hex)	Register (decimal)	Channel Number	Access	Notes
18C0	46337	Variable Value #1	R/W	Floating Point in Engineering Units.
18C2	46339	Variable Value #2	R/W	
18C4	46341	Variable Value #3	R/W	
18C6	46343	Variable Value #4	R/W	:
18C8	46345	Variable Value #5	R/W	:
18CA	46347	Variable Value #6	R/W	:
18CC	46349	Variable Value #7	R/W	:
18CE	46351	Variable Value #8	R/W	:
18D0	46353	Variable Value #9	R/W	:
18D2	46355	Variable Value #10	R/W	:
18D4	46357	Variable Value #11	R/W	:
18D6	46359	Variable Value #12	R/W	:
18D8	46361	Variable Value #13	R/W	:
18DA	46363	Variable Value #14	R/W	:
18DC	46365	Variable Value #15	R/W	:
18DE	46367	Variable Value #16	R/W	:
18E0	46369	Variable Value #17	R/W	:
18E2	46371	Variable Value #18	R/W	:
18E4	46373	Variable Value #19	R/W	:
18E6	46375	Variable Value #20	R/W	:
:	:	:		:
1ABE	46847	Variable Value #150	R/W	:

continued

Example

Query: Read Variables 1 and 2 from UMC800 at address 1 using Function Code 3 (hex codes).

01	03	18	C0	00	04	CRC	CRC

Response: from UMC800 where Variable 1 = 100.0 and Variable 2 = 55.32

01	03	08	42	C8	00	00	42	5D	47	AE	CRC	CRC

6.7 Time Register Map

Table 6-6 Time Register Map Addresses

Address (hex)	Register (decimal)	Channel Number	Access	Notes
1BE0	47137	Hours	R/W	0 to 23
1BE1	47138	Minutes	R/W	0 to 60
1BE2	47139	Seconds	R/W	0 to 60
1BE3	47140	Month	R/W	1 to 12
1BE4	47141	Day	R/W	1 to 31
1BE5	47142	Year	R/W	1970 to 2037 *The values read are always in the range of 1970 to 2037 for a write. 0 – 37 represents 2000 – 2037, 70 – 99 represents 1970 – 1999*
1BE6	47143	Week Day	R	0 to 6 (0 = Sunday)

ATTENTION

Clock registers must be written in a single transaction. They can be written in one transaction of registers 47137 through 47142 or one transaction of registers 47137 through 47143.

6.8 Alarm Status Register Map

Summary

The alarm status number is mapped to the position of the alarm in the Alarm Display Tag Group, which is assigned with the Control Builder configuration tool, starting with Group 1 up through Group 10. Group 1 applies to the first 12 alarms which are numbered starting at the top left position of the display (Alarm 1) through to the bottom right position (Alarm 12). Successive groups define alarms 13 through 120.

Table 6-7 Alarm Status Register Map Addresses

Address (hex)	Register (decimal)	Channel Number	Access	Notes
1BF0	47153	Alarm Status #1 - #16	R	Bit Packed Bit 0: Alarm #1 Status Bit 1: Alarm #2 Status : Bit 15: Alarm #16 Status 0: Alarm OFF 1: Alarm ON
1BF1	47154	Alarm Status #17 - #32	R	Bit Packed Bit 0: Alarm #17 Status Bit 1: Alarm #18 Status : Bit 15: Alarm #32 Status 0: Alarm OFF 1: Alarm ON
1BF2	47155	Alarm Status #33 - #48	R	Bit Packed Bit 0: Alarm #33 Status Bit 1: Alarm #34 Status : Bit 15: Alarm #48 Status 0: Alarm OFF 1: Alarm ON
1BF3	47156	Alarm Status #49 - #64	R	:
1BF4	47157	Alarm Status #65 - #80	R	:
1BF5	47158	Alarm Status #81 - #96	R	:
1BF6	47159	Alarm Status #97 - #112	R	:
1BF7	47160	Alarm Status #113 - #120	R	Bit Packed Bit 0: Alarm #113 Status Bit 1: Alarm #114 Status Bit 2: Alarm #115 Status Bit 3: Alarm #116 Status Bit 4: Alarm #117 Status Bit 5: Alarm #118 Status Bit 6: Alarm #119 Status Bit 7: Alarm #120 Status Bits 8-15: Unused 0: Alarm OFF 1: Alarm ON

6.9 Signal Tag Register Map

Summary

Signal tags are connected to output pins of function blocks, representing analog or digital parameters, and are read-only parameters. The signal tag number in the table corresponds to the signal tag number in the UMC 800 Control Builder configuration. You will need to access the Control Builder configuration Tag Properties printout to identify the Signal Tag numbers desired. The Modbus address is also supplied in this printout for each signal tag.

Function Code Support:

Read – Function Code 3

Table 6-8 Signal Tag Register Map Addresses

Address (hex)	Register (decimal)	Channel Number	Access	Notes
2000	48193	Tagged Signal #1	R	Floating Point in Engineering Units
2002	48195	Tagged Signal #2	R	NOTE: Digital Signal Tags are represented as 0.0 for OFF, 1.0 for ON.
2004	48197	Tagged Signal #3	R	
2006	48199	Tagged Signal #4	R	:
2008	48201	Tagged Signal #5	R	:
200A	48203	Tagged Signal #6	R	:
200C	48205	Tagged Signal #7	R	:
200E	48207	Tagged Signal #8	R	:
2010	48209	Tagged Signal #9	R	:
2012	48211	Tagged Signal #10	R	:
2014	48213	Tagged Signal #11	R	:
2016	48215	Tagged Signal #12	R	:
2018	48217	Tagged Signal #13	R	:
201A	48219	Tagged Signal #14	R	:
201C	48221	Tagged Signal #15	R	:
201E	48223	Tagged Signal #16	R	:
:	:	:	:	:
27CE	50191	Tagged Signal #500	R	:

Example

Query: Read Signal Tags 3 and 4 from UMC800 at address 1 using Function Code 3 (hex codes).

01	03	20	04	00	04	CRC	CRC

Response: from UMC800 where Signal Tag 3 = 100.0 and Signal Tag 4 = 55.32

01	03	08	42	C8	00	00	42	5D	47	AE	CRC	CRC

6.10 Set Point Program Register Maps

Summary

The SP Programmer parameters are listed according to category related to program status and interaction, other programmer parameters and program segment mapping. A section is also provided to aid in configuring a SP programmer and recipe interface for third party software.

Function Code Support:

Read – Function Code 3

Write – Function Code 16 (10 Hex)

Considerations and Methods for Downloading. Operating, and Reading Status of SP Programs:

A SP programmer interface can be developed (and recipes containing a SP profile can be created) in third party software using the parameters listed in the following table.

In creating a SP Programmer interface showing a number of segments, a graphic display might include a table referencing the maximum number of ramp/soak segments that you will be using for your process. The parameters to be referenced for each segment are listed in Table 6-15 - Register Map (Ramp/Soak Segments).

Programmer Numbers

The parameters that follow refer to SP Programmer 1. The offsets (starting addresses) for SP Programmers 2, 3 and 4 are 10 (hex) or 16 decimal:

Programmer Number	Starting Address (Hex)	Ending Address (Hex)
SP Programmer 1	1E00	1E0F
SP Programmer 2	1E10	1E1F
SP Programmer 3	1E20	1E2F
SP Programmer 4	1E30	1E3F

Controlling the Program

For controlling the program, the following parameters should be accessed:

Parameter	Addr (Hex)	Notes
SP Programmer Output	1E00	See Table 6-12
Current Segment Number	1E02	See Table 6-12
Program Elapsed Time	1E04	See Table 6-12
Segment Time Remaining	1E08	See Table 6-12
Current Segment Events	1E0A	See Table 6-12
Status	1E0B	See Table 6-12
Start (write only)	1E0C	See Table 6-12
Hold (write only)	1E0D	See Table 6-12
Advance (write only)	1E0E	See Table 6-12
Reset (write only)	1E0F	See Table 6-12
Current Program Number	1F00	See Table 6-13
Auxiliary Output	1F04	See Table 6-13

Parameters for the Profile

You will also need to define the following for the parameters for the profile:

Parameter	Addr (Hex)	Notes
Time Units	1F3A	See Table 6-13
Ramp Units (segments)	1F3B	See Table 6-13
Guaranteed Soak Type	1F3C	See Table 6-13
Guaranteed Soak Low	1F06	See Table 6-13
Guaranteed Soak High	1F08	See Table 6-13
Prog Save Request	1F02	See Table 6-13

Procedures for Downloading Setpoint Programs

These steps are for programmer 1. For programmers 2, 3, and 4, adjust the register addresses accordingly.

Table 6-9 is for downloading using Function Codes 3, 4, 6, 16.

Table 6-10 is for downloading using Function Codes 20 and 21.

Table 6-9 Steps to Download a Setpoint Program using Modbus Function Codes 3, 4, 6, 16

Step	Action
1	Set the programmer to RESET by writing any number to 47696 (1E0F). This can be done either with function code 6 or 16.
2	Clear the program by writing a 0 to registers 47937 and 47938 (1F00 and 1F01). This is a floating point register and requires a multiple register write (function code 16). This is the safest way to insure that all registers are cleared for the next program download.
3	Write the header information for parameters relevant to the program (leave all others at 0) -- registers 47943 (1F06) - 47997 (1F3C). Registers 47943 - 47968 are floats and must be written using function code 16. Registers 47995 - 47997 are bit-packed and can be written with either function code 6 or 16. Note: Display High Range Limit and Display Low Range Limit are not presently used in the UMC800.
4	Write the information for each segment required in the profile -- registers 2800 - 2807 for segment 1, 2808 - 280F for segment 2, etc. The first 2 registers are bit-packed and can be written with either function code 6 or 10. The rest of the registers are float and must be written using function code 16.
5	Save the program to a program (profile) number archive by writing a floating point number to register 47939. This will store the downloaded data utilized by the programmer block to the program (profile) number used. Profile numbers may range from 1-70.
The program is now ready to run. Note that the current program (profile) number -- register 47937 -- is automatically set to the saved program number.	

Table 6-10 Steps to Download a Setpoint Program using Modbus Function Codes 20, 21

Step	Action
1	Set the programmer to RESET by writing any number to 47696 (1E0F). This can be done either with function code 6 or 16. (could use a function code 21 scattered write, but this requires knowledge of the SPP block number in the configuration)
2	Clear the program by writing a 0 to registers 47937 and 47938 (1F00 and 1F01). This is a floating point register and requires a multiple register write (function code 16). This is the safest way to insure that all registers are cleared for the next program download. (could use a function code 21 scattered write, but this requires knowledge of the SPP block number in the configuration)
3	Write the header information for parameters relevant to the program (leave all others at 0) -- registers 47943 (1F06) - 47997 (1F3C). Registers 47943 - 47968 are floats and must be written using function code 16. Registers 47995 - 47997 are bit-packed and can be written with either function code 6 or 16. (could use a function code 21 scattered write, but this requires knowledge of the SPP block number in the configuration) Note: Display High Range Limit and Display Low Range Limit are not presently used in the UMC800.
4	Use function code 21 to write each segment required in the profile. See Section 7.
5	Save the program to a program (profile) number archive by writing a floating point number to register 47939. This will store the downloaded data utilized by the programmer block to the program (profile) number used. Profile numbers may range from 1-70. (could use a function code 21 scattered write, but this requires knowledge of the SPP block number in the configuration)
The program is now ready to run. Note that the current program (profile) number -- register 47937 -- is automatically set to the saved program number.	

Procedure for Uploading Setpoint Programs

Table 6-11 Steps to Upload a Setpoint Program using Modbus Function Codes 3, 4, 6, 16

Step	Action
1	Set the programmer to RESET by writing any number to 47696 (1E0F). This can be done either with function code 6 or 16.
2	Load the program into the setpoint programmer block by writing the program number to registers 47937 and 47938 (1F00 and 1F01). This is a floating point register and requires a multiple register write (function code 16).
3	Read the header information desired -- registers 47043 (1F06) - 47997 (1F3C) using function code 3 or 4.
4	Read the information for each segment desired using function code 3 or 4 — registers 2800 - 2807 for segment 1, 2808 - 280F for segment 2, etc.

6.11 Set Point Programmer Value Register Map

Table 6-12 Set Point Programmer Value Register Map Addresses

Address (hex)	Register (decimal)	Channel Number	Access	Notes
1E00	47681	Set Point Programmer Output	R	Floating Point in Engineering Units.
1E02	47683	Current Segment Number	R/W	Floating Point; 1...Max Segment # 50 A write changes the segment number.
1E04	47685	Program Elapsed Time	R	Floating Point in Minutes Continues to run when in Hold
1E08	47689	Segment Time Remaining	R	Floating Point in Minutes
1E0A	47691	Current Segment Events	R	Bit Packed Indicates status of events 1-16 in one register Bit 0: Event #1 : Bit 15: Event #16 0: Event OFF 1: Event ON
1E0B	47692	Status	R	Bit Packed Bit 0: 1=Ready 1: 1=Run 2: 1=Hold 3: 1=End 4: 1=Reserved 5: 1=Time Units in Minutes 6: 1=Time Units in Hours 7: Ramp Units 0: Time 1: Rate 8: Reserved 9: If bit 2 Set 0: Operator hold 1: Guaranteed soak hold 10: 0: Current segment is a soak 1: Current segment is a ramp 11-15: Reserved
1E0C	47693	Run	W	Signed 16 bit integer Write to location Starts Profile; Data ignored
1E0D	47694	Hold	W	Signed 16 bit integer Write to location Holds Profile; Data ignored
1E0E	47695	Advance	W	Signed 16 bit integer Write to location Advances Profile one segment while in Hold mode; Data ignored
1E0F	47696	Reset	W	Signed 16 bit integer Write to location Resets Profile after program is first in Hold mode; Data ignored

6.12 Set Point Programmer Additional Values Register Map

Table 6-13 Set Point Programmer Additional Values Register Map Addresses

Address (hex)	Register (decimal)	Channel Number	Access	Notes
1F00	47937	Current Program Number	R/W	Floating Point This is optional, indicates present profile number in use. This also allows entry of a profile number from the UMC800 stored profile memory (if profiles have been stored in the controller) and will retrieve the profile data for a display showing a SP profile segment table. Typically, when recipes are downloaded from third party software, this will be the number generated by the Program Save Request parameter A write to this register loads the program into the set point programmer function block; if 0 is written, the function block's program is cleared. *Notes 2*
1F02	47939	Program Save Request	R/W	Floating Point Assigns profile parameters downloaded to a profile number such as 1. **This is required by the UMC800 to be the last parameter downloaded.** This overwrites what is in this UMC800 SP Profile memory location on each download of a new SP profile. Saves the program into the archive. Writing to this register is prohibited in the run mode.
1F04	47941	Auxiliary Output	R	Floating Point
1F06	47943	Guaranteed Soak Low	R/W	Floating Point Presets High Deviation setting in engr units. *Writing to this register is only permissible in the reset or ready mode*
1F08	47945	Guaranteed Soak High	R/W	Floating Point Presets Low Deviation setting in engr units. *Writing to this register is only permissible in the reset or ready mode*
1F0A	47947	Restart Ramp Rate	R/W	Floating Point *Writing to this register is only permissible in the reset or ready mode*
1F0C	47949	Display High Range Limit	R/W	Floating Point *Writing to this register is only permissible in the reset or ready mode*
1F0E	47951	Display Low Range Limit	R/W	Floating Point *Writing to this register is only permissible in the reset or ready mode*

Address (hex)	Register (decimal)	Channel Number	Access	Notes
1F10	47953	Jog Segment	R/W	Floating Point W*riting to this register is only permissible in the reset or ready mode*
1F12	47955	Loop Start	R/W	Floating Point 0 indicates no loop. W*riting to this register is only permissible in the reset or ready mode*
1F14	47957	Loop End	R/W	Floating Point 0 indicates no loop. W*riting to this register is only permissible in the reset or ready mode*
1F16	47959	Repeats	R/W	Floating Point 0 indicates loop forever. W*riting to this register is only permissible in the reset or ready mode*
1F3A	47995	Time Units	R/W	Bit Packed Bit 0: Reserved 1: minutes 2: hours 3-15: Unused
1F3B	47996	Ramp Units	R/W	Bit Packed Bit 0: 0:Time; 1:Rate Bit 1-15: Unused W*riting to this register is only permissible in the reset or ready mode*
1F3C	47997	Guaranteed Soak Type	R/W	Bit Packed For selection of Soak (or Hold) guarantee – Per Segment (requiring selection per segment in a table) Bit 0: per segment 1: all soaks 2: all segments 3-15: Unused None if none of the bits is set W*riting to this register is only permissible in the reset or ready mode*

6.13 Set Point Programmer Segment Map

A profile contains up to 50 segments. Each segment is made up of 8 registers. The segment mapping for setpoint programmer #1 is shown below.

Table 6-14 Set Point Programmer Segment Map Addresses

Start Address	End Address	Description
2800	2807	Set Point Programmer #1 Segment 1
2808	280F	Set Point Programmer #1 Segment 2
2810 : 2988	2817 : 298F	Set Point Programmer #1 Segment 3 : Set Point Programmer #1 Segment 50

6.14 Segment Register Map

The table below describes the registers that are part of a setpoint programmer segment. To determine the actual register address for a parameter within a segment, add the register offset to the start address of the segment.

Table 6-15 Segment Register Map Addresses

Register Offset within Segment	Parameter Name	Access	Notes
0	Ramp/Soak Segment Guaranteed Soak Enable	R/W	Bit Packed Bit 0: 1 = ramp segment; 0=soak segment Bit 1: 1 = guaranteed soak enabled 0 = guaranteed soak disabled Bit 0 is ignored in the hold mode. Writing to this register is not permissible in the run mode.
1	Events	R/W	Bit Packed Bit 0: Event #1 : : Bit 15: Event #16 0: Event OFF 1: Event ON Writing to this register is only permissible in reset or ready mode.
2	Time or Rate	R/W	Floating Point in time units configured for the set point programmer Writing to this register is not permissible in the run mode.
4	Ramp or Soak value	R/W	Floating Point Writing to this register is not permissible in the run mode.
6	Soak value for auxiliary output (use “Time or Rate” for duration)	R/W	Floating Point Writing to this register is not permissible in the run mode.

6.14.1 Example For Determining a Segment Register

To change the ramp value in segment #8 of setpoint programmer #2, the register address is determined as follows.

Step 1: Use Table 6-1 to determine the start address for setpoint program #2 profile. The value is 2A00 Hex.

Step 2: Calculate the offset address for segment 8 in a profile. This is calculated as:

Segment #8 offset address = (segment number – 1) * 8

= (8-1) * 8

= 56 or 38 Hex

Step 3: Use the table above to determine the register offset for the ramp value. The value is 4.

Step 4: Calculate the address by adding the results of steps 1, 2, and 3 to determine the register address.

Register address = Setpoint program #2 profile base address
+ Segment 8 offset address
+ Ramp value register offset

= 2A00 + 38 + 4

= 2A3C

6.15 Scheduler Value Register Map

Summary

The SP Scheduler parameters are listed according to category related to SP Scheduler status plus interaction and scheduler segment mapping. A section is also provided to aid in configuring a Scheduler and recipe interface for third party software.

Function Code Support

Read – Function Code 3

Write – Function Code 16 (10 hex)

Scheduler Value Register Map

You will need to define the parameters for the Schedule as required by the application. Application notes for these parameters are provided and further defined in the **Scheduler Value Register Map** Table 6-19.

Scheduler Segment Register Map

Table 6-20 indicates the range of addresses applicable to a scheduler segment. Each segment uses 48 registers (30 hex).

Segment Register Map Addresses

Table 6-21 describes the registers that are part of a schedule segment. To determine the actual register address for a parameter within a segment, add the register offset to the start address of the segment.

Considerations and Methods for Downloading, Operating, and Reading Status of SP Schedules

A SP Scheduler interface can be developed (and recipes containing a schedule can be created) in third party software using the parameters listed in Table 6-21.

In creating a Scheduler interface showing a number of segments and outputs for each segment on a graphic display might include a table referencing the **maximum** number of segments that you will be using for your process. Refer to the **Scheduler Segment Register Map -** Table 6-20 for the range of addresses applied to each scheduler segment. Each segment uses 48 registers (30 hex). Use the **Segment Register Map -** Table 6-21 for the parameters to be referenced for read/write within each segment. Application notes for these segment parameters is provided.

Procedures for Downloading Setpoint Schedules

Table 6-16 is for downloading using Function Codes 3, 4, 6, 16.

Table 6-17 is for downloading using Function Codes 20 and 21.

Table 6-16 Steps to Download a Setpoint Schedule using Modbus Function Codes 3, 4, 6, 16

Step	Action
1	Set the scheduler to RESET by writing any number to 52367 (304E). This can be done either with function code 6 or 16.
2	Clear the schedule by writing a 0 to registers 52321 and 52322 (3020 and 3021). This is a floating point register and requires a multiple register write (function code 16). This is the safest way to insure that all registers are cleared for the next schedule download.
3	Write the header information for parameters relevant to the schedule (leave all others at 0) -- registers 52331 (302A) - 52347 (303A) and register 52368 (304F). Registers 52331 - 52347 are floats and must be written using function code 16. Register 52368 is bit-packed and can be written with either function code 6 or 16.
4	Write the information for each segment required in the schedule -- registers 3200 – 322F for segment 1, 3230 – 325F for segment 2, etc. The first 9 registers are bit-packed and can be written with either function code 6 or 10. The rest of the registers are float and must be written using function code 16.
5	Save the schedule to a schedule number archive by writing a floating point number to register 52329. This will store the downloaded data utilized by the scheduler block to the schedule number used. Schedule numbers may range from 1-50.
The schedule is now ready to run. Note that the current schedule number -- register 52321-- is automatically set to the saved schedule number.	

Table 6-17 Steps to Download a Setpoint Schedule using Modbus Function Codes 20, 21

Step	Action
1	Set the scheduler to RESET by writing any number to 52367 (304E). This can be done either with function code 6 or 16. (could use a function code 21 scattered write, but this requires knowledge of the SPP block number in the configuration)
2	Clear the schedule by writing a 0 to registers 52321 and 52322 (3020 and 3021). This is a floating point register and requires a multiple register write (function code 16). This is the safest way to insure that all registers are cleared for the next schedule download. (could use a function code 21 scattered write, but this requires knowledge of the SPP block number in the configuration)
3	Write the header information for parameters relevant to the schedule (leave all others at 0) -- registers 52331 (302A) - 52347 (303A) and register 52368 (304F). Registers 52331 - 52347 are floats and must be written using function code 16. Register 52368 is bit-packed and can be written with either function code 6 or 16. (could use a function code 21 scattered write, but this requires knowledge of the SPP block number in the configuration)
4	Use function code 21 to write each segment required in the profile. See Section 7.
5	Save the schedule to a schedule number archive by writing a floating point number to register 52329. This will store the downloaded data utilized by the scheduler block to the schedule number used. Schedule numbers may range from 1-50. (Could use a function code 21 scattered write, but this requires knowledge of the SPP block number in the configuration).

Procedure for Uploading Setpoint Schedules

Table 6-18 Steps to Upload a Setpoint Schedule using Modbus Function Codes 3, 4, 6, 16

Step	Action
1	Set the scheduler to RESET by writing any number to 52367 (304E). This can be done either with function code 6 or 16.
2	Load the schedule into the setpoint scheduler block by writing the schedule number to registers 52321 and 52322 (3020 and 3021). This is a floating point register and requires a multiple register write (function code 16)
3	Read the header information desired -- registers 52331 (302A) - 52347 (303A) and register 52368 (304F) using function code 3 or 4.
4	Read the information for each segment desired using function code 3 or 4 -- registers 3200 - 322F for segment 1, 3230 - 325F for segment 2, etc.

Table 6-19 Scheduler Value Register Map Addresses

Address (hex)	Register (decimal)	Channel Number	Access	Notes
3000	52289	Scheduler Output 1	R	Floating Point in Engineering Units.
3002	52291	Scheduler Output 2	R	Floating Point in Engineering Units.
3004	52293	Scheduler Output 3	R	Floating Point in Engineering Units.
3006	52295	Scheduler Output 4	R	Floating Point in Engineering Units.
3008	52297	Scheduler Output 5	R	Floating Point in Engineering Units.
300A	52299	Scheduler Output 6	R	Floating Point in Engineering Units.
300C	52301	Scheduler Output 7	R	Floating Point in Engineering Units.
300E	52303	Scheduler Output 8	R	Floating Point in Engineering Units.
3010	52305	Scheduler Auxiliary Output 1	R	Floating Point in Engineering Units.
3012	52307	Scheduler Auxiliary Output 2	R	Floating Point in Engineering Units.
3014	52309	Scheduler Auxiliary Output 3	R	Floating Point in Engineering Units.
3016	52311	Scheduler Auxiliary Output 4	R	Floating Point in Engineering Units.
3018	52313	Scheduler Auxiliary Output 5	R	Floating Point in Engineering Units.
301A	52315	Scheduler Auxiliary Output 6	R	Floating Point in Engineering Units.
301C	52317	Scheduler Auxiliary Output 7	R	Floating Point in Engineering Units.
301E	52319	Scheduler Auxiliary Output 8	R	Floating Point in Engineering Units.
3020	52321	Current Program Number	R/W	Floating Point This is optional. It indicates present schedule number in use. This also allows entry of a schedule number from the UMC800 stored schedule memory (if schedules have been stored in the controller) and will retrieve the schedule data for a display showing a SP schedule segment table. Typically, when recipes are downloaded from third party software, this will be the number generated by the Schedule Save Request parameter A write to this register loads the program into the scheduler function block; if 0 is written, the scheduler's schedule is cleared. Writing to this register is only permissible in reset or ready mode.
3022	52323	Current Segment Number	R/W	Floating Point; 1 thru Max Segment # A write changes the segment number.
3024	52325	Program Elapsed Time	R	Floating Point in Time Units Includes or runs when in Hold
3026	52327	Segment Time Remaining	R	Floating Point in Time Units

Address (hex)	Register (decimal)	Channel Number	Access	Notes
3028	52329	Schedule Save Request	R/W	Floating point. Assigns profile parameters downloaded to a schedule number such as 1. **This is required by the UMC800 to be the last parameter downloaded.** This overwrites what is in this UMC800 SP Schedule memory location on each download of a new SP Schedule. Saves the schedule into the archive. Writing to this register is prohibited in the run mode.
302A	52331	Guaranteed Soak Limit 1	R/W	Floating Point
302C	52333	Guaranteed Soak Limit 2	R/W	Floating Point
302E	52335	Guaranteed Soak Limit 3	R/W	Floating Point
3030	52337	Guaranteed Soak Limit 4	R/W	Floating Point
3032	52339	Guaranteed Soak Limit 5	R/W	Floating Point
3034	52341	Guaranteed Soak Limit 6	R/W	Floating Point
3036	52343	Guaranteed Soak Limit 7	R/W	Floating Point
3038	52345	Guaranteed Soak Limit 8	R/W	Floating Point
303A	52347	Jog Segment	R/W	Floating Point Defines segment for schedule to jog based on an enable to an input pin
3049	52362	Current Segment Events (Bit Packed)	R	Bit Packed Indicates status of events Bit 0: Event #1 : : Bit 15: Event #15 0: Event OFF 1: Event ON
304A	52363	Status (Bit Packed)	R	Bit Packed Bit 0: 1=Ready 1: 1=Run 2: 1=Hold 3: 1=End 4: 1=Time Units in Seconds 5: 1=Time Units in Minutes 6: 1=Time Units in Hours 7: If bit 2 Set 0: Operator hold 1: Guaranteed soak hold 8-15: Reserved
304B	52364	Start	W	Signed 16 bit integer Write to location Starts Schedule; Data ignored
304C	52365	Hold	W	Signed 16 bit integer Write to location Holds Schedule; Data ignored

Address (hex)	Register (decimal)	Channel Number	Access	Notes
304D	52366	Advance	W	Signed 16 bit integer Write to location Advances Schedule; Data ignored
304E	52367	Reset	W	Signed 16 bit integer Write to location Resets Schedule; Data ignored
304F	52368	Time Units	R/W	Bit Packed Bit 0: Reserved 2: hours 3-15: Unused

6.16 Scheduler Segment Register Map

A schedule can contain up to 50 segments. Each segment is made up of 48 (30 hex) registers. The segment mapping for Scheduler #1 is shown below:

Table 6-20 Scheduler Segment Register Map Addresses

Start Address	End Address	Description
3200	322F	Scheduler #1 Segment 1
3230	325F	Scheduler #1 Segment 2
3260	328F	Scheduler #1 Segment 3
:	:	:
3B30	3B5F	Scheduler #1 Segment 50

6.17 Segment Register Map

The table below describes the registers that are part of a schedule segment. To determine the actual register address for a parameter within a segment, add the register offset to the start address of the segment.

