

**HC900 Process Controller
Communications
User Guide**

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

About This Document

Abstract

This document provides information specific to the communications interface for Honeywell's HC900 Controller. The protocol supported for connection to the controller's Ethernet network port is Modbus/TCP (Modbus RTU protocol in a TCP/IP wrapper). . The document includes a summary of all HC900 data available (primarily floating point) for Modbus RTU access read and write including methods for access.

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1. Introduction

1.1 Overview

Communication interfaces

The HC900 controller provides Modbus communication support on three communication interfaces.

- Network port: Modbus TCP on an Ethernet connection
- Serial Port S1 RS232/RS485 selectable port. (Default RS232.): Modbus RTU
- Serial Port S2 RS232/RS485 selectable port. (Default RS485.): Modbus RTU

View or print addresses

You can print out the Modbus addresses of various parameters of the configuration (signal tags, PID loops, SP programmer, etc.) using the HC Designer report functions. With HC Designer Ver. 2.1 and later, these reports may also be exported to .csv files for view/manipulation in a spreadsheet and possible import to other HMI applications.

Fixed map or custom map

The type of addressing available: fixed or custom.

Fixed map	Custom map
Contains limited types of parameters in limited quantities (e.g., 32 loops max)	More parameters to choose from. Quantities are limited only by available addresses. (e.g., can have >32 loops.) Certain blocks can be assigned to the custom map that are not available in the fixed map. (See section 6.18.)
Objects of each type (e.g. loops 1-24, SP Programmers 1-4, etc.) are grouped and limited to certain address ranges.	Objects (e.g. loop) can be assigned any address or to multiple addresses and are not limited to certain ranges.
All parameters of a single object are addressed. For example, a PID loop has over 40 parameters and they all are mapped.	You can select which parameters of an object are mapped. For example, you can assign only 3 of a loop's 40+ parameters to the map (such as PV, SP, output), thereby increasing efficiency.
Editing is limited to -moving an object to another address within its allowed range. -assigning up to 1000 signals and variables to addresses reserved for that purpose.	Edits are virtually unlimited. Uses fixed map settings but can be edited or rebuilt as needed without the fixed map's limitations. Custom partitions can be created for organizing data however you prefer.
Available in all HC900 configuration versions	Available in HC900 configuration version 4.0 and higher

1.2 Modbus/TCP Interface

Introduction

HC900 controllers support the Modbus/TCP (also called Modbus TCP/IP or Modbus Ethernet) protocol for communications with third party HMI and SCADA software via a direct Ethernet TCP/IP connection.

The controller's Ethernet 10/100Base-T Host port is used for the Modbus/TCP connection. Ethernet TCP allows multiple concurrent connections to hosts for data interchange. The HC900 (C30/C50) supports 5 concurrent host connections using Modbus/TCP protocol messaging via this port; HC900 (C70/C70R) supports 10.

Interface Preparation

ATTENTION

To access the controller you must have a current Process Control Designer configuration file available. Some data is referenced relative to number, such as Signal Tags and Variables.

Other principal blocks, such as PID blocks, have offsets for parameter access dependent on the order in which the blocks were placed on the Function Block Diagram.

It is strongly recommended that you upload the controller configuration using the Process Control Designer configuration tool to assure that you have a current configuration.

The Process Control Designer tool provides a series of reports for use in Modbus Address identification. The "**Tag Information**" report lists the variables and Signal Tags in numeric order along with their Modbus Addresses.

A "**Block Modbus Address**" report lists the starting addresses for all principal blocks configured, identifying the offset.

Modbus/TCP Protocol

Modbus/TCP protocol, developed by Groupe Schneider's Modicon Division, is a popular, open standard for data interchange over Ethernet TCP/IP networks using a Modbus RTU command structure.

It is simply an encapsulation of Modicon's Modbus RTU protocol within a TCP/IP frame as shown below, which includes header information and the Modbus frame.

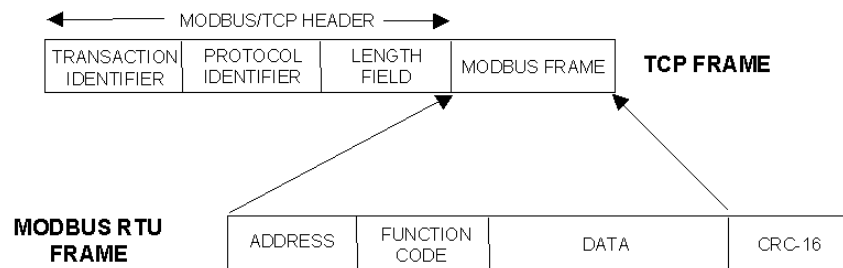


Figure 1-1 Modbus RTU Protocol within a TCP/IP Frame

The Open Modbus/TCP Specification is followed with respect to the physical, data link, and network layers. The message structure within the Modbus frame uses standard Modbus RTU function codes.

The Address part of the Modbus frame is not used (set to 00) since there is no sub-addressing intended or required. The controller IP address is the identifying address, set independently at the controller.

The error checking is supported by TCP/IP network protocols and not part of the Modbus frame.

The Transaction Identifiers and Protocol Identifiers in the header are normally all 0's (4 bytes total) while the Length field identifies the number of bytes in the Modbus frame. The controller will transmit the correct number of bytes for the remainder of the frame. However, the controller does not check this field for messages received.

The standard IEEE 32-bit floating point and 16-bit integer formats are used.

Parameter Addressing

The definition in Table 6-1 is the fixed map overview listing starting and ending addresses.

Greater detail for parameter addressing relating to a particular function class (e.g, loops, setpoint programmer, signal tags) is in referenced sub-sections. Function Codes 1, 2, 3, 4, 5, 6, 8, 16 (10h), and 17 (11h) are supported (see Table 4-1 Modbus/TCP and Modbus RTU Function Codes Definitions).

Examples for read or write access to parameters supported by the various function codes are provided in Sections 4.3 through 4.11.

Reference

The Open Modbus/TCP Specification can be obtained at the Modicon website:

<http://www.modicon.com/openmbus/standards/openmbus.htm>

HC900 Ethernet Communications Setup

See the HC900 Process Control (HC) Designer Users Guide, Doc. # 51-52-25-110 or respective HC Designer Help Files for setting up the following network parameters:

IP Address, Subnet Mask (optional), Default Gateway IP Address (optional)

1. Be sure the PC, HMI panel, or other Host device has a Network Interface Card (NIC) with an IP address (fixed or DHCP served) that allows access to controllers on the same or other subnet. Consult your IT department or network administrator for allocating IP addresses to the controllers as required.
2. You will need to set each controller's IP address prior to network connection since every HC900 controller is shipped with the default IP address of 192.168.1.254. Placing multiple controllers on the same network before they have been given unique IP addresses will cause problems.
3. On the PC, use the Utilities Worksheet in the HC Designer software to set up the serial RS-232 connection to the controller at the desired baud rate. This will require a null modem cable.
4. Select the Set Controller's Network Parameters button. Using the wizard (bottom radio button), select the PC COM port to be used, then set the controller's new network parameters including IP address, Subnet Mask (if other than default, 255.255.255.0), and Default Gateway IP address (if required, otherwise leave at default 0.0.0.0). See your IT network administrator for proper entries. (Refer to the on-line help provided with the HC Designer software, **Utilities Worksheet, Set Controller's Network Parameters**, for further details on this step).

Note: This setup will require the controller to be placed temporarily in the Program mode. After the new network parameters have been downloaded, the controller will conduct a Cold Start in its transition to RUN. This will cause an initialization if there is a current configuration in the controller.

The fixed IP address of each controller shall be set independently prior to placing on the network. See your IT systems administrator for allocating IP addresses, subnet masks, or default gateway IP address as necessary (network address filtering and routing may be necessary if the controller network access will not to be confined locally within the plant environment).

Ethernet 10/100Base-T Network Connections

Ethernet 10/100Base-T networks operating at 10/100MB/sec. are supported. A typical network arrangement is as shown below.

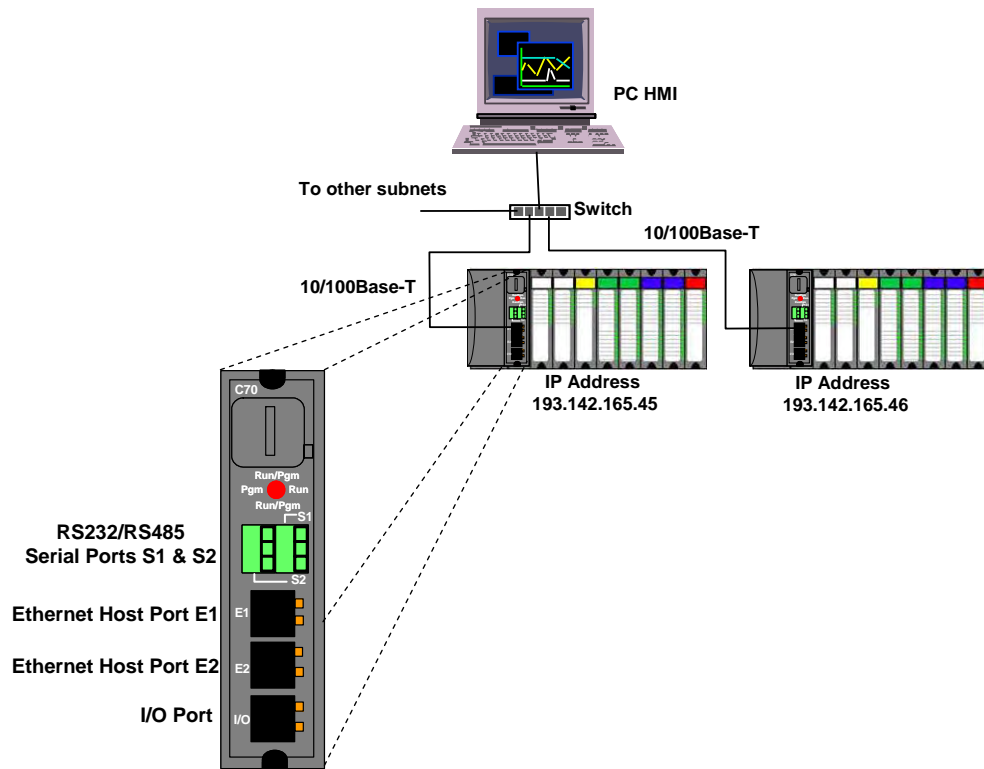


Figure 1-2 Ethernet 10/100Base-T Network Connections

Setting Up the Modbus/TCP Double Register Format

The HC900 predominantly uses an IEEE floating point format for communicating data to software applications providing Modbus/TCP protocol communications drivers. A floating point value is sent as (2) consecutive 16-bit registers, each register of which consists of two 8-bit bytes. Some software packages require the registers and bytes to be sent in a certain order. The controller can be configured to deliver the data in four different byte orders.

The Process Control Designer software tool allows this order to be selected as follows:

1. Using the Utilities Worksheet in the HC Designer software, access the Set Controller Network Parameters button and make the selection to change the Modbus TCP Double Register Format (middle radio button).
2. With the Port selected for downloading this order (using a COM port or Network port), select the appropriate byte order format if the default (FP B) is not appropriate for the application. See Table 3-1, page 10.
3. Select Next and verify (by the response in the dialog box) that the change has been made in the controller. This order can be changed in the RUN mode.

The Modbus TCP double register transmission format selection, FP LB “Little Endian Byte-Swapped”, would be selected for interface to most third party software packages which use this format as standard. The default, FP B “Big Endian” is used with SpecView32 or Honeywell’s PlantScape/Experion/EBI software and follows the “Honeywell” default format of other control and recording products. It should be noted that most PC software packages offer a register (word) swap selection in their driver package anyway, so there should never be an incompatibility.

1.3 Modbus RTU RS232/RS485 Communication Ports

This implementation is designed to provide a popular data exchange format connecting the HC900 to both Honeywell and foreign master devices via the RS232 and RS485 communication ports. The Modbus RTU allows the instrument to be a citizen on a data link shared with other devices, which subscribe to the Modicon Modbus Protocol Reference Guide PI-MBUS-300 Rev. G 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 is employed and standard IEEE 32-bit floating point and integer formats are used. Data register mapping is unique to the HC900 and other Honeywell instruments. Section 6 describes the parameter mapping for the HC900.

Modbus RTU Message Format

Table 1-1 Modbus RTU Message Formats

Coding system	8 bit binary
Number of data bits per character	10, 11, or 12 Bits start bits - 1 data bits - 8 parity bits – 0 or 1 selectable stop bits – 1 or 2 selectable
Parity	None, odd, even selectable
Bit transfer rate	1200, 2400, 4800, 9600, 19200, 38400, 57600 Selectable
Duplex	Half duplex Transceiver or TX/RX
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).

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 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 driver 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.

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.

2. IEEE 32-bit Floating Point Register Information

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

2.1 IEEE Floating Point Data Format

The formula for calculating the floating point number is:

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

(23 bit signed binary with 8 bit biased binary exponent)

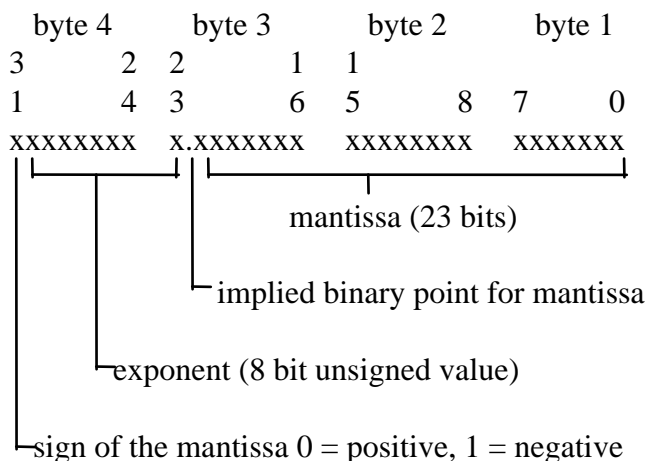


Figure 2-1 IEEE Floating Point Data format

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	xxxxxxx 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:

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

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. Modbus Double Register Format

Data that is 32 bits requires 2 sequential registers (4 bytes) to transfer its data. Data of this type includes IEEE 32-bit floating point, 32-bit signed integer and 32-bit unsigned integer. The stuffing order of the bytes into the two registers differs among Modbus/TCP hosts. To provide compatibility, the double register format for the HC900 controller is configurable.

To set the controller's double register byte order, go to the "Set Controller Network Parameters" wizard in the "Controller Utilities Function" section of the Utilities Tab on the Process Control Designer and configure "Modbus Double Register Format". This can be done in the RUN mode.

The selections are:

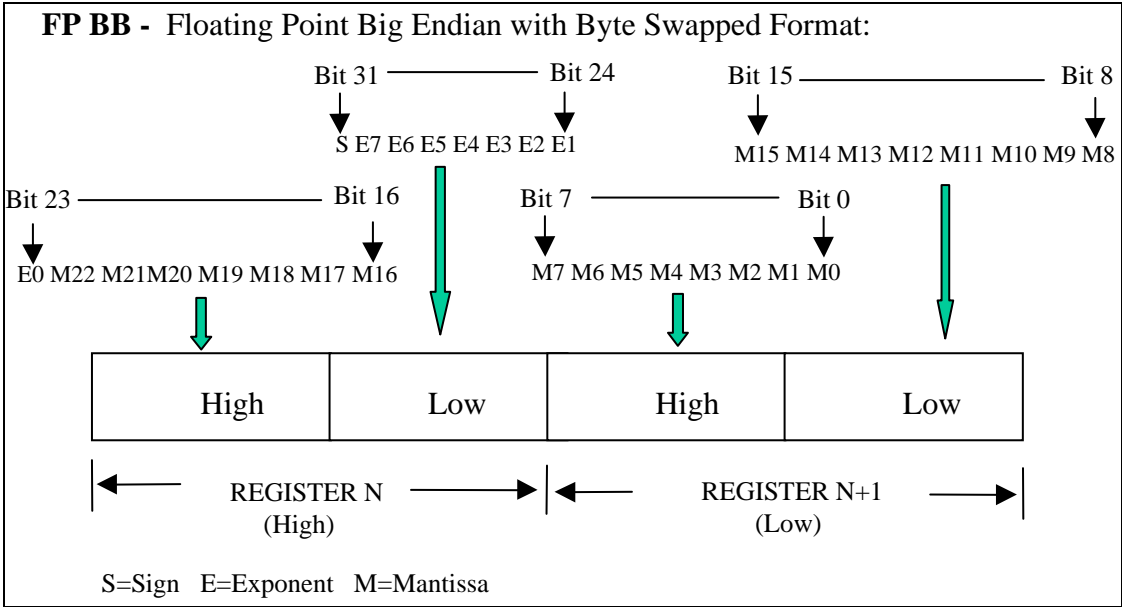
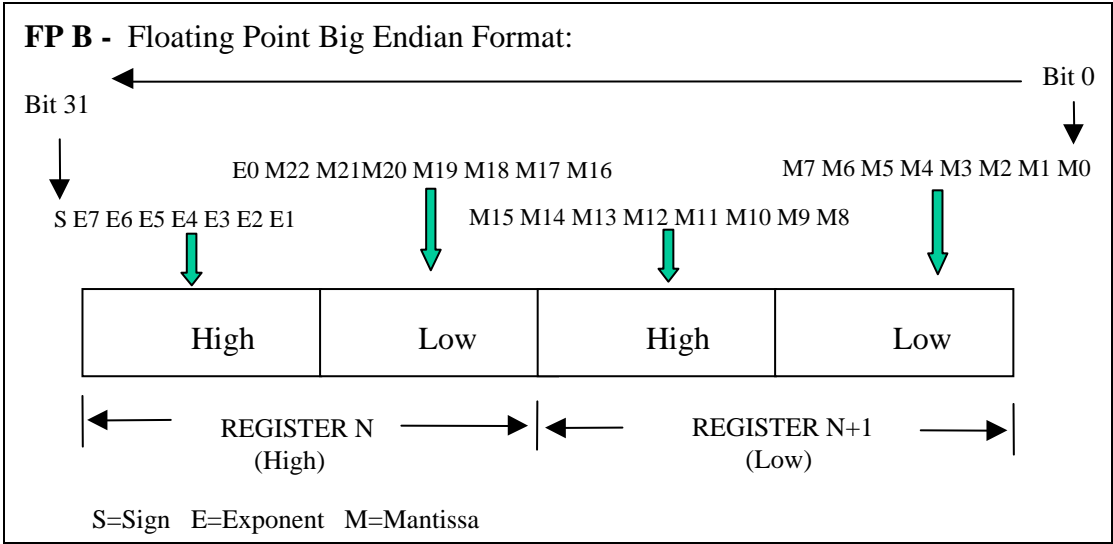
Table 3-1 Modbus Double Register Format Selections

Selection	Description	Byte order (See Figure 2-1)	Notes
FP B	Floating Point Big Endian Format	4, 3, 2, 1	HC900 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 on page IEEE Floating Point Formats on page 11 and 32-bit integer formats on page 13.