Table 6-21 Segment Register Map Addresses

Register Offset within segment	Parameter Name	Access	Notes
0000	Guaranteed Soak Type 1 (Bit Packed)	R/W	Bit Packed Bit 0: Off Bit 1: Low Bit 2: High Bit 3: Low & High Bit 4…15: Unused *Note 1*
0001	Guaranteed Soak Type 2	R/W	*See Guaranteed Soak Type 1*
0002	Guaranteed Soak Type 3	R/W	*See Guaranteed Soak Type 1*
0003	Guaranteed Soak Type 4	R/W	*See Guaranteed Soak Type 1*
0004	Guaranteed Soak Type 5	R/W	*See Guaranteed Soak Type 1*
0005	Guaranteed Soak Type 6	R/W	*See Guaranteed Soak Type 1*
0006	Guaranteed Soak Type 7	R/W	*See Guaranteed Soak Type 1*
0007	Guaranteed Soak Type 8	R/W	*See Guaranteed Soak Type 1*
0008	Events	R/W	Bit Packed Bit 0: Event #1 **:** **:** Bit 15: Event #15 0: Event OFF 1: Event ON *Note 2*
000A	Time	R/W	Floating Point in seconds *Note 1*
000C	Output #1 Ramp or Soak value	R/W	Floating Point *Note 1*
000E	Output #2 Ramp or Soak value	R/W	Floating Point *Note 1*
0010	Output #3 Ramp or Soak value	R/W	Floating Point *Note 1*
0012	Output #4 Ramp or Soak value	R/W	Floating Point *Note 1*
0014	Output #5 Ramp or Soak value	R/W	Floating Point *Note 1*
0016	Output #6 Ramp or Soak value	R/W	Floating Point *Note 1*
0018	Output #7 Ramp or Soak value	R/W	Floating Point *Note 1*

Register Offset within segment	Parameter Name	Access	Notes
001A	Output #8 Ramp or Soak value	R/W	Floating Point *Note 1*
001C	Soak value for Auxiliary Output #1	R/W	Floating Point *Note 1*
001E	Soak value for Auxiliary Output #2	R/W	Floating Point *Note 1*
0020	Soak value for Auxiliary Output #3	R/W	Floating Point *Note 1*
0022	Soak value for Auxiliary Output #4	R/W	Floating Point *Note 1*
0024	Soak value for Auxiliary Output #5	R/W	Floating Point *Note 1*
0026	Soak value for Auxiliary Output #6	R/W	Floating Point *Note 1*
0028	Soak value for Auxiliary Output #7	R/W	Floating Point *Note 1*
002A	Soak value for Auxiliary Output #8	R/W	Floating Point *Note 1*
002C	Recycle	R/W	Number of times to recycle Floating Point *Note 2*
002E	Recycle Segment	R/W	Floating Point *Note 2*

Note 1: Writing to this register is not permissible in the run mode.
Note 2: Writing to this register is only permissible in reset or ready mode

6.17.1 Example for Determining a Segment Register

To change the ramp value for Output #6 in segment #5 of setpoint scheduler #3, the register address is determined as follows.

Step 1: Use Table 6-1 to determine the start address for scheduler #3's schedule. The value is 4A00 Hex.

Step 2: Calculate the offset address for segment 5 in a schedule. This is calculated as:

Segment offset address = (segment number – 1) * 48

= (5-1) * 48

= 192 or C0 Hex

Step 3: Use the table above to determine the register offset for Output #6 ramp value. The value is 16 Hex.

Step 4: Calculate the address by adding the results of steps 1, 2, and 3 to determine the register address.

Register address = Schedule program #3's schedule start address
+ Segment 5 offset address
+ Output #6 ramp value register offset

= 4A00 + C0 + 16

= 4AD6

6.18 Hand/OFF/Auto Control Group Register Map

Summary

This table contains addresses for the Hand/Off/Auto control group. The Modbus HOA number address for a HOA can also be obtained from the Control Builder printout of Tag Properties.

Function Code Support:

Reads – Function Codes 3/4

Writes – Function Code 16 (10 hex) for preset of multiple registers (e.g., for floating point)

Writes – Function Code 6 for presetting an integer value

Table 6-22 HOA Control Group Register Map

Address (hex)	Register (decimal)	Parameter Name	Access	Notes
6600	66113	Status	R	Bit Packed Bits 0 – 3: Hand-Off-Auto State Bit 0: Off : 0=NO, 1=YES Bit 1: Hand: 0=NO, 1=YES Bit 2: Auto: 0=NO, 1=YES Bit 3: Bypass: 0=NO, 1=YES Bit 4: Request Output 0 = OFF, 1 = ON Bit 5: Local Source ON: 0=NO, 1=YES Bit 6: Remote Source ON: 0=NO, 1=YES Bit 7: Local and Remote ON: 0=NO, 1=YES Bit 7-15: Unused
6601	66114	Remote Off-state Change Request	W	Unsigned 16 Integer Data Ignored
6602	66115	Remote Hand-state Change Request	W	Unsigned 16 Integer Data Ignored
6603	66116	Remote Auto-state Change Request	W	Unsigned 16 Integer Data Ignored
6604	66117	Local Source	W	Unsigned 16 Integer Data Ignored
6605	66118	Remote Source	W	Unsigned 16 Integer Data Ignored
6606	66119	Local and Remote Source	W	Unsigned 16 Integer Data Ignored

6.19 Device Control Group Register Map

Summary

This table contains addresses for the Device Control group. The Modbus Device Control number address for a Device Control can also be obtained from the Control Builder printout of Tag Properties.

Function Code Support:

Reads – Function Codes 3/4

Writes – Function Code 16 (10 hex) for preset of multiple registers (e.g., for floating point)

Writes – Function Code 6 for presetting an integer value

Table 6-23 Device Control Group Register Map

Address (hex)	Register (decimal)	Parameter Name	Access	Notes
6B00	67393	Reset Request	W	Unsigned 16 Integer Data Ignored
6B01	67394	Status Indicator	R	Bit Packed Bits 0 – 6: Device Control State Bit 0: Ready: 0=NO, 1=YES Bit 1: Prestart: 0=NO, 1=YES Bit 2: Starting: 0=NO, 1=YES Bit 3: Running: 0=NO, 1=YES Bit 4: Stopping: 0=NO, 1=YES Bit 5: Disabled: 0=NO, 1=YES Bit 6: Failed: 0=NO, 1=YES Bit 7: Run Request Input State; 0=OFF, 1=ON Bit 8: Device Feedback Started; 0=NO, 1=YES Bit 9: Device Failed; 0=NO, 1=YES Bit 10: Automatic Reset; 0=Manual, 1=Auto Bit 11-15: Unused
6B02	67395	Remaining Delay Time	R	Floating Point in Seconds
6B04	67397	Start Delay	R/W	Floating Point in Seconds
6B06	67399	Stop Delay	R/W	Floating Point in Seconds
6B08	67401	Feedback Fail Delay	R/W	Floating Point in Seconds

7. Controller Configuration Messages (Function Codes 20 and 21)

7.1 Overview

This section describes function codes 20 and 21 which provide additional functionality not available using the function codes described in the previous sections.

The additional functionality includes:

- read/write function block dynamic data that is not part of the function code 03 register set
- read function block inputs and outputs that are not part of the function code 03 register set
- read detail of an alarm point
- read the event summary buffer
- acknowledge alarms and events
- upload historical data for alarms and events

For Function Codes 20 and 21, the Byte Swap configuration does not apply. All numbers are represented in the FP B byte order. Refer to Subsection 3.3.

All digital numbers are represented as Floating Point 0 for OFF and Floating Point 1 for ON.

ATTENTION

To access the controller you must have a current Control Builder configuration file available. Data is referenced relative to function block number and the index number of the desired parameter. It is suggested that you upload the controller configuration using the Control Builder configuration tool to assure that you have a current configuration. The Control Builder tool can provide a printout of all function blocks used, their number and detail. You will also need to use the Control Builder Function Block Reference Guide as a reference for the function block index numbers for contained parameters.

7.2 Function Code 20 – Read General Reference Data

Description

The UMC800 uses function code 20 (14h) "Read General Reference" to implement the "read" configuration messages. These include:

- Read Contiguous 32-bit Values
- Read Scattered 32-bit Values
- Read Setpoint Program Segment
- Read Alarm Point Detail
- Historical Data Upload
- Event Summary
- Read Setpoint Scheduler Segment
- Loopback Test

Query

The query message uses the standard function code 20 header followed by the UMC800 configuration message. The Byte Count equals the total number of bytes between the Byte Count and the CRC. This number cannot exceed 255; therefore, the configuration message content is limited to 248 bytes maximum.

Query message format for function code 20 (14h)

Slave Address	Function Code	Byte Count	Reference Type (00)	File Number High (00)	File Number Low (00)	Starting Address High (00)	Start Address Low (00)	Register Count High (00)	Register Count Low (00)	UMC800 Configuration Message (max 248 bytes)	CRC	CRC

Response

The response is the standard function code 20 header followed by the UMC800 configuration message. Byte Count is adjusted to account for the number of bytes in the response.

Response message format for function code 20 (14h)

Slave Address	Function Code	Byte Count	Reference Type (00)	File Number High (00)	File Number Low (00)	Starting Address High (00)	Start Address Low (00)	Register Count High (00)	Register Count Low (00)	UMC800 Configuration Message (max 248 bytes)	CRC	CRC

ATTENTION

For query and response, Reference Type, File Number, Address, and Register Count bytes should be set to 0.

Example Query with Read Contiguous

Use the UMC800 message "read contiguous 32 bit" to read the PV, working setpoint, output, and mode of the PID function block. Assume the function block number of the PID block is 2. Assume a slave address 02.

Format of query:

02	14	0E	00	00	00	00	00	00	00	00	02	04	00	02	02	09	CRC	CRC
Contents from left to right: Slave address = 02 Function code = 14 (read) Byte count =14 decimal (0E hex) Reference type File number high File number low Starting address high Starting address low Register count high Register count low										Contents of "Read Contiguous 32 bit" configuration message. See Figure 7-1. Contents from left to right: Header = 00 Function Code = 02 Number of values requested = 04 Filler Byte = 00 Table = 02 (parameters are dynamic, see Table 8-77) Block number = 02 Index = 09 (index number of first value requested. See Table 8-77)								

Example Response for Read Contiguous

Continuing with the example query above, the following response would be returned, assuming the query was acknowledged, the PV and WSP values are both 100, the output is 0 %, and the mode is LSP AUTO.

Format of response

02	14	1A	00	00	00	00	00	00	00	Contents of "Read Contiguous 32 bit" configuration message. See * below.	CRC	CRC

Contents from left to right:
- Slave address = 02
- Function code = 14 (read)
- Byte count =26 decimal (1A hex)
- Reference type
- File number high
- File number low
- Starting address high
- Starting address low
- Register count high
- Register count low

* Contents of "Read Contiguous 32 bit" configuration message. See Figure 7-1.

09	02	04	42	C8	00	00	42	C8	00	00	00	00	00	00	40	80	00	00

Contents from left to right:
Acknowledge = 09
Function Code = 02
Number of values returned = 04
Value of PV = 42C80000
Value of WSP = 42C80000
Value of output = 00000000
Value of mode = 40800000 (See Table 8-78).
(Values are in IEEE format.. Each value requested uses 4 bytes in the response.)

Example Query with Read Scattered

Use the UMC800 message "read scattered 32 bit" to read the following:

- AI1 output value
- PID2 PV, working setpoint, output, and mode
- PID7 PV, working setpoint, output, and mode
- Assume a slave address 02

Format of query:

02	14	1E	00	00	00	00	00	00	00	Contents of "Read Scattered 32 bit" configuration message. See * below.	CRC	CRC

Contents from left to right:
- Slave address = 02
- Function code = 14 (read)
- Byte count =30 decimal (1E hex)
- Reference type
- File number high
- File number low
- Starting address high
- Starting address low
- Register count high
- Register count low

*Contents of "Read Scattered 32 bit" configuration message. See Figure 7-2.

00	03	09	00	02	01	01	02	09	02	0A	02	0B	02	0C	07	09	07	0A	07	0B	07	0C

Contents from left to right:

Header = 00
Function Code = 03
Number of values requested = 09
Filler Byte = 00
Table = 02 (parameters are dynamic, see Table 8-5 and Table 8-77)
Block number (of AI) = 01
Index = 01 (output. See Table 8-5)
Block number (of PID) = 02
Index = 09 (PV. See Table 8-77)
Block number = 02
Index = 0A (WSP. See Table 8-77)
Block number = 02
Index = 0B (Output. See Table 8-77)
Block number = 02
Index = 0C (Mode. See Table 8-77)
Block number (of PID) = 07
Index = 09 (PV. See Table 8-77)
Block number = 07
Index = 0A (WSP. See Table 8-77)
Block number = 07
Index = 0B (output. See Table 8-77)
Block number = 07
Index = 0C (mode. See Table 8-77)

Example Response of Read Scattered

Continuing with the example query above, the following response would be returned, assuming the following:

- query was acknowledged,
- AI1 output = 500
- PID2 PV = 500
- PID2 WSP = 520
- PID2 output = 10%
- PID2 mode is LSP AUTO.
- PID7 PV = 200
- PID7 WSP = 100
- PID7 output = 80%
- PID7 mode is LSP AUTO.

Format of response:

02	14	2E	00	00	00	00	00	00	00	Contents of "Read Scattered 32 bit" configuration message. See * below.	CRC	CRC

Contents from left to right:
Slave address = 02
Function code = 14 (read)
Byte count = 46 decimal (2E hex)
Reference type
File number high
File number low
Starting address high
Starting address low
Register count high
Register count low

* Contents of "Read Scattered 32 bit" configuration message. See Figure 7-2.

09	03	09	43	FA	00	00	43	FA	00	00	44	02	00	00	41	20	00	00	40	80	00	00	43	48	00	00	42	C8	00	00	42	A0	00	00	40	80	00	00

Contents from left to right:
Acknowledge = 09
Function Code = 03
Number of values returned = 09
Value of AI1 output = 43FA0000
Value of PID2 PV = 43FA0000
Value of PID2 WSP = 44020000
Value of PID2 output = 41200000
Value of PID2 mode = 40800000 (See Table 8-78).
Value of PID7 PV = 43480000
Value of PID7 WSP = 42C80000
Value of PID7 output = 42A00000
Value of PID7 mode = 40800000 (See Table 8-78).
(Values are in IEEE format. Each value requested uses 4 bytes in the response.)

Example Query of Read Setpoint Program Segments

Use the UMC800 message "Read Setpoint Program Segments" to read all data associated with segments 1, 2, 3, and 4. Assume slave address = 02, SPP function block #4.

Format of query:

02	14	0C	00	00	00	00	00	00	00	00	05	04	06	01
Contents from left to right: Slave address = 02 Function code = 14 (read) Byte count = 12 decimal (0C hex) Reference type File number high File number low Starting address high Starting address low Register count high Register count low										Contents of "Read Setpoint Program Segments" configuration message. See Figure 7-4. Contents of Header = 00 Function code = 05 Number of consecutive segments = 4 Programmer function block number = 6 Starting segment number = 1				

Example Response of Read Setpoint Program Segments

Continuing with the example above, the following response would be returned, assuming the query is acknowledged and assuming the following segment data.

Contents of Segments 1-4

	Segment #1	Segment #2	Segment #3	Segment #4
Segment Type	Ramp (1)	Soak (0)	Ramp (1)	Soak (0)
Guaranteed Soak Enable	0	1	0	0
Events 9 – 16 (LSB is Event 9)	00010011	00001011	00001001	00001001
Events 1 – 8 (LSB is Event 1)	10000000	10000000	00000000	00000000
Time or Rate	40	160	60	1
Value	100	2000	2000	100
Aux Value	1.0	1.0	1.0	0.0

Format of response:

02	14	4A	00	00	00	00	00	00	00	Contents of "Read Setpoint Program Segment" configuration message. See * below.	CRC	CRC

Contents from left to right:
- Slave address = 02
- Function code = 14 (read)
- Byte count = 74 decimal (4A hex)
- Reference type
- File number high
- File number low
- Starting address high
- Starting address low
- Register count high
- Register count low

* Contents of "Read Setpoint Program Segments" configuration message. See Figure 7-4 and Table 7-1.

09	05	04	01	00	13	80	42	20	00	00	42	C8	00	00	3F	80	00	00	00	01	0B	80	43	20	00	00	44	FA	00	00	3F	80	00	00	…
… cont'd	01	00	09	00	42	70	00	00	44	FA	00	00	3F	80	00	00	00	00	09	00	3F	80	00	00	42	C8	00	00	00	00	00	00			

Contents from left to right:

Acknowledge = 09
Function code = 05
Number of consecutive segments which follow = 4
Segment #1 Type = Ramp
Segment #1 Guar. Soak = Disabled
Segment #1 Events 9-16 = 13 hex
Segment #1 Events 1-8 = 80 hex.
Segment #1 Time = 42200000 (in IEEE format.)
Segment #1 Value = 42C80000 (in IEEE format.)
Segment #1 Aux. Value = 3F800000 (in IEEE format.)
Segment #2 Type = Soak
Segment #2 Guar. Soak = Enabled
Segment #2 Events 9-16 = 0B hex
Segment #2 Events 1-8 = 80 hex.
Segment #2 Time = 43200000 (in IEEE format.)
Segment #2 Value = 44FA0000 (in IEEE format.)
Segment #2 Aux. Value = 3F800000 (in IEEE format.)
Segment #3 Type = Ramp
Segment #3 Guar. Soak = Disabled
Segment #3 Events 9-16 = 09 hex
Segment #3 Events 1-8 = 00 hex.
Segment #3 Time = 42700000 (in IEEE format.)
Segment #3 Value = 44FA0000 (in IEEE format.)
Segment #3 Aux. Value = 3F800000 (in IEEE format.)
Segment #4 Type = Soak
Segment #4 Guar. Soak = Disabled
Segment #4 Events 9-16 = 09 hex
Segment #4 Events 1-8 = 00 hex.
Segment #4 Time = 3F800000 (in IEEE format.)
Segment #4 Value = 42C80000 (in IEEE format.)
Segment #4 Aux. Value = 00000000 (in IEEE format.)

7.3 Function Code 21 – Write General Reference Data

Description

The UMC800 uses function code 21 (15h) "Write General Reference" to implement the "write" configuration messages. These include:

- Write Scattered 32-bit Values
- Write Setpoint Program Segment
- Write Alarm Acknowledge
- Historical Data Upload Acknowledge
- Event Acknowledge
- Write Setpoint Scheduler Segment

Query

The query message uses the standard function code 21 header followed by the UMC800 configuration message. The Byte Count equals the total number of bytes between the Byte Count and the CRC. This number cannot exceed 255, therefore the configuration message content is limited to 248 bytes maximum.

Query message format for function code 21 (15h)

Slave Address	Function Code	Byte Count	Reference Type (00)	File Number High (00)	File Number Low (00)	Starting Address High (00)	Start Address Low (00)	Register Count High (00)	Register Count Low (00)	UMC800 Configuration Message (max 248 bytes)	CRC	CRC

Response

The response is the standard function code 21 header followed by the UMC800 configuration message. Byte Count is adjusted to account for the number of bytes in the response.

Response message format for function code 21 (15h)

Slave Address	Function Code	Byte Count	Reference Type (00)	File Number High (00)	File Number Low (00)	Starting Address High (00)	Start Address Low (00)	Register Count High (00)	Register Count Low (00)	UMC800 Configuration Message (max 248 bytes)	CRC	CRC

ATTENTION

In query and response, Reference Type, File Number, Address, and Register Count bytes should be set to 0.

Example Query

Use the UMC800 message "write scattered 32-bit" to write a value of 100 to the LSP of the PID function block and to change to AUTO mode. Assume the function block number of the PID block is 2. Assume a slave address 02.

Format of query:

02	15	18	00	00	00	00	00	00	00	80	03	02	00	02	02	01	42	C8	00	00	02	04	00	00	00	00	CRC	CRC
Contents from left to right: Slave address = 02 Function code = 15 (write) Byte count =24 decimal (18 hex) Reference type File number high File number low Starting address high Starting address low Register count high Register count low										Contents of "Write Scattered 32 bit" configuration message. See Figure 7-3. Contents from left to right: Header = 80 Function Code = 03 Number of values requested = 02 Filler Byte = 00 Table = 02 (Table 8-77) Block number = 02 Index = 01 (index number of LSP. See Table 8-77) Value of LSP in IEEE format = 42C80000\) Block number = 02 Index = 04 (index number of man_mode. See Table 8-77) Value of man_mode = 00000000 (OFF).																

Example Response

Continuing with the example query above, the following response would be returned, assuming the query was acknowledged.

02	15	09	00	00	00	00	00	00	00	09	03	CRC	CRC
Contents from left to right: Slave address = 02 Function code = 15 (write) Byte count = 9 decimal (09 hex) Reference type File number high File number low Starting address high Starting address low Register count high Register count low										Contents of "Write Scattered 32 bit" configuration message. See Figure 7-3. Contents from left to right: Acknowledge = 09 Function Code = 03			

7.4 Configuration Message Formats

7.4.1 Overview

Introduction

This section describes the overall format of the request and response messages for the UMC800 Configuration Message bytes on function codes 20 and 21. Refer to sections 7.2 and 7.3 for an anatomy of a message format.

Available Messages

Below are listed the available message requests that are available in this application:

Function Code 20 (Read)	See section	Function Code 21 (Write)	See section
Read Contiguous 32-bit Values	7.4.2	Write Scattered 32-bit Values	7.4.4
Read Scattered 32-bit Values	7.4.3	Write Setpoint Program Segment	7.4.6
Read Setpoint Program Segment	7.4.5	Write Alarm Acknowledge	7.4.8
Read Alarm Point Detail	7.4.7	Historical Data Upload Acknowledge	7.4.10
Historical Data Upload	7.4.9	Event Acknowledge	7.4.12
Event Summary	7.4.11	Write Setpoint Scheduler Segment	7.4.14
Read Setpoint Scheduler Segment	7.4.13		
Loopback Test	7.4.15		

Block Parameters

The location or address for data in the UMC800 controller consists of a Table Type, a Block Number, and an Index Number.

Table Type identifies whether it's a Dynamic (I/O) parameter or Static (configuration) parameter.

Block Number identifies a given function block entered in the Function Block Diagram (FBD) configuration with a unique assigned number between 1 and 250. The block number assignment can be printed out from the Control Builder.

Index Number identifies a particular parameter in a given block type that is accessible for communication purposes. This index information is available from the tables in Section 8 - *Function Parameter Index Reference*.

Variables

Note that a block number (251) has indices that have been assigned automatically for variables entered in the Function Block Diagram configuration. *Refer to subsection 8.88.* The index number assignments for variables can be printed out from the Control Builder.

7.4.2 Read Contiguous 32-Bit Values

Introduction

Figure 7-1 shows the Read request and response format for Function Code 2 - Contiguous 32-Bit values. This operation lets you read a list of 32-Bit values from a specific block given the starting index number and the number of values involved. Up to 61 contiguous values may be read per message (4 bytes per value returned).

Message Formats

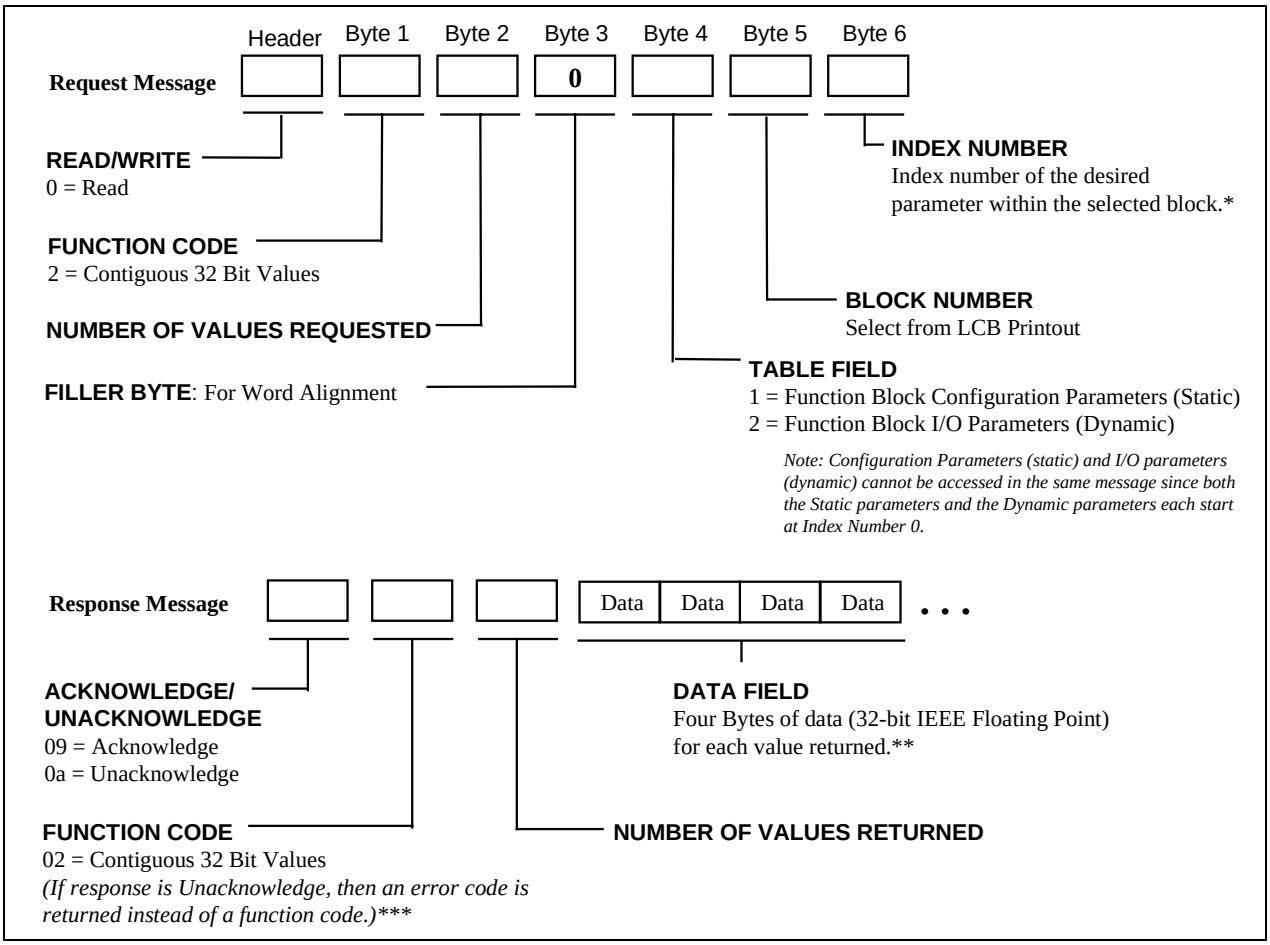


Figure 7-1 Read Contiguous 32-Bit Request and Response Message Formats

*See Parameter Index tables for Block types in Section 8.

**See Section 3.3

*** See Table 7-5 on page 87.

7.4.3 Read Scattered 32-Bit Values

Introduction

Figure 7-2 shows the Read request and response format for Function Code 3 - Scattered 32-Bit values. This operation lets you read 32-Bit values from a specific block given the index numbers and the number of values involved. Up to 61 values may be read per message (4 bytes per value returned).

Message Formats

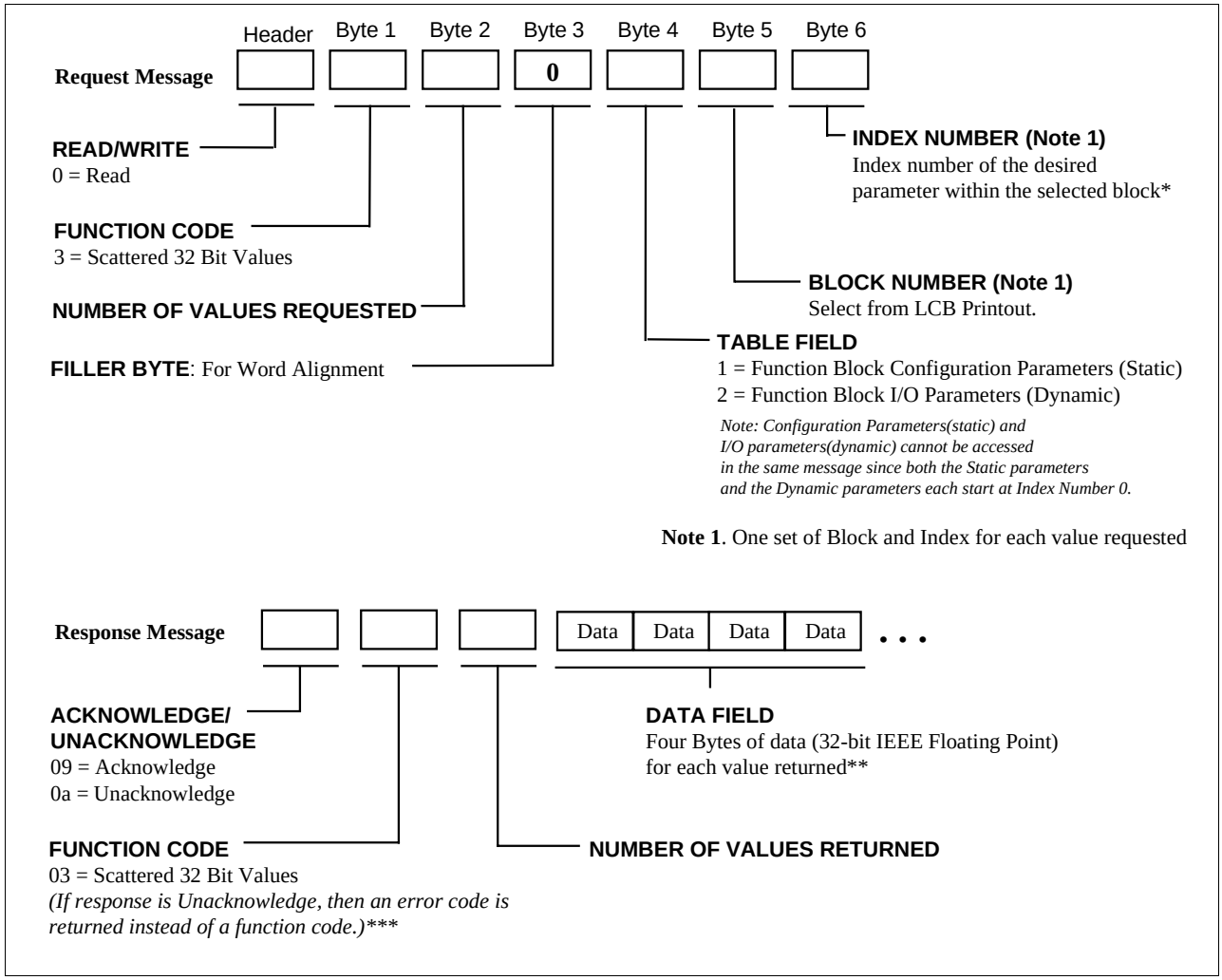


Figure 7-2 Read Scattered 32-Bit Request and Response Message Formats

*See Parameter Index tables for Block types in Section 8.

**See subsection 3.3

*** See Table 7-5 on page 87.

7.4.4 Write Scattered 32-Bit Values

Introduction

Figure 7-3 shows the Write request and response format for Function Code 3 - Scattered 32-Bit values. This operation lets you write 32-Bit values to a specific block given the index numbers and the number of values involved. Up to 42 values may be written per message (6 bytes per value requested).

Message Formats

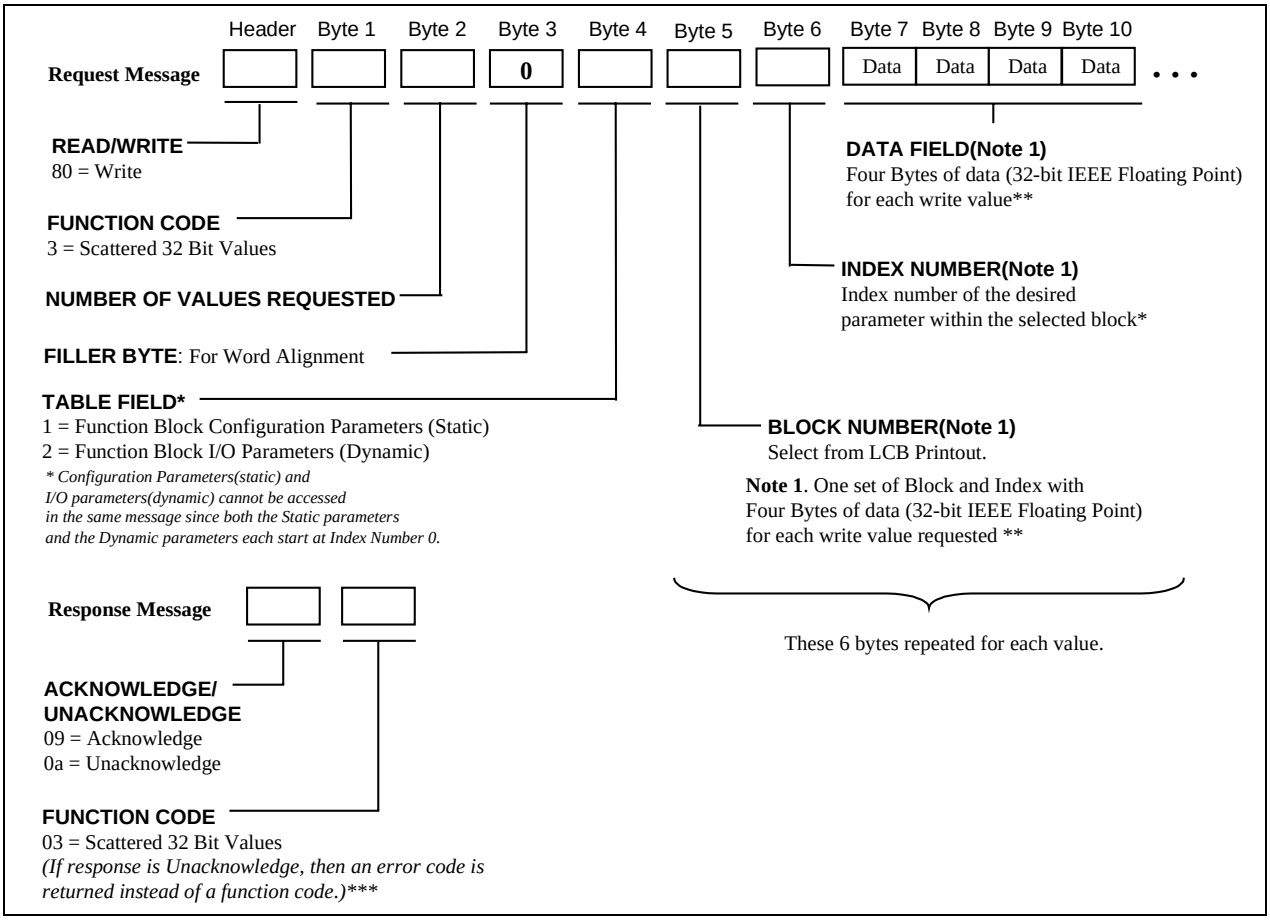


Figure 7-3 Write Scattered 32-Bit Request and Response Message Formats

*See Parameter Index tables for Block types in Section 8.

**See subsection 3.3

*** See Table 7-5 on page 87.

7.4.5 Read Setpoint Program Segment

Introduction

Figure 7-4 shows the Read request and response format for Function Code 5 – Setpoint Program Table. This operation lets you read one or more consecutive segments from a setpoint programmer block. Up to 15 segments may be read per message (16 bytes per segment returned). Note that the data is read from the specified active programmer in the controller, not from a profile in controller memory.

Message Formats

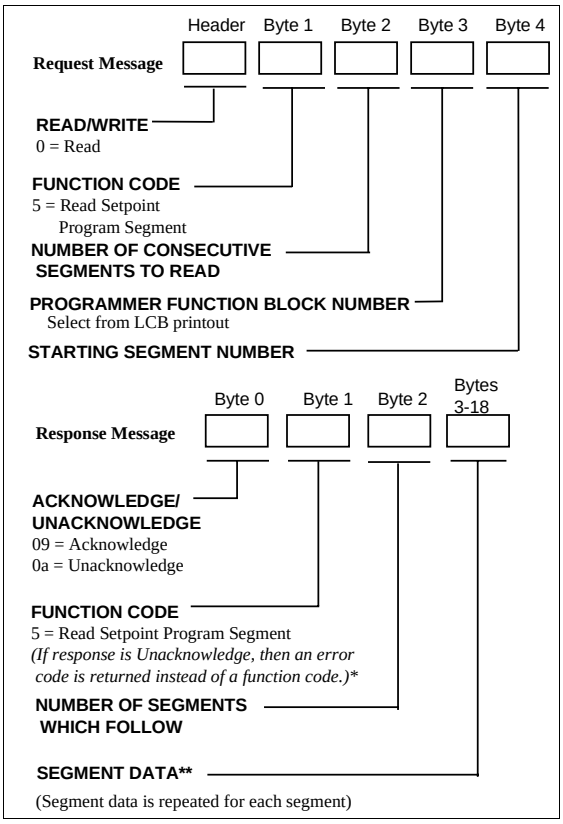


Figure 7-4 Read Setpoint Program Segment

*See Table 7-5 on page 87.

**See Table 7-1

Segment Data

Table 7-1 contains the segment data. This data is repeated for each consecutive segment requested.

Table 7-1 Setpoint Programmer Segment Data

Byte # for Read SP Segment	Byte # for Write SP Segment	Name	Description
3	5	Segment Type	1 = ramp segment; 0 = soak segment
4	6	Guaranteed Soak Enable	1 = guaranteed soak enabled; 0 = guaranteed soak disabled.
5	7	Events 9 – 16	Events 9 – 16 states; 1 = Enabled; Bit packed (LSB is event 9)
6	8	Events 1 – 8	Events 1 – 8 states; 1 = Enabled; Bit packed (LSB is event 1)
7-10	9-12	Time or Rate	Time or Rate value in floating point notation. ***
11-14	13-16	Value	Starting value for ramp or soak in floating point notation. ***
15-18	17-20	Aux Value	Soak value for auxiliary output in floating point notation. ***

***See section 3.3.

7.4.6 Write Setpoint Program Segment

Introduction

Figure 7-5 shows the Write request and response format for Function Code 5 – Setpoint Program Table. This operation lets you write one or more consecutive segments to a setpoint programmer block. Up to 15 segments may be written per message (16 bytes per segment). Note that the data is written to the specified active programmer in the controller, not to a profile in controller memory.

Message Formats

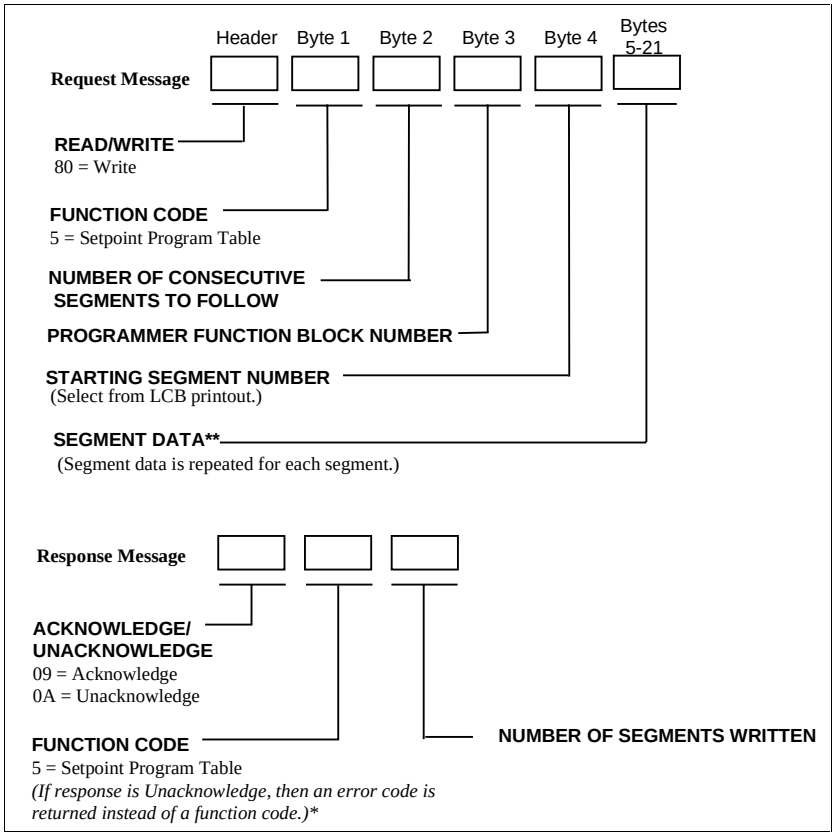


Figure 7-5 Write Setpoint Program Segment

* See Table 7-5 on page 87.

** See Table 7-1

7.4.7 Read Alarm Point Detail

Introduction

Figure 7-6 shows the Read request and response format for Function Code 9 – Read Alarm Point Detail. This operation lets you see various alarm parameters.

Message Formats

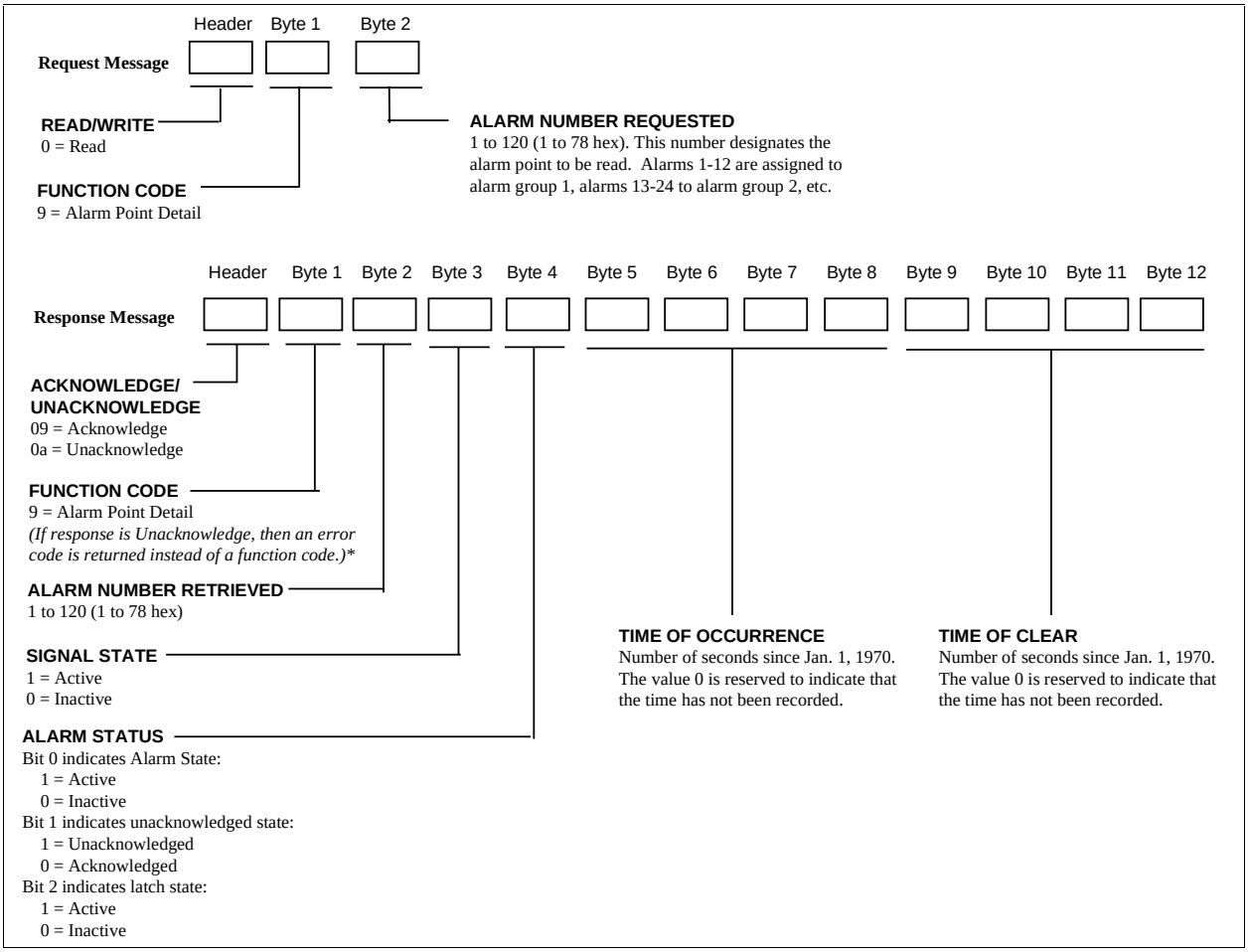


Figure 7-6 Read Alarm Point Detail

* See Table 7-5 on page 87.

7.4.8 Write Alarm Acknowledge

Introduction

Figure 7-7 shows the Write request and response format for Function Code 6 – Acknowledge Alarms. This operation lets you acknowledge one or more alarms in an alarm group.

Message Formats

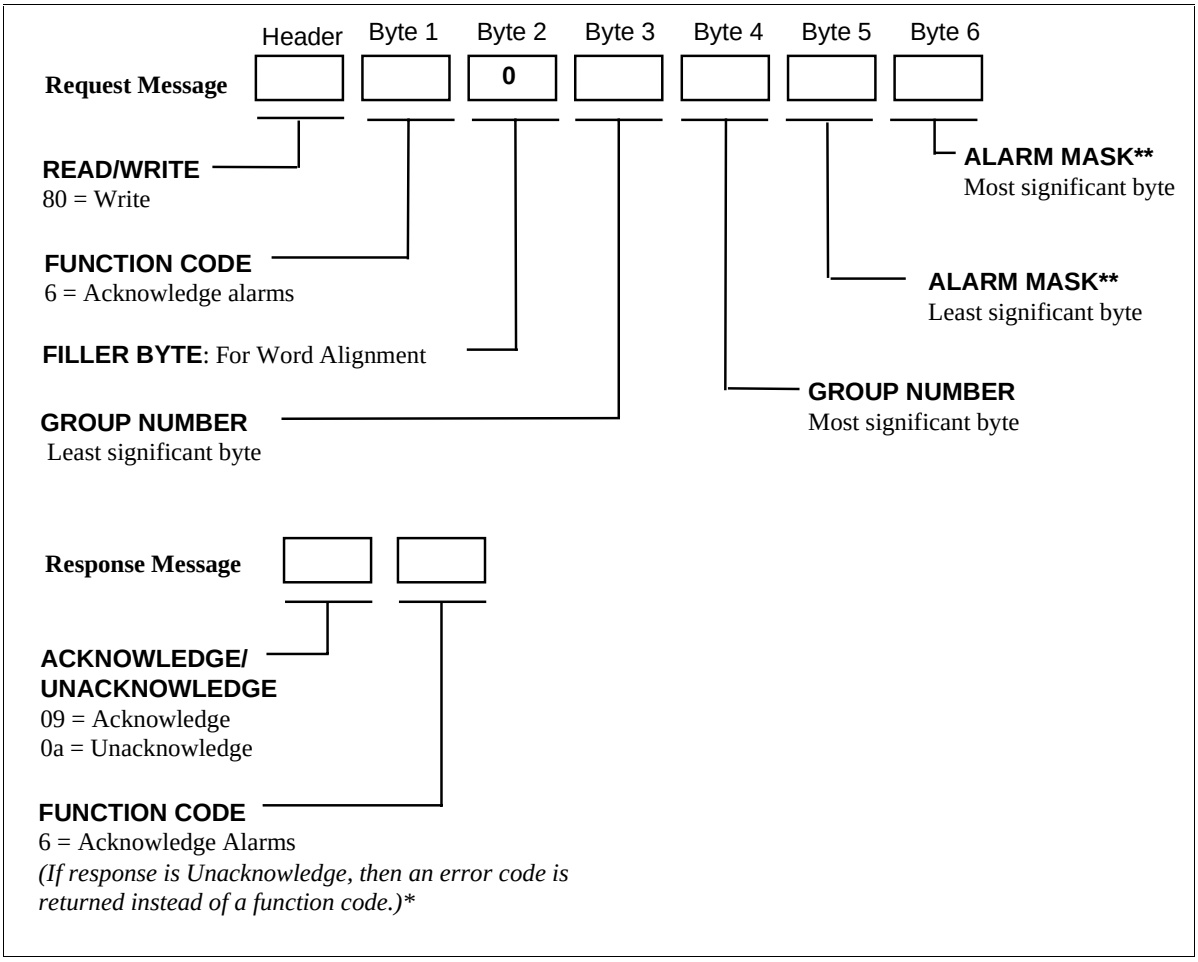


Figure 7-7 Write Alarm Acknowledge

*See Table 7-5 on page 87.

** See Table 7-2.

Alarm Mask

The bits in the Alarm Mask bytes correspond to the alarms in the group. Setting a bit to 1 indicates that the corresponding alarm is to be acknowledged.

Table 7-2 Contents of Alarm Mask Bytes

Contents of Byte 5 (least significant byte)							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Alarm #8	Alarm #7	Alarm #6	Alarm #5	Alarm #4	Alarm #3	Alarm #2	Alarm #1
Contents of Byte 6 (most significant byte)							
Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
0	0	0	0	Alarm #12	Alarm #11	Alarm #10	Alarm #9

Example

To acknowledge Alarms #5 and #12 of alarm group #7, set bits 4 and 11 to 1. That is, bytes 5 and 6 are set to hex values 10 and 8, respectively.

Contents of Byte 5 (least significant byte)							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	0	0	1	0	0	0	0
Contents of Byte 6 (most significant byte)							
Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
0	0	0	0	1	0	0	0

For the alarm group number, Bytes 3 and 4 are set to 7 and 0, respectively.

7.4.9 Historical Data Upload

Introduction

Figure 7-8 shows the Read request and response format for Function Code 10 – Historical Data Upload. This operation lets you read the historical data of alarms and events that occurred since the last historical data upload request. Up to 39 historical records can be returned per message (6 bytes per record).

Message Formats

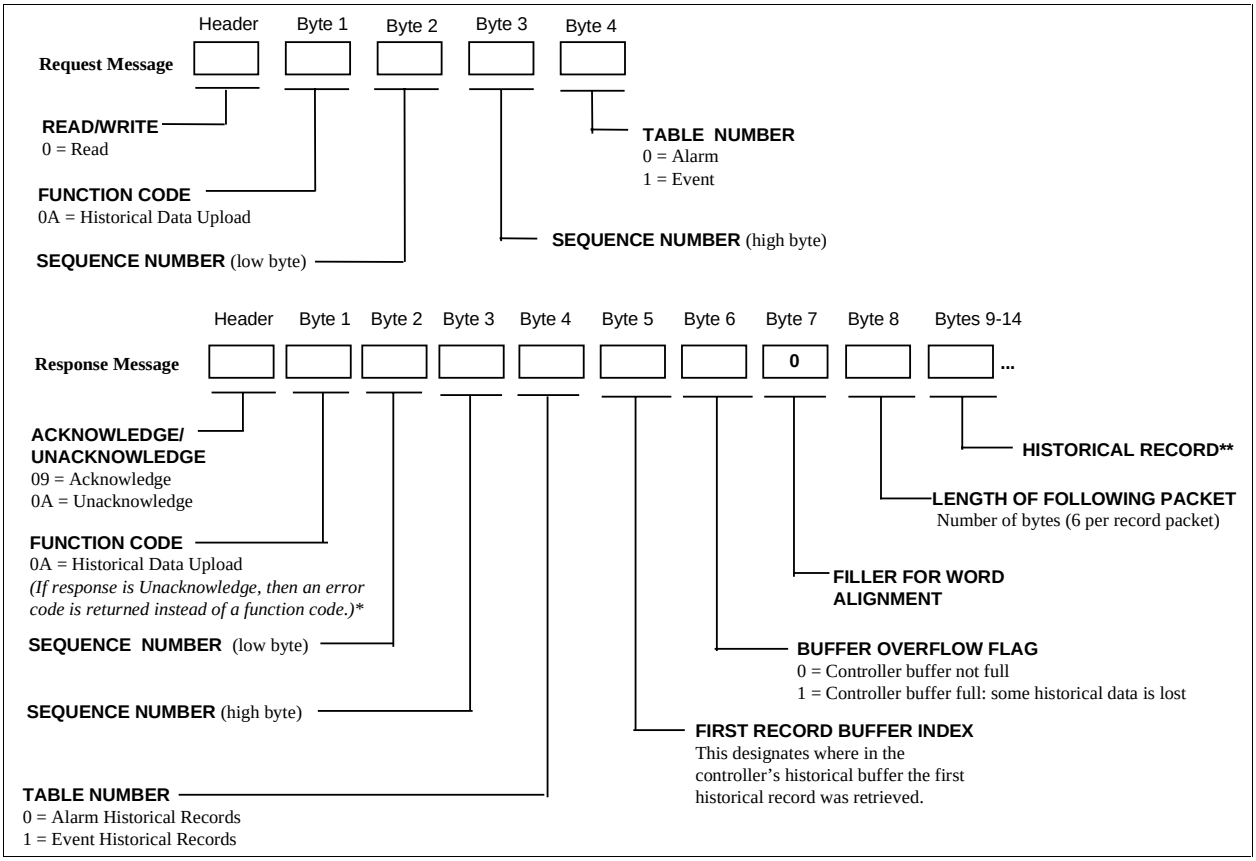


Figure 7-8 Historical Data Upload

*See Table 7-5 on page 87.

**See Table 7-3

Description

The upload can span several transactions. To keep the host and controller synchronized, a sequence number is used. The sequence number starts at 1 and is incremented by 1 on each additional transaction. The controller echoes the sequence number back to the host so that the host knows that it is synchronized. The host can request the retransmission of a packet that was not received correctly by asking for the same packet twice. The UMC800 indicates the last packet with sequence number FF.

Example of a multipacket transaction

Request:	00 0A 01 00 00
Response from UMC800:	09 0A 01 00 …
Request:	00 0A 02 00 00
Response from UMC800:	09 0A 02 00 …
Request:	00 0A 03 00 00
Response from UMC800 indicating last packet:	09 0A FF 00 …

Historical Record Format

Each Historical Record packet has the following format.

Table 7-3 Historical Record Format

Byte #	Contents
9	Signal state 0 = Off 1 = On
10	Event number (1 to 20 hex) or Alarm number (1 to 78 hex)
11-14	Time (seconds since Jan. 1, 1970.)

7.4.10 Historical Data Upload Acknowledge

Introduction

Figure 7-9 shows the Write request and response format for Function Code 10—Historical Data Upload Acknowledge. This operation lets you inform the UMC800 that the last packet of the historical data upload was processed properly.

Message Formats

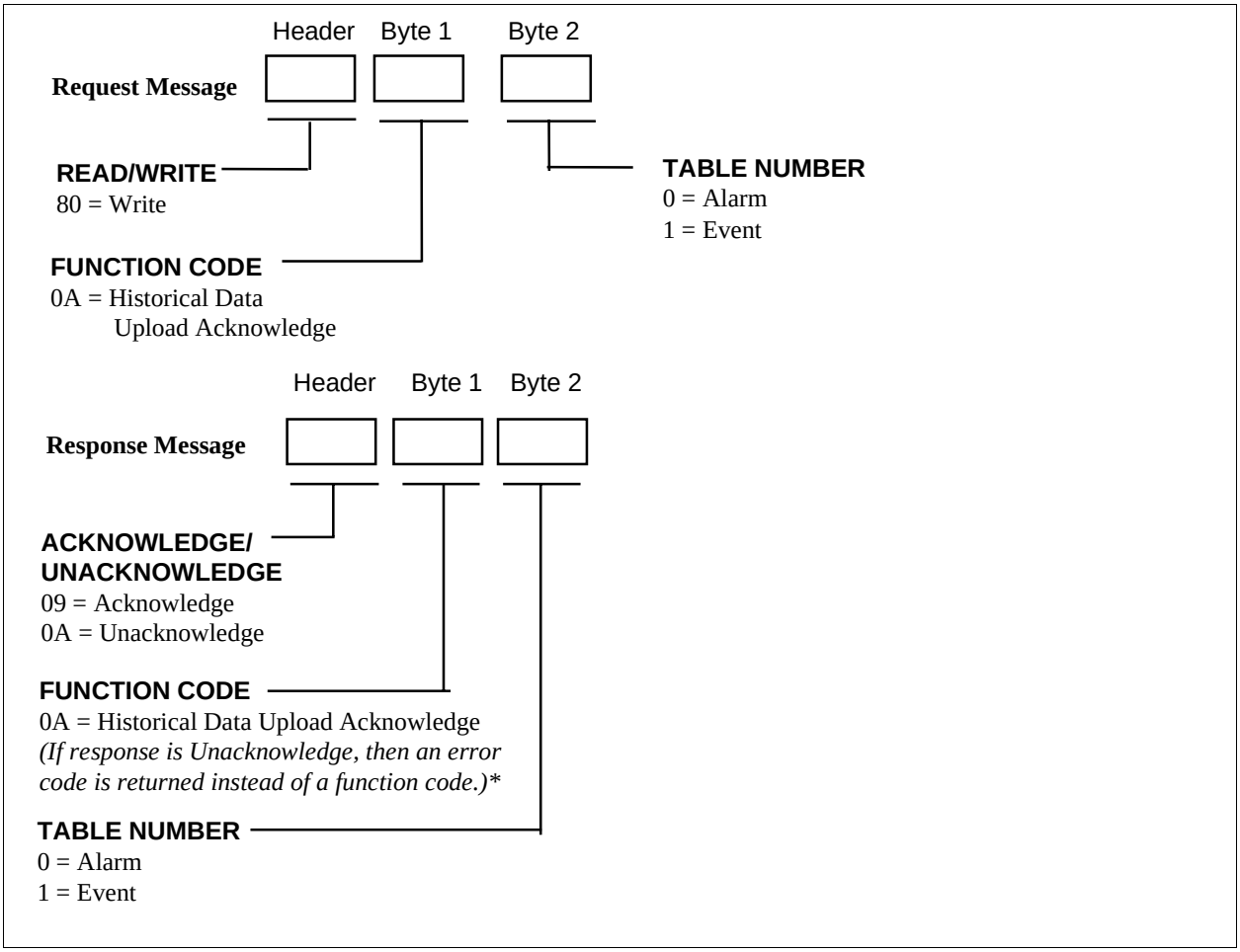


Figure 7-9 Historical Data Upload Acknowledge

* See Table 7-5 on page 87.

7.4.11 Event Summary

Introduction

Figure 7-10 shows the Read request and response format for Function Code 11 – Read Event Summary. This operation lets you retrieve the last 10 event occurrences. These events are organized from newest to oldest.