NOTE: Byte Swapping only applies to Function Codes 3, 4, and 16.

3.1 IEEE Floating Point Formats



continued next page

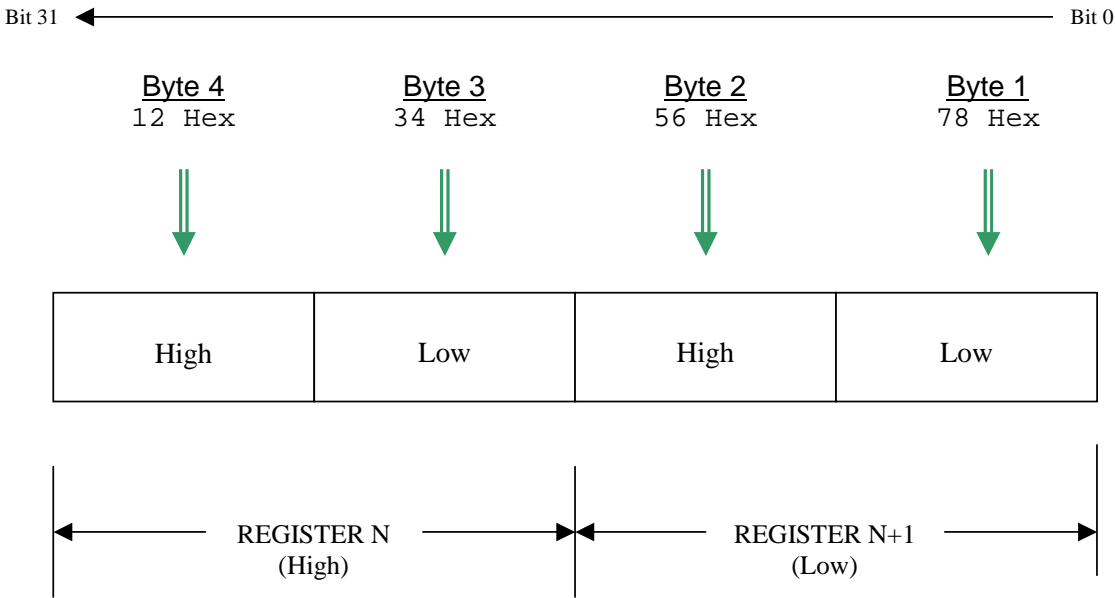
3.2 Unsigned/signed 32-bit Register Formats

The formats descriptions below use the value 12345678 Hex as an example. Where the binary representation is:

	Byte 4 = 12 Hex								Byte 3 = 34 Hex								Byte 2 = 56 Hex								Byte 1 = 78 Hex							
Bits	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0	0	1	0	1	0	1	1	0	0	1	1	1	1	0	0	0

FP B – Big Endian Format

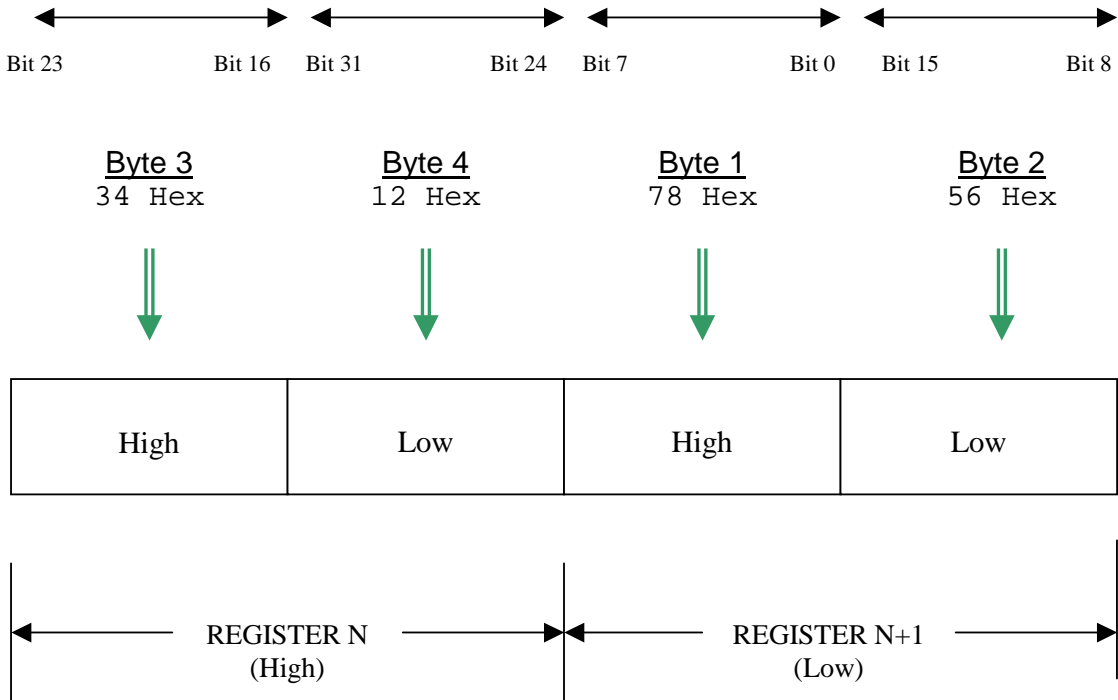
The value 12345678 Hex will be represented as follows:



Modbus Double Register Format
Unsigned/signed 32-bit Register Formats

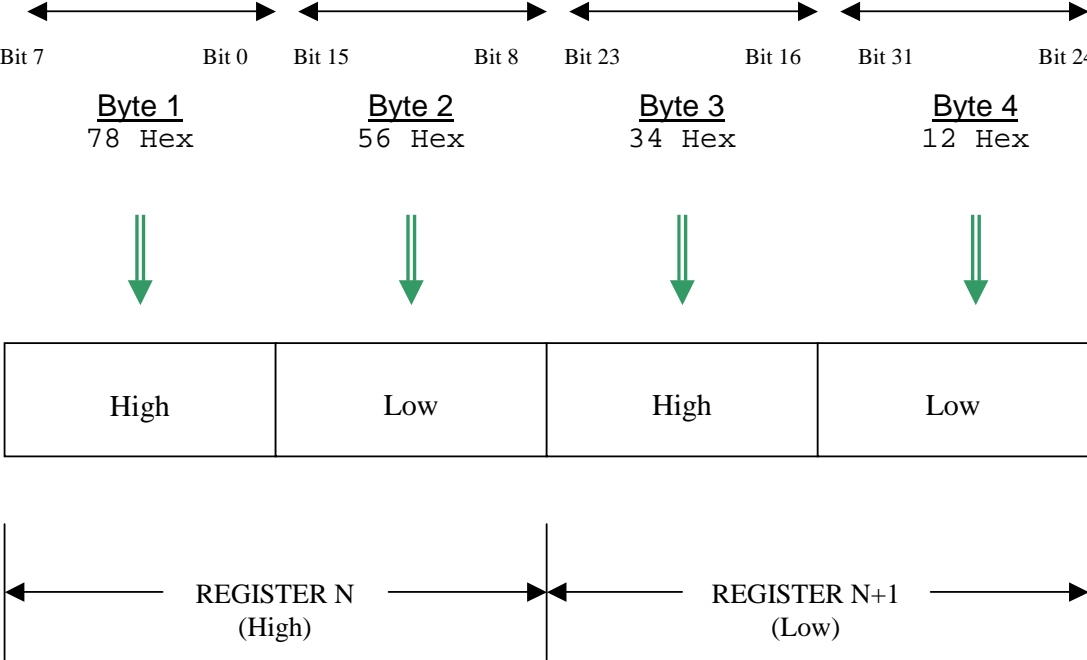
FP BB – Big Endian Byte Swapped Format

The value 12345678 Hex will be represented as follows:



FP L – Little Endian Format

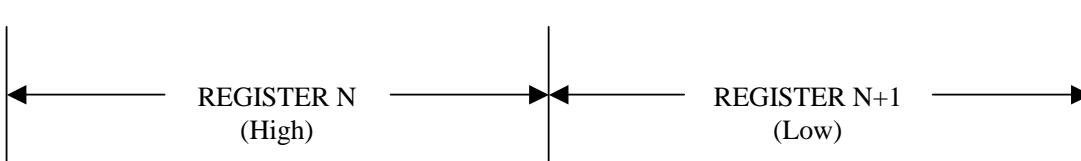
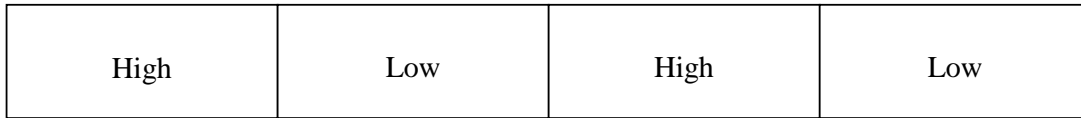
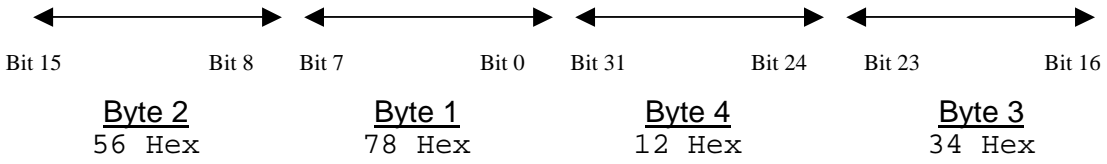
The value 12345678 Hex will be represented as follows:



Modbus Double Register Format
Unsigned/signed 32-bit Register Formats

FP LB – Little Endian Byte Swap Format

The value 12345678 Hex will be represented as follows:



4. Modbus/TCP & Modbus RTU Function Codes

4.1 Function code definitions

The HC900 Modbus protocol uses a subset of the standard Modbus function codes to provide access to process-related information. These standard function codes provide basic support for IEEE 32-bit floating point numbers, 32-bit unsigned/signed integer and 16-bit integer register representation of instrument's process data.

Repolling of data is not supported by this instrument.

Table 4-1 Modbus/TCP and 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	Read Holding 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.
04	Read Input Registers	Provides Read access to any Analog Input Channel positioned in any Rack or Slot.
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.

4.2 Fixed Modbus Map

Table 4-2 and Table 4-3 list the the maximum number of Object Addresses and maximum number of registers allowed per request. Also shown are differences between firmware versions 2.3 and 2.4.

Note 1: In versions 4.0 and higher these maximums apply to fixed map but not to the custom map.

Note 2: In versions 4.0 and higher function code 03 is not available for analog inputs.

Table 4-2 Maximum Number of Objects (fixed map only)

Object Name	Max. No. of Objects		Function Code
	C30	C50/C70/C70R	
Analog Inputs	96/12 slots v2.3 192/12 slots v2.4	640 v2.3 1280 v2.4	3: can only access first 8 slots of rack 1. Not available in version 4.0 or higher. 4: can access all slots and racks
Discrete Input	192/12 slots v2.3 384/12 slots v2.4	1280 v2.3 2560 v2.4	2
Discrete Output/Coil	192/12 slots v2.3 384/12 slots v2.4	1280 v2.3 2560 v2.4	1: read 5: force
Loop*	8	32	3
Variable Value	600	600	3
Set Point Programmer Value*	8	8	3
Segments per Set Point Programmer*	50	50	3
Signal tags	2000	2000 (C50) 5000 (C70/C70R)	3
Scheduler Value*	2	2	3
Segments per Schedule*	50	50	3
Sequencer*	4	4	3
Stage*	8	8	3
Ramp*	8	8	3
Hand-Off-Auto*	16	16	3
Alternator*	6	6	3
Device Control*	16	16	3
User Defined Registers	1024	1024	3

Table 4-3 Maximum Number of Registers Allowable per Request

Function Code	Max. No. of Registers
1, 2	2040 bits
3, 4	127 Registers 63 Floats
5	1 Coil
6	1 Register
10h	127 Registers 63 Floats

4.3 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 HC900 using 16 bit addressing for DO access and data is returned in a binary format mapped into bytes.

The Modbus Comm Digital I/O Channel-to-address mapping is shown starting on page 26.

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 rack slot and channel number of the digital output being read.

Example Query: Read DO channels 1 to 16, located in Rack #1, Slot #1; from the controller with slave address 1.

Query message format for function code 01

	Slave Address (00 for TCP)	Function Code	Starting Address High	Starting Address Low	Number DO High	Number DO Low	CRC (RTU)	CRC (RTU)
TCP Example	00	01	00	00	00	10		
RTU Example	01	01	00	00	00	10	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.

Example Response: DO channels 2 and 6 located in Rack #1, Slot #1 are on; all others are off.

Response message format for function code 01

	Slave Address (00 for TCP)	Function Code	Byte Count	Data	Data	CRC (RTU)	CRC (RTU)
TCP Example	00	01	02	22	00		
RTU Example	01	01	02	22	00	CRC	CRC

In the response the status of DOs 1 - 8 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 8 through 1 is: OFF-OFF-ON-OFF-OFF-OFF-ON-OFF. The status of DOs 9 - 16 are shown a 00hex, or 0000 0000 with the same bit ordering.

Digital I/O Channel to Address Mapping

If you have any 32-channel DI/DO modules or if you have firmware version 2.4 or higher you must use the newer maps in Table 4-4 and Table 4-5. However, use the older maps in Table 4-6 and Table 4-7 if:

- Your controller is firmware version 2.3 or earlier or
- You have already mapped out 16-channel DI/DO, have no 32-channel DI/DO modules, and don't want to change to the newer map.

Note: Up to 16 slots are accommodated in the protocol even though the largest rack available supports 12 slots.

Each DI/DO consumes 1 Modbus bit address.

Decimal addressing is typically non-zero based for DI/DO access (1-based), applicable to coil or register address.

Table 4-4 DI/DO Address Map (v2.4 and higher, up to 32-channel)

Rack	Channels	Coil number/register number	Modbus Hex Address Range
1*	1 - 512	2001 – 2512	7D0 – 9CF
2	513 – 1024	2513 – 3024	9D0 – BCF
3	1025 – 1536	3025 – 3536	BD0 – DCF
4	1537 - 2048	3537 – 4048	DD0 – FCF
5	2049 - 2560	4049 - 4560	FD0 – 11CF
*See Table 4-5 for detailed map of Rack #1			

The coil (register) number for a DI/DO is based on the DI/DO's position in the card cage. It is determined from the formula:

$$\text{Coil (register) Number} = [(\text{Rack}-1)*512] + [(\text{Slot}-1)*32] + \text{channel in module} + 2000$$

Example: To monitor a coil (register) located in the 2nd channel of slot 10 of rack 3, the Modbus coil (register) number is:

$$[(3-1)*512] + [(10-1)*32] + 2 + 2000 = 3314$$

Some third party software packages will require the 1-based coil/register number to be used for the address while others will require the 0-based hex address.

Table 4-5 Rack #1 DI/DO Address map (version 2.4 and higher, up to 32-channel)

Slot 1			Slot 2			Slot 3			Slot 4		
CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex
32	2032	7EF	32	2064	80F	32	2096	82F	32	2128	84F
31	2031	7EE	31	2063	80E	31	2095	82E	31	2127	84E
30	2030	7ED	30	2062	80D	30	2094	82D	30	2126	84D
29	2029	7EC	29	2061	80C	29	2093	82C	29	2125	84C
28	2028	7EB	28	2060	80B	28	2092	82B	28	2124	84B
27	2027	7EA	27	2059	80A	27	2091	82A	27	2123	84A
26	2026	7E9	26	2058	809	26	2090	829	26	2122	849
25	2025	7E8	25	2057	808	25	2089	828	25	2121	848
24	2024	7E7	24	2056	807	24	2088	827	24	2120	847
23	2023	7E6	23	2055	806	23	2087	826	23	2119	846
22	2022	7E5	22	2054	805	22	2086	825	22	2118	845
21	2021	7E4	21	2053	804	21	2085	824	21	2117	844
20	2020	7E3	20	2052	803	20	2084	823	20	2116	843
19	2019	7E2	19	2051	802	19	2083	822	19	2115	842
18	2018	7E1	18	2050	801	18	2082	821	18	2114	841
17	2017	7E0	17	2049	800	17	2081	820	17	2113	840
16	2016	7DF	16	2048	7FF	16	2080	81F	16	2112	83F
15	2015	7DE	15	2047	7FE	15	2079	81E	15	2111	83E
14	2014	7DD	14	2046	7FD	14	2078	81D	14	2110	83D
13	2013	7DC	13	2045	7FC	13	2077	81C	13	2109	83C
12	2012	7DB	12	2044	7FB	12	2076	81B	12	2108	83B
11	2011	7DA	11	2043	7FA	11	2075	81A	11	2107	83A
10	2010	7D9	10	2042	7F9	10	2074	819	10	2106	839
9	2009	7D8	9	2041	7F8	9	2073	818	9	2105	838
8	2008	7D7	8	2040	7F7	8	2072	817	8	2104	837
7	2007	7D6	7	2039	7F6	7	2071	816	7	2103	836
6	2006	7D5	6	2038	7F5	6	2070	815	6	2102	835
5	2005	7D4	5	2037	7F4	5	2069	814	5	2101	834
4	2004	7D3	4	2036	7F3	4	2068	813	4	2100	833
3	2003	7D2	3	2035	7F2	3	2067	812	3	2099	832
2	2002	7D1	2	2034	7F1	2	2066	811	2	2098	831
1	2001	7D0	1	2033	7F0	1	2065	810	1	2097	830