Message Formats

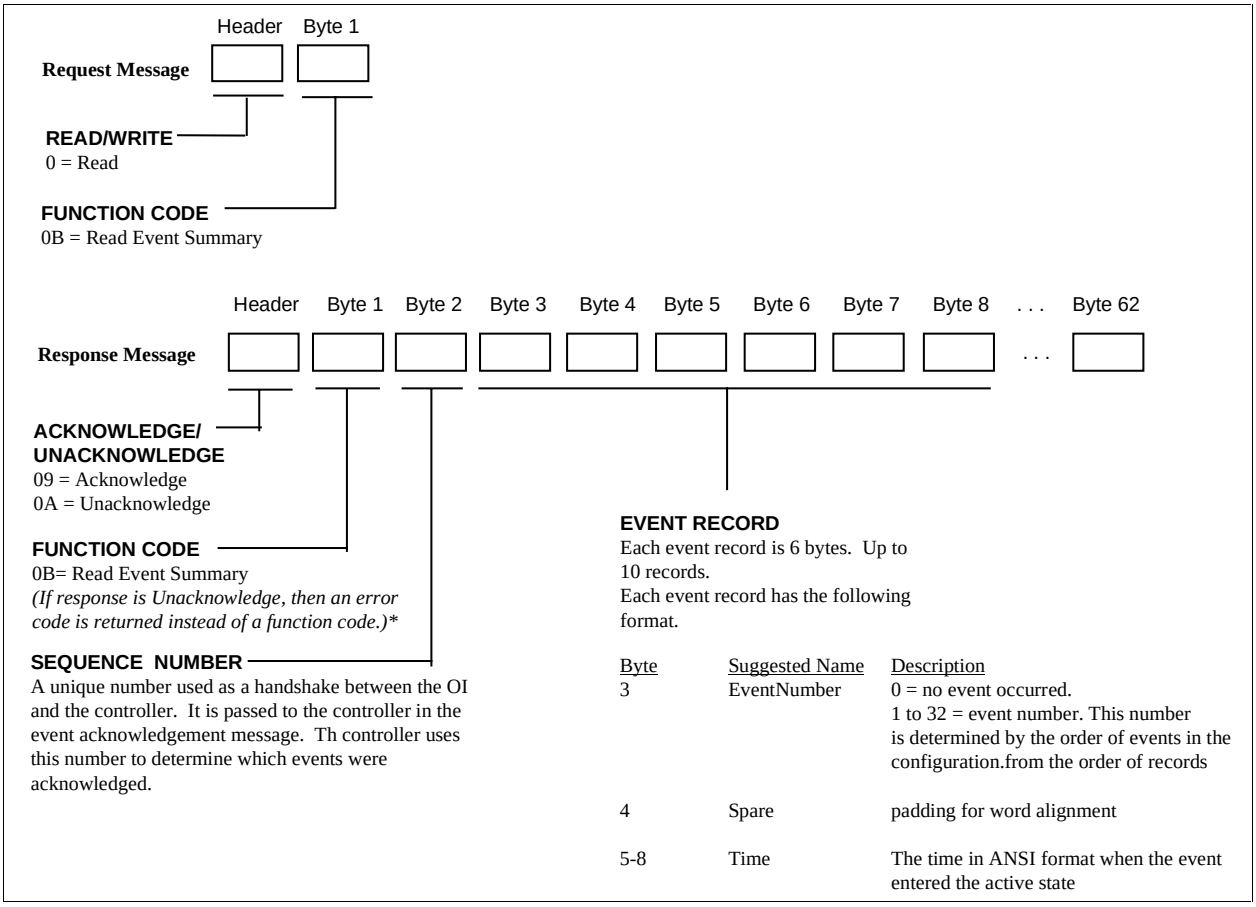


Figure 7-10 Event Summary

* See Table 7-5 on page 87.

7.4.12 Event Acknowledge

Introduction

Figure 7-11 shows the Write request and response format for Function Code 12 – Event Acknowledge. This operation lets you acknowledge the active events that were uploaded in the Event Summary message.

Message Formats

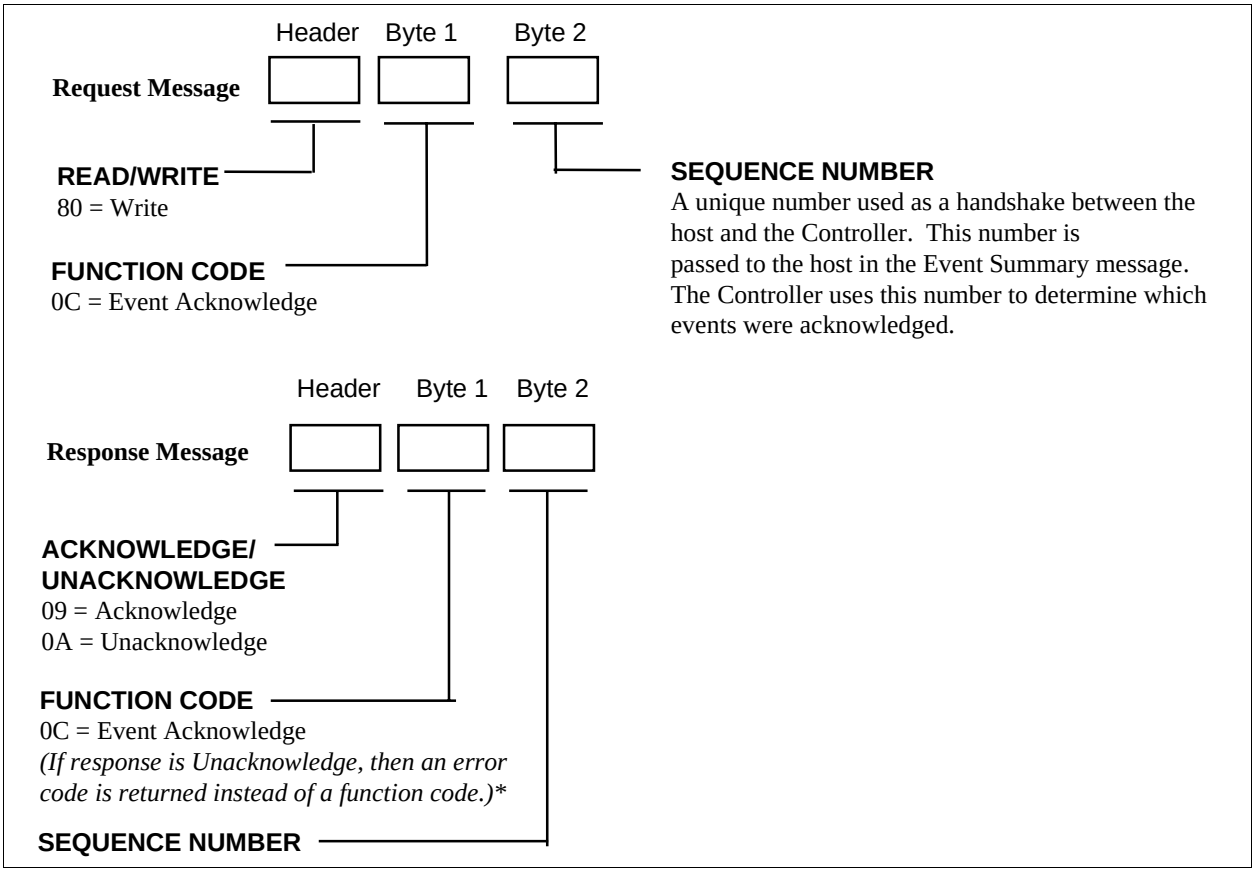


Figure 7-11 Event Acknowledge

* See Table 7-5 on page 87.

7.4.13 Read Setpoint Scheduler Segment

Introduction

Figure 7-12 shows the Read request and response format for Function Code 18 – Read Setpoint Scheduler Segment. This operation lets you read one or more consecutive segments from a setpoint scheduler block. Up to 2 segments can be read per message (84 bytes per segment returned). Note that the data is read from the specified active scheduler in the controller, not from a schedule in controller memory.

Message Formats

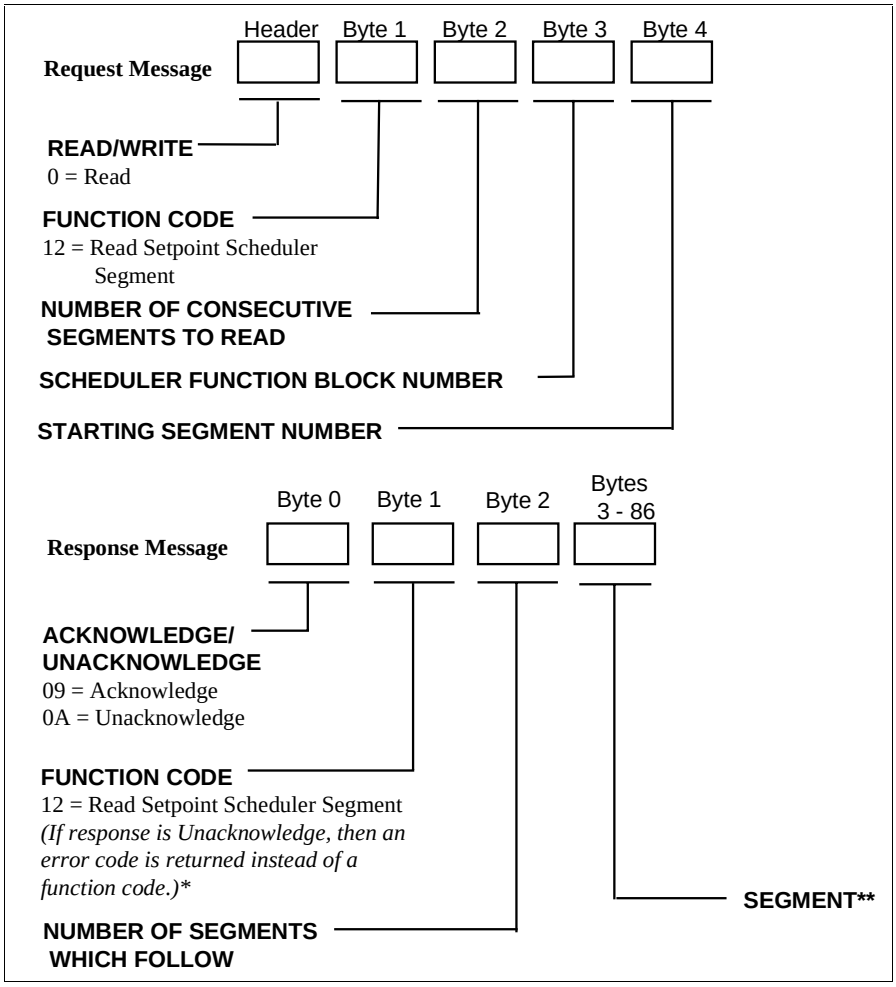


Figure 7-12 Read Setpoint Scheduler Segment

*See Table 7-5 on page 87.

**See Table 7-4.

Table 7-4 Scheduler Segment Data Format

Byte Index	Name	Description
0-3	Time	Time value for the segment in floating point notation***
4	Guaranteed Soak Type for Setpoint 1	0 = off; 1 = low; 2 = high; 3 = low & high
5	Guaranteed Soak Type for Setpoint 2	0 = off; 1 = low; 2 = high; 3 = low & high
6	Guaranteed Soak Type for Setpoint 3	0 = off; 1 = low; 2 = high; 3 = low & high
7	Guaranteed Soak Type for Setpoint 4	0 = off; 1 = low; 2 = high; 3 = low & high
8	Guaranteed Soak Type for Setpoint 5	0 = off; 1 = low; 2 = high; 3 = low & high
9	Guaranteed Soak Type for Setpoint 6	0 = off; 1 = low; 2 = high; 3 = low & high
10	Guaranteed Soak Type for Setpoint 7	0 = off; 1 = low; 2 = high; 3 = low & high
11	Guaranteed Soak Type for Setpoint 8	0 = off; 1 = low; 2 = high; 3 = low & high
12, 13	Recycle	Number of times to recycle; 16 bit integer (0 – 999)
14, 15	Recycle Segment	Recycle segment jump point; 16 bit integer (0 – 50)
16 - 19	Value 1	1st setpoint starting ramp value; floating point notation***
20 – 23	Value 2	2nd setpoint starting ramp value; floating point notation***
24 – 27	Value 3	3rd setpoint starting ramp value; floating point notation***
28 – 31	Value 4	4th setpoint starting ramp value; floating point notation ***
32 – 35	Value 5	5th setpoint starting ramp value; floating point notation ***
36 – 39	Value 6	6th setpoint starting ramp value; floating point notation ***
40 – 43	Value 7	7th setpoint starting ramp value; floating point notation ***
44 – 47	Value 8	8th setpoint starting ramp value ; floating point notation***
48 – 51	Aux Value	1st auxiliary value; floating point notation***
52 – 55	Aux Value	2nd auxiliary value; floating point notation***
56 – 59	Aux Value	3rd auxiliary value; floating point notation***
60 – 63	Aux Value	4th auxiliary value; floating point notation***
64 – 67	Aux Value	5th auxiliary value; floating point notation***
68 – 71	Aux Value	6th auxiliary value; floating point notation***
72 – 75	Aux Value	7th auxiliary value; floating point notation***
76 – 79	Aux Value	8th auxiliary value; floating point notation***
80	Events 9 – 16	Events 9 – 16 states; 1 = Enabled; Bit packed (LSB is event 9)
81	Events 1 – 8	Events 1 – 8 states; 1 = Enabled; Bit packed (LSB is event 1)
82	Unused	Set to 0
83	Unused	Set to 0

***See section 3.3

7.4.14 Write Setpoint Scheduler Segment

Introduction

Figure 7-13 shows the Write request and response format for Function Code 18 – Write Setpoint Scheduler Segment. This operation lets you write one or more consecutive segments to a setpoint scheduler block. Up to 2 segments can be written per message (84 bytes per segment requested). Note that the data is written to the specified active scheduler in the controller, not to a schedule in controller memory.

Message Formats

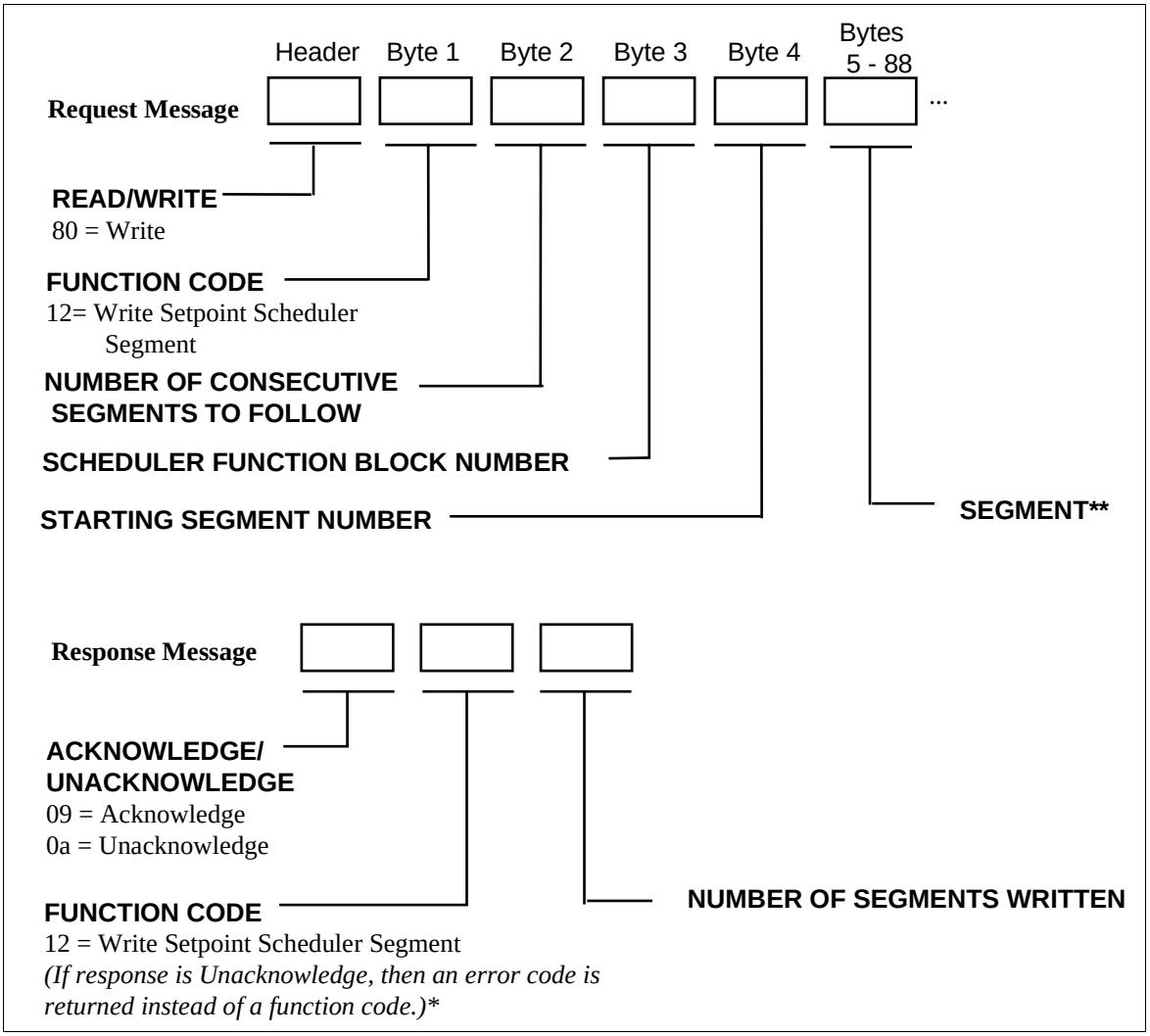


Figure 7-13 Write Setpoint Scheduler Segment

*See Table 7-5 on page 87.

**See Table 7-4 on page 84.

7.4.15 Loopback

Introduction

Figure 7-14 shows the Request and Response format for Function Code 250 - Loopback Test. This operation lets you echo back a string of bytes from the controller to the Host. Up to 245 bytes can be requested per message.

Message Formats

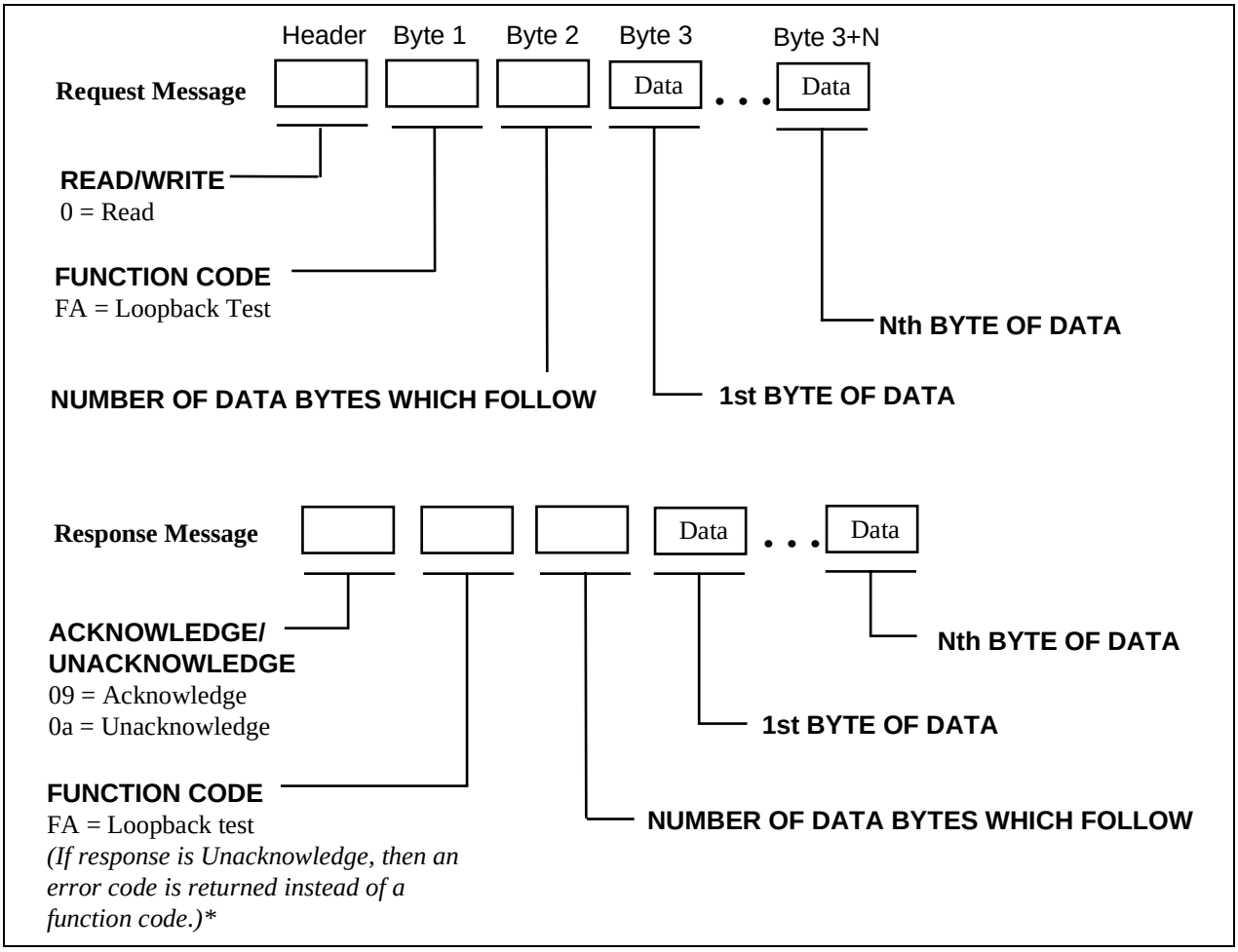


Figure 7-14 Loopback Request and Response Message Formats

* See Table 7-5 on page 87.

7.4.16 Application Error Codes

List of Codes

These codes are returned when NAK is received in the response for a request that is rejected.

Table 7-5 Application Error Codes

Error Code	Definition
0	No Errors
0x1	Bad Command
0x2	Bad Operation
0x4	Bad data for the Command
0x8	Not Used
0xA	Busy Doing Command – Try Again Later
0x10	Invalid Header Byte
0x11	Bad Message Length
0x20	Bad Database Download Sequence
0x21	Invalid Database Table Number
0x22	Bad Record Number
0x23	Table Number Changed in the Middle of Download
0x24	Database Revision Level Mismatch
0x25	Bad Packet Size
0x26	Incomplete Record
0x27	SPP or SPS Database Table too big
0x30	Setpoint Program or Setpoint Scheduler Segment Overrun
0x31	SPP or SPS – Invalid Mode for Editing (Not Reset or Hold)

8. Function Parameter Index Reference

8.1 Parameter Index Numbers

Function Block parameter tables

Refer to the tables listed below to find the correct Dynamic (I/O) or Static (Configuration) parameter index number for a given function block that is to be accessed through a communications message.

Abbreviations

The abbreviations used in the tables are:

REAL Floating Point Analog Numbers

BOOL Digital ON and OFF states

C Contained Parameter

I Input Value

O Output Value

R Read Only

R/W Read/Write

W Write

In this section

Refer to Table 8-1for a listing of each function block type and respective reference subsection.

Table 8-1 Function Block Look-up Table

Function Block Type Identification Label		See Subsection
ABS	(Absolute Value)	8.2
ADD	(Addition 2 Inputs**)**	8.3
4ADD	(Addition 4 Inputs)	8.4
AI	(Analog Input)	8.5
ALM	(Analog Alarm)	8.6
2AND	(AND - 2 Inputs)	8.7
4AND	(AND - 4 Inputs)	8.8
8AND	(AND - 8 Inputs)	8.9
AMB	(Auto/Manual Bias)	8.10
AO	(Analog Output)	8.11
ASYS	(Alarm System Monitor)	8.12
BCD	(Binary Coded Decimal Translator)	8.13
BOOL	(Free Form Logic)	8.14
CARB	(Carbon Potential)	8.15

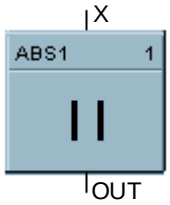
Function Block Type Identification Label		See Subsection
CMPR	(Comparison)	8.16
DC	(Device Control)	8.18
DCMP	(Deviation Compare)	8.19
DENC	(Digital Encoder)	8.20
DEWP	(Dewpoint)	8.21
DI	(Digital Input)	8.22
8DI	(Eight Digital Inputs)	8.23
DIV	(Division)	8.24
DO	(Digital Output)	8.25
8DO	(Eight Digital Outputs)	8.26
DSW	(Digital Switch)	8.27
FGEN	(Function Generator)	8.28
FI	(Frequency Input)	8.29
FSS	(Four Selector Switch)	8.30
FSYS	(System Monitor-Fast Logic)	8.31
HLLM	(High-Low Limiter)	8.32
HMON	(High Monitor)	8.33
HOA	(Hand/Off/Auto)	8.34
HSEL	(High Selector)	8.35
LDLG	(Lead Lag)	8.36
LMON	(Low Monitor)	8.37
LSEL	(Low Selector)	8.38
LTCH	(Latch)	8.39
MATH	(Free Form Math)	8.40
MBR	(Modbus Read)	8.41
MBS	(Modbus Slave Status)	8.42
MBW	(Modbus Write)	8.43
MDFL	(Mode Flag**)**	8.44
MMA	(Min-Max-Average-Sum)	8.45
MSF	(Mass Flow)	8.46
MUL	(Multiplication - 2 Inputs)	8.47
4MUL	(Multiplication - 4 Inputs)	8.48
NEG	(Negate)	8.49
NOT	(Not Boolean Logic)	8.50
ONDT	(On Delay Timer)	8.51
OFDT	(Off Delay Timer)	8.52
ON/OFF	(On/Off Control)	8.53

Function Block Type Identification Label		See Subsection
2OR	(OR - 2 Inputs)	8.54
4OR	(OR - 4 Inputs)	8.55
8OR	(OR - 8 Inputs)	8.56
PI	(Pulse Input)	8.57
PID	(Proportional, Integral, Derivative)	8.58
PT	(Periodic Timer)	8.59
RCP	(Recipe Selector)	8.60
RH	(Relative Humidity)	8.61
ROC	(Rate of Change)	8.62
RSW	(Rotary Switch)	8.63
RTMR	(Resettable Timer)	8.64
SCB	(Scale and Bias)	8.65
SPEV	(Setpoint Programmer Event Decoder)	8.66
SPP	(Setpoint Programmer)	8.67
SPS	(Setpoint Scheduler)	8.68
SPSA	(Setpoint Scheduler Auxiliary Setpoint)	8.69
STFL	(Setpoint Scheduler State Flag)	8.70
STSW	(Setpoint Scheduler State Switch)	8.71
SQRT	(Square Root)	8.72
SUB	(Subtraction - 2 Inputs)	8.73
4SUB	(Subtraction - 4 Inputs)	8.74
SW	(Analog Switch)	8.75
TAHD	(Track and Hold)	8.76
TGFF	(Toggle Flip Flop)	8.77
TOT	(Totalizer)	8.78
TPO	(Time Proportional Output)	8.79
TPSC	(Three Position Step Control)	8.80
TRIG	(Trigger)	8.81
UPDN	(UP/Down Counter)	8.82
VLIM	(Velocity (rate) Limiter)	8.83
WTUN	(Write Tuning Constant)	8.84
WVAR	(Write Variable)	8.85
XFR	(Transfer Switch)	8.86
XOR	(Exclusive OR)	8.87
Variables	(Assigned Function Block Number 251)	8.88

8.2 ABS Function Block

Description

The **ABS** label stands for **Absolute Value**. This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-2 ABS Dynamic Parameters

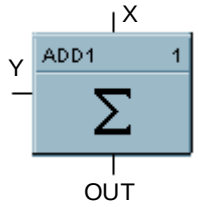
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	result
X	2	REAL	I	R	input

Static Configuration Parameters: None

8.3 ADD Function Block

Description

The **ADD** label stands for **Addition Mathematical Operation (2 Inputs)**. This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-3 ADD Dynamic Parameters

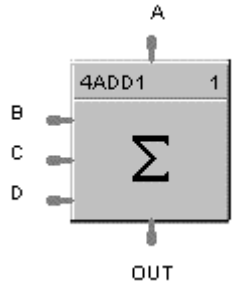
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
X	2	REAL	I	R	input 1
Y	3	REAL	I	R	input 2

Static Configuration Parameters: None

8.4 4ADD Function Block

Description

The **4ADD** label stands for **Addition Mathematical Operation (4 Inputs).** This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-4 4ADD Dynamic Parameters

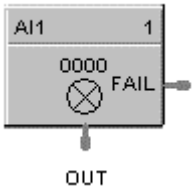
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
A	2	REAL	I	R	input 1
B	3	REAL	I	R	input 2
C	4	REAL	I	R	input 3
D	5	REAL	I	R	input 4

Static Configuration Parameters: None

8.5 AI Function Block

Description

The **AI** label stands for **Analog Input**. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-5 AI Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	Block Status (see section 9.2 for code list)
OUT	1	REAL	O	R	analog input value (eu)
FAIL	2	BOOL	O	R	Failed input indication

Static Configuration Parameters:

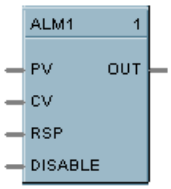
Table 8-6 AI Static Configuration Parameters

Parameter	Index	Type	Description
filt_time	2	REAL	filter time constant (seconds) {0-120} [default 0]
bias	3	REAL	bias (eu).{-99999 to 99999} [default 0]
failsafe	4	REAL	failsafe value (eu) [default 0]
range_hi	6	REAL	high range value [default 0]
range_lo	7	REAL	low range value [default 100]