**Modbus/TCP & Modbus RTU Function Codes
Function Code 01 – Read Digital Output Status**

Slot 5			Slot 6			Slot 7			Slot 8		
CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex
32	2160	86F	32	2192	88F	32	2224	8AF	32	2256	8D0
31	2159	86E	31	2191	88E	31	2223	8AE	31	2255	8CE
30	2158	86D	30	2190	88D	30	2222	8AD	30	2254	8CD
29	2157	86C	29	2189	88C	29	2221	8AC	29	2253	8CC
28	2156	86B	28	2188	88B	28	2220	8AB	28	2252	8CB
27	2155	86A	27	2187	88A	27	2219	8AA	27	2251	8CA
26	2154	869	26	2186	889	26	2218	8A9	26	2250	8C9
25	2153	868	25	2185	888	25	2217	8A8	25	2249	8C8
24	2152	867	24	2184	887	24	2216	8A7	24	2248	8C7
23	2151	866	23	2183	886	23	2215	8A6	23	2247	8C6
22	2150	865	22	2182	885	22	2214	8A5	22	2246	8C5
21	2149	864	21	2181	884	21	2213	8A4	21	2245	8C4
20	2148	863	20	2180	883	20	2212	8A3	20	2244	8C3
19	2147	862	19	2179	882	19	2211	8A2	19	2243	8C2
18	2146	861	18	2178	881	18	2210	8A1	18	2242	8C1
17	2145	860	17	2177	880	17	2209	8A0	17	2241	8C0
16	2144	85F	16	2176	87F	16	2208	89F	16	2240	8BF
15	2143	85E	15	2175	87E	15	2207	89E	15	2239	8BE
14	2142	85D	14	2174	87D	14	2206	89D	14	2238	8BD
13	2141	85C	13	2173	87C	13	2205	89C	13	2237	8BC
12	2140	85B	12	2172	87B	12	2204	89B	12	2236	8BB
11	2139	85A	11	2171	87A	11	2203	89A	11	2235	8BA
10	2138	859	10	2170	879	10	2202	899	10	2234	8B9
9	2137	858	9	2169	878	9	2201	898	9	2233	8B8
8	2136	857	8	2168	877	8	2200	897	8	2232	8B7
7	2135	856	7	2167	876	7	2199	896	7	2231	8B6
6	2134	855	6	2166	875	6	2198	895	6	2230	8B5
5	2133	854	5	2165	874	5	2197	894	5	2229	8B4
4	2132	853	4	2164	873	4	2196	893	4	2228	8B3
3	2131	852	3	2163	872	3	2195	892	3	2227	8B2
2	2130	851	2	2162	871	2	2194	891	2	2226	8B1
1	2129	850	1	2161	870	1	2193	890	1	2225	8B0

Modbus/TCP & Modbus RTU Function Codes
Function Code 01 – Read Digital Output Status

Slot 9			Slot 10			Slot 11			Slot 12		
CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex
32	2288	8EF	32	2320	90F	32	2352	92F	32	2384	94F
31	2287	8EE	31	2319	90E	31	2351	92E	31	2383	94E
30	2286	8ED	30	2318	90D	30	2350	92D	30	2382	94D
29	2285	8EC	29	2317	90C	29	2349	92C	29	2381	94C
28	2284	8EB	28	2316	90B	28	2348	92B	28	2380	94B
27	2283	8EA	27	2315	90A	27	2347	92A	27	2379	94A
26	2282	8E9	26	2314	909	26	2346	929	26	2378	949
25	2281	8E8	25	2313	908	25	2345	928	25	2377	948
24	2280	8E7	24	2312	907	24	2344	927	24	2376	947
23	2279	8E6	23	2311	906	23	2343	926	23	2375	946
22	2278	8E5	22	2310	905	22	2342	925	22	2374	945
21	2277	8E4	21	2309	904	21	2341	924	21	2373	944
20	2276	8E3	20	2308	903	20	2340	923	20	2372	943
19	2275	8E2	19	2307	902	19	2339	922	19	2371	942
18	2274	8E1	18	2306	901	18	2338	921	18	2370	941
17	2273	8E0	17	2305	900	17	2337	920	17	2369	940
16	2272	8DF	16	2304	8FF	16	2336	91F	16	2368	93F
15	2271	8DE	15	2303	8FE	15	2335	91E	15	2367	93E
14	2270	8DD	14	2302	8FD	14	2334	91D	14	2366	93D
13	2269	8DC	13	2301	8FC	13	2333	91C	13	2365	93C
12	2268	8DB	12	2300	8FB	12	2332	91B	12	2364	93B
11	2267	8DA	11	2299	8FA	11	2331	91A	11	2363	93A
10	2266	8D9	10	2298	8F9	10	2330	919	10	2362	939
9	2265	8D8	9	2297	8F8	9	2329	918	9	2361	938
8	2264	8D7	8	2296	8F7	8	2328	917	8	2360	937
7	2263	8D6	7	2295	8F6	7	2327	916	7	2359	936
6	2262	8D5	6	2294	8F5	6	2326	915	6	2358	935
5	2261	8D4	5	2293	8F4	5	2325	914	5	2357	934
4	2260	8D3	4	2292	8F3	4	2324	913	4	2356	933
3	2259	8D2	3	2291	8F2	3	2323	912	3	2355	932
2	2258	8D1	2	2290	8F1	2	2322	911	2	2354	931
1	2257	8D0	1	2289	8F0	1	2321	910	1	2353	930

**Modbus/TCP & Modbus RTU Function Codes
Function Code 01 – Read Digital Output Status**

Slot 13			Slot 14			Slot 15			Slot 16		
CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex
32	2416	96F	32	2448	98F	32	2480	9AF	32	2512	9CF
31	2415	96E	31	2447	98E	31	2479	9AE	31	2511	9CE
30	2414	96D	30	2446	98D	30	2478	9AD	30	2510	9CD
29	2413	96C	29	2445	98C	29	2477	9AC	29	2509	9CC
28	2412	96B	28	2444	98B	28	2476	9AB	28	2508	9CB
27	2411	96A	27	2443	98A	27	2475	9AA	27	2507	9CA
26	2410	969	26	2442	989	26	2474	9A9	26	2506	9C9
25	2409	968	25	2441	988	25	2473	9A8	25	2505	9C8
24	2408	967	24	2440	987	24	2472	9A7	24	2504	9C7
23	2407	966	23	2439	986	23	2471	9A6	23	2503	9C6
22	2406	965	22	2438	985	22	2470	9A5	22	2502	9C5
21	2405	964	21	2437	984	21	2469	9A4	21	2501	9C4
20	2404	963	20	2436	983	20	2468	9A3	20	2500	9C3
19	2403	962	19	2435	982	19	2467	9A2	19	2499	9C2
18	2402	961	18	2434	981	18	2466	9A1	18	2498	9C1
17	2401	960	17	2433	980	17	2465	9A0	17	2497	9C0
16	2400	95F	16	2432	97F	16	2464	99F	16	2496	9BF
15	2399	95E	15	2431	97E	15	2463	99E	15	2495	9BE
14	2398	95D	14	2430	97D	14	2462	99D	14	2494	9BD
13	2397	95C	13	2429	97C	13	2461	99C	13	2493	9BC
12	2396	95B	12	2428	97B	12	2460	99B	12	2492	9BB
11	2395	95A	11	2427	97A	11	2459	99A	11	2491	9BA
10	2394	959	10	2426	979	10	2458	999	10	2490	9B9
9	2393	958	9	2425	978	9	2457	998	9	2489	9B8
8	2392	957	8	2424	977	8	2456	997	8	2488	9B7
7	2391	956	7	2423	976	7	2455	996	7	2487	9B6
6	2390	955	6	2422	975	6	2454	995	6	2486	9B5
5	2389	954	5	2421	974	5	2453	994	5	2485	9B4
4	2388	953	4	2420	973	4	2452	993	4	2484	9B3
3	2387	952	3	2419	972	3	2451	992	3	2483	9B2
2	2386	951	2	2418	971	2	2450	991	2	2482	9B1
1	2385	950	1	2417	970	1	2449	990	1	2481	9B0

Table 4-6 DI/DO Address Map (Firmware version 2.3 and earlier, 16 channels max)

Rack	Channels	Coil number/ Register number	Modbus Hex Address Range
1*	1 - 256	1 – 256	0 - FF
2	257 - 512	257 - 512	100 - 1FF
3	513 - 768	513 – 768	200 - 2FF
4	769 - 1024	769 – 1024	300 - 3FF
5	1025 - 1280	1025 - 1280	400 - 4FF
*See Table 4-7 for detailed addresses of Rack #1			

The coil (register) number for a digital I/O is based on the DI/DO's position in the card cage. It is determined from the formula:

$$\text{Coil (register) Number} = [(\text{Rack}-1)*256] + [(\text{Slot}-1)*16] + \text{channel in module}$$

Example: To monitor a coil (register) located in the 2nd channel of slot 10 of rack 3, the Modbus coil (register) number is:

$$[(3-1)*256] + [(10-1)*16] + 2 = 658$$

Some third party software packages will require the 1-based coil/register number to be used for the address while others will require the 0-based hex address.

Table 4-7 Rack #1 DI/DO address map (v2.3 and earlier, up to 16-channel)

Slot 1			Slot 2			Slot 3			Slot 4		
CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex	CH#	Coil/ register	Addr. Hex
16	16	0F	16	32	1F	16	48	2F	16	64	3F
15	15	0E	15	31	1E	15	47	2E	15	63	3E
14	14	0D	14	30	1D	14	46	2D	14	62	3D
13	13	0C	13	29	1C	13	45	2C	13	61	3C
12	12	0B	12	28	1B	12	44	2B	12	60	3B
11	11	0A	11	27	1A	11	43	2A	11	59	3A
10	10	9	10	26	19	10	42	29	10	58	39
9	9	8	9	25	18	9	41	28	9	57	38
8	8	7	8	24	17	8	40	27	8	56	37
7	7	6	7	23	16	7	39	26	7	55	36
6	6	5	6	22	15	6	38	25	6	54	35
5	5	4	5	21	14	5	37	24	5	53	34
4	4	3	4	20	13	4	36	23	4	52	33
3	3	2	3	19	12	3	35	22	3	51	32
2	2	1	2	18	11	2	34	21	2	50	31
1	1	0	1	17	10	1	33	20	1	49	30

Modbus/TCP & Modbus RTU Function Codes
Function Code 01 – Read Digital Output Status

Slot 5		
CH#	Coil/ register	Addr. Hex
16	80	4F
15	79	4E
14	78	4D
13	77	4C
12	76	4B
11	75	4A
10	74	49
9	73	48
8	72	47
7	71	46
6	70	45
5	69	44
4	68	43
3	67	42
2	66	41
1	65	40

Slot 6		
CH#	Coil/ register	Addr. Hex
16	96	5F
15	95	5E
14	94	5D
13	93	5C
12	92	5B
11	91	5A
10	90	59
9	89	58
8	88	57
7	87	56
6	86	55
5	85	54
4	84	53
3	83	52
2	82	51
1	81	50

Slot 7		
CH#	Coil/ register	Addr. Hex
16	112	6F
15	111	6E
14	110	6D
13	109	6C
12	108	6B
11	107	6A
10	106	69
9	105	68
8	104	67
7	103	66
6	102	65
5	101	64
4	100	63
3	99	62
2	98	61
1	97	60

Slot 8		
CH#	Coil/ register	Addr. Hex
16	128	7F
15	127	7E
14	126	7D
13	125	7C
12	124	7B
11	123	7A
10	122	79
9	121	78
8	120	77
7	119	76
6	118	75
5	117	74
4	116	73
3	115	72
2	114	71
1	113	70

Slot 9		
CH#	Coil/ register	Addr. Hex
16	144	8F
15	143	8E
14	142	8D
13	141	8C
12	140	8B
11	139	8A
10	138	89
9	137	88
8	136	87
7	135	86
6	134	85
5	133	84
4	132	83
3	131	82
2	130	81
1	129	80

Slot 10		
CH#	Coil/ register	Addr. Hex
16	160	9F
15	159	9E
14	158	9D
13	157	9C
12	156	9B
11	155	9A
10	154	99
9	153	98
8	152	97
7	151	96
6	150	95
5	149	94
4	148	93
3	147	92
2	146	91
1	145	90

Slot 11		
CH#	Coil/ register	Addr. Hex
16	176	AF
15	175	AE
14	174	AD
13	173	AC
12	172	AB
11	171	AA
10	170	A9
9	169	A8
8	168	A7
7	167	A6
6	166	A5
5	165	A4
4	164	A3
3	163	A2
2	162	A1
1	161	A0

Slot 12		
CH#	Coil/ register	Addr. Hex
16	192	BF
15	191	BE
14	190	BD
13	189	BC
12	188	BB
11	187	BA
10	186	B9
9	185	B8
8	184	B7
7	183	B6
6	182	B5
5	181	B4
4	180	B3
3	179	B2
2	178	B1
1	177	B0

Modbus/TCP & Modbus RTU Function Codes
Function Code 01 – Read Digital Output Status

Slot 13		
CH#	Coil/ register	Addr. Hex
16	208	CF
15	207	CE
14	206	CD
13	205	CC
12	204	CB
11	203	CA
10	202	C9
9	201	C8
8	200	C7
7	199	C6
6	198	C5
5	197	C4
4	196	C3
3	195	C2
2	194	C1
1	193	C0

Slot 14		
CH#	Coil/ register	Addr. Hex
16	224	DF
15	223	DE
14	222	DD
13	221	DC
12	220	DB
11	219	DA
10	218	D9
9	217	D8
8	216	D7
7	215	D6
6	214	D5
5	213	D4
4	212	D3
3	211	D2
2	210	D1
1	209	D0

Slot 15		
CH#	Coil/ register	Addr. Hex
16	240	EF
15	239	EE
14	238	ED
13	237	EC
12	236	EB
11	235	EA
10	234	E9
9	233	E8
8	232	E7
7	231	E6
6	230	E5
5	229	E4
4	228	E3
3	227	E2
2	226	E1
1	225	E0

Slot 16		
CH#	Coil/ register	Addr. Hex
16	256	FF
15	255	FE
14	254	FD
13	253	FC
12	252	FB
11	251	FA
10	250	F9
9	249	F8
8	248	F7
7	247	F6
6	246	F5
5	245	F4
4	244	F3
3	243	F2
2	242	F1
1	241	F0

4.4 Function Code 02 - Read Digital Input Status

Description

Function code 02 (1X references) is used to read a digital input's ON/OFF status using 16 bit addressing for DI access and data is returned in a binary format mapped into bytes.

The Modbus Comm Digital I/O Channel to address mapping is shown starting on page 26.

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.

Example: Read inputs for channels 1 to 16 in Rack #1, Slot 1, from the controller with slave address 1.

Query message format for function code 02

	Slave Address (00 for TCP)	Function Code	Starting Address High	Starting Address Low	Number Inputs High	Number Inputs Low	CRC (RTU)	CRC (RTU)
TCP Example	00	02	00	00	00	10		
RTU Example	01	02	00	00	00	10	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.

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

Response message format for function code 02

	Slave Address (00 for TCP)	Function Code	Byte Count	Data	Data	CRC (RTU)	CRC (RTU)
TCP Example	00	02	02	22	00		
RTU Example	01	02	02	22	00	CRC	CRC

In the response the status of inputs 1 - 8 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: OFF-OFF-ON-OFF-OFF-OFF-ON-OFF. The status of inputs 9-16 are shown as 00 hex, or 0000 0000 with the same bit ordering.

4.5 Function Code 03- Read Holding (Data) Registers

Description

Function code 03 (also referred to as 4X decimal references) is used to read 32-bit floating point, 32-bit unsigned/signed integer and 16 bit integer data in the controller as described in Section 6. Registers are consecutive.

In pre-4.0 configurations only it is also used to Read certain analog input modules for commonality of UMC800 controller addresses. This applies to analog input modules positioned ONLY in the first 8 Slots of Rack #1, providing support ONLY for the first 64 channels. **Use Function Code 04 to address all analog inputs in the HC900 controller.**

Table 4-8 HC900 AI Address Mapping supported by Function Code 03

Rack	Channel	Register Range	Hex Address Range
1	1 - 64	1 - 127	0 -7F (uses register addressing 1800 - 187Fh)
	65 - 128	65 - 255	Not Supported

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.

Example: Read PV, Remote SP, Working SP, and Output as floating point values for Loop #1 in the controller at slave address 1.

Query message format for function code 03

	Slave Address (00 for TCP)	Function Code	Starting Address High	Starting Address Low	Number Addresses High	Number Addresses Low	CRC (RTU)	CRC (RTU)
TCP Example	00	03	00	40	00	08		
RTU Example	01	03	00	40	00	08	CRC	CRC

Response

The register data in the response message is 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. 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 page 10. 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

**Modbus/TCP & Modbus RTU Function Codes
Function Code 03- Read Holding (Data) Registers**

master station requests only one register at an address of a floating point value then half of a float will be returned.

The Modbus RTU protocol has a single byte count for function code 03, therefore the Modbus RTU protocol can only process up to 63 floating point and 127 16-bit integer values in a single request.

Example: PV, Remote SP, Working SP, and Output where PV=100.0, RSP=100.0, WSP=100.0, and Out=55.32 as floating point values where AI #1 = 100.0 and AI #2 = 55.32

Response message format for function codes 03

	Slave Address (00 for TCP)	Function Code	Byte Count	Data	Data	Data	Data	CRC (RTU)	CRC (RTU)
TCP Example	00	03	10	42 C8 00 00 (100)	42 C8 00 00 (100)	42 C8 00 00 (100)	42 5D 47 AE (55.32)		
RTU Example	01	03	10	42 C8 00 00 (100)	42 C8 00 00 (100)	42 C8 00 00 (100)	42 5D 47 AE (55.32)	CRC	CRC

4.6 Function Code 04 - Read Input Registers

Description

Function code 04(3X references) provides read access to Analog Input modules positioned in *any* Rack or Slot. All values are in IEEE 32-bit floating point format.

For HC900 CPUs and Scanners with firmware version 2.3 and earlier, each Rack is allocated space for a maximum of 16 Slots and each Slot assumes Modules with a maximum of 8 Channels, which consumes 16 Modbus Register addresses. See Table 4-9.

For HC900 CPUs and Scanners with firmware version 2.4 and higher, each Rack is allocated space for a maximum of 16 Slots and each Slot assumes Modules with a maximum of 16 Channels, which consumes 32 Modbus Register addresses. See Table 4-10.

In Table 4-9 and Table 4-10 the register addressing is 1-based while the hex addressing is 0-based.

Table 4-9 HC900 AI Address Mapping supported by Function Code 04 (v2.3)

Rack	Channels	Register Range (decimal)	Hex Address Range
1	1 - 128	1 - 255	0 - FE
2	129 - 256	257 - 511	100 - 1FE
3	257 - 384	513 - 767	200 - 2FE
4	385 - 512	769 - 1023	300 - 3FE
5	513 - 640	1025 - 1279	400 - 4FE

Table 4-10 HC900 AI Address Mapping supported by Function Code 04 (v2.4 and higher)

Rack	Channels	Register Range (decimal)	Hex Address Range
1	1 - 256	2001 - 2511	0 - 9CE
2	257 - 512	2513 - 3023	9D0 - BCE
3	513 - 768	3025 - 3535	BD0 - DCE
4	769 - 1024	3537 - 4047	DD0 - FCE
5	1025 - 1280	4049 - 4559	FD0 - 11CE

If a request is made to an address that does not exist in the map in Section 1, 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.

Example: Read analog inputs #1 and #2 (Rack #1, Module #1) addresses 0-3, as floating point values from the controller at slave address 1.