8.6 ALM Function Block

Description

The **ALM** label stands for the **Analog Alarm function.** This block is part of the *Alarms/Monitor* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-7 ALM Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
ack	1	BOOL	C	R/W	ON acknowledges the alarm
OUT	2	BOOL	O	R	output
PV	3	REAL	I	R	Process variable
CV	4	REAL	I	R	Compare value
RSP	5	REAL	I	R	Remote setpoint
DISABLE	6	BOOL	I	R	ON disables alarm action

Static Configuration Parameters:

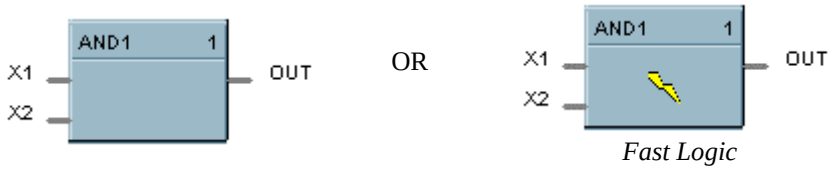
Table 8-8 ALM Static Configuration Parameters

Parameter	Index	Type	Description
lsp	0	REAL	local setpoint in eu {-99999.9 to 99999.9}
rem_mode	1	BOOL	ON selects RSP

8.7 2AND Function Block

Description

The **2AND** label stands for the **AND Boolean function (2 Inputs).** This block is part of the *Logic* or *Fast Logic* category. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-9 2AND Dynamic Parameters

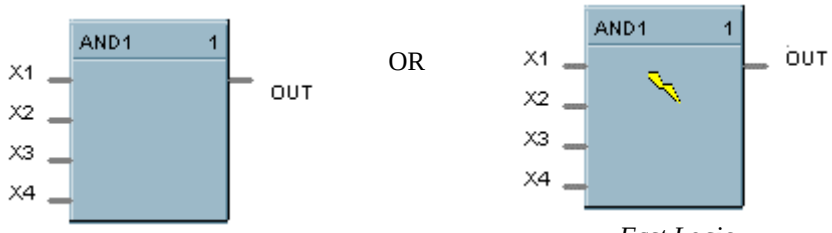
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
DIG_1(X1)	2	BOOL	I	R	input
DIG_2(X2)	3	BOOL	I	R	input

Static Configuration Parameters: None

8.8 4AND Function Block

Description

The **4AND** label stands for the **AND Boolean function (4 Inputs).** This block is part of the *Logic or Fast Logic* category. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-10 4AND Dynamic Parameters

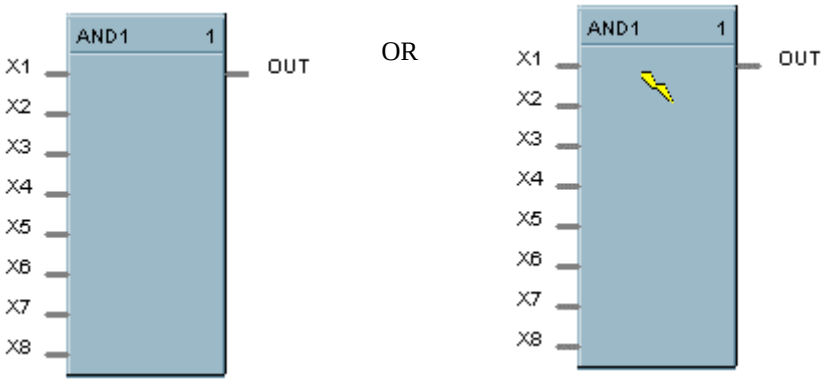
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
DIG_1(X1)	2	BOOL	I	R	input
DIG_2(X2)	3	BOOL	I	R	input
DIG_3(X3)	4	BOOL	I	R	input
DIG_4(X4)	5	BOOL	I	R	input

Static Configuration Parameters: None

8.9 8AND Function Block

Description

The **8AND** label stands for the **AND Boolean function (8 Inputs)**. This block is part of the *Logic* or *Fast Logic* category. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-11 8AND Dynamic Parameters

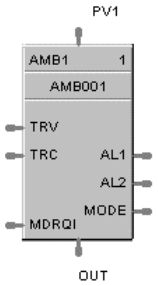
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	Output
DIG_1(X1)	2	BOOL	I	R	input
DIG_2(X2)	3	BOOL	I	R	input
DIG_3(X3)	4	BOOL	I	R	input
DIG_4(X4)	5	BOOL	I	R	input
DIG_5(X5)	6	BOOL	I	R	input
DIG_6(X6)	7	BOOL	I	R	input
DIG_7(X7)	8	BOOL	I	R	input
DIG_8(X8)	9	BOOL	I	R	Input

Static Configuration Parameters: None

8.10 AMB Function Block

Description

The AMB label stands for Auto/Manual Bias Function. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Dynamic Values:

Table 8-12 AMB Dynamic Values

Parameter	Index	Type	Use	R/W	Description
Status	0	REAL	C	R	block status
Bias	1	REAL	C	R	calculated bias (%)
Man_mode	2	BOOL	C	R/W	manual output mode request {OFF, ON}
Man_out	3	REAL	C	R/W	manual output value –5 to 105 (%)
Pv	4	REAL	C	R	Process Variable in % for monitoring
OUT	5	REAL	O	R	control output –5 to 105 (%)
MODE	6	REAL	O	R	actual mode encoded per note 3
ALl	7	BOOL	O	R	Alarm 1
AL2	8	BOOL	O	R	Alarm 2
PVI	9	REAL	I	R	Process Variable Input (%) (pv_lo <= PV <= pv_hi)
TRV	10	REAL	I	R	Output Track Value (%)
TRC	11	BOOL	I	R	Output Track Command {OFF, ON}
MDRQI	12	REAL	I	R	External Mode Request encoded per note 4

Static Configuration Values:

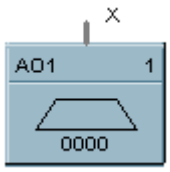
Table 8-13 AMB Static Configuration Values

Parameter	Index	Type	Description
pv_hi	0	REAL	pv High Range value -5 to 105%
pv_lo	1	REAL	pv Low Range value –5 to 105%
outhilim	5	REAL	output high limit, -5 to **105**
outlolim	6	REAL	output low limit, **-5** to 105
failsafe	7	REAL	failsafe output value, -5 to 105, (default **0**)
al_sp[4]	8-11	REAL	alarm set points al1spl, al1sp2, al2spl, al2sp2, -99999 to 99999 (default **0**)
al_hyst	16	REAL	alarm hysterysis **0** to 5 (%)

8.11 AO Function Block

Description

The **AO** label stands for **Analog Output**. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-14 AO Dynamic Parameters

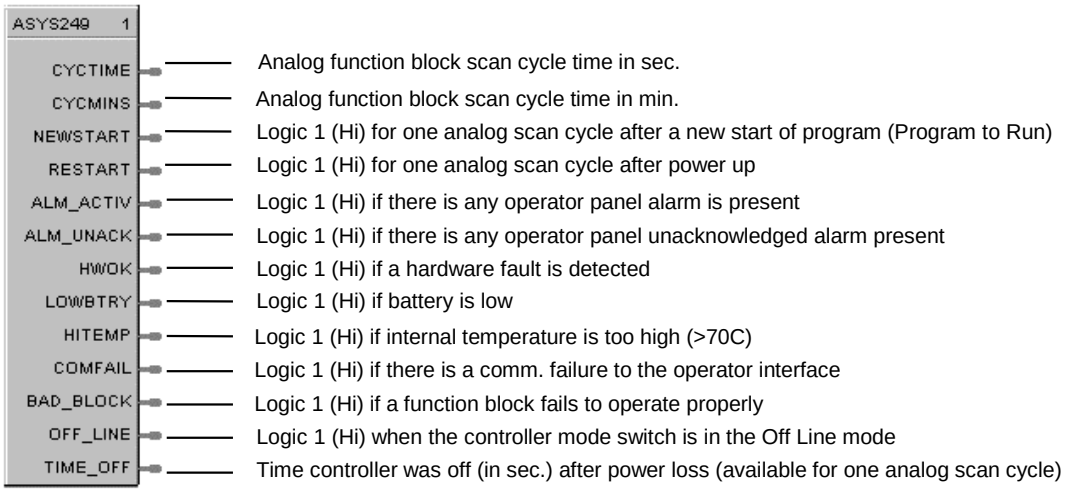
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
IN (X)	1	REAL	I	R	analog input value (eu)

Static Configuration Parameters: None

8.12 ASYS Function Block

Description

The **Analog System Status Block (ASYS)** is a function block and is part of the *Alarm/Monitor* category. It provides read access to controller status values including those related to the Analog execution cycle. The output may be connected to function block inputs. The outputs may also be connected to signal tags for operator interface monitoring. The ASYS System Monitoring block is assigned block number 249. It looks like this graphically on the Control Builder:



Dynamic Parameters:

Table 8-15 ASYS Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
CYC_CNT	1	REAL	C	R	number of control block cycles
EXCTIME	3	REAL	C	R	control block execution time in seconds
PK_EXCTIME	4	REAL	C	R	peak control block execution time in seconds
RES_CONSUME	5	REAL	C	R	resources consumed specified in percent
CB_OVERRUN	6	REAL	C	R	Number of control block cycle overruns
EXECFAULT	7	BOOL	C	R	ON = executive fault
CYCTIME	8	REAL	O	R	control block cycle time in seconds
CYCMINS	9	REAL	O	R	control block cycle time in minutes
NEWSTART	10	BOOL	O	R	ON = new start
RESTART	11	BOOL	O	R	ON = warm start
ALM_ACTIV	12	BOOL	O	R	ON = active alarm
ALM_UNACK	13	BOOL	O	R	ON = unacknowledged alarm
HWOK	14	BOOL	O	R	ON = no hardware faults

Parameter	Index	Type	Use	R/W	Description
LOWBTRY	15	BOOL	O	R	ON = battery is low
HITEMP	16	BOOL	O	R	ON = high RJ temperature
BAD_BLOCK	18	BOOL	O	R	ON = one or more blocks have bad status
RUNMODE	20	BOOL	C	R	ON = run mode is active
PRGMODE	21	BOOL	C	R	ON = program mode is active
MIN_PER_TICK	26	REAL	C	R	minutes per OS tick
CODE_REV	28	REAL	C	R	code revision number
REALTIME_OFF	30	REAL	O	R	Number of seconds the controller was powered down.*

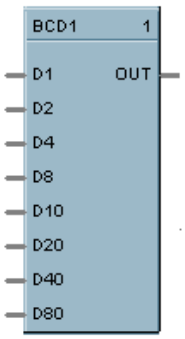
*Valid for only control block execution cycle after power-up.

Static Configuration Parameters: None.

8.13 BCD Function Block

Description

The **BCD** label stands for **Binary Coded Decimal Translator.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-16 BCD Dynamic Parameters

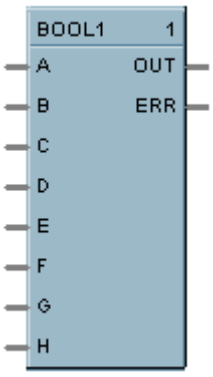
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	W	Result (0 to 99)
DIG_A(D1)	2	BOOL	I	R	Bit 0 of the BCD lower digit
DIG_B(D2)	3	BOOL	I	R	Bit 1 of the BCD lower digit
DIG_C(D4)	4	BOOL	I	R	Bit 2 of the BCD lower digit
DIG_D(D8)	5	BOOL	I	R	Bit 3 of the BCD lower digit
DIG_E(D10)	6	BOOL	I	R	Bit 0 of the BCD upper digit
DIG_F(D20)	7	BOOL	I	R	Bit 1 of the BCD upper digit
DIG_G(D40)	8	BOOL	I	R	Bit 2 of the BCD upper digit
DIG_H(D80)	9	BOOL	I	R	Bit 3 of the BCD upper digit

Static Configuration Parameters: None

8.14 BOOL Function Block

Description

The **BOOL** label stands for **Free Form Logic.** This block is part of the *Logic* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-17 BOOL Dynamic Parameters

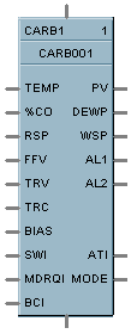
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	Result
ERR	2	BOOL	O	R	Error indication
A	3	BOOL	I	R	Input 1
B	4	BOOL	I	R	Input 2
C	5	BOOL	I	R	Input 3
D	6	BOOL	I	R	Input 4
E	7	BOOL	I	R	Input 5
F	8	BOOL	I	R	Input 6
G	9	BOOL	I	R	Input 7
H	10	BOOL	I	R	Input 8

Static Configuration Parameters: None

8.15 CARB Function Block

Description

The **CARB** label stands for **Carbon Potential.** This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-18 CARB Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 6.2 for code list)
lsp	1	REAL	C	R/W	local set point (eu)
lsp2	2	REAL	C	R/W	local set point 2 (eu)
rem_mode	3	BOOL	C	R/W	remote set point mode request {OFF, ON}
man_mode	4	BOOL	C	R/W	manual output mode request {OFF, ON}
man_out	5	REAL	C	R/W	manual output value –5 to 105 (%)
tune_req	6	BOOL	C	R/W	limit cycle auto-tuning request {OFF, ON}
rsp_eu	7	REAL	C	R	remote set point in eu for monitoring
deviation	8	REAL	C	R	Deviation in eu for monitoring
PV	9	REAL	O	R	Calculated Process Variable (Percent Carbon) for monitoring
DSP	10	REAL	O	R	Display Set Point in eu for monitoring
OUT	11	REAL	O	R	control output –5 to 105 (%)
MODE	12	REAL	O	R	actual mode encoded
All	13	BOOL	O	R	Alarm 1
AL2	14	BOOL	O	R	Alarm 2
DEWPT	15	REAL	O	R	Calculated dewpoint [replaces BCO]
ATI	16	BOOL	O	R	Auto Tune Indicator. ON = Auto Tune in progress
O2	17	REAL	I	R	Oxygen sensor input (0 to 100%)
RSP	18	REAL	I	R	Remote Set Point (% or eu per sp_units)

Parameter	Index	Type	Use	R/W	Description
FFV	19	REAL	I	R	Feed Forward Value (%)
TRV	20	REAL	I	R	Output Track Value (%)
TRC	21	BOOL	I	R	Output Track Command {OFF, ON}
BCI	23	REAL	I	R	Back Calculation Input (%)
BIAS	24	REAL	I	R	Remote bias value for ratio PID
TEMP	26	REAL	I	R	Temperature input (°F or °C per USE_METRIC)
%CO	27	REAL	I	R	Percent carbon monoxide

Static Configuration Parameters:

Table 8-19 CARB Static Configuration Parameters

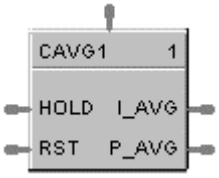
Parameter	Index	Type	Description
GAIN	0	REAL	proportional gain, 0.1 to 1000 or proportional band, 0.1% to 1000% [Tune Set 1]
RATE	1	REAL	derivative time, **0** or 0.1 to 10 (minutes) [Tune Set 1]
RESET	2	REAL	integration time, **0** or 0.02 to 50 (minutes) or repeats per minute, 0 or 0.02 to 50 (repeats) [Tune Set 1]
pv_hi	4	REAL	pv High Range value –99999 to 99999 (default **100**)
pv_lo	5	REAL	pv Low Range value –99999 to 99999 (default **0**)
sp_hi_lim	11	REAL	set point high limit, -99999 to 99999 (default **100**)
sp_lo_lim	12	REAL	set point low limit, -99999 to 99999 (default **0**)
outhilim	14	REAL	output high limit, -5 to **105**
outlolim	15	REAL	output low limit, **-5** to 105
failsafe	16	REAL	failsafe output value, -5 to 105, (default **0**)
al_sp[4]	17-20	REAL	alarm set points al1spl, al1sp2, al2spl, al2sp2, -99999 to 99999 (default **0**)
al_hyst	25	REAL	alarm hysteresis **0** to 5 (%)
man_reset	26	REAL	Manual Reset, -100 to 100 (in % output) (default **0**) [used for both tune sets]
FUZZY	28	BOOL	ON enables fuzzy logic overshoot suppression (default **OFF**)
TUNESET2	29	BOOL	Use tune set 2 (default **OFF**)
GAIN2	30	REAL	proportional gain, 0.1 to 1000 or proportional band, 0.1% to 1000% [Tune Set 2]
RATE2	31	REAL	derivative time, **0** or 0.1 to 10 (minutes) [Tune Set 2]
RESET2	32	REAL	integration time, **0** or 0.02 to 50 (minutes) or repeats per minute, 0 or 50 to 0.02 (repeats) [Tune Set 2]

Parameter	Index	Type	Description
use_propband	33	BOOL	Use Gain (**0**) or Proportional Band (1)
use_rpm	34	BOOL	Use minutes (**0**) or repeats per minute (1) for integral constant
sp_rate_dn	35	REAL	Set point low rate of change limit, **0** (off) to 99999 (eu/min)
sp_rate_up	36	REAL	Set point high rate of change limit, **0** (off) to 99999 (eu/min)
FF_GAIN	37	REAL	Feed forward gain, **0.0** to 10.0
RATIO	39	REAL	Gain value for Ratio PID (-20 to 20) (default **1**) [used when RA_BIAS > 0]
LBIAS	40	REAL	Bias value for Ratio PID when RA_BIAS = LOC_BIAS](-99999 to 99999) (**0**)
devbar_hi	41	REAL	High scale value for deviation bar graph (0 to 99999) (default **100**)
devbar_low	42	REAL	Low scale value for deviation bar graph [always = -devbar_hi]
L%CO	43	REAL	Local percent carbon monoxide (2.0 to 35.0, default 20.0)
REM_CO	44	BOOL	Use %CO input instead of local L%CO (default = OFF)
FURNACE_FACTOR	45	REAL	Furnace Factor in %C (-0.5 to 0.5)
ANTI_SOOT	46	BOOL	Anti-soot SP limit enable (default = OFF)
TEMP_LO_LIM	48	REAL	Trigger value for LOTEMP Boolean output (0 to 2500°F)
PERCENT_H	50	REAL	Percent hydrogen (1 to 100, default = 40)

8.16 CAVG Function Block

Description

The **CAVG** label stands for **Continuous Average.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-20 CAVG Dynamic Parameters

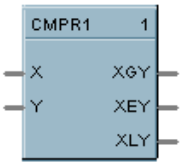
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
I_AVG	1	REAL	O	R	instantaneous calculated average value
P_AVG	2	REAL	O	R	previous calculated average value
INPUT	3	REAL	I	R	Analog Input
HOLD	4	BOOL	I	R	When ON prevents the input samples from being accumulated and the timer will continue to decrement. Outputs are held at their last calculated values.
RESET	5	BOOL	I	R	OFF = accumulate input and calculate average ON = no accumulation or averaging; hold last output On to Off transition = initialize the average output to current input value, initialize the periodic timer

Static Configuration Parameters: None

8.17 CMPR Function Block

Description

The **CMPR** label stands for **Comparison Calculation.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-21 CMPR Dynamic Parameters

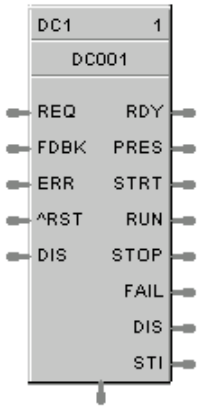
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
XGY	1	BOOL	O	R	X Greater than Y
XEY	2	BOOL	O	R	X Equals Y
XLY	3	BOOL	O	R	X Less than Y
X	4	REAL	I	R	input 1
Y	5	REAL	I	R	input 2

Static Configuration Parameters: None

8.18 DC Function Block

Description

The **DC** label stands for **Device Control.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-22 DC Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
req_reset	1	BOOL	C	R/W	ON = request to reset the control if in the Failed State
rem_time	2	ULONG	C	R	Time in seconds (count-down), where: if in the STARTING state, then remaining start time. If in the STOPPING state, then the remaining stop time. Otherwise 0 sec.
RDY	3	BOOL	O	R	ON while in the Ready State, otherwise OFF
PRES	4	BOOL	O	R	ON while in the Pre-Start State (while start delay timer is counting), otherwis OFF
STRT	5	BOOL	O	R	ON while in the Starting state (while feedback delay timer is counting or fdbk is ON), otherwise OFF
RUN	6	BOOL	O	R	ON when in the Running state, otherwise OFF
STOP	7	BOOL	O	R	ON while in the Stop state, otherwise OFF
FAIL	8	BOOL	O	R	ON while in the Failed state, otherwise OFF
DIS	9	BOOL	O	R	ON while in the Disabled state, otherwise OFF
STI	10	REAL	O	R	Enumeration representing the different states {NOT USED, READY, PRESTART, STARTING, RUNNING, STOPPING, DISABLED, FAIL}

Parameter	Index	Type	Use	R/W	Description
OUT	11	BOOL	O	R	ON while in the Running and Stopping state, otherwise OFF.
run_req	12	BOOL	I	R	ON = Request to transition to the Starting state OFF = Request to transition to the Stopping state
fdbk	13	BOOL	I	R	Feedback from the device; ON = device has started, OFF = device has not started
ERR	14	BOOL	I	R	Device Failure ON = device reports a failure; causes the control to transition to the Failure state OFF = no device failure
reset	15	BOOL	I	R	an OFF to ON transition will manually reset the control when it is in the Fail state
disable_in	16	BOOL	I	R	OFF = the device control operates normally ON = immediately transitions to the Disabled state; prevents the device from starting if in the ready state or immediately shuts-down the device if it is currently in the Starting or Running state

Static Configuration Parameters:

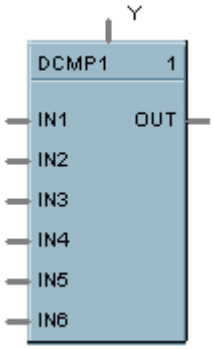
Table 8-23 DC Static Configuration Parameters

Parameter	Index	Type	Description
automatic_reset	0	BOOL	if set to auto, then the block will reset itself after the failure (Fail input) turns off. If set to manual, a Reset (signal input or from the OI station) is required to remove the failure condition. This parameter is determined when the block is configured {ON = Automatic Reset, OFF = Manual Reset} [default = OFF]
start_delay	1	ULONG	start-delay ON time and output on-delay time. Range 0-99999 seconds. [default = 0]
stop_delay	2	ULONG	Stop-Delay – time delay before the output turns OFF after an Off request. This parameter is configurable from the OI, (range 0 – 99999 seconds) [default = 0]
fdbk_fail_delay	3	ULONG	Feedback-Fail-Delay – timers starts in Starting state. If fdbk turns ON, timer continues in Running state. When timer expires in either Starting or Running state and fdbk is OFF, block goes to the Fail state. If fdbk is ON, stays or goes to Running state and the timer is reset to 0 seconds. This parameter is configurable from the OI, (range 0 – 99999 seconds) [default = 0]

8.19 DCMP Function Block

Description

The **DCMP** label stands for **Deviation Compare.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-24 DCMP Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
IN1	2	REAL	I	R	input 1
IN2	3	REAL	I	R	input 2
IN3	4	REAL	I	R	input 3
IN4	5	REAL	I	R	input 4
IN5	6	REAL	I	R	input 5
IN6	7	REAL	I	R	input 6
REF(Y)	8	REAL	I	R	reference input

Static Configuration Parameters:

Table 8-25 DCMP Static Configuration Parameters

Parameter	Index	Type	Description
+ DEV	0	REAL	plus deviation
- DEV	1	REAL	minus deviation

8.20 DENC Function Block

Description

The **DENC** label stands for **Digital Encoder.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.

Dynamic Parameters:

Table 8-26 DENC Dynamic Parameters

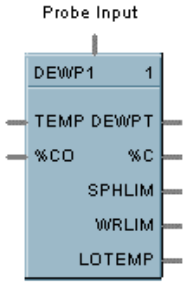
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
inct	1	REAL	O	R	number of IN set to ON
denc	2	REAL	O	R	encoded parameter containing Boolean state of each input (see note 1)
in[16]	3-18	BOOL	I	R	input

Static Configuration Parameters: None

8.21 DEWP Function Block

Description

The **DEWP** label stands for **Dewpoint Calculation**. This block is part of the *Calculations* category. It looks like this graphically on the Control builder.



Dynamic Parameters:

Table 8-27 DEWP Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
DEWPT	1	REAL	O	R	Calculated dew point output.
%C	2	REAL	O	R	Calculated percent carbon output.
SPHLIM	3	REAL	O	R	Control set point high limit for anti-soot
WRLIM	4	BOOL	O	R	Command to write the set point high limit.
LOTEMP	5	BOOL	O	R	ON when TEMP is <= calculated low temperature dropoff.
O2	6	REAL	I	R	Oxygen sensor input (0 to 100%)
TEMP	7	REAL	I	R	Temperature input (°F or °C per USE_METRIC)
%CO	8	REAL	I	R	Percent carbon monoxide input

Static Configuration Parameters:

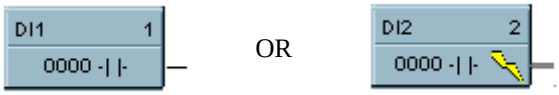
Table 8-28 DEWP Static Configuration Parameters

Parameter	Index	Type	Description
L%CO	0	REAL	Local percent carbon monoxide (2.0 to 35.0, default 20.0)
REM_CO	1	BOOL	Use %CO input instead of local L%CO (default = OFF)
FURNACE_FACTOR	2	REAL	Furnace Factor in %C (-0.5 to 0.5)
ANTI_SOOT	3	BOOL	Anti-soot SP limit enable
TEMP_LO_LIM	5	REAL	Trigger value for LOTEMP Boolean output (0 to 2500°F)
PERCENT_H	7	REAL	Percent hydrogen (1 to 100, default = 40)

8.22 DI Function Block

Description

The **DI** label stands for **Discrete Input.** This block is part of the *Logic* or *Fast Logic* categories. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-29 DI Dynamic Parameters

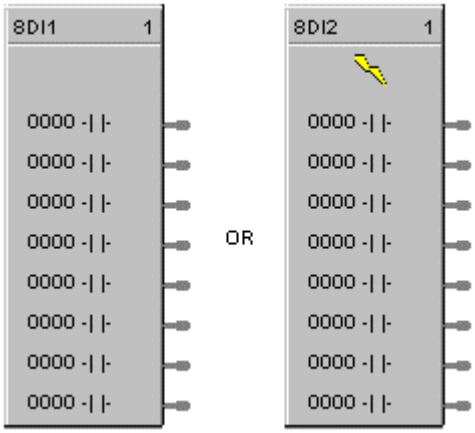
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT_D	1	BOOL	O	R	

Static Configuration Parameters: None

8.23 8 DI Function Block

Description

The **8DI** label stands for **Eight Point Digital Inputs.** This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-30 Eight DI Dynamic Parameters

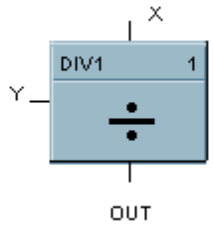
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT_D[8]	1-8	BOOL	O	R	values of digital card inputs

Static Configuration Parameters: None

8.24 DIV Function Block

Description

The **DIV** label stands for **Division Mathematical operation**. This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-31 DIV Dynamic Parameters

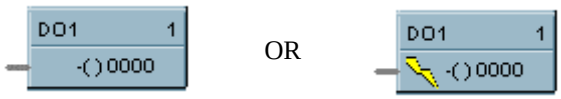
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
X	2	REAL	I	R	input 1
Y	3	REAL	I	R	input 2

Static Configuration Parameters: None

8.25 DO Function Block

Description

The **DO** label stands for **Digital Output.** This block is part of the *Logic or Fast Logic* category. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-32 DO Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT_D	1	REAL	C	R	Physical output value
IN_D	2	BOOL	I	R	

Static Configuration Parameters: None

8.26 8 DO Function Block

Description

The **8DO** label stands for **Eight Point Digital Outputs.** This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.