Query message format for function code 04

	Slave Address (00 for TCP)	Function Code	Starting Address High	Starting Address Low	Number Addresses High	Number Addresses Low	CRC (RTU)	CRC (RTU)
TCP Example	00	04	00	00	00	04		
RTU Example	01	04	00	00	00	04	CRC	CRC

Response

The register data in the response message is 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. 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 1.3. 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, then half of a float will be returned.

The Modbus RTU protocol has a single byte count for function code 04, therefore the Modbus RTU protocol can only process up to 63 floating point values in a single request.

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

Response message format for function codes 04

	Slave Address (00 for TCP)	Function Code	Byte Count	Data	Data	CRC (RTU)	CRC (RTU)
TCP Example	00	04	08	42 C8 00 00 (100)	42 5D 47 AE (55.32)		
RTU Example	01	04	08	42 C8 00 00 (100)	42 5D 47 AE (55.32)	CRC	CRC

4.7 Function Code 05 - Force Single Digital Output

Description

Force a single digital output (OX 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 4-5.

(Table 4-7 for V 2.3 and older CPUs).

The HC900 does not support broadcast, and forcing can only be done in the Run or Run/Prog mode.

Query

The query message specifies the DO to be forced. In CPU firmware revisions 2.4 or greater, DO coils are addressed starting at 2001d (7D0h). DO 1 is bit address 2001d.

The requested ON/OFF state is specified by a constant in the query data field.

A value of FF 00 hex forces the output to be ON.

A value of 00 00 hex forces the output 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 HC900 controller. The DO module's diagnostic LED flashes Amber when a force condition is present. 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.

Example: Force DO Card Rack #1, Slot 1, Channel 6 ON in the controller at slave address 1.

Query message format for function code 05

	Slave Address (00 for TCP)	Function Code	DO Address High	DO Address Low	Force Data High	Force Data Low	CRC (RTU)	CRC (RTU)
TCP Example	00	05	07	D5	FF	00		
RTU Example	01	05	07	D5	FF	00	CRC	CRC

Response

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

Example: Force DO Card Rack #1, Slot 1, Channel 6 ON in the controller at slave address 1.

Response message format for function code 05

	Slave Address (00 for TCP)	Function Code	DO Address High	DO Address Low	Force Data High	Force Data Low	CRC (RTU)	CRC (RTU)
TCP Example	00	05	07	D5	FF	00		
RTU Example	01	05	07	D5	FF	00	CRC	CRC

The Modbus Comm Digital I/O Channel to address mapping is shown starting on page 26.

4.8 Function Code 06 - Preset Single Register

Description

Presents integer value into a single register (also referred to as 4X references).

The HC900 does not support Broadcast.

The registers that are specified in Section 6 with an access type “W” and integer and bit packed (16-bit register) data types, can be written to via Function Code 06. Also, digital variables in 32-bit floating point format can be written using this function code. Writing a non-zero value to either register of the digital variable will result in a floating point 1 to be written to the variable. Writing a zero value to either register will result in the variable being set to 0.

Query

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

Example: Set Rack #1, Loop #1 to Auto (address 00FAh) in the controller at slave address 1

Query message format for function code 06

	Slave Address (00 for TCP)	Function Code	Address High	Address Low	Preset Data High	Preset Data Low	CRC (RTU)	CRC (RTU)
TCP Example	00	06	00	FA	00	01		
RTU Example	01	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.

Example: Set Rack #1, Loop #1 to Auto (address 00FAh) in the controller at slave address 1.

Response message format for function code 06

	Slave Address (00 for TCP)	Function Code	Address High	Address Low	Preset Data High	Preset Data Low	CRC (RTU)	CRC (RTU)
TCP Example	00	06	00	FA	00	01		
RTU Example	01	06	00	FA	00	01	CRC	CRC

4.9 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.

Example: 00 08 01 02 03 04

Query message format for function code 08

	Slave Address (00 for TCP)	Function Code	Any data, length limited to approximately half the length of the data buffer	CRC (RTU)	CRC (RTU)
TCP Example	00	08	01 02 03 04		
RTU Example	01	08	01 02 03 04	CRC	CRC

Response

Example: 00 08 01 02 03 04

Response message format for function code 08

	Slave Address (00 for TCP)	Function Code	Data bytes received	CRC (RTU)	CRC (RTU)
TCP Example	00	08	01 02 03 04		
RTU Example	01	08	01 02 03 04	CRC	CRC

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

Description

Presets values into a sequence of holding registers (also referred to as 4X references). The HC900 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).

Writing to half of a digital variable will be accepted. A non-zero write to either register will result in a floating point 1 to be written to the variable. Writing a zero to either register will result in the variable being set to 0.

Query

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

Example: Preset Rack #1, Variable #1 (address 18C0h) to 100.0 in the controller at slave address 1.

Query message format for function code 16 (10h)

	Slave Address (00 for TCP)	Function Code	Start Address High	Start Address Low	Number Addresses High	Number Addresses Low	Byte Count	Data	CRC (RTU)	CRC (RTU)
TCP Example	00	10	18	C0	00	02	04	42 C8 00 00		
RTU Example	01	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 1.3. 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 1.3. 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 code (See Section 5).

Example: Response from presetting Rack #1, Variable #1 (address 18C0h) to 100.0 from the controller.

Response message format for function code 16 (10h)

	Slave Address (00 for TCP)	Function Code	Start Address High	Start Address Low	Number Addresses High	Number Addresses Low	CRC (RTU)	CRC (RTU)
TCP Example	00	10	18	C0	00	02		
RTU Example	01	10	18	C0	00	02	CRC	CRC

4.11 Function Code 17 (11h) - Report HC900 ID

Description

Function code 17 (11h) is used to report the device information such as Slave ID, device description and firmware version.

Query

The query message specifies the function code only.

Example: Read Device ID from a slave at address 2.

Query message format for function code 17 (11h)

	Slave Address (00 for TCP)	Function Code	CRC (RTU)	CRC (RTU)
TCP Example	00	11		
RTU Example	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 Description	Model ID	Device Class ID	Device Mapping	CRC (RTU)	CRC (RTU)
---------------	---------------	------------	----------	----------------------	--------------------	----------	-----------------	----------------	-----------	-----------

Slave Address – 00 for TCP. RTU is slave address. Example: 02

Slave ID - The Slave ID number for the HC930 is 93 (hex). For the HC950 it is 95 (hex) (one byte) (byte 3). For HC970 it is 70 (hex). For HC970R it is 7A (hex).

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

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

'H'	'C'	'g'	'5' or '3' or '7'	'0' or 'A'	"	"	<i>up to 9 character version number in floating point notation.</i>	<i>zeros are appended for the remaining bytes</i>
-----	-----	-----	-------------------------------	------------------	---	---	---	---

For example, an HC950 with version number 2.000 would have the following device description:

'H'	'C'	'g'	'5'	'0'	"	"	'2'	'.'	'0'	'0'	'0'	0	0	0	0
-----	-----	-----	-----	-----	---	---	-----	-----	-----	-----	-----	---	---	---	---

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

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

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

Continued

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	Signal tags
12	Signal tags List 2
13	Analog Inputs Accessed Using 3x Registers
14	Sequencers
15	Stage
16	Ramp
17	Hand Off Auto
18	Alternators
19	Device Controls
20	Control Loops Extended
21	Setpoint Programmers Extended
22	Schedulers Extended
23	Sequencers Extended

5. Modbus RTU Exception Codes

5.1 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 the controller at slave address 01.

```
TCP: 00 03 18 20 00 02  
RTU: 01 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.

```
TCP: 00 83 04  
RTU: 01 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 not 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 rejected 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.

6. Parameters accessible with Function Code 03, 06,10h

6.1 Overview

What's in this section?

Section 6 describes all parameters accessible by Function Code 03, 06 and 10h. 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.

Considerations for SIL-compliant Controllers

For SIL-compliant controllers such as C30S, C50S, etc, it must be noted that if a function block or variable is on a Safety worksheet, then all the parameters or values for that block or variable is READ-ONLY. This overrides all description of blocks/variables in the sections below. If the function block is on a Process worksheet, then the description of blocks/variables in the below sections apply as described.

How parameters are mapped to addresses

There are two methods available for accessing Modbus parameters:

- Use a fixed map to access pre-defined parameters at fixed addresses. These parameters and their fixed addresses are described in Sections 6.2 through 6.17.
- Build a custom map to assign parameters to any addresses. These parameters are described in Sections 6.2 through 6.17. Also, the custom map can contain additional parameters not available to the fixed map, see Section 6.18. The custom map uses the fixed map's address assignments as the default but, unlike the fixed map, you can change these addresses and assign any parameter to any address. Therefore, the addresses shown for the fixed map don't necessarily apply to your custom map. You can see the custom map addresses in HCDesigner, as well as view or print the custom map.

Your version of HC 900 configuration (pre-4.0 or 4.0 and up) determines the type of address mapping available, see table below.

Fixed map	Custom map
Available in all HC900 configuration versions	Available in HC900 configuration version 4.0 and higher. Certain blocks can be assigned to the custom map that are not available in the fixed map. (See section 6.18.)
Contains limited types of parameters in limited quantities (e.g., 32 loops max)	More parameters to choose from and unlimited quantities (e.g., >32 loops)
Function block type (e.g. loop) can be assigned to any address partitioned for that block type.	Can create from scratch or can import fixed map for customization. Function block type (e.g. loop) can be assigned to any address or to multiple addresses.
Parameters are partitioned using fixed partitions according to type (e.g. loops 1-24, SP Programmers 1-4, etc.)	Parameters need not be partitioned or can use custom partitions
Must use fixed addresses	Can use fixed addresses, or can assign parameters to desired addresses
Can access only the parameters shown in the fixed map	Can access the same parameters as the fixed map but can use any addresses. Can access additional parameters not available in fixed map.
Contains gaps in addresses especially between partitions	Address gaps can be eliminated by assigning parameters to contiguous addresses.

Which parameters can be mapped?

Function Block	Category/Filter Selection	Available in Fixed Map	Available in Custom Map
AGA8-Detail Block	AGAs	No	Yes
AGA8-Gross Block	AGAs	No	Yes
Alternator Block	Alternators	Yes	Yes
XYR5000 Base Station Block	Communications	No	Yes
XYR5000 Transmitter Block	Communications	No	Yes
XYR6000 Transmitter Block	Communications	No	Yes
UDC Loop Block	Communications	No	Yes
UDC Loop2 Block	Communications	No	Yes
Calendar Event Block	Counters/Timers	No	Yes
Device Control Block	Device Controls	Yes	Yes
Hand Off Auto Block	Hand Off Autos	Yes	Yes
Four Selector Switch Block	Logic	No	Yes
Push Button Block	Logic	No	Yes
PID Loop Block	Loops	Yes	Yes
On Off Loop Block	Loops	Yes	Yes
Carbon Loop Block	Loops	Yes	Yes
Three Pos. Step Cont. Block	Loops	Yes	Yes
Auto Manual Bias Block	Loops	Yes	Yes
Set Point Programmer Block	Programmeters	Yes	Yes
Ramp Block	Ramps	Yes	Yes
Set Point Scheduler Block	Schedulers	Yes	Yes
Sequencer Block	Sequencers	Yes	Yes
Stage Block	Stages	Yes	Yes
Position Proportional Output Block	NA	No	No
Peer-Peer Block	NA	No	No
Modbus Slave Block	NA	No	No
Modbus/TCP Slave Block	NA	No	No
XYR6000 Gateway	NA	No	No

For parameters available only in a custom map, see section 6.18.

6.2 Fixed Map

Table 6-1 describes the fixed register map for Function Code 03, 06 and 10h.

- Except for User-Defined Signals and Variables, all items shown are assigned automatically to the addresses shown.
- Details on each item type are in sections 6.3 through 6.17.
- There are several gaps of unused addresses in the fixed map; Table 6-1 does not explicitly show these gaps, it shows only the range of addresses used by items. For example, there is a gap of unused addresses between Loop 1's end address 00FF and Loop 2's start address 0140. There are also gaps of unused addresses within Loop 1's range.
- Parameters for blocks such as Setpoint Programmers and Sequencers are divided into two or three sections of the map.
- Custom maps can contain additional quantities and parameters beyond what is included in the fixed map.

Conversion between Address (Hex) Number and Register (Decimal) Number

To convert the address number to the register number, convert the address from hexadecimal to decimal and add 1. Registers are addressed starting at zero: registers 1-16 are addressed as 0-15.

To convert the register number to the address number, subtract 1 from the register and convert to hex.

Table 6-1 Fixed Map (listed by increasing address)

Fixed Start Address (hex)	Fixed End Address (hex)	Item Description	See section
0000	< 0040	Miscellaneous Parameters	6.3
0040	00FF	Loop #1 (floating point & bit packed)	6.4
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)	
1040	10FF	Loop #17 (floating point & bit packed)	
1140	11FF	Loop #18 (floating point & bit packed)	
1240	12FF	Loop #19 (floating point & bit packed)	
1340	13FF	Loop #20 (floating point & bit packed)	
1440	14FF	Loop #21 (floating point & bit packed)	
1540	15FF	Loop #22 (floating point & bit packed)	

Parameters accessible with Function Code 03, 06,10h
Fixed Map

Fixed Start Address (hex)	Fixed End Address (hex)	Item Description	See section	
1640	16FF	Loop #23 (floating point & bit packed)		
1740	17FF	Loop #24 (floating point & bit packed)		
1800	187F	Analog Input Value (#1-#64) First 8 slots of Rack #1 only - Function Code 03	6.5	
18C0	1D6F	Variable Value (#1 - #600)	6.6	
1DF0	1DF6	Time	6.7	
1E00	1E0F	Set Point Programmer #1	6.8	
1E10	1E1F	Set Point Programmer #2		
1E20	1E2F	Set Point Programmer #3		
1E30	1E3F	Set Point Programmer #4		
1F00	1F3F	Set Point Programmer #1 (Additional Values)		
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	Signal Tags (#1 - #1000) (legacy)		6.9
2800	29FF	Set Point Programmer #1 Segments		6.8
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	6.10	
3050	309F	Scheduler #2 Value		
3200	3B5F	Scheduler #1 Segments		
3B60	5A9F	Signal Tags (#1 - #4000) (HC900)	6.9	
5AA0	5ABF	Sequencer #1 Parameters	6.11	
5AC0	5CBF	Sequencer #1 Step 1 Table (64 steps in sequence)	6.11	
5CC0	5CFF	Sequencer #1 State Table	6.11	
5D00	5D1F	Sequencer #2 Parameters	6.11	
5D20	5F1F	Sequencer #2 Step 1 Table (64 steps in sequence)	6.11	
5F20	5F5F	Sequencer #2 State Table	6.11	
5F60	5F7F	Sequencer #3 Parameters	6.11	
5F80	617F	Sequencer #3 Step 1 Table (64 steps in sequence)	6.11	
6180	61BF	Sequencer #3 State Table	6.11	
6200	6227	Stage #1	6.12	
6230	6257	Stage #2		
6260	6287	Stage #3		
6290	62B7	Stage #4		
62C0	62E7	Stage #5		
62F0	6317	Stage #6		
6320	6347	Stage #7		
6350	6377	Stage #8		
6400	642D	Ramp #1	6.13	
6430	645D	Ramp #2		

**Parameters accessible with Function Code 03, 06,10h
Fixed Map**

Fixed Start Address (hex)	Fixed End Address (hex)	Item Description	See section	
6460	648D	Ramp #3		
6490	64BD	Ramp #4		
64C0	64ED	Ramp #5		
64F0	651D	Ramp #6		
6520	654D	Ramp #7		
6550	657D	Ramp #8		
6600	6606	Hand Off Auto #1		6.14
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		
6700	6725	Alternator #1	6.15	
6730	6755	Alternator #2		
6760	6785	Alternator #3		
6790	67B5	Alternator #4		
67C0	67E5	Alternator #5		
67F0	6815	Alternator #6		
6820	6845	Alternator #7		
6850	6875	Alternator #8		
6880	68A5	Alternator #9		
68B0	68D5	Alternator #10		
68E0	6905	Alternator #11		
6910	6935	Alternator #12		
6940	6965	Alternator #13		
6970	6995	Alternator #14		
69A0	69C5	Alternator #15		
69D0	69F5	Alternator #16		
6B00	6B09	Device Control #1	6.16	
6B10	6B19	Device Control #2		
6B20	6B29	Device Control #3		

Parameters accessible with Function Code 03, 06,10h
Fixed Map

Fixed Start Address (hex)	Fixed End Address (hex)	Item Description	See section	
6B30	6B39	Device Control #4		
6B40	6B49	Device Control #5		
6B50	6B59	Device Control #6		
6B60	6B69	Device Control #7		
6B70	6B79	Device Control #8		
6B80	6B89	Device Control #9		
6B90	6B99	Device Control #10		
6BA0	6BA9	Device Control #11		
6BB0	6BB9	Device Control #12		
6BC0	6BC9	Device Control #13		
6BD0	6BD9	Device Control #14		
6BE0	6BE9	Device Control #15		
6BF0	6BF9	Device Control #16		
6C00	755F	Scheduler #2 Segments		6.10
7840	78FF	Loop #25 (floating point & bit packed)		6.4
7940	79FF	Loop #26 (floating point & bit packed)		
7A40	7AFF	Loop #27 (floating point & bit packed)		
7B40	7BFF	Loop #28 (floating point & bit packed)		
7C40	7CFF	Loop #29 (floating point & bit packed)		
7D40	7DFF	Loop #30 (floating point & bit packed)		
7E40	7EFF	Loop #31 (floating point & bit packed)		
7F40	7FFF	Loop #32 (floating point & bit packed)		
8000	800F	Set Point Programmer #5	6.8	
8010	801F	Set Point Programmer #6		
8020	802F	Set Point Programmer #7		
8030	803F	Set Point Programmer #8		
8070	80AF	Set Point Programmer #5 (Additional Values)		
80B0	80EF	Set Point Programmer #6 (Additional Values)		
80F0	812F	Set Point Programmer #7 (Additional Values)		
8130	816F	Set Point Programmer #8 (Additional Values)		
8200	83FF	Set Point Programmer #5 Segments		
8400	85FF	Set Point Programmer #6 Segments		
8600	87FF	Set Point Programmer #7 Segments		
8800	89FF	Set Point Programmer #8 Segments		
A000	A01F	Sequencer #4 Parameters	6.11	
A020	A21F	Sequencer #4 Step 1 Table (64 steps in sequence)		
A220	A25F	Sequencer #4 State Table		
B000	B3E7	User defined signal or variable. Read-only if a signal tag. Read/write if a variable.	6.17	

Note: Additional parameters are available for custom maps only. See Section 6.18.

6.3 Miscellaneous Parameters

In HC Designer's custom map these parameters are grouped under the Item Filter "System Parameters."

Table 6-2 Miscellaneous Parameters

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
0000	0001	Instrument Mode	R/W	Bit Packed Indicators: Bit 0: 1:Diagnostic Bit 1: 1:Calibration (unused by UMC800/HC9xx) 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: 1:Fail-over (Write Only; C70R Only) Bit 7: Lead slot position: 0: A; 1: B (C70R Only) Bit 8: 1:On-demand write database to FLASH Bit 9: Database write status: 0: Done; 1: Busy Bit 10-15: Unused
0002	0003	Load Recipe	R/W	Floating Point Read: Returns zero Write: Loads the recipe, identified in the request, from the recipe pool.
0004	0005	Reserve Status	R	Bit Packed Bit 0: Available for failover Bit 1: Available for failover with no RSM Bit 2: Available for failover with switch bad Bit 3: Available for failover with scanner communication failure Bit 4: Unsynchronized database Bit 5: Invalid database Bit 6: Software version mismatch Bit 7-15: Reserved <i>C70R Only</i>

6.4 Loop Values

About loop addresses

This table contains fixed addresses of Loop #1. See **Table 6-1 for starting and ending fixed addresses (hex) for Loop #2 through Loop #32**. Each successive control loop is offset by 256 with the exception that loop 25 has a new starting address and loop 26 – 32 are offset by 256. The loop number corresponds to the PID block entry sequence during Process Control Designer configuration. The Modbus loop number address for a loop can also be obtained from the Process Control Designer printout of Block Modbus Addresses.

The addresses given in Table 6-3 do not necessarily apply to loops in the custom map. For custom addresses view or print a report in HC Designer.

Function Code Support:

Reads – Function Code 3

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 Values

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Loop type				Access	Notes	
			PID On / Off	Carb	3Pos	AMB			
0040	0065	PV	✓	✓	✓		✓	R	Floating Point in Engineering Units.
0042	0067	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	0069	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	0071	Output	✓	✓	✓		✓	R/W	Floating Point in Engineering Units.
0048	0073	PV	✓	✓	✓		✓	R	Floating Point in Engineering Units.
004A	0075	Carbon Potential block temperature			✓			R	Floating Point in Engineering Units
004C	0077	Gain #1 (Prop Band #1 if active)	✓		✓			R/W	Floating Point . (in units per what was configured in the HC900: Gain or Proportional Band)
004E	0079	Direction	✓	✓	✓			R	Floating Point 0.0=Direct; 1.0=Reverse
0050	0081	Reset #1	✓		✓			R/W	Floating Point in Repeats/Minute or Minutes/Repeat.
0052	0083	Rate #1	✓		✓			R/W	Floating Point in Minutes
0054	0085	Cycle Time for Analog Scan	✓	✓	✓		✓	R	Floating Point in Seconds
0056	0087	PV Low Range	✓	✓	✓		✓	R	Floating Point in Engineering Units.
0058	0089	PV High Range	✓	✓	✓		✓	R	Floating Point in Engineering Units.
005A	0091	Alarm #1 SP #1	✓	✓	✓		✓	R/W	Floating Point in Engineering Units.
005C	0093	Alarm #1 SP #2	✓	✓	✓		✓	R/W	Floating Point in Engineering Units.
0060	0097	Gain #2 (Prop Band #2 if active)	✓		✓			R/W	Floating Point

Parameters accessible with Function Code 03, 06,10h
Loop Values

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Loop type				Access	Notes	
			PID / Off	On	Carb	3Pos			AMB
0062	0099	Three Position Step Motor Deadband					R/W	Floating Point in percent	
0064	0101	Reset #2	✓		✓		R/W	Floating Point in Repeats/Minute or Minutes/Repeat as configured in the HC900.	
0066	0103	Rate #2	✓		✓		R/W	Floating Point in Minutes	
0068	0105	Cycle Time for Analog Scan	✓	✓	✓	✓	R	Floating Point in Seconds	
006A	0107	LSP #1	✓	✓	✓	✓	R/W	Floating Point in Engineering Units	
006C	0109	LSP #2	✓	✓	✓	✓	R/W	Floating Point in Engineering Units.	
006E	0111	Alarm #2 SP #1	✓	✓	✓	✓	R/W	Floating Point in Engineering Units.	
0070	0113	Alarm #2 SP #2	✓	✓	✓	✓	R/W	Floating Point in Engineering Units.	
0074	0117	SP Low Limit	✓	✓	✓	✓	R/W	Floating Point in Engineering Units. Operator Limit	
0076	0119	SP High Limit	✓	✓	✓	✓	R/W	Floating Point in Engineering Units. Operator Limit	
0078	0121	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	0123	Output Low Limit	✓		✓		✓	R/W	Floating Point in Engineering Units.
007C	0125	Output High Limit	✓		✓		✓	R/W	Floating Point in Engineering Units.
007E	0127	Output Working Value	✓	✓	✓	✓	✓	R/W	Floating Point in Engineering Units.
0086	0135	Ratio	✓		✓			R/W	Floating Point in Engineering Units.
0088	0137	Bias	✓		✓		✓	R/W	Floating Point in Engineering Units. Auto/Man bias block, value is Read-Only
008A	0139	Deviation	✓	✓	✓	✓		R	Floating Point in Engineering Units. (SP-PV)
008E	0143	Manual Reset	✓		✓			R/W	Floating Point in Engineering Units.
0090	0145	Feed-forward Gain	✓		✓			R/W	Floating Point in Engineering Units.
0092	0147	Local Percent Carbon Monoxide			✓			R/W	Floating Point in Engineering Units.
0094	0149	Furnace Factor			✓			R/W	Floating Point in Engineering Units.
0096	0151	Percent Hydrogen			✓			R/W	Floating Point in Engineering Units.
0098	0153	On/Off Output Hysteresis		✓				R/W	Floating Point in percent of input span
009A	0155	Carbon Potential Dewpoint			✓			R/W	Floating Point in Engineering Units
009C	0157	Three Position Step Motor Time				✓		R/W	Floating Point in seconds
00F7	0248	Enable/Disable Fuzzy	✓		✓	✓		R/W	Bit Packed Bit 0: 0:Disable; 1:Enable
00F8	0249	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	0250	Anti-soot set point limit enable			✓			R/W	Bit Packed Bit 0: 0:Off; 1:On Bit 1-15: Unused
00FA	0251	Auto/Manual State	✓	✓	✓	✓	✓	R/W	Bit Packed Bit 0: 0:Manual; 1:Auto Bit 1-15: Unused

**Parameters accessible with Function Code 03, 06,10h
Loop Values**

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Loop type					Access	Notes
			PID On / Off	Carb	3Pos	AMB			
00FB	0252	Set Point State	✓	✓	✓	✓		R/W	Bit Packed (selects either SP1 or SP2 as a local SP if the HC900 is configured as such in PID setup) Bit 0: 0:SP1; 1:SP2 Bit 1-15: Unused
00FC	0253	Remote/Local Set Point State	✓	✓	✓	✓		R/W	Bit Packed Bit 0: 0:LSP; 1:RSP Bit 1-15: Unused
00FD	0254	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	0255	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
See Table 6-28 on page 92for additional loop parameters for custom maps only.									

Examples for loop queries using Function Codes 3, 6, 16

Example 1

Query: Read PV, Remote SP, Working SP, Output for Loop 1 from HC900 at slave address 01 using Function Code 3 (hex codes). This will be accomplished by accessing contiguous registers.

TCP:

00	03	00	40	00	08
----	----	----	----	----	----

RTU:

01	03	00	40	00	08	CRC	CRC
----	----	----	----	----	----	-----	-----

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

TCP:

00	03	10	44	7A	00	00	44	7A	00	00	44	7A	00	00	42	48	00	00
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

RTU:

01	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 HC900 at slave address 01 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.

TCP:

00	10	00	6A	00	02	04	42	C8	00	00
----	----	----	----	----	----	----	----	----	----	----

RTU:

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

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

TCP:

00	10	00	6A	00	02
----	----	----	----	----	----

RTU:

01	10	00	6A	00	02	CRC	CRC
----	----	----	----	----	----	-----	-----

Example 3:

Query: Using Function code 6, set Loop #1 to Auto (register 00FA hex) at controller at slave address 01. This is a bit-packed single register data type. Registers are addressed starting at 0: Register 1 is addressed as 0.

TCP:

00	06	00	FA	00	01
----	----	----	----	----	----

RTU:

01	06	00	FA	00	01	CRC	CRC
----	----	----	----	----	----	-----	-----

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

TCP:

00	06	00	FA	00	01
----	----	----	----	----	----

RTU:

01	06	00	FA	00	01	CRC	CRC
----	----	----	----	----	----	-----	-----

6.5 Analog Input - Function Code 03

Summary

Not available for versions 4.0 and later. Used to access analog input parameters for the first 8 channels of the first 8 modules of Rack #1. (Address compatible with UMC800.)

To access *any* analog input channels use Function Code 04. See page 32.

Analog Input Example: AI1 through AI64. The mapping is with respect to card position starting with the first card module position and continuing to the 8th module position. The first module position would be AI1 thru AI8. The next AI card in slot 2 would be AI9 thru AI16 and so on.

Function Code Support:

Reads – Function Codes 03 (limited to the first 8 slots of Rack #1)

Table 6-4 Analog Input Value Addresses - Function Code 03

Fixed Address (hex)	Fixed Register (decimal)	Channel Number	Access	Notes
1800	6145	Analog Input #1	R	Floating Point in Engineering Units.
1802	6147	Analog Input #2	R	
1804	6149	Analog Input #3	R	
1806	6151	Analog Input #4	R	
1808	6153	Analog Input #5	R	
180A	6155	Analog Input #6	R	
180C	6157	Analog Input #7	R	
180E	6159	Analog Input #8	R	
1810	6161	Analog Input #9	R	
1812	6163	Analog Input #10	R	
1814	6165	Analog Input #11	R	
1816	6167	Analog Input #12	R	
:	:	:		
187E	6271	Analog Input #64	R	

Example

Read Analog Inputs 1 and 2 from HC900 at slave address 01 using Function Code 03.

TCP:

00	03	18	00	00	04
----	----	----	----	----	----

RTU:

01	06	00	FA	00	01	CRC	CRC
----	----	----	----	----	----	-----	-----

Response from HC900 where AI1 = 100.0 and AI 2 = 55.32

TCP:

00	03	08	42	C8	00	00	42	5D	47	AE
----	----	----	----	----	----	----	----	----	----	----

RTU:

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

6.6 Variables

Summary

Variables (analog or digital) are writeable parameters in HC900 attached to input pins of function blocks. Digital Variable status is also represented in floating point: 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 HC900 configuration.

You will need to access the HC900 Process Control Designer configuration or corresponding configuration printout of Tag Information Report to identify the Variable numbers desired.

Single byte writes are permitted to digital variables. A non-zero will automatically set the digital variable to a floating point 1 and a zero write to a single register will set the digital variable to 0.

Function Code Support:

Read – Function Code 3

Write – Function Codes 6 (digital variables only), 16 (10 Hex)

The addresses given in Table 6-5 do not necessarily apply to variables in the custom map. For custom addresses view or print a report in HC Designer.

Table 6-5 Variables

Fixed Address (hex)	Fixed Register (decimal)	Parameter	Access	Notes	
18C0	6337	Variable Value #1	R/W	Floating Point in Engineering Units.	
18C2	6339	Variable Value #2	R/W		
18C4	6341	Variable Value #3	R/W		
18C6	6343	Variable Value #4	R/W		:
18C8	6345	Variable Value #5	R/W		:
18CA	6347	Variable Value #6	R/W		:
18CC	6349	Variable Value #7	R/W		:
18CE	6351	Variable Value #8	R/W		:
18D0	6353	Variable Value #9	R/W		:
18D2	6355	Variable Value #10	R/W		:
18D4	6357	Variable Value #11	R/W		:
18D6	6359	Variable Value #12	R/W		:
18D8	6361	Variable Value #13	R/W		:
18DA	6363	Variable Value #14	R/W		:
18DC	6365	Variable Value #15	R/W		:
18DE	6367	Variable Value #16	R/W		:
18E0	6369	Variable Value #17	R/W		:
18E2	6371	Variable Value #18	R/W		:
18E4	6373	Variable Value #19	R/W		:
18E6	6375	Variable Value #20	R/W		:
:	:	:		:	
1D6E	7535	Variable Value #600	R/W	:	

**Parameters accessible with Function Code 03, 06,10h
Time**

Example

Query: Read Variables 1 and 2 from HC900 at address 1 using Function Code 3 (hex codes).

TCP:

00	03	18	C0	00	04
----	----	----	----	----	----

RTU:

01	03	18	C0	00	04	CRC	CRC
----	----	----	----	----	----	-----	-----

Response: from HC900 where Variable 1 = 100.0 and Variable 2 = 55.32

TCP:

00	03	08	42	C8	00	00	42	5D	47	AE
----	----	----	----	----	----	----	----	----	----	----

RTU:

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

6.7 Time

The addresses given in Table 6-6 do not necessarily apply to time parameters in the custom map. For custom addresses view or print a report in HC Designer.

In HC Designer’s custom map these parameters are grouped under the Item Filter “System Parameters.”

You must add them all to the custom map in order to write to them. See Attention below.

Table 6-6 Time parameters

Fixed Address (hex)	Fixed Register (decimal)	Parameter	Access	Notes
1DF0	7665	Hours	R/W	0 to 23
1DF1	7666	Minutes	R/W	0 to 60
1DF2	7667	Seconds	R/W	0 to 60
1DF3	7668	Month	R/W	1 to 12
1DF4	7669	Day	R/W	1 to 31
1DF5	7670	Year	R/W	1970 to 2037 <i>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</i>
1DF6	7671	Week Day	R	0 to 6 (0 = Sunday)

ATTENTION

Time registers must all be written in a single transaction. Writing to Week Day is optional.

6.8 Set Point Programmer

Summary

The SP Programmer parameters are listed according to category related to program status and interaction, other programmer parameters and program segment mapping.

In the fixed map each SP Programmer is assigned to three non-contiguous sections of the map:

- SP Programmer parameters (Table 6-9)
- SP Programmer Additional parameters (Table 6-9, page 60)
- SPP Programmer segments (Table 6-10).

In a custom map the above parameters may be contiguous.

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 6-10.

Procedure for Downloading Setpoint Profile

These steps are for programmer 1. For programmers 2, 3, 4, 5, 6, 7, and 8 adjust the register addresses accordingly by adding offset for starting addresses.

Table 6-7 is for downloading using Function Codes 3, 4, 6, 16.

If using a custom map, you need to know the addresses of the parameters referred to in this procedure. Use HC Designer to print a report showing the Modbus registers of the SP Programmers.

Table 6-7 Steps to Download a Setpoint Program using Modbus Function Codes 3, 6, 16

Step	Action
1	Set the programmer to RESET by writing any number to Reset parameter (p. 60). This can be done either with function code 6 or 16.
2	Clear the program by writing a 0 to Current Program Number (p. 60). 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 profile (leave all others at 0). See Table 6-9 items marked with **. Do not write yet to Program Save Request (p. 60). Floating point registers must be written using function code 16. Bit-packed registers can be written with either function code 6 or 16. Note: Display High Range Limit and Display Low Range Limit (p. 60) are not presently used in the HC900 but can be used on external operator interfaces.
4	Write the information for each segment required in the profile. Each segment uses 8 registers and all 400 registers of the 50 segments are contiguous. See Table 6-10. The first 2 registers of each segment are bit-packed and can be written with either function code 6 or 10; the last 6 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 Program Save Request (p. 60). This will store the downloaded data utilized by the programmer block to the program (profile) number used. Profile numbers may range from 1-99.
The program is now ready to run. Note that the Current Program Number (p. 60) is automatically set to the saved program number.	

Procedure for Uploading Setpoint Programs

If using a custom map, you need to know the addresses of the parameters referred to in this procedure. Use HC Designer to create a report showing the Modbus registers of the SP Programmers.

Table 6-8 Steps to Upload a Setpoint Program using Modbus Function Codes 3, 6, 16

Step	Action
1	Set the programmer to RESET by writing any number to the address (p. 60). 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 Current Program Number (p. 60). This is a floating point register and requires a multiple register write (function code 16).
3	Using function code 3, read the header information desired. See Table 6-9 items marked with **.
4	Read the information for each segment desired using function code 3. See Table 6-10.

Set Point Programmer parameters

This table contains Values of SP Programmers. *Fixed addresses are for SP Programmer #1; see Table 6-1 for fixed addresses of other SP Programmers.*

Parameters commonly used for controlling a program are marked with a single asterisk*.

Parameters commonly used to define a setpoint profile are marked with two asterisks **.

The addresses given in Table 6-9 do not necessarily apply to programmers in the custom map. For custom addresses view or print a report in HC Designer.