Dynamic Parameters:

Table 8-33 Eight DO Dynamic Parameters

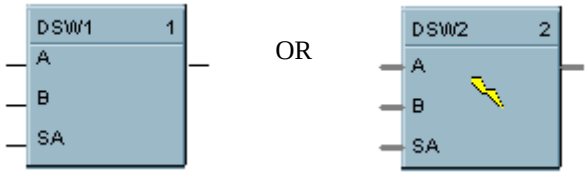
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT_D[8]	1-8	REAL	C	R	Physical output value
IN_D[8]	9-16	BOOL	I	R	

Static Configuration Parameters: None

8.27 DSW Function Block

Description

The **DSW** label stands for **Digital Switch.** This block is part of the *Logic* or *Fast Logic* categories. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-34 DSW Dynamic Parameters

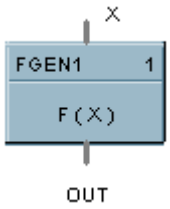
Index	Parameter	Type	Use	R/W	Description
0	status	REAL	C	R	block status (see section 9.2 for code list)
1	OUT	BOOL	O	R	output
2	A	BOOL	I	R	input A
3	B	BOOL	I	R	input B
4	SA	BOOL	I	R	Select A

Static Configuration Parameters: None

8.28 FGEN Function Block

Description

The **FGEN** label stands for **Function Generator - 10 Segment**. This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder:



Dynamic Parameters:

Table 8-35 FGEN Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
X	2	REAL	I	R	input

Static Configuration Parameters:

Table 8-36 FGEN Static Configuration Parameters

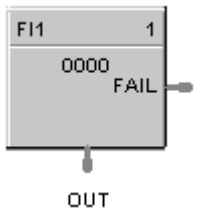
Parameter	Index	Type	Description
xb[0]	0	REAL	x breakpoint 1 (-99999 to 999999)
xb[1]	1	REAL	x breakpoint 2 (-99999 to 999999)
xb[2]	2	REAL	x breakpoint 3 (-99999 to 999999)
xb[3]	3	REAL	x breakpoint 4 (-99999 to 999999)
xb[4]	4	REAL	x breakpoint 5 (-99999 to 999999)
xb[5]	5	REAL	x breakpoint 6 (-99999 to 999999)
xb[6]	6	REAL	x breakpoint 7 (-99999 to 999999)
xb[7]	7	REAL	x breakpoint 8 (-99999 to 999999)
xb[8]	8	REAL	x breakpoint 9 (-99999 to 999999)
xb[9]	9	REAL	x breakpoint 10 (-99999 to 999999)
xb[10]	10	REAL	x breakpoint 11 (-99999 to 999999)
yb[0]	11	REAL	output value at x breakpoint 1 (-99999 to 999999)
yb[1]	12	REAL	output value at x breakpoint 2 (-99999 to 999999)
yb[2]	13	REAL	output value at x breakpoint 3 (-99999 to 999999)

Parameter	Index	Type	Description
yb[3]	14	REAL	output value at x breakpoint 4 (-99999 to 999999)
yb[4]	15	REAL	output value at x breakpoint 5 (-99999 to 999999)
yb[5]	16	REAL	output value at x breakpoint 6 (-99999 to 999999)
yb[6]	17	REAL	output value at x breakpoint 7 (-99999 to 999999)
yb[7]	18	REAL	output value at x breakpoint 8 (-99999 to 999999)
yb[8]	19	REAL	output value at x breakpoint 9 (-99999 to 999999)
yb[9]	20	REAL	output value at x breakpoint 10 (-99999 to 999999)
yb[10]	21	REAL	output value at x breakpoint 11 (-99999 to 999999)

8.29 FI Function Block

Description

The **FI** label stands for **Frequency Input.** This block is part of the *Logic* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-37 FI Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	Frequency input value (eu)
FAIL	2	BOOL	O	R	Failed input indication from hardware module

Static Configuration Parameters:

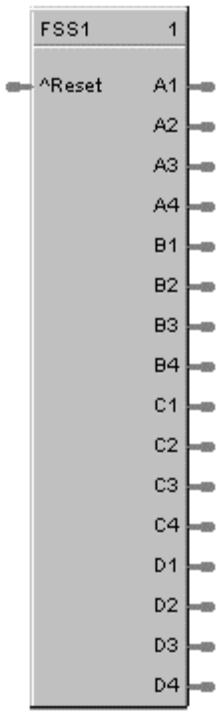
Table 8-38 FI Static Configuration Parameters

Parameter	Index	Type	Description
Address	0	ADDR	Address of physical frequency input channel
unused	1	REAL	spare (to keep parameters aligned with similar AI parameters)
Filter_Time	2	REAL	filter time constant (range 0.0 – 120.0 seconds) [default 0]
Bias	3	REAL	bias value applied to the output (range = 0-100000 EU) [default 0]
Failsafe	4	REAL	failsafe value [default 0]
Failsafe_type	5	ULONG	{FAILSAFE, RANGE_HIGH, RANGE_LO} [default - not checked]
EU_High	6	REAL	High range value (range = 0.0 to 100000 EU) [default 100]
EU_Low	7	REAL	Low range value (range = 0.0 to 100000 EU) [default 0]
Freq_Zero_Limit	8	REAL	Zero value of the input device (10Hz to 100KHz) [default 100Hz] U/M is Hz.
Freq_Span_Limit	9	REAL	Highest value of the input device (10 Hz to 100 KHz) [default 10 KHz] (must be larger than the lower limit) U/M is Hz.

8.30 FSS Function Block

Description

The **FSS** label stands for **Four-Selector Switch**. This block is part of the *Logic* category. It looks like this graphically on the Control Builder:



Dynamic Parameters:

Table 8-39 FSS Dynamic Parameters

Index	Parameter	Type	Use	R/W	Description
0	status	REAL	C	R	block status (see section 9.2 for code list)
9	A1	BOOL	O	R	Bank A output #1
10	A2	BOOL	O	R	Bank A output #2
11	A3	BOOL	O	R	Bank A output #3
12	A4	BOOL	O	R	Bank A output #4
13	B1	BOOL	O	R	Bank B output #1
14	B2	BOOL	O	R	Bank B output #2
15	B3	BOOL	O	R	Bank B output #3
16	B4	BOOL	O	R	Bank B output #4
17	C1	BOOL	O	R	Bank C output #1
18	C2	BOOL	O	R	Bank C output #2
19	C3	BOOL	O	R	Bank C output #3

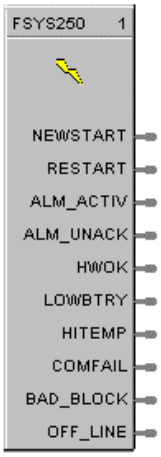
Index	Parameter	Type	Use	R/W	Description
20	C4	BOOL	O	R	Bank C output #4
21	D1	BOOL	O	R	Bank D output #1
22	D2	BOOL	O	R	Bank D output #2
23	D3	BOOL	O	R	Bank D output #3
24	D4	BOOL	O	R	Bank D output #4
25	Reset	BOOL	I	R	Off to On requests a reset state

Static Configuration Parameters: None

8.31 FSYS Function Block

Description

The **Fast Logic Status Block (FSYS)** is a function block and is part of the *Fast Logic* category. It provides read access to controller status values including those related to the Fast Logic execution cycle. The output may be connected to function block inputs. The outputs may also be connected to signal tags for operator interface monitoring. The FSYS System Monitoring block is assigned block number 250. It looks like this graphically on the Control Builder:



Dynamic Parameters:

Table 8-40 FSYS Dynamic Parameters

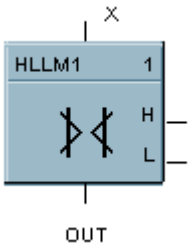
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
CYC_CNT	1	REAL	C	R	number of control block cycles
EXCTIME	3	REAL	C	R	control block execution time in seconds
PK_EXCTIME	4	REAL	C	R	peak control block execution time in seconds
EXECFAULT	7	BOOL	C	R	ON = executive fault
CYCTIME	8	REAL	C	R	control block cycle time in seconds
CYCMINS	9	REAL	C	R	control block cycle time in minutes
NEWSTART	10	BOOL	O	R	ON = new start
RESTART	11	BOOL	O	R	ON = warm start
ALM_ACTIV	12	BOOL	O	R	ON = active alarm
ALM_UNACK	13	BOOL	O	R	ON = unacknowledged alarm
HWOK	14	BOOL	O	R	ON = no hardware faults
LOWBTRY	15	BOOL	O	R	ON = battery is low
HITEMP	16	BOOL	O	R	ON = high RJ temperature
BAD_BLOCK	18	BOOL	O	R	ON = one or more blocks have bad status

Static Configuration Parameters: None

8.32 HLLM Function Block

Description

The HLLM label stands for **High Low Limiter**. This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder:



Dynamic Parameters:

Table 8-41 HLLM Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	primary output
H	2	BOOL	O	R	high limit indication
L	3	BOOL	O	R	low limit indication
X	4	REAL	I	R	input

Static Configuration Parameters:

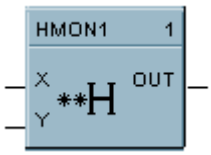
Table 8-42 HLLM Static Configuration Parameters

Parameter	Index	Type	Description
hilim	0	REAL	high limit {-99999 to 999999} for Analog X value
lolim	1	REAL	low limit {-99999 to 999999} for Analog X value

8.33 HMON Function Block

Description

The **HMON** label stands for **High Monitor.** This block is part of the *Alarm/Monitor* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-43 HMON Dynamic Parameters

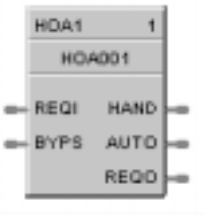
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	Output
X	2	REAL	I	R	Monitored input
Y	3	REAL	I	R	Trip point

Static Configuration Parameters: None

8.34 HOA Function Block

Description

The **HOA** label stands for **Hand/Off/Auto Switch.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-44 HOA Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
current_state	1	ULONG	C	R	current state of the block {OFF, HAND, AUTO,BYPASS}
local_state_req	2	ULONG	C	R/W	request to change the hand/off/auto state; Only monitored when “bypass_in” is OFF and HOA_Source is set to Local or Local_Remote {NO_REQUEST,OFF, HAND, AUTO}
remote_state_req	3	ULONG	C	R/W	request to change the hand/off/auto state. Only monitored when “bypass_in” is OFF and HOA_Source is set to Remote or Local_Remote {NO_REQUEST,OFF, HAND, AUTO}
HOA_source	4	ULONG	C	R	Permitted source for a state change request {LOCAL, REMOTE, LOCAL_REMOTE}
feedback_value	5	ULONG	C	R	Range 0-8, where 0 = Undefined
hand_out	6	BOOL	O	R	ON when the current state is ‘hand’
auto_out	7	BOOL	O	R	ON when the current state is ‘auto’
req_out	8	BOOL	O	R	ON when the current state is ‘Auto’ and the REQ input is ON or when the current state is “Hand”, otherwise OFF.
req_in	9	BOOL	I	R	When the current state is ‘Auto’ then Req_out equals Req_in, when not in ‘Auto’, the state of this pin is ignored
bypass_in	10	BOOL	I	R	ON places block in the Bypass State and forces req_out OFF. ON to OFF transition returns block to previous state (Hand/Off/Auto)

Static Configuration Parameters:

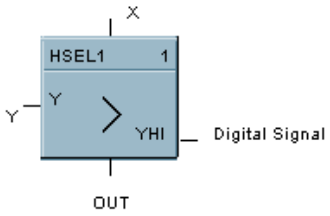
Table 8-45 HOA Static Configuration Parameters

Parameter	Index	Type	Description
init_hoa_source	0	ULONG	Initial HOA source for new state requests. {LOCAL, REMOTE, LOCAL_REMOTE} [default = LOCAL_REMOTE}
init_state	1	ULONG	Start up state of the function block {OFF, HAND, AUTO} [default = AUTO]
feedbackSrcBlockNum	2	ULONG	Block Number of the function block the feedback analog signal tag references.
feedbackSrcOutIndex	3	ULONG	Output index of the function block the feedback analog signal tag references.

8.35 HSEL Function Block

Description

The **HSEL** label stands for **High Selector.** This block is part of the *Signal Selectors* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-46 HSEL Dynamic Parameters

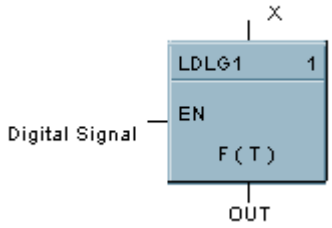
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	primary output
YHI(YLO)	2	BOOL	O	R	override indication
X	3	REAL	I	R	input
Y	4	REAL	I	R	input

Static Configuration Parameters: None

8.36 LDLG Function Block

Description

The **LDLG** label stands for **Lead/Lag.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-47 LDLG Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
IN	2	REAL	I	R	primary input
EN	3	BOOL	I	R	enable

Static Configuration Parameters: None

8.37 LMON Function Block

Description

The **LMON** label stands for **Low Monitor.** This block is part of the *Alarm/Monitor* category. It looks like this graphically on the Control Builder.

Dynamic Parameters:

Table 8-48 LMON Dynamic Parameters

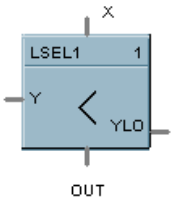
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	Output
X	2	REAL	I	R	Monitored input
Y	3	REAL	I	R	Trip point

Static Configuration Parameters: None

8.38 LSEL Function Block

Description

The **LSEL** label stands for **Low Selector.** This block is part of the *Signal Selectors* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-49 LSEL Dynamic Parameters

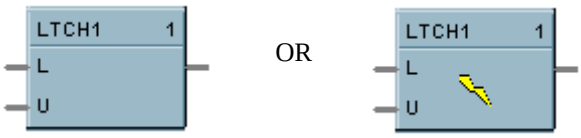
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	primary output
YHI(YLO)	2	BOOL	O	R	override indication
X	3	REAL	I	R	input
Y	4	REAL	I	R	input

Static Configuration Parameters: None

8.39 LTCH Function Block

Description

The **LTCH** label stands for **Latch.** This block is part of the *Logic* or *Fast Logic* category. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-50 LTCH Dynamic Parameters

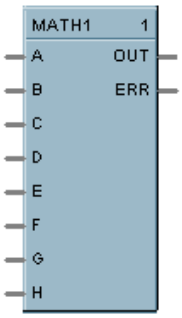
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
L	2	BOOL	I	R	latch command
U	3	BOOL	I	R	unlatch command

Static Configuration Parameters: None

8.40 MATH Function Block

Description

The **MATH** label stands for **Free Form Math.** This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-51 MATH Dynamic Parameters

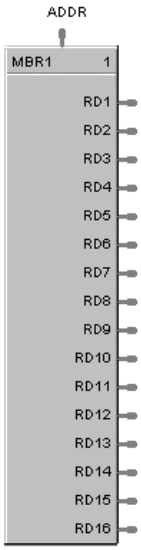
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	Result
ERR	2	BOOL	O	R	Error indication
A	3	REAL	I	R	Input 1
B	4	REAL	I	R	Input 2
C	5	REAL	I	R	Input 3
D	6	REAL	I	R	Input 4
E	7	REAL	I	R	Input 5
F	8	REAL	I	R	Input 6
G	9	REAL	I	R	Input 7
H	10	REAL	I	R	Input 8

Static Configuration Parameters: None

8.41 MBR Function Block

Description

The **MBR** label stands for **Modbus Read.** This block is part of the *Communications* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-52 MBR Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
data_val[16]	1-16	REAL	O	R	last read value from selected address

Static Configuration Parameters:

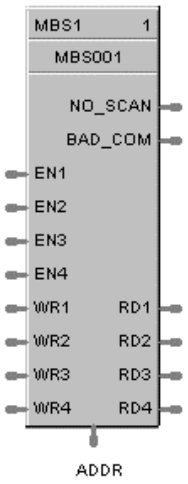
Table 8-53 MBR Static Parameters

Parameter	Index	Type	Description
reg_used[16]	64-79	BOOL	ON = register request is assigned to the RDx pin

8.42 MBS Function Block

Description

The **MBS** label stands for **Modbus Slave Status.** This block is part of the *Communications* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-54 MBS Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
no_scan	1	BOOL	O	R	ON = device is “out of scan” OFF = device is “in scan”
bad_com	2	BOOL	O	R	ON = bad quality or device not defined OFF = good communications
r_val[4]	3-6	REAL	O	R	last read value from selected address
w_val[4]	8-11	REAL	I	R	value to be written to the selected register address
enable[4]	12-15	REAL	I	R	ON = data value is written once per scan

Static Configuration Parameters:

Table 8-55 MBS Static Parameters

Parameter	Index	Type	Description
w_reg_used[4]	27-30	BOOL	ON = register request assigned to WRx pin
r_reg_used[4]	31-34	BOOL	ON = register request assigned to the RDx pin

8.43 MBW Function Block

Description

The **MBW** label stands for **Modbus Write.** This block is part of the *Communications* category. It looks like this graphically on the Control Builder.

Dynamic Parameters:

Table 8-56 MBW Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
data_val[8]	2-9	REAL	I	R	value to be written to the selected register address
enable[8]	10-17	REAL	I	R	ON = data value is written once per scan

Static Configuration Parameters:

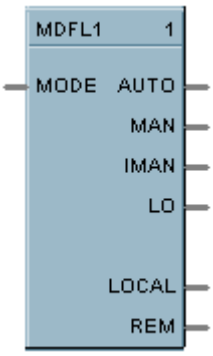
Table 8-57 MBW Static Parameters

Parameter	Index	Type	Description
reg_used[8]	16-23	BOOL	ON = register request is assigned to the WRx pin

8.44 MDFL Function Block

Description

The **MDFL** label stands for **Mode Flag.** This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-58 MDFL Dynamic Parameters

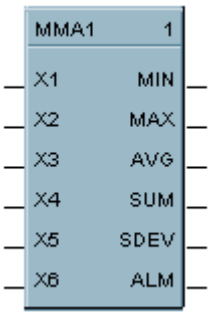
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
AUTO	1	BOOL	O	R	ON if MODE = 0.0 or 4.0, else OFF
MAN	2	BOOL	O	R	ON if MODE = 1.0 or 5.0, else OFF
IMAN	3	BOOL	O	R	ON if MODE = 2.0 or 6.0, else OFF
LO	4	BOOL	O	R	ON if MODE = 3.0 0r 7.0, else OFF
LOCAL	5	BOOL	O	R	ON if MODE > 3.0, else OFF
REM	6	BOOL	O	R	ON if MODE < 4.0, else OFF
MODE	7	REAL	I	R	Encoded mode input

Static Configuration Parameters: None

8.45 MMA Function Block

Description

The **MMA** label stands for **Min-Max-Average-Sum.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-59 MMA Dynamic Parameters

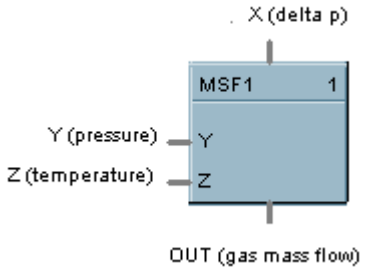
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
MIN	1	REAL	O	R	minimum input value
MAX	2	REAL	O	R	maximum input value
AVG	3	REAL	O	R	average of input values
SUM	4	REAL	O	R	sum of input values
SDEV	5	REAL	O	R	standard deviation of inputs
ALM	6	BOOL	O	R	deviation alarm
X1-X6	7-12	REAL	I	R	inputs

Static Configuration Parameters: None

8.46 MSF Function Block

Description

The **MSF** label stands for **Mass Flow Calculation.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-60 MSF Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
X	2	REAL	I	R	
Y	3	REAL	I	R	
Z	4	REAL	I	R	

Static Configuration Parameters:

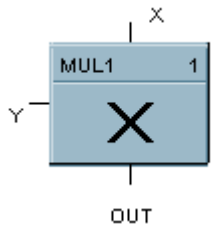
Table 8-61 MSF Static Configuration Parameters

Parameter	Index	Type	Description
Kg	0	REAL	Orifice Constant {-99999 to 999999}
Kx	1	REAL	Delta Pressure Scaler {-99999 to 999999}
Ky	2	REAL	Pressure Scaler {-99999 to 999999}
Kz	3	REAL	Temperature Scaler {-99999 to 999999}
Bx	4	REAL	Pressure Bias {-99999 to 999999}
By	5	REAL	Delta Pressure Bias {-99999 to 999999}
Bz	6	REAL	Temperature Bias {-99999 to 999999}
DROPOFF	7	REAL	low dropoff value (EU) {0 to 99999} [default 0]

8.47 MUL Function Block

Description

The **MUL** label stands for **Multiplication Mathematical Operation (2 Inputs).** This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-62 MUL Dynamic Parameters

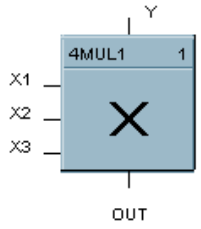
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
X	2	REAL	I	R	input 1
Y	3	REAL	I	R	input 2

Static Configuration Parameters: None

8.48 4MUL Function Block

Description

The **4MUL** label stands for **Multiplication Mathematical Operation (4Inputs)**. This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-63 4MUL Dynamic Parameters

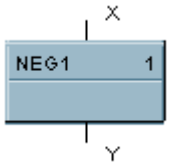
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
A	2	REAL	I	R	input 1
B	3	REAL	I	R	input 2
C	4	REAL	I	R	input 3
D	5	REAL	I	R	input 4

Static Configuration Parameters: None

8.49 NEG Function Block

Description

The **NEG** label stands for **Negate**. This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-64 NEG Dynamic Parameters

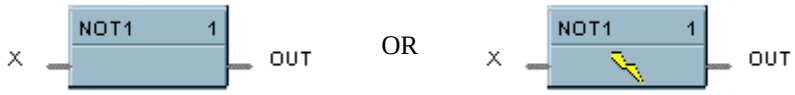
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	result
X	2	REAL	I	R	input

Static Configuration Parameters: None

8.50 NOT Function Block

Description

The **NOT** label stands for the **NOT Boolean logic function or Logic Inverter**. This block is part of the *Logic* or *Fast Logic* category. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-65 NOT Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
X	2	BOOL	I	R	input

Static Configuration Parameters: None

8.51 ONDT Function Block

Description

The **ONDT** label stands for the **On Delay Timer**. This block is part of the *Fast Logic* category. It looks like this graphically on the Control Builder.

Dynamic Parameters:

Table 8-66 ONDT Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	W	output
RUN_RST	2	BOOL	I	R	ON = run, OFF = reset

Static Configuration Parameters:

Table 8-67 ONDT Static Parameters

Parameter	Index	Type	Description
Delay	0	REAL	Delay Time (0 seconds, 0 to 9999.9)

8.52 OFDT Function Block

Description

The **OFDT** label stands for the **Off Delay Timer**. This block is part of the *Fast Logic* category. It looks like this graphically on the Control Builder.

Dynamic Parameters:

Table 8-68 OFDT Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	W	output
RST_RUN	2	BOOL	I	R	ON = reset, OFF = run

Static Configuration Parameters:

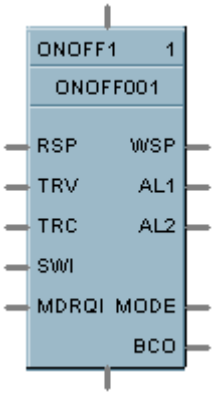
Table 8-69 ONDT Static Parameters

Parameter	Index	Type	Description
Delay	0	REAL	Delay Time (0 seconds, 0 to 9999.9)

8.53 ON/OFF Function Block

Description

The **ON/OFF** label stands for the **On/Off Control function**. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-70 ON/OFF Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
lsp	1	REAL	C	R/W	local set point (eu)
lsp2	2	REAL	C	R/W	local set point 2 (eu)
rem_mode	3	BOOL	C	R/W	remote set point mode request {OFF, ON}
man_mode	4	BOOL	C	R/W	manual output mode request {OFF, ON}
man_out	5	BOOL	C	R/W	On/Off
rsp_eu	6	REAL	C	R	remote set point in eu for monitoring
deviation	7	REAL	C	R	Deviation in eu for monitoring
pv	8	REAL	C	R	Process Variable in eu for monitoring
WSP	9	REAL	O	R	Working Set Point in eu for monitoring
OUT	10	BOOL	O	R	On/Off
MODE	11	REAL	O	R	actual mode encoded
All	12	BOOL	O	R	Alarm 1
AL2	13	BOOL	O	R	Alarm 2
BCO	14	REAL	O	R	Back Calculation Out (%)
PVI	15	REAL	I	R	Process Variable Input (eu) (pv_lo <= PV <= pv_hi)
RSP	16	REAL	I	R	Remote Set Point (% or eu per sp_units)
TRV	17	BOOL	I	R	On/Off
TRC	18	BOOL	I	R	Manual On/Off

Static Configuration Parameters:

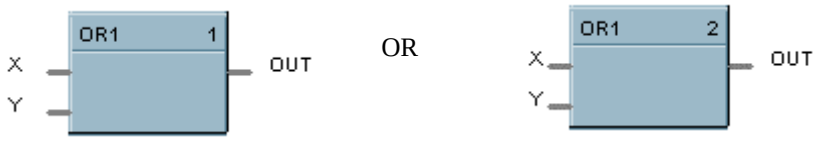
Table 8-71 ON/OFF Static Configuration Parameters

Parameter	Index	Type	Description
pv_hi	0	REAL	pv High Range value –99999 to 99999 (default **100**)
pv_lo	1	REAL	pv Low Range value –99999 to 99999 (default **0**)
sp_hi_lim	6	REAL	set point high limit, -99999 to 99999 (default **100**)
sp_lo_lim	7	REAL	set point low limit, -99999 to 99999 (default **0**)
sp_rate_dn	9	REAL	Set point low rate of change limit, **0** (off) to 99999 (eu/min)
sp_rate_up	10	REAL	Set point high rate of change limit, **0** (off) to 99999 (eu/min)
devbar_hi	11	REAL	High scale value for deviation bar graph (0 to 99999) (default **100**)
devbar_low	12	REAL	Low scale value for deviation bar graph [always = -devbar_hi]
Output Hysteresis	13	REAL	Off – 0 to 10% of Input Span
al_sp[4]	14-17	REAL	alarm set points al1sp1, al1sp2, al2sp1, al2sp2, -99999 to 99999 (default 0)
al_hyst	22	REAL	alarm hysteresis 0 to 5 (%)
Fail Safe Out	23	BOOL	Fail Safe Out = On/Off

8.54 2OR Function Block

Description

The **2OR** label stands for the inclusive **OR (2 Inputs) Boolean logic function**. This block is part of the *Logic* or *Fast Logic* category. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-72 2OR Dynamic Parameters

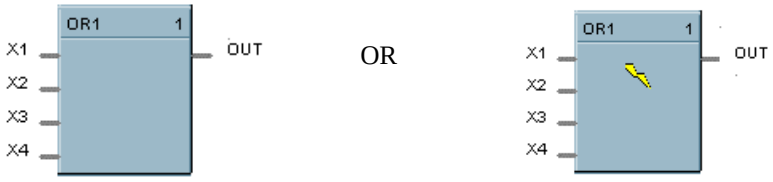
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
DIG_1	2	BOOL	I	R	input
DIG_2	3	BOOL	I	R	input

Static Configuration Parameters: None

8.55 4OR Function Block

Description

The **4OR** label stands for the inclusive **OR (4 Inputs) Boolean logic function**. This block is part of the *Logic* or *Fast Logic* category. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-73 4OR Dynamic Parameters

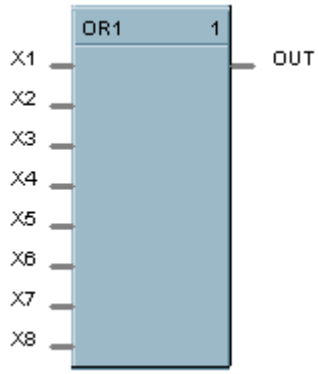
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
DIG_1	2	BOOL	I	R	input
DIG_2	3	BOOL	I	R	input
DIG_3	4	BOOL	I	R	input
DIG_4	5	BOOL	I	R	input

Static Configuration Parameters: None

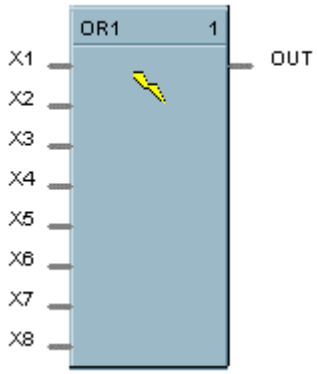
8.56 8OR Function Block

Description

The **8OR** label stands for the inclusive **OR (8 Inputs) Boolean logic function**. This block is part of the *Logic or Fast Logic* category. It looks like this graphically on the Control Builder.



OR



Fast Logic

Dynamic Parameters:

Table 8-74 8OR Dynamic Parameters

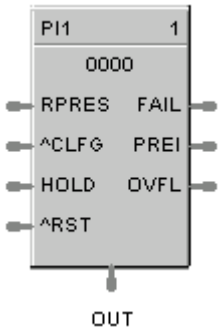
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
DIG_1	2	BOOL	I	R	input
DIG_2	3	BOOL	I	R	input
DIG_3	4	BOOL	I	R	input
DIG_4	5	BOOL	I	R	input
DIG_5	6	BOOL	I	R	input
DIG_6	7	BOOL	I	R	input
DIG_7	8	BOOL	I	R	input
DIG_8	9	BOOL	I	R	input

Static Configuration Parameters: None

8.57 PI Function Block

Description

The **PI** label stands for **Pulse Input.** This block is part of the *Logic* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-75 PI Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
out	1	REAL	O	R	Accumulated EU count
fail	2	BOOL	O	R	failed input indication
prei	3	BOOL	O	R	ON when the accumulated count => preset count
ovfl	4	BOOL	O	R	ON when the count on the module overflows
rpres	5	REAL	I	R	Remote preset count in EU; 0 = no alarm indication on PREI pin
clfg	6	BOOL	I	R	OFF to ON transition clears the fail and ovfl flags to zero
hold	7	BOOL	I	R	ON holds the hardware pulse counter at the current value
reset	8	BOOL	I	R	OFF to ON transition resets the pulse counter to zero when the hold input is set to ON. Also clears the fail and ovfl flags

Static Configuration Parameters:

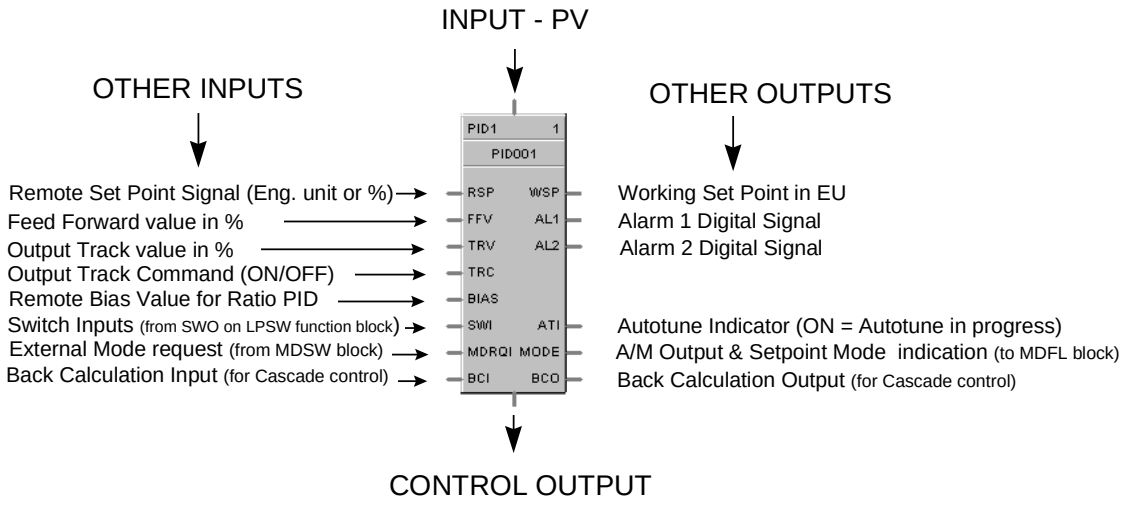
Table 8-76 PI Static Configuration Parameters

Parameter	Index	Type	Description
Pulse_addr	0	ADDR	Address of physical pulse input channel
Pulse_weight	1	REAL	Number of EU per pulse. (range = 0 – 99999 EU) [default = 1]
Preset_action	2	BOOL	OFF – (latch) the hardware module output latches ON until Reset. The PREI latches ON until the module acknowledge the Reset ON – (trigger) the hardware module output turns ON for 1 second. The PREI turns ON for approx. 1 sec (see note 6) [default = ON]
Local_preset	3	REAL	Local preset count in EU; 0 = no alarm indication on PREI pin (there are no limits) [default = 0]
Remote	4	BOOL	ON = use remote preset count, OFF = use local preset count [default = ON]

8.58 PID Function Block

Description

The **PID** label stands for **Proportional, Integral, Derivative (3-mode)** control action. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-77 PID Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
lsp	1	REAL	C	R/W	local set point (eu)
lsp2	2	REAL	C	R/W	local set point 2 (eu)
rem_mode	3	BOOL	C	R/W	remote set point mode request {OFF, ON}
man_mode	4	BOOL	C	R/W	manual output mode request {OFF, ON}
man_out	5	REAL	C	R/W	manual output value –5 to 105 (%)
tune_req	6	BOOL	C	R/W	limit cycle auto-tuning request {OFF, ON}
rsp_eu	7	REAL	C	R	remote set point in eu for monitoring
deviation	8	REAL	C	R	Deviation in eu for monitoring
pv	9	REAL	C	R	Process Variable in eu for monitoring
WSP	10	REAL	O	R	Working setpoint display in eu for monitoring
OUT	11	REAL	O	R	control output –5 to 105 (%)
MODE	12	REAL	O	R	actual mode encoded . See Table 8-78.
ALl	13	BOOL	O	R	Alarm 1
AL2	14	BOOL	O	R	Alarm 2

Parameter	Index	Type	Use	R/W	Description
BCO	15	REAL	O	R	Back Calculation Out (%)
ATI	16	BOOL	O	R	Auto Tune Indicator. ON = Auto Tune in progress
PVI	17	REAL	I	R	Process Variable Input (eu) (pv_lo <= PV <= pv_hi)
RSP	18	REAL	I	R	Remote Set Point (% or eu per sp_units)
FFV	19	REAL	I	R	Feed Forward Value (%)
TRV	20	REAL	I	R	Output Track Value (%)
TRC	21	BOOL	I	R	Output Track Command {OFF, ON}
BCI	23	REAL	I	R	Back Calculation Input (%)
BIAS	24	REAL	I	R	Remote bias value for ratio PID

Table 8-78 PID Modes

Mode	Decimal value	IEEE hex value
RSP AUTO	0.0	00000000
RSP MAN	1.0	3F800000
RSP IMAN	2.0	40000000
RSP LO	3.0	40400000
LSP AUTO	4.0	40800000
LSP MAN	5.0	40A00000
LSP IMAN	6.0	40C00000
LSP LO	7.0	40E00000

Static Configuration Parameters:

Table 8-79 PID Static Configuration Parameters

Parameter	Index	Type	Description
GAIN	0	REAL	proportional gain, 0.1 to 1000 or proportional band, 0.1% to 1000% [Tune Set 1]
RATE	1	REAL	derivative time, **0** or 0.1 to 10 (minutes) [Tune Set 1]
RESET	2	REAL	integration time, **0** or 0.02 to 50 (minutes) or repeats per minute, 0 or 0.02 to 50 (repeats) [Tune Set 1]
pv_hi	4	REAL	pv High Range value –99999 to 99999 (default **100**)
pv_lo	5	REAL	pv Low Range value –99999 to 99999 (default **0**)
sp_hi_lim	11	REAL	set point high limit, -99999 to 99999 (default **100**)

Parameter	Index	Type	Description
sp_lo_lim	12	REAL	set point low limit, -99999 to 99999 (default **0**)
outhilim	14	REAL	output high limit, -5 to **105**
outlolim	15	REAL	output low limit, **-5** to 105
failsafe	16	REAL	failsafe output value, -5 to 105, (default **0**)
al_sp[4]	17-20	REAL	alarm set points al1spl, al1sp2, al2spl, al2sp2, -99999 to 99999 (default **0**)
al_hyst	25	REAL	alarm hysteresis **0** to 5 (%)
man_reset	26	REAL	Manual Reset, -100 to 100 (in % output) (default **0**) [used for both tune sets]
FUZZY	28	BOOL	ON enables fuzzy logic overshoot suppression (default **OFF**)
TUNESET2	29	BOOL	Use tune set 2 (default **OFF**)
GAIN2	30	REAL	proportional gain, 0.1 to 1000 or proportional band, 0.1% to 1000% [Tune Set 2]
RATE2	31	REAL	derivative time, **0** or 0.1 to 10 (minutes) [Tune Set 2]
RESET2	32	REAL	integration time, **0** or 0.02 to 50 (minutes) or repeats per minute, 0 or 50 to 0.02 (repeats) [Tune Set 2]
use_propband	33	BOOL	Use Gain (**0**) or Proportional Band (1)
use_rpm	34	BOOL	Use minutes (**0**) or repeats per minute (1) for integral constant
sp_rate_dn	35	REAL	Set point low rate of change limit, **0** (off) to 99999 (eu/min)
sp_rate_up	36	REAL	Set point high rate of change limit, **0** (off) to 99999 (eu/min)
FF_GAIN	37	REAL	Feed forward gain, **0.0** to 10.0
RATIO	39	REAL	Gain value for Ratio PID (-20 to 20) (default **1**) [used when RA_BIAS > 0]
LBIAS	40	REAL	Bias value for Ratio PID when RA_BIAS = LOC_BIAS](-99999 to 99999) (**0**)
devbar_hi	41	REAL	High scale value for deviation bar graph (0 to 99999) (default **100**)
devbar_low	42	REAL	Low scale value for deviation bar graph [always = -devbar_hi]

8.59 PTMR Function Block

Description

The **PTMR** label stands for **Periodic Timer**. This block is part of the *Logic* category. It looks like this graphically on the Control Builder.

Dynamic Parameters:

Table 8-80 PTMR Dynamic Parameters

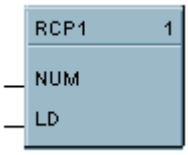
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
EVENT	1	BOOL	O	R	output
RST	2	BOOL	I	R	reset input

Static Configuration Parameters: None

8.60 RCP Function Block

Description

The **RCP** label stands for **Recipe Selector**. This block is part of the *Setpoint Program* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-81 RCP Dynamic Parameters

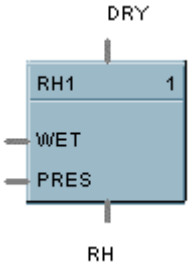
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
NUM	1	REAL	I	R	recipe number
LOAD	2	BOOL	I	R	load command

Static Configuration Parameters: None

8.61 RH Function Block

Description

The **RH** label stands for **Relative Humidity**. This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-82 RH Dynamic Parameters

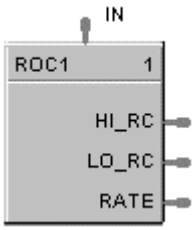
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
RH	1	REAL	O	R	Relative Humidity
DRY	2	REAL	I	R	Dry bulb temperature
WET	3	REAL	I	R	Wet bulb temperature
PRES	4	REAL	I	R	Atmospheric Pressure

Static Configuration Parameters: None

8.62 ROC Function Block

Description

The **ROC** label stands for **Rate of Change**. This block is part of the Auxiliary category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-83 ROC Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
hi_rc	1	BOOL	O	R	ON if rate > setpoint, else OFF
lo_rc	2	BOOL	O	R	ON if rate < setpoint, else OFF
rate	3	REAL	O	R	Rate of Change in EU/min
IN	4	REAL	I	R	Analog Input

Static Configuration Parameters:

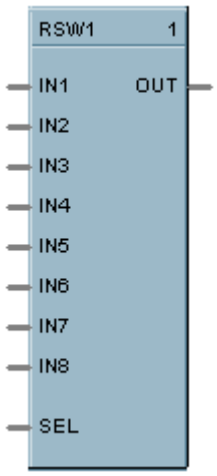
Table 8-84 ROC Static Configuration Parameters

Parameter	Index	Type	Description
filt_time	0	REAL	filter time constant
range_hi	1	REAL	high rate of change setpoint Range = 0 (off) to 99999.9 eu/min
range_lo	2	REAL	low rate of change setpoint Range = 0 (off) to 99999.9 eu/min
direction_hi	3	REAL	0 = both, 1 = increment only, 2 = decrement only
direction_lo	4	REAL	0 = both, 1 = increment only, 2 = decrement only
hysteresis	5	REAL	Range (0 – 999)

8.63 RSW Function Block

Description

The **RSW** label stands for **Rotary Switch**. This block is part of the *Signal Selectors* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-85 RSW Dynamic Parameters

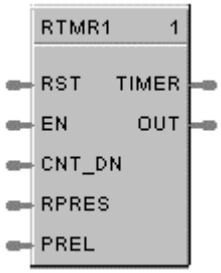
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
IN1	2	REAL	I	R	input 1
IN2	3	REAL	I	R	input 2
IN3	4	REAL	I	R	input 3
IN4	5	REAL	I	R	input 4
IN5	6	REAL	I	R	input 5
IN6	7	REAL	I	R	input 6
IN7	8	REAL	I	R	input 7
IN8	9	REAL	I	R	input 8
SEL	10	REAL	I	R	select input to output

Static Configuration Parameters: None

8.64 RTMR Function Block

Description

The **RTMR** label stands for **Resettable Timer**. This block is part of the *Counters/Timers* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-86 RTMR Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
TIMER	2	REAL	O	R	remaining time in seconds
RPRES	3	REAL	I	R/W	Remote preset (0.0 – 99999.9) if 'count-up' then represents Stop value in seconds if 'count-down' then represents Start value in seconds
RST	4	BOOL	I	R	OFF to ON transition, Reset
EN	5	BOOL	I	R	ENABLE ON = run; timer is counting, OFF = timer is stopped; output (TIMER) held at last value
PREL	6	REAL	I	R	Preload: if 'count-up' then represents Start value in seconds if 'count-down' then represents Stop value in seconds (Range = 0.0 – 99999.9)
CNT_DN	7	BOOL	I	R	ON = count-down, OFF = count-up

Static Configuration Parameters:

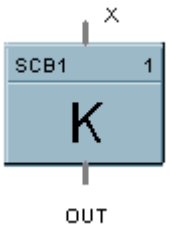
Table 8-87 RTMR Static Configuration Parameters

Parameter	Index	Type	Description
lpres	0	REAL	Local preset (0.0 – 99999.9) if count-up then Stop value in seconds if count-down then Start value in seconds
remote	1	BOOL	ON = use Remote Preset, OFF = use Local Preset
use_preload	2	BOOL	Use external preload rather than zero for starting or stopping.

8.65 SCB Function Block

Description

The **SCB** label stands for **Scale and Bias**. This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-88 SCB Dynamic Parameters

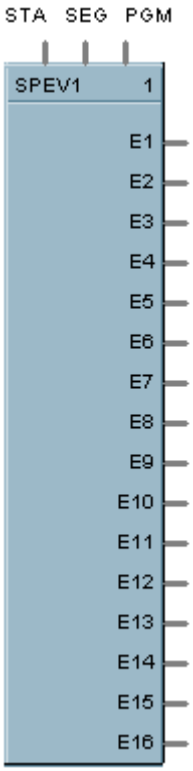
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
X	2	REAL	I	R	input

Static Configuration Parameters: None

8.66 SPEV Function Block

Description

The **SPEV** label stands for **Setpoint Programming Events**. This block is part of the *Setpoint Program* and *Setpoint Scheduler* categories. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-89 SPEV Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
E1	1	BOOL	O	R	event 1
E2	2	BOOL	O	R	event 2
E3	3	BOOL	O	R	event 3
E4	4	BOOL	O	R	event 4
E5	5	BOOL	O	R	event 5
E6	6	BOOL	O	R	event 6
E7	7	BOOL	O	R	event 7
E8	8	BOOL	O	R	event 8
E9	9	BOOL	O	R	event 9
E10	10	BOOL	O	R	event 10

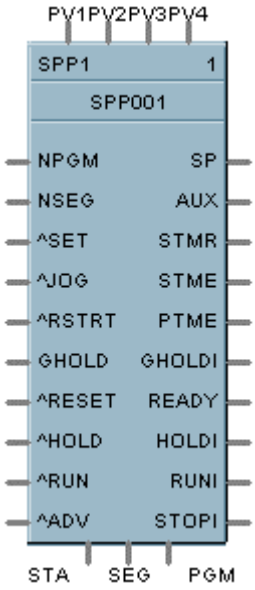
Parameter	Index	Type	Use	R/W	Description
E11	11	BOOL	O	R	event 11
E12	12	BOOL	O	R	event 12
E13	13	BOOL	O	R	event 13
E14	14	BOOL	O	R	event 14
E15	15	BOOL	O	R	event 15
E16	16	BOOL	O	R	event 16
STA	17	REAL	I	R	program state
SEG	18	REAL	I	R	current segment number
PGM	19	REAL	I	R	current program number

Static Configuration Parameters: None

8.67 SPP Function Block

Description

The **SPP** label stands for **Setpoint Programmer**. This block is part of the *Setpoint Program* category. It looks like this graphically on the Control Builder.



Dynamic Contained Parameters:

Table 8-90 SPP Dynamic Contained Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
save_req	1	REAL	C	R/W	save current program request mailbox
sta_req	2	REAL	C	R/W	state change request
pgm_req	3	REAL	C	R/W	program change request
seg_req	4	REAL	C	R/W	segment change request
seg_ramp	5	BOOL	C	R	TRUE if current segment is a ramp
soaksp	6	REAL	C	R	soak setpoint (eu)
duration	7	REAL	C	R	segment duration (minutes)
PV	8	REAL	C	R	value of PV being controlled by SP program
adv_req	9	BOOL	C	R/W	segment advance request (leading edge)
lTimeStamp	16	LONG	C	R	Time of last modification
fGuarSoako	17	REAL	C	R/W	guaranteed soak low limit
fGuarSoakHi	18	REAL	C	R/W	guaranteed soak high limit

Parameter	Index	Type	Use	R/W	Description
fRestartRamp	19	REAL	C	R/W	ramp rate to use when power down restart is in effect
fJogSeg	20	REAL	C	R/W	segment jumped to on a pulse to JOG input
fLoopStart	21	REAL	C	R/W	first segment in a loop – 0->no loop
fLoopEnd	22	REAL	C	R/W	last segment in a loop – 0->no loop
fDispHiLim	28	REAL	C	R/W	output high limit for display purposes only
fDispLoLim	29	REAL	C	R/W	output low limit for display purposes only
bRampTime	31	BOOL	C	R/W	TRUE = ramp time, FALSE = ramp rate

Dynamic Output Parameters:

Table 8-91 SPP Dynamic Output Parameters

Parameter	Index	Type	Use	R/W	Description
STA	34	REAL	O	R	program state {N/A, RESET, RUN, HOLD, GHOLD, STOP}
SEG	35	REAL	O	R	current segment number
PGM	36	REAL	O	R	current program number
SP	37	REAL	O	R	setpoint output (EU)
AUX	38	REAL	O	R	auxiliary output (EU)
STMR	39	REAL	O	R	time remaining in current segment (minutes)
STME	40	REAL	O	R	time elapsed in current segment (minutes)
PTME	41	REAL	O	R	time elapsed in program (minutes).
GHOLDI	42	BOOL	O	R	set when program is in the GHOLD state
READY	43	BOOL	O	R	set when program is in RESET state
RUNI	44	BOOL	O	R	set when program is in RUN state
HOLDI	45	BOOL	O	R	set when program is in HOLD state
STOPI	46	BOOL	O	R	set when program is in STOP state

Dynamic Input Parameters:

Table 8-92 SPP Dynamic Input Parameters

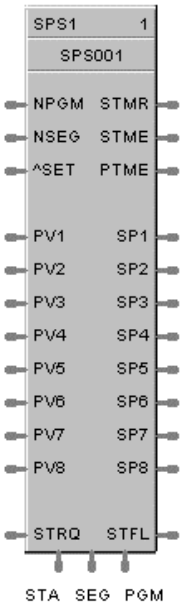
Parameter	Index	Type	Use	R/W	Description
PV1	47	REAL	I	R	process variable (EU), for deviation check
PV2	48	REAL	I	R	2nd process variable (EU), for deviation check
PV3	49	REAL	I	R	3rd process variable (EU), for deviation check
Aux PV	50	REAL	I	R	Auxiliary process variable (EU)
NPGM	51	REAL	I	R	program number (when SET is ON)
NSEG	52	REAL	I	R	starting segment number (when SET is ON)
SET	53	BOOL	I	R	pulse input to load PGM and SSEG numbers
JOG	54	BOOL	I	R	pulse input for jog
RSTRT	55	BOOL	I	R	pulse input for restart action
GHOLD	56	BOOL	I	R	guaranteed soak hold, for sync
RESET	57	BOOL	I	R	pulse input for reset
HOLD	58	BOOL	I	R	pulse input for hold
RUN	59	BOOL	I	R	pulse input for run
ADV	60	BOOL	I	R	pulse input for advance

Static Configuration Parameters: None

8.68 SPS Function Block

Description

The **SPS** label stands for **Master Setpoint Scheduler**. This block is part of the *Setpoint Scheduler* category. It looks like this graphically on the Control Builder.



Dynamic Contained Parameters:

Table 8-93 SPS Dynamic Contained Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
save_req	1	REAL	C	R/W	save current program request mailbox
sta_req	2	REAL	C	R/W	state change request
pgm_req	3	REAL	C	R/W	program change request
seg_req	4	REAL	C	R/W	segment change request
soaksp [8]	5-12	REAL	C	R	soak setpoint (eu)
duration	13	REAL	C	R	segment duration (minutes/hours)
PV [8]	14-21	REAL	C	R	value of PV being controlled by SP program
adv_req	22	BOOL	C	R/W	segment advance request (leading edge)
fGuarLimit[8]	30-37	REAL	C	R/W	guaranteed soak low/high limit
fJogSeg	38	REAL	C	R/W	segment jumped to on a pulse to JOG input

Dynamic Output Parameters:

Table 8-94 SPS Dynamic Output Parameters

Parameter	Index	Type	Use	R/W	Description
STA	40	REAL	O	R	program state {N/A, RESET, RUN, HOLD, GHOLD, STOP}
SEG	41	REAL	O	R	current segment number
PGM	42	REAL	O	R	current program number
SP1	43	REAL	O	R	Setpoint #1 output (EU)
SP2	44	REAL	O	R	Setpoint #2 output (EU)
SP3	45	REAL	O	R	Setpoint #3 output (EU)
SP4	46	REAL	O	R	Setpoint #4 output (EU)
SP5	47	REAL	O	R	Setpoint #5 output (EU)
SP6	48	REAL	O	R	Setpoint #6 output (EU)
SP7	49	REAL	O	R	Setpoint #7 output (EU)
SP8	50	REAL	O	R	Setpoint #8 output (EU)
STMR	51	REAL	O	R	time remaining in current segment (minutes)
STME	52	REAL	O	R	time elapsed in current segment (minutes)
PTME	53	REAL	O	R	time elapsed in program (minutes).
STFL	54	REAL	O	R	current state flag

Dynamic Input Parameters:

Table 8-95 SPS Dynamic Input Parameters

Parameter	Index	Type	Use	R/W	Description
PV1	55	REAL	I	R	1st process variable (EU)
PV2	56	REAL	I	R	2nd process variable (EU)
PV3	57	REAL	I	R	3rd process variable (EU)
PV4	58	REAL	I	R	4th process variable (EU)
PV5	59	REAL	I	R	5th process variable (EU)
PV6	60	REAL	I	R	6th process variable (EU)
PV7	61	REAL	I	R	7th process variable (EU)
PV8	62	REAL	I	R	8th process variable (EU)
STRQ	63	REAL	I	R	Encoded state request from STSW block
NPGM	64	REAL	I	R	Program number (when SET is ON)
NSEG	65	REAL	I	R	Starting segment number (when SET is ON)
SET	66	BOOL	I	R	Pulse input to load PGM and SSEG numbers

Static Configuration Parameters:

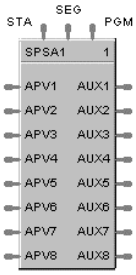
Table 8-96 SPS Static Configuration Parameters

Index	Parameter	Type	Description
0 - 7	failsafe[8]	REAL	failsafe setpoint, value (eu)

8.69 SPSA Function Block

Description

The **SPSA** label stands for **Setpoint Scheduler Auxiliary Setpoint Block**. This block is part of the *Setpoint Scheduler*category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-97 SPSA Dynamic Parameters

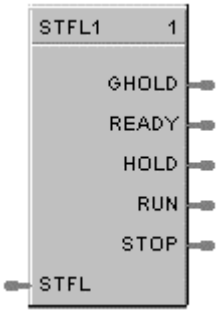
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
AUX1	1	REAL	O	R	Auxiliary output #1
AUX2	2	REAL	O	R	Auxiliary output #2
AUX3	3	REAL	O	R	Auxiliary output #3
AUX4	4	REAL	O	R	Auxiliary output #4
AUX5	5	REAL	O	R	Auxiliary output #5
AUX6	6	REAL	O	R	Auxiliary output #6
AUX7	7	REAL	O	R	Auxiliary output #7
AUX8	8	REAL	O	R	Auxiliary output #8
STA	9	REAL	I	R	Program state (for configuration - cosmetic only)
SEG	10	REAL	I	R	Current segment number
PGM	11	REAL	I	R	Current program number
APV1	12	REAL	I	R	1st Aux. process variable (EU)
APV2	13	REAL	I	R	2nd Aux. process variable (EU)
APV3	14	REAL	I	R	3rd Aux. process variable (EU)
APV4	15	REAL	I	R	4th Aux. process variable (EU)
APV5	16	REAL	I	R	5th Aux. process variable (EU)
APV6	17	REAL	I	R	6th Aux. process variable (EU)
APV7	18	REAL	I	R	7th Aux. process variable (EU)
APV8	19	REAL	I	R	8th Aux. process variable (EU)

Static Configuration Parameters: None

8.70 STFL Function Block

Description

The **STFL** label stands for the **Setpoint Scheduler State Flags.** This block is part of the *Setpoint Scheduler* category. It looks like this graphically on the Control Builder.



Dynamic Values:

Table 8-98 STFL Dynamic Values

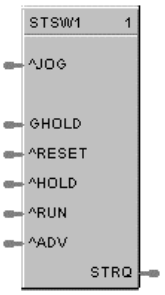
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
GHOLD	1	BOOL	O	R	ON if state = 1.0, else OFF
READY	2	BOOL	O	R	ON if state = 2.0, else OFF
HOLD	3	BOOL	O	R	ON if state = 4.0, else OFF
RUN	4	BOOL	O	R	ON if state = 8.0, else OFF
STOP	5	BOOL	O	R	ON if state = 16.0, else OFF
STFL	6	REAL	I	R	Encoded state input

Static Configuration Values: None

8.71 STSW Function Block

Description

The **STSW** label stands for the **Setpoint Scheduler State Switch.** This block is part of the *Setpoint Scheduler* category. It looks like this graphically on the Control Builder.



Dynamic Values:

Table 8-99 STSW Dynamic Values

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
STRQ	1	REAL	O	R	Encoded state request output
JOG	2	BOOL	I	R	OFF to ON requests jog state
GHOLD	3	BOOL	I	R	ON = guaranteed hold state ON to OFF and previous state was Run, then return to RUN mode
RESET	4	BOOL	I	R	OFF to ON requests reset state
HOLD	5	BOOL	I	R	OFF to ON requests hold state
RUN	6	BOOL	I	R	OFF to ON requests run state
ADV	7	BOOL	I	R	OFF to ON requests advance state

Static Configuration Values: None

8.72 SQRT Function Block

Description

The **SQRT** label stands for **Square Root**. This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.