Table 6-9 Set Point Programmer parameters

Fixed Address (hex)	Fixed Register (decimal)	Parameter	Access	Notes
1E00	7681	Set Point Programmer Output*	R	Floating Point in Engineering Units.
1E02	7683	Current Segment Number*	R/W	Floating Point; 1...Max Segment # 50 A write changes the segment number.
1E04	7685	Program Elapsed Time*	R	Floating Point in Minutes Continues to run when in Hold
1E08	7689	Segment Time Remaining*	R	Floating Point in Minutes
1E0A	7691	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	7692	Status*	R	Bit Packed Bit 0: 1=Ready Bit 1: 1=Run Bit 2: 1=Hold Bit 3: 1=End Bit 4: 1=Reserved Bit 5: 1=Time Units in Minutes Bit 6: 1=Time Units in Hours Bit 7: Ramp Units 0: Time 1: Rate Bit 8: Reserved Bit 9: If bit 2 Set 0: Operator hold 1: Guaranteed soak hold Bit 10: 0: Current segment is a soak 1: Current segment is a ramp Bit 11-15: Reserved
1E0C	7693	Run*	W	Signed 16 bit integer Write to location Starts Profile; Data ignored
1E0D	7694	Hold*	W	Signed 16 bit integer Write to location Holds Profile; Data ignored
1E0E	7695	Advance*	W	Signed 16 bit integer Write to location Advances Profile one segment while in Hold mode; Data ignored

**Parameters accessible with Function Code 03, 06,10h
Set Point Programmer**

Fixed Address (hex)	Fixed Register (decimal)	Parameter	Access	Notes
1E0F	7696	Reset*	W	Signed 16 bit integer Write to location Resets Profile after program is first in Hold mode; Data ignored
<i>Setpoint Programmer Additional Parameters:</i>				
1F00	7937	Current Program Number*	R/W	Floating Point Indicates the present profile number in use. This also allows entry of a profile number from the HC900 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.
1F02	7939	Program Save Request**	R/W	Floating Point Assigns profile parameters downloaded to a profile number such as 1. This is required by the HC900 to be the last parameter downloaded. This overwrites what is in this HC900 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	7941	Auxiliary Output*	R	Floating Point
1F06	7943	Guaranteed Soak Low**	R/W	Floating Point Presets High Deviation setting in engineering units. Writing to this register is only permissible in the reset or ready mode
1F08	7945	Guaranteed Soak High**	R/W	Floating Point Presets Low Deviation setting in engineering units. Writing to this register is only permissible in the reset or ready mode
1F0A	7947	Restart Ramp Rate	R/W	Floating Point Writing to this register is only permissible in the reset or ready mode
1F0C	7949	Display High Range Limit	R/W	Floating Point Writing to this register is only permissible in the reset or ready mode. Not presently used in the HC900 but can be used on external operator interfaces.
1F0E	7951	Display Low Range Limit	R/W	Floating Point Writing to this register is only permissible in the reset or ready mode. Not presently used in the HC900 but can be used on external operator interfaces

**Parameters accessible with Function Code 03, 06,10h
Set Point Programmer**

Fixed Address (hex)	Fixed Register (decimal)	Parameter	Access	Notes
1F10	7953	Jog Segment	R/W	Floating Point Writing to this register is only permissible in the reset or ready mode
1F12	7955	Loop Start	R/W	Floating Point 0 indicates no loop. Writing to this register is only permissible in the reset or ready mode
1F14	7957	Loop End	R/W	Floating Point 0 indicates no loop. Writing to this register is only permissible in the reset or ready mode
1F16	7959	Repeats	R/W	Floating Point 0 indicates loop forever. Writing to this register is only permissible in the reset or ready mode
1F3A	7995	Time Units**	R/W	Bit Packed Bit 0: Reserved 1: minutes 2: hours 3-15: Unused
1F3B	7996	Ramp Units**	R/W	Bit Packed Bit 0: 0:Time; 1:Rate Bit 1-15: Unused Writing to this register is only permissible in the reset or ready mode
1F3C	7997	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 Writing to this register is only permissible in the reset or ready mode

Set Point Profile Segments

The table below describes the registers that are part of a setpoint profile segment. A profile contains up to 50 segments and each segment consumes 8 registers, therefore each profile uses 400 contiguous registers. To determine the actual register address for a parameter within a segment, add the register offset to the start address of the segment. *This table contains fixed addresses of SP Programmer #1 Segments; see Table 6-1 for starting addresses of other SP Programmer Segments.*

The addresses given in Table 6-10 do not necessarily apply to segments in the custom map. For custom addresses view or print a report in HC Designer.

Table 6-10 SP Programmer Segments

Fixed Address (Hex)	Fixed Register (Decimal)	Register Offset	Parameter	Access	Notes
2800	10241	0	Segment #1 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.
2801	10242	1	Segment #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.
2802	10243	2	Segment #1 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.
2804	10245	4	Segment #1 Ramp or Soak value	R/W	Floating Point Writing to this register is not permissible in the run mode.
2806	10247	6	Segment #1 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.
2808	10249	8	Segment #2 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.
.
.
.
298E	10639	398	Segment #50 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.

Example For Determining a Segment Register's fixed address

Note: Custom map users should ignore this procedure. Obtain segment addresses by printing a Modbus Register Report in HC Designer.

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 programmer #2 segments. The value is 2A00 Hex.

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

$$\begin{aligned}\text{Segment \#8 offset address} &= (\text{segment number} - 1) * 8 \\ &= (8-1) * 8 \\ &= 56 \text{ or } 38 \text{ Hex}\end{aligned}$$

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.

$$\begin{aligned}\text{Register address} &= \text{Setpoint program \#2 segment start address} \\ &\quad + \text{Segment 8 offset address} \\ &\quad + \text{Ramp value register offset} \\ &= 2A00 + 38 + 4 \\ &= 2A3C\end{aligned}$$

6.9 Signal Tags

Summary

Signal tags are connected to output pins of function blocks, representing analog or digital parameters, and are read-only parameters. Digital Signal tags are also represented in floating point, 0.0 for OFF or logic 0, 1.0 for ON or logic 1. The signal tag number in Table 6-11 corresponds to the signal tag number in the HC900 Process Control Designer configuration. You will need to access the Process Control Designer configuration "Tag Information" report to identify the Signal Tag numbers desired.

Note: to convert floating point values (analog or digital) to integer 16, (for use with third party touch panels and associated HMI software, for example), use the *user-defined* signals and variables for assigning new Modbus addresses and associated data type, configurable in HC Designer, Ver. 2.0 or later.

Function Code Support:

Read – Function Code 3

NOTES:

- Floating Point in Engineering Units
- Digital Signal Tags are represented as 0.0 for OFF, 1.0 for ON.
- Access is Read Only
- Signal tags 1-1000 have two addresses each; one for legacy use and one for HC900. For example, signal tag #1 is at hex addresses 2000 and 3B60.

The addresses given in Table 6-11 do not necessarily apply to signal tags in the custom map. For custom addresses view or print a report in HC Designer.

Table 6-11 Signal Tags

Legacy			HC900 Range		
Fixed Address (hex)	Fixed Register (decimal)	Parameter	Fixed Address (hex)	Fixed Register (decimal)	Channel Number
2000	8193	Signal tag #1	3B60	15201	Signal tag #1
2002	8195	Signal tag #2	3B62	15203	Signal tag #2
2004	8197	Signal tag #3	3B64	15205	Signal tag #3
2006	8199	Signal tag #4	3B66	15207	Signal tag #4
2008	8201	Signal tag #5	3B68	15209	Signal tag #5
200A	8203	Signal tag #6	3B6A	15211	Signal tag #6
200C	8205	Signal tag #7	3B6C	15213	Signal tag #7
200E	8207	Signal tag #8	3B6E	15215	Signal tag #8
2010	8209	Signal tag #9	3B70	15217	Signal tag #9
2012	8211	Signal tag #10	3B72	15219	Signal tag #10
.
.
.
27CE	10191	Signal tag #1000	432E	17199	Signal tag #1000
			4330	17201	Signal tag #1001
			.	.	.
			.	.	.
			.	.	.
			5A9E	23199	Signal tag #4000

Example

Query: Read Signal Tags 3 and 4 from HC900 at address 1 using Function Code 3 (hex codes).

TCP:

00	03	20	04	00	04
----	----	----	----	----	----

RTU:

01	03	20	04	00	04	CRC	CRC
----	----	----	----	----	----	-----	-----

Response: from HC900 where Signal Tag 3 = 100.0 and Signal Tag 4 = 55.32

TCP:

00	03	08	42	C8	00	00	42	5D	47	AE
----	----	----	----	----	----	----	----	----	----	----

RTU:

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

6.10 Scheduler

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.

In the fixed map each Scheduler is assigned to two non-contiguous sections of the map:

- Scheduler parameters (Table 6-15)
- Schedule segments (Table 6-16).

In a custom map the above parameters may be contiguous.

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 6-15 contains Value Register addresses of SP Scheduler #1. See Table 6-1 for starting and ending addresses (hex) for SP Scheduler #2.

Scheduler Segment Register Map

Table 6-16 indicates the range of addresses applicable to a scheduler segment. Each segment uses 48 registers (30 hex).

Segment Register Map Addresses

Table 6-17 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 6-17.

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 6-16 for the range of addresses applied to each scheduler segment. Each segment uses 48 registers (30 hex). Use the **Segment Register Map** - Table 6-17 for the parameters to be referenced for read/write within each segment. Application notes for these segment parameters is provided.

Scheduler Addresses

The parameters that follow refer to SP Scheduler #1. Table 6-12 lists the Starting and Ending addresses for all of the SP Schedulers. For custom addresses view or print a report in HC Designer.

Table 6-12 SP Scheduler Addresses

Scheduler Number	Starting Address (Hex)	Starting Register (Decimal)	Ending Address (Hex)	Ending Register (decimal)
SP Scheduler 1	3000	12289	304F	12368
SP Scheduler 2	3050	12369	309F	12448

Procedures for Downloading Setpoint Schedules

Table 6-13 is for downloading using Function Codes 3, 6, 16.

Table 6-13 Steps to Download a Setpoint Schedule using Modbus Function Codes 3, 6, 16

Step	Action
1	Set the scheduler to RESET by writing any number to Reset (p. 70). This can be done either with function code 6 or 16.
2	Clear the schedule by writing a 0 to Current Program Number (p. 69). 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, that is, Guaranteed Soak Limits 1-8 (p. 69), Jog Segment (p. 69), Time Units (p. 70). Guaranteed Soak Limits 1-8 and Jog Segment are floats and must be written using function code 16. Time Units is bit-packed and can be written with either function code 6 or 16. Leave all others at 0.
4	Write the information for each segment required in the schedule (p. 71). 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 Schedule Save Request (p. 69). 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 program (schedule) number (p. 69) is automatically set to the saved schedule number.	

Procedure for Uploading Setpoint Schedules

Table 6-14 Steps to Upload a Setpoint Schedule using Modbus Function Codes 3, 6, 16

Step	Action
1	Set the scheduler to RESET by writing any number to Reset (p. 70). 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 Current Program Number (p. 69). This is a floating point register and requires a multiple register write (function code 16)
3	Read the header information desired. Guaranteed Soak Limits 1-8 (p. 69), Jog Segment (p. 69), Time Units (p. 70). Use function code 3.
4	Read the information for each segment in the schedule (p. 71) using function code 3.

Scheduler parameters

This table contains Values of Schedulers. Fixed addresses are for Scheduler #1; see Table 6-1 for fixed addresses of other Schedulers.

Parameters commonly used for controlling a scheduler are marked with a single asterisk*.

Parameters commonly used to define a schedule are marked with two asterisks **.

The addresses given in Table 6-15 do not necessarily apply to schedulers in the custom map. For custom addresses view or print a report in HC Designer.

Table 6-15 Scheduler Parameters

Fixed Address (hex)	Fixed Register (decimal)	Parameter	Access	Notes
3000	12289	Scheduler Output 1**	R	Floating Point in Engineering Units.
3002	12291	Scheduler Output 2**	R	Floating Point in Engineering Units.
3004	12293	Scheduler Output 3**	R	Floating Point in Engineering Units.
3006	12295	Scheduler Output 4**	R	Floating Point in Engineering Units.
3008	12297	Scheduler Output 5**	R	Floating Point in Engineering Units.
300A	12299	Scheduler Output 6**	R	Floating Point in Engineering Units.
300C	12301	Scheduler Output 7**	R	Floating Point in Engineering Units.
300E	12303	Scheduler Output 8**	R	Floating Point in Engineering Units.
3010	12305	Scheduler Auxiliary Output 1**	R	Floating Point in Engineering Units.
3012	12307	Scheduler Auxiliary Output 2**	R	Floating Point in Engineering Units.
3014	12309	Scheduler Auxiliary Output 3**	R	Floating Point in Engineering Units.
3016	12311	Scheduler Auxiliary Output 4**	R	Floating Point in Engineering Units.
3018	12313	Scheduler Auxiliary Output 5**	R	Floating Point in Engineering Units.
301A	12315	Scheduler Auxiliary Output 6**	R	Floating Point in Engineering Units.
301C	12317	Scheduler Auxiliary Output 7**	R	Floating Point in Engineering Units.
301E	12319	Scheduler Auxiliary Output 8**	R	Floating Point in Engineering Units.

**Parameters accessible with Function Code 03, 06,10h
Scheduler**

Fixed Address (hex)	Fixed Register (decimal)	Parameter	Access	Notes
3020	12321	Current Program Number*	R/W	Floating Point Indicates the present schedule number in use. This also allows entry of a schedule number from the HC900 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	12323	Current Segment Number*	R/W	Floating Point; 1 thru Max Segment # A write changes the segment number.
3024	12325	Program Elapsed Time*	R	Floating Point in Time Units Includes or runs when in Hold
3026	12327	Segment Time Remaining*	R	Floating Point in Time Units
3028	12329	Schedule Save Request*	R/W	Floating point. Assigns profile parameters downloaded to a schedule number such as 1. This is required by the HC900 to be the last parameter downloaded. This overwrites what is in this HC900 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	12331	Guaranteed Soak Limit 1**	R/W	Floating Point
302C	12333	Guaranteed Soak Limit 2**	R/W	Floating Point
302E	12335	Guaranteed Soak Limit 3**	R/W	Floating Point
3030	12337	Guaranteed Soak Limit 4**	R/W	Floating Point
3032	12339	Guaranteed Soak Limit 5**	R/W	Floating Point
3034	12341	Guaranteed Soak Limit 6**	R/W	Floating Point
3036	12343	Guaranteed Soak Limit 7**	R/W	Floating Point
3038	12345	Guaranteed Soak Limit 8**	R/W	Floating Point
303A	12347	Jog Segment*	R/W	Floating Point Defines segment for schedule to jog based on an enable to an input pin
3049	12362	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

**Parameters accessible with Function Code 03, 06,10h
Scheduler**

Fixed Address (hex)	Fixed Register (decimal)	Parameter	Access	Notes
304A	12363	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	12364	Start*	W	Signed 16 bit integer Write to location Starts Schedule; Data ignored
304C	12365	Hold*	W	Signed 16 bit integer Write to location Holds Schedule; Data ignored
304D	12366	Advance*	W	Signed 16 bit integer Write to location Advances Schedule; Data ignored
304E	12367	Reset*	W	Signed 16 bit integer Write to location Resets Schedule; Data ignored
304F	12368	Time Units*	R/W	Bit Packed Bit 0: Reserved 1: minutes 2: hours 3-15: Unused

Scheduler Segment Fixed Register Map

A schedule can contain up to 50 segments. Each segment is made up of 48 (30 hex) registers, for a total of 2400 contiguous registers. This table contains Segment Map fixed addresses of SP Scheduler #1. *See Table 6-1 for starting and ending addresses (hex) for SP Scheduler #2 Addresses.*

The addresses given in Table 6-16 do not necessarily apply to scheduler segments in the custom map. For custom addresses view or print a report in HC Designer.

Table 6-16 Scheduler #1 Segment Fixed Addresses

Fixed Start Address (Hex)	Fixed Start Register (Decimal)	Fixed End Address (Hex)	Fixed End Register (Decimal)	Description
3200	12801	322F	12847	Scheduler #1 Segment 1
3230	12849	325F	12896	Scheduler #1 Segment 2
3260	12897	328F	12944	Scheduler #1 Segment 3
:	:	:	:	:
3B30	15153	3B5F	15200	Scheduler #1 Segment 50

Segment registers

The table below describes the registers that are part of a setpoint schedule. A schedule contains 50 segments. Each segment is made up of 28 parameters (Segment n Guaranteed Soak Type 1 through Segment n Recycle Segment) which consumes 48 (30 hex) registers, for a total of 2400 contiguous registers. This table contains fixed addresses of Schedule #1 Segments; see Table 6-1 for fixed addresses of Schedule Segments. In a custom map the segment registers contiguously follow the other Schedule registers listed in Table 6-15.

All 50 segments are used to define a schedule. You can't specify which segments get assigned.

The addresses given in Table 6-17 do not necessarily apply to segments in the custom map. For custom addresses view or print a report in HC Designer.

Table 6-17 Schedule Segments 1-50

Fixed Start Address (Hex)	Fixed Start Register (Decimal)	Offset (Hex)	Offset (Decimal)	Parameter Name	Access	Notes
3200	12801	0000	0000	Segment #1 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
3201	12802	0001	0001	Segment #1 Guaranteed Soak Type 2	R/W	See Guaranteed Soak Type 1
3202	12803	0002	0002	Segment #1 Guaranteed Soak Type 3	R/W	See Guaranteed Soak Type 1
3203	12804	0003	0003	Segment #1 Guaranteed Soak Type 4	R/W	See Guaranteed Soak Type 1
3204	12805	0004	0004	Segment #1 Guaranteed Soak Type 5	R/W	See Guaranteed Soak Type 1
3205	12806	0005	0005	Segment #1 Guaranteed Soak Type 6	R/W	See Guaranteed Soak Type 1
3206	12807	0006	0006	Segment #1 Guaranteed Soak Type 7	R/W	See Guaranteed Soak Type 1
3207	12808	0007	0007	Segment #1 Guaranteed Soak Type 8	R/W	See Guaranteed Soak Type 1
3208	12809	0008	0008	Segment #1 Events	R/W	Bit Packed Bit 0: Event #1 : : Bit 15: Event #15 0: Event OFF 1: Event ON Note 2
320A	12811	000A	0010	Segment #1 Time	R/W	Floating Point in seconds Note 1
320C	12813	000C	0012	Segment #1 Output #1 Ramp or Soak value	R/W	Floating Point Note 1
320E	12815	000E	0014	Segment #1 Output #2 Ramp or Soak value	R/W	Floating Point Note 1
3210	12817	0010	0016	Segment #1 Output #3 Ramp or Soak value	R/W	Floating Point Note 1

**Parameters accessible with Function Code 03, 06,10h
Scheduler**

Fixed Start Address (Hex)	Fixed Start Register (Decimal)	Offset (Hex)	Offset (Decimal)	Parameter Name	Access	Notes
3212	12819	0012	0018	Segment #1 Output #4 Ramp or Soak value	R/W	Floating Point Note 1
3214	12821	0014	0020	Segment #1 Output #5 Ramp or Soak value	R/W	Floating Point Note 1
3216	12823	0016	0022	Segment #1 Output #6 Ramp or Soak value	R/W	Floating Point Note 1
3218	12825	0018	0024	Segment #1 Output #7 Ramp or Soak value	R/W	Floating Point Note 1
321A	12827	001A	0026	Segment #1 Output #8 Ramp or Soak value	R/W	Floating Point Note 1
321C	12829	001C	0028	Segment #1 Soak value for Auxiliary Output #1	R/W	Floating Point Note 1
321E	12831	001E	0030	Segment #1 Soak value for Auxiliary Output #2	R/W	Floating Point Note 1
3220	12833	0020	0032	Segment #1 Soak value for Auxiliary Output #3	R/W	Floating Point Note 1
3222	12835	0022	0034	Segment #1 Soak value for Auxiliary Output #4	R/W	Floating Point Note 1
3224	12837	0024	0036	Segment #1 Soak value for Auxiliary Output #5	R/W	Floating Point Note 1
3226	12839	0026	0038	Segment #1 Soak value for Auxiliary Output #6	R/W	Floating Point Note 1
3228	12841	0028	0040	Segment #1 Soak value for Auxiliary Output #7	R/W	Floating Point Note 1
322A	12843	002A	0042	Segment #1 Soak value for Auxiliary Output #8	R/W	Floating Point Note 1
322C	12845	002C	0044	Segment #1 Recycle	R/W	Number of times to recycle Floating Point Note 2
322E	12847	002E	0046	Segment #1 Recycle Segment	R/W	Floating Point Note 2
<i>The above parameters are repeated for segments 2 through 50.</i>						
3230	12848	0030	0048	Segment #2 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
.
.
.
3B5E	15199	095E	2398	Segment #50 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

Example for Determining a Segment Fixed Register

Note: Custom map users must get segment addresses by printing a Modbus Register Report in HC Designer.