Dynamic Parameters:

Table 8-100 SQRT Dynamic Parameters

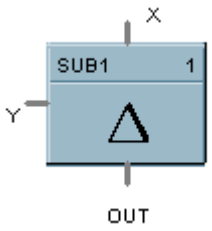
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	result
X	2	REAL	I	R	input

Static Configuration Parameters: None

8.73 SUB Function Block

Description

The **SUB** label stands for the **Subtraction mathematical operation (2 Inputs).** This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-101 SUB Dynamic Parameters

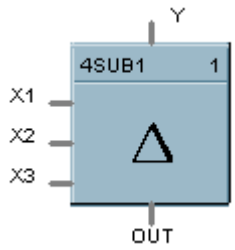
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
X	2	REAL	I	R	input 1
Y	3	REAL	I	R	input 2

Static Configuration Parameters: None

8.74 4SUB Function Block

Description

The **4SUB** label stands for the **Subtraction mathematical operation (4 Inputs).** This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-102 4SUB Dynamic Parameters

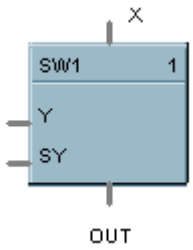
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
A	2	REAL	I	R	input 1
B	3	REAL	I	R	input 2
C	4	REAL	I	R	input 3
D	5	REAL	I	R	input 4

Static Configuration Parameters: None

8.75 SW Function Block

Description

The **SW** label stands for **Analog Switch**. This block is part of the *Signal Selectors* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-103 SW Dynamic Parameters

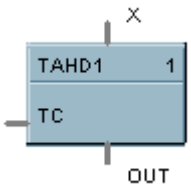
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
X	2	REAL	I	R	
Y	3	REAL	I	R	
SY	4	BOOL	I	R	select Y when ON

Static Configuration Parameters: None

8.76 TAHD Function Block

Description

The TAHD label stands for **Track and Hold.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-104 TAHD Dynamic Parameters

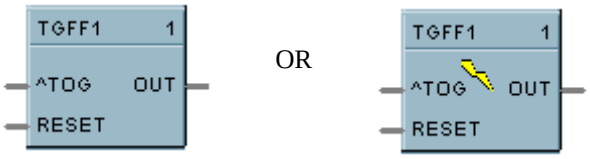
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
X	2	REAL	I	R	primary input
TC	3	BOOL	I	R	track command

Static Configuration Parameters: None

8.77 TGFF Function Block

Description

The **TGFF** label stands for **Toggle Flip-Flop.** This block is part of the *Logic or Fast Logic* category. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-105 TGFF Dynamic Parameters

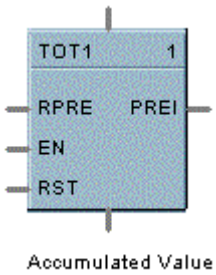
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
TOG	2	BOOL	I	R	toggle input
RESET	3	BOOL	I	R	reset input

Static Configuration Parameters: None

8.78 TOT Function Block

Description

The **TOT** label stands for **Totalizer.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-106 TOT Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
TOT	1	REAL	O	R	total (eu)
PREI	2	BOOL	O	R	preset indicator
IN	3	REAL	I	R	analog input value (eu)
RPRE	4	REAL	I	R	remote preset in eu (1 to 999999)
EN	5	BOOL	I	R	ON enables the totalizer
RST	6	BOOL	I	R	ON resets the totalizer

Static Configuration Parameters:

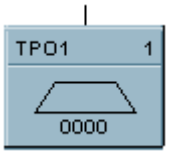
Table 8-107 TOT Static Configuration Parameters

Parameter	Index	Type	Description
lpre	1	REAL	local preset (1 to 999999)
rem	2	BOOL	ON selects remote preset
decr	3	BOOL	ON selects decreasing from preset

8.79 TPO Function Block

Description

The **TPO** label stands for **Time Proportional Output.** This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-108 TPO Dynamic Parameters

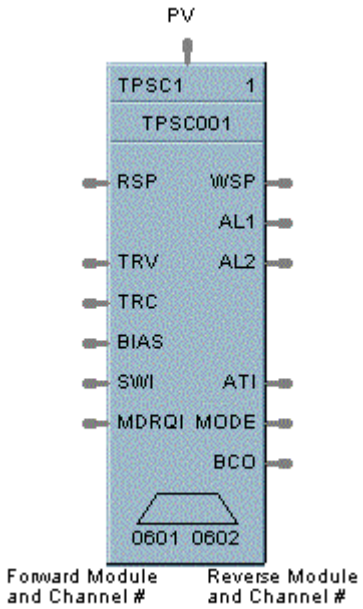
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
IN	1	REAL	I	R	analog input value (usually %)

Static Configuration Parameters: None

8.80 TPSC (3POS) Function Block

Description

The **TPSC (3POS)** label stands for **Three Position Step Control operation**. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-109 TPSC Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
lsp	1	REAL	C	R/W	local set point (eu)
lsp2	2	REAL	C	R/W	local set point 2 (eu)
rem_mode	3	BOOL	C	R/W	remote set point mode request {OFF, ON}
man_mode	4	BOOL	C	R/W	manual output mode request {OFF, ON}
man_out	5	REAL	C	R/W	manual output value 0 to 100 (%)
tune_req	6	BOOL	C	R/W	limit cycle auto-tuning request {OFF, ON}
rsp_eu	7	REAL	C	R	remote set point in eu for monitoring
deviation	8	REAL	C	R	Deviation in eu for monitoring
pv	9	REAL	C	R	Process Variable in eu for monitoring
fbpct	10	REAL	C	R	Percent feedback estimation for monitoring
DSP	11	REAL	O	R	Display Set Point in eu for monitoring
MODE	12	REAL	O	R	actual mode encoded

Parameter	Index	Type	Use	R/W	Description
All	13	BOOL	O	R	Alarm 1
AL2	14	BOOL	O	R	Alarm 2
BCO	15	REAL	O	R	Back Calculation Out (%)
ATI	16	BOOL	O	R	Auto Tune Indicator. ON = Auto Tune in progress
PVI	17	REAL	I	R	Process Variable Input (eu) (pv_lo <= PV <= pv_hi)
RSP	18	REAL	I	R	Remote Set Point (% or eu per sp_units)
TRV	19	REAL	I	R	Output Track Value (%)
TRC	20	BOOL	I	R	Output Track Command {OFF, ON}
BIAS	22	REAL	I	R	Remote bias value for ratio PID

Static Configuration Parameters:

Table 8-110 TPSC Static Configuration Parameters

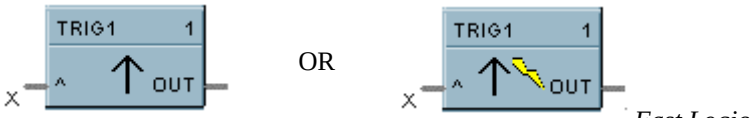
Parameter	Index	Type	Description
GAIN	0	REAL	proportional gain, 0.1 to 1000 or proportional band, 0.1% to 1000% [Tune Set 1]
RATE	1	REAL	derivative time, **0** or 0.1 to 10 (minutes) [Tune Set 1]
RESET	2	REAL	integration time, 0.02 to 50 (minutes) or repeats per minute, 0.02 to 50 (repeats) [Tune Set 1]
pv_hi	3	REAL	pv High Range value –99999 to 99999 (default **100**)
pv_lo	4	REAL	pv Low Range value –99999 to 99999 (default **0**)
sp_hi_lim	10	REAL	set point high limit, -99999 to 99999 (default **100**)
sp_lo_lim	11	REAL	set point low limit, -99999 to 99999 (default **0**)
failsafe_hi	13	BOOL	ON sets motor to 100% when in failsafe. OFF sets motor to 0% (default **OFF**)
al_sp[4]	14-17	REAL	alarm set points al1spl, al1sp2, al2spl, al2sp2, -99999 to 99999 (default **0**)
al_hyst	22	REAL	alarm hysteresis **0** to 5 (%)
ATOUTHILIM	25	REAL	auto-tuning output high limit, 0% to **100%**
ATOUTLOLIM	26	REAL	auto-tuning output low limit, **0%** to 100%
FUZZY	27	BOOL	ON enables fuzzy logic overshoot suppression (default **OFF**)
TUNESET2	28	BOOL	Use tune set 2 (default **OFF**)
GAIN2	29	REAL	proportional gain, 0.1 to 1000 or proportional band, 0.1% to 1000% [Tune Set 2]
RATE2	30	REAL	derivative time, **0** or 0.1 to 10 (minutes) [Tune Set 2]
RESET2	31	REAL	integration time, 0.02 to 50 (minutes) or repeats per minute, 50 to 0.02 (repeats) [Tune Set 2]

Parameter	Index	Type	Description
use_propband	32	BOOL	Use Gain (**0**) or Proportional Band (1)
use_rpm	33	BOOL	Use minutes (**0**) or repeats per minute (1) for integral constant
sp_rate_dn	34	REAL	Set point low rate of change limit, **0** (off) to 99999 (eu/min)
sp_rate_up	35	REAL	Set point high rate of change limit, **0** (off) to 99999 (eu/min)
RATIO	37	REAL	Gain value for Ratio PID (-20 to 20) (default **1**) [used when RA_BIAS > 0]
LBIAS	38	REAL	Bias value for Ratio PID when RA_BIAS = LOC_BIAS](-99999 to 99999) (**0**)
devbar_hi	39	REAL	High scale value for deviation bar graph (0 to 99999) (default **100**)
devbar_low	40	REAL	Low scale value for deviation bar graph [always = -devbar_hi]
deadband	43	REAL	adjustable gap between forward and reverse motor operation (.5 to 5%)

8.81 TRIG Function Block

Description

The **TRIG** label stands for **Trigger or "One Shot" operation**. This block is part of the *Logic* or *Fast Logic* category. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-111 TRIG Dynamic Parameters

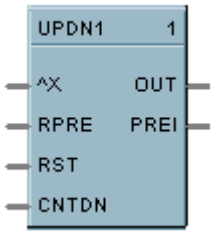
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
X	2	BOOL	I	R	input

Static Configuration Parameters: None

8.82 UPDN Function Block

Description

The **UPDN** label stands for **UP/DOWN Counter.** This block is part of the *Logic* category. It looks like this graphically on the Control Builder:



Dynamic Parameters:

Table 8-112 UPDN Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	W	output
PREI	2	BOOL	O	W	preset indicator
X	3	BOOL	I	R	positive edge detect count input
RPRE	4	REAL	I	R	remote preset (1 to 999999)
RST	5	BOOL	I	R	ON resets the count
CNTDN	6	BOOL	I	R	ON counts down

Static Configuration Parameters:

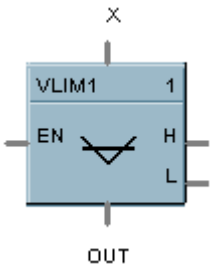
Table 8-113 UPDN Static Configuration Parameters

Parameter	Index	Type	Description
lpre	0	REAL	local preset (1 to 99999)
rem	1	BOOL	ON selects remote preset

8.83 VLIM Function Block

Description

The **VLIM** label stands for **Velocity (Rate) Limiter.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-114 VLIM Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	primary output
H	2	BOOL	O	R	high rate limit indication
L	3	BOOL	O	R	low rate limit indication
X	4	REAL	I	R	primary input
EN	5	BOOL	I	R	enable input

Static Configuration Parameters:

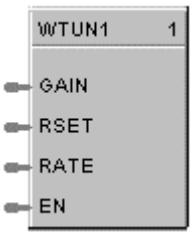
Table 8-115 VLIM Static Configuration Parameters

Parameter	Index	Type	Description
irate	0	REAL	increase rate limit (eu/min, >=0) {0 to 99999}
drate	1	REAL	decrease rate limit (eu/min, >=0) {0 to 99999}

8.84 WTUN Function Block

Description

The **WTUN** label stands for **Write Tuning Constants.** This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Dynamic Values

Table 8-116 WTUN Dynamic Parameters

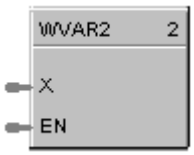
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
GAIN	1	REAL	I	R	proportional gain, 0.1 to 1000
RSET	2	REAL	I	R	integration time, 0.02 to 50 (minutes)
RATE	3	REAL	I	R	derivative time, 0.1 to 10 (minutes)
EN	4	BOOL	I	R	enable

Static Configuration Values: None

8.85 WVAR Function Block

Description

The **WVAR** label stands for **Write Variable.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-117 WVAR Dynamic Parameters

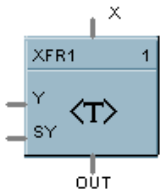
Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
X	1	REAL or BOOL	I	R	value to be written
EN	2	BOOL	I	R	enable change

Static Configuration Parameters: None

8.86 XFR Function Block

Description

The **XFR** label stands for **Bumpless Analog Transfer Switch**. This block is part of the *Signal Selectors* category. It looks like this graphically on the Control Builder.



Dynamic Parameters:

Table 8-118 XFR Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	REAL	O	R	output
X	2	REAL	I	R	
Y	3	REAL	I	R	
SY	4	BOOL	I	R	select Y when ON

Static Configuration Parameters:

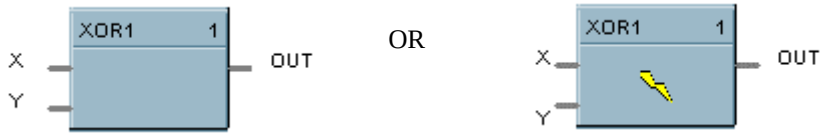
Table 8-119 XFR Static Configuration Parameters

Parameter	Index	Type	Description
xrate	0	REAL	transfer to X rate (eu/min, >=0) {0 to 99999}
yrate	1	REAL	transfer to Y rate (eu/min, >=0) {0 to 99999}

8.87 XOR Function Block

Description

The **XOR** label stands for the **Exclusive OR Boolean operation**. This block is part of the *Logic and Fast Logic* category. It looks like this graphically on the Control Builder.



Fast Logic

Dynamic Parameters:

Table 8-120 XOR Dynamic Parameters

Parameter	Index	Type	Use	R/W	Description
status	0	REAL	C	R	block status (see section 9.2 for code list)
OUT	1	BOOL	O	R	output
DIG_1	2	BOOL	I	R	input
DIG_2	3	BOOL	I	R	input

Static Configuration Parameters: None

8.88 Variables

Description

Assigned Block Number (250) provides a means of reading from and writing to various arrays of variables.

List Block Number 250 in your request message and the required index number. The index numbers (0 to 149) for the various variables can be obtained from the Control Builder variable list printout.

Digital Variables are represented as a floating point 0 for OFF, and a floating point 1 for ON.

ATTENTION

For Communications, subtract 1 from the variable index number on the Print out.

For Example: Variable 1 will be Variable 0 for communications purposes.

Dynamic Parameters:

Table 8-121 Variables

Parameter	Index	Type	Use	R/W	Description
Variable Parameter	0 - 149	REAL	C	R	Array of Variables (0 to 99999.9)

9. Block Status Types

9.1 Overview

Introduction

Table 9-1 lists the Function Block Status Values and definitions for communication reference when Index 0 is requested in a Dynamic (I/O) Table of a function block.

Common Function Block Status Types

These status types are common to all block types:

- UNEXECUTED
- OK
- BAD TYPE
- BAD ICNT (Input Count)
- BAD SSR

9.2 Block Status Values and Definitions

Table 9-1 lists the Status Values that could be returned when you request Index Number 0 in a dynamic table for a block in your request message. The Status Type and Definition for each is also listed.

Table 9-1 Block Status Values

Floating Point Value	Status Type	Definition
0.0	UNEXECUTED	The block was never executed.
100.0	OK	Normal successful execution.
200.0	FORCED	Output is being forced.
300.0	DIV BY 0	Attempted divide by 0.
400.0	BAD ICNT	The input count passed to the block is greater than the number of inputs for the block.
500.0	BAD TYPE	The block has an illegal control block type assigned to it.
600.0	BAD SSR	Invalid signal source record.
700.0	BAD PV	PV is out of range.
800.0	BAD PGM	Setpoint program is invalid or unused.
900.0	BAD SGM	Setpoint program segment number is invalid or out of range.
1000.0	BAD VPID	Illegal variable parameter index.
1100.0	BAD CVID	Illegal configuration value index.
1200.0	BAD BLKNUM	Illegal control block number.

Floating Point Value	Status Type	Definition
1300.0	NEG SQRT	Attempted square root of a negative number.
1400.0	BAD TUNVAL	Bad tuning constant value.
1500.0	COMM FAIL	cannot communicate with device
1600.0	DEV FAIL	Device reports self test failure
1700.0	BAD DEVID	Invalid device ID
1800.0	BAD BPADDR	Illegal backpan address. This could indicate that the backpan board is either not installed or the wrong board is installed at the address.
1900.0	BAD RECIPE	Illegal recipe number.
2000.0	BAD CHANID	Illegal channel number or module number
2100.0	BAD RANGE	PV HI <= PV LO in PID blocks.
2200.0	TOO MANY	Too many blocks of a restricted type
2300.0	BAD LOOPID	Illegal Loop number
2400.0	UNDERFLOW STACK	During the equation evaluation, an attempt was made to pop an item off the evaluation stack when the stack was empty.
2500.0	OVERFLOW STACK	During equation evaluation, an attempt was made to push an item on the stack when the stack was full.
2600.0	NOT EMPTY STACK	At the conclusion of the equation evaluation, the evaluation stack was not empty.
2700.0	LOG OF NEG NUM	Attempted log of a negative number.
2800.0	UNKNOWN TOKEN	An unknown token was encountered during the evaluation of the equation.
2900.0	POWER ERR	For the power operator (x^y), either x is zero and y is less than or equal to zero, or x is less than zero and y is not an integer.
3000.0	EXP ERR	x is large enough to make e^x overflow.
3100.0	LOG ERR	Attempted log of 0.
3200.0	LOG10 ERR	Attempted log10 of 0.
3300.0	BAD INTEGRAL	Integral for a PID block equals 0.

10. Diagnostics and Troubleshooting

10.1 Overview

This section provides diagnostic and troubleshooting information to help in evaluating controller communications operating status, and taking actions to correct faults. Symptoms are listed, as well as the possible cause and recommended user action for correcting fault conditions, if necessary.

Table 10-1 Modbus Communications Troubleshooting

Symptom	Possible Cause	Probable Solution
UMC800 slave is not responding to the master's request	UMC is not powered up	Apply power to the UMC800
	UMC800 is missing the communications card	Order and install a UMC800 communications card.
	UMC800 Comm card is not installed properly	Install the communications cable to COMM A on the UMC800
		Install the communications cable to the proper port on the master
	UMC800 Station Address is incorrect	Check the address to which the master is issuing the request and compare it to the UMC800's actual address. Change one to match the other if they are not equal.
	Baud rates do not match	Check the baud rate at the master and compare it to the UMC800's baud rate. Change one to match the other if they are not equal.
	Noise on the communications network: Check the COMM A status screen on either the O/I or from the PC software. Monitor the number of messages received and the errors accounted.	Ensure that the communication cable is properly terminated. Ensure that no other slave on the network is set with the same station address as the UMC800 that is exhibiting problems.
Comunications to the UMC800 slave is intermittent	Noise on the communications network: Check the COMM A status screen on either the O/I or from the PC software. Monitor the number of messages received and the errors accounted.	Ensure that the communication cable is properly terminated. Ensure that no other slave on the network is set with the same station address as the UMC800 that is exhibiting problems.

11. Appendix: CRC-16 Calculation

See following function:

```
extern void calculate_CRC(unsigned char *message, int length, unsigned char *CRC)
{
unsigned char CRCHi, CRCLo, TempHi, TempLo;

static const unsigned char table[512] = {
0x00, 0x00, 0xC0, 0xC1, 0xC1, 0x81, 0x01, 0x40, 0xC3, 0x01, 0x03, 0xC0, 0x02, 0x80, 0xC2, 0x41,
0xC6, 0x01, 0x06, 0xC0, 0x07, 0x80, 0xC7, 0x41, 0x05, 0x00, 0xC5, 0xC1, 0xC4, 0x81, 0x04, 0x40,
0xCC, 0x01, 0x0C, 0xC0, 0x0D, 0x80, 0xCD, 0x41, 0x0F, 0x00, 0xCF, 0xC1, 0xCE, 0x81, 0x0E, 0x40,
0x0A, 0x00, 0xCA, 0xC1, 0xCB, 0x81, 0x0B, 0x40, 0xC9, 0x01, 0x09, 0xC0, 0x08, 0x80, 0xC8, 0x41,
0xD8, 0x01, 0x18, 0xC0, 0x19, 0x80, 0xD9, 0x41, 0x1B, 0x00, 0xDB, 0xC1, 0xDA, 0x81, 0x1A, 0x40,
0x1E, 0x00, 0xDE, 0xC1, 0xDF, 0x81, 0x1F, 0x40, 0xDD, 0x01, 0x1D, 0xC0, 0x1C, 0x80, 0xDC, 0x41,
0x14, 0x00, 0xD4, 0xC1, 0xD5, 0x81, 0x15, 0x40, 0xD7, 0x01, 0x17, 0xC0, 0x16, 0x80, 0xD6, 0x41,
0xD2, 0x01, 0x12, 0xC0, 0x13, 0x80, 0xD3, 0x41, 0x11, 0x00, 0xD1, 0xC1, 0xD0, 0x81, 0x10, 0x40,
0xF0, 0x01, 0x30, 0xC0, 0x31, 0x80, 0xF1, 0x41, 0x33, 0x00, 0xF3, 0xC1, 0xF2, 0x81, 0x32, 0x40,
0x36, 0x00, 0xF6, 0xC1, 0xF7, 0x81, 0x37, 0x40, 0xF5, 0x01, 0x35, 0xC0, 0x34, 0x80, 0xF4, 0x41,
0x3C, 0x00, 0xFC, 0xC1, 0xFD, 0x81, 0x3D, 0x40, 0xFF, 0x01, 0x3F, 0xC0, 0x3E, 0x80, 0xFE, 0x41,
0xFA, 0x01, 0x3A, 0xC0, 0x3B, 0x80, 0xFB, 0x41, 0x39, 0x00, 0xF9, 0xC1, 0xF8, 0x81, 0x38, 0x40,
0x28, 0x00, 0xE8, 0xC1, 0xE9, 0x81, 0x29, 0x40, 0xEB, 0x01, 0x2B, 0xC0, 0x2A, 0x80, 0xEA, 0x41,
0xEE, 0x01, 0x2E, 0xC0, 0x2F, 0x80, 0xEF, 0x41, 0x2D, 0x00, 0xED, 0xC1, 0xEC, 0x81, 0x2C, 0x40,
0xE4, 0x01, 0x24, 0xC0, 0x25, 0x80, 0xE5, 0x41, 0x27, 0x00, 0xE7, 0xC1, 0xE6, 0x81, 0x26, 0x40,
0x22, 0x00, 0xE2, 0xC1, 0xE3, 0x81, 0x23, 0x40, 0xE1, 0x01, 0x21, 0xC0, 0x20, 0x80, 0xE0, 0x41,
0xA0, 0x01, 0x60, 0xC0, 0x61, 0x80, 0xA1, 0x41, 0x63, 0x00, 0xA3, 0xC1, 0xA2, 0x81, 0x62, 0x40,
0x66, 0x00, 0xA6, 0xC1, 0xA7, 0x81, 0x67, 0x40, 0xA5, 0x01, 0x65, 0xC0, 0x64, 0x80, 0xA4, 0x41,
0x6C, 0x00, 0xAC, 0xC1, 0xAD, 0x81, 0x6D, 0x40, 0xAF, 0x01, 0x6F, 0xC0, 0x6E, 0x80, 0xAE, 0x41,
0xAA, 0x01, 0x6A, 0xC0, 0x6B, 0x80, 0xAB, 0x41, 0x69, 0x00, 0xA9, 0xC1, 0xA8, 0x81, 0x68, 0x40,
0x78, 0x00, 0xB8, 0xC1, 0xB9, 0x81, 0x79, 0x40, 0xBB, 0x01, 0x7B, 0xC0, 0x7A, 0x80, 0xBA, 0x41,
0xBE, 0x01, 0x7E, 0xC0, 0x7F, 0x80, 0xBF, 0x41, 0x7D, 0x00, 0xBD, 0xC1, 0xBC, 0x81, 0x7C, 0x40,
0xB4, 0x01, 0x74, 0xC0, 0x75, 0x80, 0xB5, 0x41, 0x77, 0x00, 0xB7, 0xC1, 0xB6, 0x81, 0x76, 0x40,
0x72, 0x00, 0xB2, 0xC1, 0xB3, 0x81, 0x73, 0x40, 0xB1, 0x01, 0x71, 0xC0, 0x70, 0x80, 0xB0, 0x41,
0x50, 0x00, 0x90, 0xC1, 0x91, 0x81, 0x51, 0x40, 0x93, 0x01, 0x53, 0xC0, 0x52, 0x80, 0x92, 0x41,
0x96, 0x01, 0x56, 0xC0, 0x57, 0x80, 0x97, 0x41, 0x55, 0x00, 0x95, 0xC1, 0x94, 0x81, 0x54, 0x40,
0x9C, 0x01, 0x5C, 0xC0, 0x5D, 0x80, 0x9D, 0x41, 0x5F, 0x00, 0x9F, 0xC1, 0x9E, 0x81, 0x5E, 0x40,
0x5A, 0x00, 0x9A, 0xC1, 0x9B, 0x81, 0x5B, 0x40, 0x99, 0x01, 0x59, 0xC0, 0x58, 0x80, 0x98, 0x41,
0x88, 0x01, 0x48, 0xC0, 0x49, 0x80, 0x89, 0x41, 0x4B, 0x00, 0x8B, 0xC1, 0x8A, 0x81, 0x4A, 0x40,
0x4E, 0x00, 0x8E, 0xC1, 0x8F, 0x81, 0x4F, 0x40, 0x8D, 0x01, 0x4D, 0xC0, 0x4C, 0x80, 0x8C, 0x41,
0x44, 0x00, 0x84, 0xC1, 0x85, 0x81, 0x45, 0x40, 0x87, 0x01, 0x47, 0xC0, 0x46, 0x80, 0x86, 0x41,
0x82, 0x01, 0x42, 0xC0, 0x43, 0x80, 0x83, 0x41, 0x41, 0x00, 0x81, 0xC1, 0x80, 0x81, 0x40, 0x40,
  };
        CRCHi = 0xff;
        CRCLo = 0xff;

        while(length)
        {
                TempHi = CRCHi;
                TempLo = CRCLo;
                CRCHi = table[2 * (*message ^ TempLo)];
                CRCLo = TempHi ^ table[(2 * (*message ^ TempLo)) + 1];
                message++;
                length--;
        };
        CRC [0] = CRCLo;
        CRC [1] = CRCHi;
        return;
}
```

Index

F

G

H

I, J, K

L

M

N

O

P, Q

R

S

T

U

V

W

X, Y, Z

HSM8

HONEYWELL SERVICE CENTERS

ARGENTINA

HONEYWELL S.A.I.C.
BELGRANO 1156
BUENOS AIRES
ARGENTINA
Tel. : 54 1 383 9290

ASIA PACIFIC

HONEYWELL ASIA PACIFIC Inc.
Room 3213-3225
Sun Kung Kai Centre
N° 30 Harbour Road
WANCHAI
HONG KONG
Tel. : 852 829 82 98

AUSTRALIA

HONEYWELL LIMITED
5 Thomas Holt Drive
North Ryde Sydney
NSW AUSTRALIA 2113
Tel. : 61 2 353 7000

AUSTRIA

HONEYWELL AUSTRIA G.m.b.H.
Handelskai 388
A1020 VIENNA
AUSTRIA
Tel. : 43 1 727 800

BELGIUM

HONEYWELL S.A.
3 Avenue de Bourget
B-1140 BRUSSELS
BELGIUM
Tel. : 32 2 728 27 11

BRAZIL

HONEYWELL DO BRAZIL AND CIA
Rua Jose Alves Da Chunha
Lima 172
BUTANTA
05360.050 SAO PAULO SP
BRAZIL
Tel. : 55 11 819 3755

BULGARIA

HONEYWELL EOOD
14, Iskarsko Chausse
POB 79
BG- 1592 Sofia
BULGARIA
Tel : 359-791512/ 794027/ 792198

CANADA

HONEYWELL LIMITED
THE HONEYWELL CENTRE
529 Mc Nicoll Avenue
M2H 2C9 NORTH YORK,
ONTARIO
CANADA
Tel. : 416 502 5200

CZECH REPUBLIC

HONEYWELL, Spol.s.r.o.
Budejovicka 1
140 21 Prague 4
Czech Republic
Tel. : 42 2 6112 3434

DENMARK

HONEYWELL A/S
Automatikvej 1
DK 2860 Soeborg
DENMARK
Tel. : 45 39 55 56 58

FINLAND

HONEYWELL OY
Ruukintie 8
FIN-02320 ESPOO 32
FINLAND
Tel. : 358 0 3480101

FRANCE

HONEYWELL S.A.
Bâtiment « le Mercury »
Parc Technologique de St Aubin
Route de l'Orme (CD 128)
91190 SAINT-AUBIN
FRANCE
Tel. from France: 01 60 19 80 00
From other countries: 33 1 60 19 80 00

GERMANY

HONEYWELL AG
Kaiserleistrasse 39
D-63067 OFFENBACH
GERMANY
Tel. : 49 69 80 640

HUNGARY

HONEYWELL Kft
Gogol u 13
H-1133 BUDAPEST
HUNGARY
Tel. : 36 1 451 43 00

ICELAND

HONEYWELL
Hataekni .hf
Armuli 26
PO Box 8336
128 reykjavik
Iceland
Tel : 354 588 5000

ITALY

HONEYWELL S.p.A.
Via P. Gobetti, 2/b
20063 Cernusco Sul Naviglio
ITALY
Tel. : 39 02 92146 1

MEXICO

HONEYWELL S.A. DE CV
AV. CONSTITUYENTES 900
COL. LOMAS ALTAS
11950 MEXICO CITY
MEXICO
Tel : 52 5 259 1966

THE NETHERLANDS

HONEYWELL BV
Laaderhoogtweg 18
1101 EA AMSTERDAM ZO
THE NETHERLANDS
Tel : 31 20 56 56 911

HSM8

HONEYWELL SERVICE CENTERS

NORWAY

HONEYWELL A/S
Askerveien 61
PO Box 263
N-1371 ASKER
NORWAY
Tel. : 47 66 76 20 00

POLAND

HONEYWELL Sp.z.o.o
UI Domainewksa 41
02-672 WARSAW
POLAND
Tel. : 48 22 606 09 00

PORTUGAL

HONEYWELL PORTUGAL LDA
Edificio Suecia II
Av. do Forte nr 3 - Piso 3
2795 CARNAXIDE
PORTUGAL
Tel. : 351 1 424 50 00

REPUBLIC OF IRELAND

HONEYWELL
Unit 1
Robinhood Business Park
Robinhood Road
DUBLIN 22
Republic of Ireland
Tel. : 353 1 4565944

REP. OF SINGAPORE

HONEYWELL PTE LTD
BLOCK 750E CHAI CHEE ROAD
06-01 CHAI CHEE IND. PARK
1646 SINGAPORE
REP. OF SINGAPORE
Tel. : 65 2490 100

REPUBLIC OF SOUTH AFRICA

HONEYWELL
Southern Africa
PO BOX 138
Milnerton 7435
REPUBLIC OF SOUTH AFRICA
Tel. : 27 11 805 12 01

ROMANIA

HONEYWELL Office
Bucharest
147 Aurel Vlaicu Str., Sc.Z.,
Apt 61/62
R-72921 Bucharest
ROMANIA
Tel : 40-1 211 00 76/ 211 79 43

RUSSIA

HONEYWELL INC
4th Floor Administrative
Buiilding of AO "Luzhniki"
Management
24 Luzhniki
119048 Moscow
RUSSIA
Tel : 7 095 796 98 00/01

SLOVAKIA

HONEYWELL Ltd
Mlynske nivy 73
PO Box 75
820 07 BRATISLAVA 27
SLOVAKIA
Tel. : 421 7 52 47 400/425

SPAIN

HONEYWELL S.A
Factory
Josefa Valcarcel, 24
28027 MADRID
SPAIN
Tel. : 34 91 31 3 61 00

SWEDEN

HONEYWELL A.B.
S-127 86 Skarholmen
STOCKHOLM
SWEDEN

Tel. : 46 8 775 55 00

SWITZERLAND

HONEYWELL A.G.
Hertistrasse 2
8304 WALLISELLEN
SWITZERLAND
Tel. : 41 1 831 02 71

TURKEY

HONEYWELL Otomasyon ve
Kontrol
Sistemlen San ve Tic A.S.
(Honeywell Turkey A.S.)
Emirhan Cad No 144
Barbaros Plaza C. Blok Kat 18
Dikilitas 80700 Istanbul
TURKEY
Tel : 90-212 258 18 30

UNITED KINGDOM

HONEYWELL
Unit 1,2 &4 Zodiac House
Calleva Park
Aldermaston
Berkshire RG7 8HW
UNITED KINGDOM
Tel : 44 11 89 81 95 11

U.S.A.

HONEYWELL INC.
INDUSTRIAL CONTROLS DIV.
1100 VIRGINIA DRIVE
PA 19034-3260 FT. WASHINGTON
U.S.A.
Tel. : 215 641 3000

VENEZUELA

HONEYWELL CA
APARTADO 61314
1060 CARACAS
VENEZUELA
Tel. : 58 2 239 0211

Honeywell

Sensing and Control
Honeywell
11 West Spring Street
Freeport, IL 61032

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