Note: To change the ramp value for Output #6 in segment #5 of setpoint scheduler #2, the register address is determined as follows.

Step 1: Use Table 6-1 to determine the start address for scheduler #2's segments. The value is 6C00 Hex.

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

$$\begin{aligned}\text{Segment offset address} &= (\text{segment number} - 1) * 48 \\ &= (5-1) * 48 \\ &= 192 \text{ or C0 Hex}\end{aligned}$$

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.

$$\begin{aligned}\text{Register address} &= \text{Schedule \#2 segment start address} \\ &+ \text{Segment 5 offset address} \\ &+ \text{Output \#6 ramp value register offset} \\ &= 6C00 + C0 + 16 \\ &= 6CD6\end{aligned}$$

6.11 Sequencer

Summary

In the fixed map each Sequencer uses three non-contiguous sections of the map:

- Sequencer parameters (Table 6-21)
- Sequencer steps (Table 6-21)
- Sequencer states (Table 6-21).

In a custom map the above parameters are contiguous.

Function Code Support

Read – Function Code 3

Write – Function Code 16 (10 hex)

Sequencers 1-4 Parameter Addresses

The addresses given in Table 6-18 do not necessarily apply to sequencers in the custom map. For custom addresses view or print a report in HC Designer.

Table 6-18 Sequencers 1-4 Parameters Fixed Addresses

	Starting Address (Hex)	Starting Register (Decimal)	Ending Address (Hex)	Ending Address (Decimal)
Sequencer #1 Parameters	5AA0	23201	5AB5	23222
Sequencer #2 Parameters	5D00	23809	5D1F	23840
Sequencer #3 Parameters	5F60	24417	5F7F	24448
Sequencer #4 Parameters	A000	40961	A01F	40992

Sequencers 1-4 Step 1 Addresses

The addresses given in Table 6-19 do not necessarily apply to sequencer steps in the custom map. For custom addresses view or print a report in HC Designer.

Table 6-19 Sequencer 1-4 Step 1 Fixed Addresses

	Starting Address (Hex)	Starting Register (Decimal)	Ending Address (Hex)	Ending Address (Decimal)
Sequencer #1 Step 1 Table	5AC0	23233	5CBF	23744
Sequencer #2 Step 1 Table	5D20	23841	5F1F	24532
Sequencer #3 Step 1 Table	5F80	24449	617f	24960
Sequencer #4 Step 1 Table	A020	40993	A21F	41504

Sequencers 1-4 State Addresses

The addresses given in Table 6-20 do not necessarily apply to sequencer states in the custom map. For custom addresses view or print a report in HC Designer.

Table 6-20 Sequencer 1-4 State Fixed Addresses

	Starting Address (Hex)	Starting Register (Decimal)	Ending Address (Hex)	Ending Address (Decimal)
Sequencer #1 State Table	5CC0	23745	5CFF	23808
Sequencer #2 State Table	5F20	24353	5F5F	24416
Sequencer #3 State Table	6180	24961	61BF	25024
Sequencer #4 State Table	A220	41505	A25F	41568

Sequencer Parameters

Fixed addresses are for Sequencer #1. For fixed addresses of other Sequencers see Table 6-1, or Table 6-18, Table 6-19, and Table 6-20.

Parameters commonly used for controlling a sequencer are marked with a single asterisk*.

Parameters commonly used to define a sequence are marked with two asterisks **.

Note: in the custom map either all or none of the segment step data is addressed, you can't specify which steps get addressed.

The addresses given in Table 6-21 do not necessarily apply to sequencers in the custom map. For custom addresses view or print a report in HC Designer.

Table 6-21 Sequencer Parameters

Fixed Address (hex)	Fixed Register (decimal)	Parameter	Access	Notes
5AA0	23201	Not used	N/A	Not used
5AA1	23202	Save current sequence request**	R/W	Integer, Saves current sequence to archive and assigns it to the number written (1-20).
5AA2	23203	Reset*	W	Integer, Write to this location results in reset action and data is ignored.
5AA3	23204	Run*	W	Integer, Write to this location starts run action and data is ignored.
5AA4	23205	Hold*	W	Integer, Write to this location results in reset action and data is ignored.
5AA5	23206	Advance*	W	Integer, Write to this location results in an advance to next step and data is ignored. <i>Writing to this register is only permissible in the hold mode.</i>
5AA6	23207	Not used	N/A	Not used
5AA7	23208	Step jumped to on Jog*	R/W	Integer Step number for jog.
5AA8	23209	Current Sequence number *	R	Integer Sequence number loaded.
5AA9	23210	Step Number*	R	Integer value for current step number.
5AAA	23211	Load Sequence number *	R/W	Integer, sequence number loaded to sequencer. <i>Writing to this register is only permissible in the Ready mode.</i>

**Parameters accessible with Function Code 03, 06,10h
Sequencer**

Fixed Address (hex)	Fixed Register (decimal)	Parameter	Access	Notes
5AAB	23212	Step number change request*	R/W	Integer, go to a step number in any mode.
5AAC	23213	Outputs*	R	Integer, Bit packed for 16 output values 0:OFF 1:ON
5AAD	23214	Time units**	R/W	Integer, 0=hrs, 1=minutes.
5AAE	23215	Elapsed Sequence Time*	R	Floating point value for elapsed sequence time in minutes.
5AB0	23217	Time Remaining in current step*	R	Floating point value for time remaining in current step in minutes.
5AB2	23219	Sequence status*	R	Integer value for bit packed current sequence state : Bit 0 = Ready Bit 1 = Run Bit 2 =Hold Bit 3 = Stop Bit 4 = Disable Bit 5 = time units (minutes) Bit 6 = time units (hours)
5AB4	23221	State*	R	Integer value for current state number
5AB6	23223	Auxiliary Output*	R	Floating point value auxiliary output
<i>The following parameters are partitioned as Sequencer Steps and are not contiguous with the previous partition. All 64 steps are used to define a sequence.</i>				
5AC0	23233	Sequencer #1 Step #1 Time Next step	R/W	Integer value of the next step executed when time expires.
5AC1	23234	Sequencer #1 Step #1 Event1 Next step	R/W	Integer value of the next step executed when configured event 1 transitions from OFF to ON.
5AC2	23235	Sequencer #1 Step #1 Event2 Next step	R/W	Integer value of the next step executed when configured event 2 transitions from OFF to ON.
5AC3	23236	Sequencer #1 Step #1 Advance Next step	R/W	Integer value of the next step executed when Advance transitions from OFF to ON.
5AC4	23237	Sequencer #1 Step #1 Step Time	R/W	Floating value for time of present step.
5AC6	23239	Sequencer #1 Step #1 Auxiliary Output	R/W	Floating Auxiliary analog value associated with the step.
5AC8	23241	Sequencer #1 Step #2 Time Next step	R/W	Integer value of the next step executed when time expires.
.
.
.
5CBE	23743	Sequencer #1 Step #64 Auxiliary Output	R/W	Floating Auxiliary analog value associated with the step.
<i>The following parameters are partitioned as Sequencer States and are contiguous with the previous partition. All 64 state numbers are used to define a sequence.</i>				

**Parameters accessible with Function Code 03, 06,10h
Sequencer**

Fixed Address (hex)	Fixed Register (decimal)	Parameter	Access	Notes
5CC0	23745	Sequencer #1 State Number Step #1	R/W	Integer state number of the output definitions as configured between 1 and 50.
5CC1	23746	Sequencer #1 State Number Step #2	R/W	Integer state number of the output definitions as configured between 1 and 50.
5CC2	23747	Sequencer #1 State Number Step #3	R/W	Integer state number of the output definitions as configured between 1 and 50.
.
.
.
5CFF	23808	Sequencer #1 State Number Step #64	R/W	Integer state number of the output definitions as configured between 1 and 50.

6.12 Stage

Summary

This section contains addresses for the Stage function blocks.

See the Stage Register Maps in Table 6-1 for starting and ending addresses (hex) for Stage #1 through Stage #8 Map Addresses.

The Modbus Stage number address for a Stage block can also be obtained from the Process Control Designer report.

Function Code Support:

Reads – Function Code 3

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

For custom addresses view or print a report in HC Designer.

Table 6-22 Stage Parameters

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
6200	25089	PV1	R	Floating Point in Engineering Units
6202	25091	PV2	R	Floating Point in Engineering Units
6204	25093	Stage #1-4 Override Status	R	Bit Packed: Bit 0: Stage #1 Override Active: 0=NO, 1=YES Bit 1: Stage #1 Override ON: 0=OFF, 1=ON Bit 2: Stage #2 Override Active: 0=NO, 1=YES Bit 3: Stage #2 Override ON: 0=OFF, 1=ON Bit 4: Stage #3 Override Active: 0=NO, 1=YES Bit 5: Stage #3 Override ON: 0=OFF, 1=ON Bit 6: Stage #4 Override Active: 0=NO, 1=YES Bit 7: Stage #4 Override ON: 0=OFF, 1=ON Bits 8-15: Unused
6205	25094	Stage #1-4 PV On/Off Comparison	R	Bit Packed: Bit 0: Stage #1 On Comparitor: 0=PV1, 1=PV2 Bit 1: Stage #1 Off Comparitor: 0=PV1, 1=PV2 Bit 2: Stage #2 On Comparitor: 0=PV1, 1=PV2 Bit 3: Stage #2 Off Comparitor: 0=PV1, 1=PV2 Bit 4: Stage #3 On Comparitor: 0=PV1, 1=PV2 Bit 5: Stage #3 Off Comparitor: 0=PV1, 1=PV2 Bit 6: Stage #4 On Comparitor: 0=PV1, 1=PV2 Bit 7: Stage #4 Off Comparitor: 0=PV1, 1=PV2 Bit 8-15: Unused

**Parameters accessible with Function Code 03, 06,10h
Stage**

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
6206	25095	Stage #1-4 Previous/Next Interlock	R	Bit Packed: Bit 0: Stage #1 Interlock with Previous Stage 0=NO, 1=YES Bit 1: Stage #1 Interlock with Next Stage 0=NO, 1=YES Bit 2: Stage #1 Error with Interlocks 0=NO, 1=YES Bit 3: Stage #2 Interlock with Previous Stage 0=NO, 1=YES Bit 4: Stage #2 Interlock with Next Stage 0=NO, 1=YES Bit 5: Stage #2 Error with Interlocks 0=NO, 1=YES Bit 6: Stage #3 Interlock with Previous Stage 0=NO, 1=YES Bit 7: Stage #3 Interlock with Next Stage 0=NO, 1=YES Bit 8: Stage #3 Error with Interlocks 0=NO, 1=YES Bit 9: Stage #4 Interlock with Previous Stage 0=NO, 1=YES Bit 10: Stage #4 Interlock with Next Stage 0=NO, 1=YES Bit 11: Stage #4 Error with Interlocks 0=NO, 1=YES Bit 12 - 15: Unused
6207	25096	Stage #1-4 Output Status (Request)	R	Bit Packed: Bit 0: Stage #1 Output Enable: 0=NO, 1=YES Bit 1: Stage #1 Output ON: 0=OFF, 1=ON Bit 2: Stage #2 Output Enable: 0=NO, 1=YES Bit 3: Stage #2 Output ON: 0=OFF, 1=ON Bit 4: Stage #3 Output Enable: 0=NO, 1=YES Bit 5: Stage #3 Output ON: 0=OFF, 1=ON Bit 6: Stage #4 Output Enable: 0=NO, 1=YES Bit 7: Stage #4 Output ON: 0=OFF, 1=ON Bit 8-15: Unused
6208	25097	Stage #1 ON Setpoint	R/W	Floating Point in Engineering Units
620A	25099	Stage #2 ON Setpoint	R/W	Floating Point in Engineering Units
620C	25101	Stage #3 ON Setpoint	R/W	Floating Point in Engineering Units

**Parameters accessible with Function Code 03, 06,10h
Stage**

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
620E	25103	Stage #4 ON Setpoint	R/W	Floating Point in Engineering Units
6210	25105	Stage #1 OFF Setpoint	R/W	Floating Point in Engineering Units
6212	25107	Stage #2 OFF Setpoint	R/W	Floating Point in Engineering Units
6214	25109	Stage #3 OFF Setpoint	R/W	Floating Point in Engineering Units
6216	25111	Stage #4 OFF Setpoint	R/W	Floating Point in Engineering Units
6218	25113	Stage #1 Latch Delay	R/W	Floating Point in Seconds
621A	25115	Stage #2 Latch Delay	R/W	Floating Point in Seconds
621C	25117	Stage #3 Latch Delay	R/W	Floating Point in Seconds
621E	25119	Stage #4 Latch Delay	R/W	Floating Point in Seconds
6220	25121	Stage #1 Unlatch Delay	R/W	Floating Point in Seconds
6222	25123	Stage #2 Unlatch Delay	R/W	Floating Point in Seconds
6224	25125	Stage #3 Unlatch Delay	R/W	Floating Point in Seconds
6226	25127	Stage #4 Unlatch Delay	R/W	Floating Point in Seconds

6.13 Ramp

Summary

This section contains parameters and addresses for the Ramp.

See the Ramp Register Maps in Table 6-1 for starting and ending addresses (hex) for Ramp #2 through Ramp #8 Map Addresses.

The Modbus Ramp number address for a Ramp can also be obtained from the Process Control Designer printout of "Block Modbus Addresses".

Function Code Support:

Reads – Function Code 3

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

For custom addresses view or print a report in HC Designer.

Table 6-23 Ramp Parameters

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
6400	25601	PV	R	Floating Point in Engineering Units
6402	25603	Ramp Output	R	Floating Point in Engineering Units
6404	25605	Ramp Default	R	Floating Point in Engineering Units
6406	25607	Ramp Lag Time	R/W	Floating Point in Seconds
6408	25609	Ramp Transfer Up	R/W	Floating Point in Engineering Unit/Second
640A	25611	Ramp Transfer Dn	R/W	Floating Point in Engineering Unit/Second
640C	25613	Ramp #1-4 Enable	R	Bit Packed: Bit 0: Ramp #1 Enable: 0=NO, 1=YES Bit 1: Ramp #2 Enable: 0=NO, 1=YES Bit 2: Ramp #3 Enable: 0=NO, 1=YES Bit 3: Ramp #4 Enable: 0=NO, 1=YES Bit 4-15: Unused
640D	25614	Ramp #1-4 Override Status	R	Bit Packed Bit 0: Ramp #1 Override Active: 0= NO, 1=YES Bit 1: Ramp #1 Override to High Limit: 0=Low Limit, 1= High Limit Bit 2: Ramp #2 Override Active: 0= NO, 1=YES Bit 3: Ramp #2 Override to High Limit: 0=Low Limit, 1= High Limit Bit 4: Ramp #3 Override Active: 0= NO, 1=YES Bit 5: Ramp #3 Override to High Limit: 0=Low Limit, 1= High Limit Bit 6: Ramp #4 Override Active: 0= NO, 1=YES Bit 7: Ramp #4 Override to High Limit: 0=Low Limit, 1= High Limit Bit 8-15: Unused
640E	25615	Ramp #1 Output Scale High	R/W	Floating Point in Engineering Units

**Parameters accessible with Function Code 03, 06,10h
Ramp**

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
6410	25617	Ramp #2 Output Scale High	R/W	Floating Point in Engineering Units
6412	25619	Ramp #3 Output Scale High	R/W	Floating Point in Engineering Units
6414	25621	Ramp #4 Output Scale High	R/W	Floating Point in Engineering Units
6416	25623	Ramp #1 Output Scale Low	R/W	Floating Point in Engineering Units
6418	25625	Ramp #2 Output Scale Low	R/W	Floating Point in Engineering Units
641A	25627	Ramp #3 Output Scale Low	R/W	Floating Point in Engineering Units
641C	25629	Ramp #4 Output Scale Low	R/W	Floating Point in Engineering Units
641E	25631	Ramp #1 Input Limit High	R/W	Floating Point in Engineering Units
6420	25633	Ramp #2 Input Limit High	R/W	Floating Point in Engineering Units
6422	25635	Ramp #3 Input Limit High	R/W	Floating Point in Engineering Units
6424	25637	Ramp #4 Input Limit High	R/W	Floating Point in Engineering Units
6426	25639	Ramp #1 Input Limit Low	R/W	Floating Point in Engineering Units
6428	25641	Ramp #2 Input Limit Low	R/W	Floating Point in Engineering Units
642A	25643	Ramp #3 Input Limit Low	R/W	Floating Point in Engineering Units
642C	25645	Ramp #4 Input Limit Low	R/W	Floating Point in Engineering Units

6.14 Hand/OFF/Auto Control

Summary

This table contains Hand/Off/Auto Map addresses of HOA #1.

See the HOA Register Maps Table 6-1 for starting and ending addresses (hex) for Hand/Off/Auto #2 through Hand/Off/Auto #16 Map Addresses.

The Modbus HOA number address for a HOA can also be obtained from the Process Control Designer printout of "Block Modbus Addresses".

Function Code Support:

Reads – Function Code 3

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

For custom addresses view or print a report in HC Designer.

Table 6-24 HOA Control Parameters

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
6600	26113	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	26114	Remote Off-state Change Request	W	Unsigned 16 Integer Data Ignored
6602	26115	Remote Hand-state Change Request	W	Unsigned 16 Integer Data Ignored
6603	26116	Remote Auto-state Change Request	W	Unsigned 16 Integer Data Ignored
6604	26117	Local Source	W	Unsigned 16 Integer Data Ignored
6605	26118	Remote Source	W	Unsigned 16 Integer Data Ignored
6606	26119	Local and Remote Source	W	Unsigned 16 Integer Data Ignored

6.15 Alternator

Summary

This section contains addresses for the Alternator #1group.

See the Alternator Register Maps in Table 6-1 for starting and ending addresses (hex) for Alternator #2 through Alternator #16 Map Addresses.

The Modbus Alternator number address for an Alternator can also be obtained from the Process Control Designer report.

Function Code Support:

Reads – Function Code 3

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

ATTENTION

Output Order Sequence registers must be written in a single transaction. Duplicate sequence values (1-16) are not permitted.

For custom addresses view or print a report in HC Designer.

Table 6-25 Alternator Parameters

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
6700	26369	Alternator Status	R	Bit Packed Bit 0: Enable: 0=NO, 1=YES Bit 1: Low Capacity 0=Meeting Capacity, 1=Low Capacity Bit 2-15: Unused
6701	26370	Device Ready (#1-16)	R	Bit Packed: Bit 0: Device #1 Ready: 0=NO, 1=YES Bit 1: Device #2 Ready: 0=NO, 1=YES Bit 2: Device #3 Ready: 0=NO, 1=YES Bit 3: Device #4 Ready: 0=NO, 1=YES Bit 4: Device #5 Ready: 0=NO, 1=YES Bit 5: Device #6 Ready: 0=NO, 1=YES Bit 6: Device #7 Ready: 0=NO, 1=YES Bit 7: Device #8 Ready: 0=NO, 1=YES Bit 8: Device #9 Ready: 0=NO, 1=YES Bit 9: Device #10 Ready: 0=NO, 1=YES Bit 10: Device #11 Ready: 0=NO, 1=YES Bit 11: Device #12 Ready: 0=NO, 1=YES Bit 12: Device #13 Ready: 0=NO, 1=YES Bit 13: Device #14 Ready: 0=NO, 1=YES Bit 14: Device #15 Ready: 0=NO, 1=YES Bit 15: device #16 Ready: 0=NO, 1=YES

**Parameters accessible with Function Code 03, 06,10h
Alternator**

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
6702	26371	Input Status #1-8	R	Bit Packed: Bit 0: Input #1 Enable: 0=NO, 1=YES Bit 1: Input #1 ON: 0=OFF, 1=ON Bit 2: Input #2 Enable: 0=NO, 1=YES Bit 3: Input #2 ON: 0=OFF, 1=ON Bit 4: Input #3 Enable: 0=NO, 1=YES Bit 5: Input #3 ON: 0=OFF, 1=ON Bit 6: Input #4 Enable: 0=NO, 1=YES Bit 7: Input #4 ON: 0=OFF, 1=ON Bit 8: Input #5 Enable: 0=NO, 1=YES Bit 9: Input #5 ON: 0=OFF, 1=ON Bit 10: Input #6 Enable: 0=NO, 1=YES Bit 11: Input #6 ON: 0=OFF, 1=ON Bit 12: Input #7 Enable: 0=NO, 1=YES Bit 13: Input #7 ON: 0=OFF, 1=ON Bit 14: Input #8 Enable: 0=NO, 1=YES Bit 15: Input #8 ON: 0=OFF, 1=ON
6703	26372	Input Status #9-16	R	Bit Packed: Bit 0: Input #9 Enable: 0=NO, 1=YES Bit 1: Input #9 ON: 0=OFF, 1=ON Bit 2: Input #10 Enable: 0=NO, 1=YES Bit 3: Input #10 ON: 0=OFF, 1=ON Bit 4: Input #11 Enable: 0=NO, 1=YES Bit 5: Input #11 ON: 0=OFF, 1=ON Bit 6: Input #12 Enable: 0=NO, 1=YES Bit 7: Input #12 ON: 0=OFF, 1=ON Bit 8: Input #13 Enable: 0=NO, 1=YES Bit 9: Input #13 ON: 0=OFF, 1=ON Bit 10: Input #14 Enable: 0=NO, 1=YES Bit 11: Input #14 ON: 0=OFF, 1=ON Bit 12: Input #15 Enable: 0=NO, 1=YES Bit 13: Input #15 ON: 0=OFF, 1=ON Bit 14: Input #16 Enable: 0=NO, 1=YES Bit 15: Input #16 ON: 0=OFF, 1=ON

Parameters accessible with Function Code 03, 06,10h
Alternator

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
6704	26373	Output Status #1-4	R	Bit Packed: Bit 0: Output #1 Enable: 0=NO, 1=YES Bit 1: Output #1 Used: 0=NO, 1=YES Bit 2: Output #1 ON: 0=OFF, 1=ON Bit 3: Unused Bit 4: Output #2 Enable: 0=NO, 1=YES Bit 5: Output #2 Used: 0=NO, 1=YES Bit 6: Output #2 ON: 0=OFF, 1=ON Bit 7: Unused Bit 8: Output #3 Enable: 0=NO, 1=YES Bit 9: Output #3 Used: 0=NO, 1=YES Bit 10: Output #3 ON: 0=OFF, 1=ON Bit 11: Unused Bit 12: Output #4 Enable: 0=NO, 1=YES Bit 13: Output #4 Used: 0=NO, 1=YES Bit 14: Output #4 ON: 0=OFF, 1=ON Bit 15: Unused
6705	26374	Output Status #5-8	R	Bit Packed: Bit 0: Output #5 Enable: 0=NO, 1=YES Bit 1: Output #5 Used: 0=NO, 1=YES Bit 2: Output #5 ON: 0=OFF, 1=ON Bit 3: Unused Bit 4: Output #6 Enable: 0=NO, 1=YES Bit 5: Output #6 Used: 0=NO, 1=YES Bit 6: Output #6 ON: 0=OFF, 1=ON Bit 7: Unused Bit 8: Output #7 Enable: 0=NO, 1=YES Bit 9: Output #7 Used: 0=NO, 1=YES Bit 10: Output # ON: 0=OFF, 1=ON Bit 11: Unused Bit 12: Output #8 Enable: 0=NO, 1=YES Bit 13: Output #8 Used: 0=NO, 1=YES Bit 14: Output # ON: 0=OFF, 1=ON Bit 15: Unused

**Parameters accessible with Function Code 03, 06,10h
Alternator**

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
6706	26375	Output Status #9-12	R	Bit Packed: Bit 0: Output #9 Enable: 0=NO, 1=YES Bit 1: Output #9 Used: 0=NO, 1=YES Bit 2: Output #9 ON: 0=OFF, 1=ON Bit 3: Unused Bit 4: Output #10 Enable: 0=NO, 1=YES Bit 5: Output #10 Used: 0=NO, 1=YES Bit 6: Output #10 ON: 0=OFF, 1=ON Bit 7: Unused Bit 8: Output #11 Enable: 0=NO, 1=YES Bit 9: Output # Used: 0=NO, 1=YES Bit 10: Output #11 ON: 0=OFF, 1=ON Bit 11: Unused Bit 12: Output #12 Enable: 0=NO, 1=YES Bit 13: Output #12 Used: 0=NO, 1=YES Bit 14: Output #12 ON: 0=OFF, 1=ON Bit 15: Unused
6707	26376	Output Status #13-16	R	Bit Packed: Bit 0: Output #13 Enable: 0=NO, 1=YES Bit 1: Output #13 Used: 0=NO, 1=YES Bit 2: Output #13 ON: 0=OFF, 1=ON Bit 3: Unused Bit 4: Output # Enable: 0=NO, 1=YES Bit 5: Output #14 Used: 0=NO, 1=YES Bit 6: Output #14 ON: 0=OFF, 1=ON Bit 7: Unused Bit 8: Output #15 Enable: 0=NO, 1=YES Bit 9: Output #15 Used: 0=NO, 1=YES Bit 10: Output #15 ON: 0=OFF, 1=ON Bit 11: Unused Bit 12: Output #16 Enable: 0=NO, 1=YES Bit 13: Output #16 Used: 0=NO, 1=YES Bit 14: Output #16 ON: 0=OFF, 1=ON Bit 15: Unused
6708	26377	Request Style	R	Bit Packed: Bit 0: Direct: 0=NO, 1=YES Bit 1: Rotary: 0=NO, 1=YES Bit 2: FOFO: 0=NO, 1=YES Bit 3: Fixed: 0=NO, 1=YES Bit 4-15: Unused
6709	26378	Direct Request	W	Unsigned 16 Integer Data Ignored
670A	26379	Rotary Request	W	Unsigned 16 Integer Data Ignored
670B	26380	First on/First off Request	W	Unsigned 16 Integer Data Ignored
670C	26381	Fixed Request	W	Unsigned 16 Integer Data Ignored

Parameters accessible with Function Code 03, 06,10h
Alternator

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
670D	26382	Advance Request	W	This does not apply if current style is Direct or if Advance Active configuration parameter is set to OFF Unsigned 16 Integer Data Ignored
670E	26383	Input Count	R	Floating Point in Counts
6710	26385	Output On-Delay	R/W	Floating Point in Seconds
6712	26387	Output Off-Delay	R/W	Floating Point in Seconds
6714	26389	Input Enable (1-16)	R/W	Bit Packed: Bit 0: Device #1 Enable: 0=NO, 1=YES Bit 1: Device #2 Enable: 0=NO, 1=YES Bit 2: Device #3 Enable: 0=NO, 1=YES Bit 3: Device #4 Enable: 0=NO, 1=YES Bit 4: Device #5 Enable: 0=NO, 1=YES Bit 5: Device #6 Enable: 0=NO, 1=YES Bit 6: Device #7 Enable: 0=NO, 1=YES Bit 7: Device #8 Enable: 0=NO, 1=YES Bit 8: Device #9 Enable: 0=NO, 1=YES Bit 9: Device #10 Enable: 0=NO, 1=YES Bit 10: Device #11 Enable: 0=NO, 1=YES Bit 11: Device #12 Enable: 0=NO, 1=YES Bit 12: Device #13 Enable: 0=NO, 1=YES Bit 13: Device #14 Enable: 0=NO, 1=YES Bit 14: Device #15 Enable: 0=NO, 1=YES Bit 15: Device #16 Enable: 0=NO, 1=YES
6715	26390	Output Enable (1-16)	R/W	Bit Packed: Bit 0: Device #1 Enable: 0=NO, 1=YES Bit 1: Device #2 Enable: 0=NO, 1=YES Bit 2: Device #3 Enable: 0=NO, 1=YES Bit 3: Device #4 Enable: 0=NO, 1=YES Bit 4: Device #5 Enable: 0=NO, 1=YES Bit 5: Device #6 Enable: 0=NO, 1=YES Bit 6: Device #7 Enable: 0=NO, 1=YES Bit 7: Device #8 Enable: 0=NO, 1=YES Bit 8: Device #9 Enable: 0=NO, 1=YES Bit 9: Device #10 Enable: 0=NO, 1=YES Bit 10: Device #11 Enable: 0=NO, 1=YES Bit 11: Device #12 Enable: 0=NO, 1=YES Bit 12: Device #13 Enable: 0=NO, 1=YES Bit 13: Device #14 Enable: 0=NO, 1=YES Bit 14: Device #15 Enable: 0=NO, 1=YES Bit 15: Device #16 Enable: 0=NO, 1=YES
6716	26391	Output Order Sequence #1	R	Unsigned 16 integer
6717	26392	Output Order Sequence #2	R	Unsigned 16 integer
6718	26393	Output Order Sequence #3	R	Unsigned 16 integer

**Parameters accessible with Function Code 03, 06,10h
Alternator**

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
6719	26394	Output Order Sequence #4	R	Unsigned 16 integer
671A	26395	Output Order Sequence #5	R	Unsigned 16 integer
671B	26396	Output Order Sequence #6	R	Unsigned 16 integer
671C	26397	Output Order Sequence #7	R	Unsigned 16 integer
671D	26398	Output Order Sequence #8	R	Unsigned 16 integer
671E	26399	Output Order Sequence #9	R	Unsigned 16 integer
671F	26400	Output Order Sequence #10	R	Unsigned 16 integer
6720	26401	Output Order Sequence #11	R	Unsigned 16 integer
6721	26402	Output Order Sequence #12	R	Unsigned 16 integer
6722	26403	Output Order Sequence #13	R	Unsigned 16 integer
6723	26404	Output Order Sequence #14	R	Unsigned 16 integer
6724	26405	Output Order Sequence #15	R	Unsigned 16 integer
6725	26406	Output Order Sequence #16	R	Unsigned 16 integer

6.16 Device Control

Summary

This table contains addresses for the Device Control group #1.

See the **Device Control Register Maps in Table 6-1 for starting and ending addresses (hex) for Device Control #2 through Device Control #16 Map Addresses.**

The Modbus Device Control number address for a Device Control can also be obtained from the Process Control Designer report.

Function Code Support:

Reads – Function Code 3

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

For custom addresses view or print a report in HC Designer.

Table 6-26 Device Control parameters

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
6B00	27393	Reset Request	W	Unsigned 16 Integer Data Ignored
6B01	27394	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	27395	Remaining Delay Time	R	Floating Point in Seconds
6B04	27397	Start Delay	R/W	Floating Point in Seconds
6B06	27399	Stop Delay	R/W	Floating Point in Seconds
6B08	27401	Feedback Fail Delay	R/W	Floating Point in Seconds

6.17 User Defined Signals and Variables

Each register can be assigned to a signal tag or variable defined in a function block diagram. The data type is configurable to be floating-point, signed-16, unsigned-16, signed-32, or unsigned-32. Floating point, signed-32, and unsigned-32 must start on an even hex address. 32-bit data uses the same byte-order format as defined for the port's double-register format. Writing a non-zero to a digital variable will set the variable to ON regardless of the data type. Single register writes to 32-bit digital variables are permitted. Integer data is scaled based on the number of decimal places defined for the variable/signal.

For custom addresses view or print a report in HC Designer.

Table 6-27 User Defined Registers

Fixed Address (hex)	Fixed Register (decimal)	Parameter Name	Access	Notes
B000 to B3E7	45057 to 46056	User defined signal or variable	Signal: R Variable: R/W	Read only if a signal tag Read/write if a variable

6.18 Custom map parameters

These parameters are available only if you are building a custom map, that is, for configuration versions 4.0 and later. Note that parameters elsewhere in section 6 are also available for the custom map.

For custom addresses view or print a report in HC Designer.

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Table 6-28 Custom map Loop parameters

Parameter Name	Loop type					Access	Notes
	PID	On/Off	Carb	3Pos	AMB		
Accutune III Selection	✓		✓			R/W	Integer: 0 – disable 1 – limit cycle 2 – SP tuning
SP Change Steps	✓		✓			R/W	Float in the range of 5% to 15%
SP Step Direction	✓		✓				Integer: 0 = UP 1 = DOWN
PV Adaptive Enable/Disable	✓		✓			R/W	Integer: 0 = Disable 1 = Enable
Autotune Error	✓		✓			R/W	0=Tune Not Ready or in Wait State 1=Tune Ready 2=Tune Running 3=Failed Process Identification – SP Tune 4=SP Error – SP Tune 5=Bad Kpg – SP Tune 6=Failed Output Limit – SP Tune 7=Failed Minimum PV – SP Tune 8=PV Adaptive Running 9=Tuning Aborted
AutoManual LocalRemote Mode	✓	✓	✓	✓	✓	R/W R/W R/W R R R/W	Unsigned 16 0.0 = LSP MAN 1.0 = LSP AUTO 2.0 = RSP AUTO 4.0 = LSP IMAN or RSP IMAN 5.0 = LSP LO or RSP LO 6.0 = RSP_MAN

Table 6-29 Custom map Push Button and Four Selector Switch parameters

Parameter Name	Access	Notes
Button F1	W	Integer: Write 1 to “push” the button
Button F2	W	Integer: Write 1 to “push” the button
Button F3	W	Integer: Write 1 to “push” the button
Button F4	W	Integer: Write 1 to “push” the button
Bank A State	R/W	Integer in the range of 1 to 4
Bank B State	R/W	Integer in the range of 1 to 4
Bank C State	R/W	Integer in the range of 1 to 4
Bank D State	R/W	Integer in the range of 1 to 4

Table 6-30 Custom map AGA Gross parameters

Parameter Name	Access	Notes
Copy Entered Gas Vals Local	R/W	FLOAT 32 BIT
CO2 Entered	R/W	FLOAT 32 BIT
Hydrogen Entered	R/W	FLOAT 32 BIT
CO Entered	R/W	FLOAT 32 BIT
Method2 Nitrogen Entered	R/W	FLOAT 32 BIT
TB	R/W	FLOAT 32 BIT
PB	R/W	FLOAT 32 BIT
Use online Gas Analyzer Vals	R/W	FLOAT 32 BIT
Override Range Error	R/W	FLOAT 32 BIT
Method Used	R/W	FLOAT 32 BIT
Gas Rel Density	R/W	FLOAT 32 BIT
Rel Density Ref Temp	R/W	FLOAT 32 BIT
Rel Density Ref Press	R/W	FLOAT 32 BIT
Method1 Heat Val	R/W	FLOAT 32 BIT
Method1 Cal Ref Temp	R/W	FLOAT 32 BIT
Method1 Cal Ref Press	R/W	FLOAT 32 BIT
Method1 Comb Ref Temp	R/W	FLOAT 32 BIT
CO2 LCL	R	FLOAT 32 BIT
Hydrogen LCL	R	FLOAT 32 BIT
CO LCL	R	FLOAT 32 BIT
Method2 Nitrogen LCL	R	FLOAT 32 BIT

Table 6-31 Custom map AGA Detail parameters

Parameter Name	Access	Notes
Copy Entered Gas Vals Local	R/W	FLOAT 32 BIT
Methane Entered	R/W	FLOAT 32 BIT
Nitrogen Entered	R/W	FLOAT 32 BIT
CO2 Entered	R/W	FLOAT 32 BIT
Ethane Entered	R/W	FLOAT 32 BIT
Propane Entered	R/W	FLOAT 32 BIT
H2O Entered	R/W	FLOAT 32 BIT
H2S Entered	R/W	FLOAT 32 BIT
Hydrogen Entered	R/W	FLOAT 32 BIT
CO Entered	R/W	FLOAT 32 BIT
Oxygen Entered	R/W	FLOAT 32 BIT
I-Butane Entered	R/W	FLOAT 32 BIT
N-Butane Entered	R/W	FLOAT 32 BIT
I-Pentane Entered	R/W	FLOAT 32 BIT
N-Pentane Entered	R/W	FLOAT 32 BIT
Hexane Entered	R/W	FLOAT 32 BIT
Heptane Entered	R/W	FLOAT 32 BIT
Octane Entered	R/W	FLOAT 32 BIT
Nonane Entered	R/W	FLOAT 32 BIT
Decane Entered	R/W	FLOAT 32 BIT
Helium Entered	R/W	FLOAT 32 BIT
Argon Entered	R/W	FLOAT 32 BIT
TB	R/W	FLOAT 32 BIT

Parameters accessible with Function Code 03, 06,10h
Custom map parameters

Parameter Name	Access	Notes
PB	R/W	FLOAT 32 BIT
Use online Gas Analyzer Vals	R/W	FLOAT 32 BIT
Override Range Error	R/W	FLOAT 32 BIT
Methane LCL	R	FLOAT 32 BIT
Nitrogen LCL	R	FLOAT 32 BIT
CO2 LCL	R	FLOAT 32 BIT
Ethane LCL	R	FLOAT 32 BIT
Propane LCL	R	FLOAT 32 BIT
H2O LCL	R	FLOAT 32 BIT
H2S LCL	R	FLOAT 32 BIT
Hydrogen LCL	R	FLOAT 32 BIT
CO LCL	R	FLOAT 32 BIT
Oxygen LCL	R	FLOAT 32 BIT
I-Butane LCL	R	FLOAT 32 BIT
N-Butane LCL	R	FLOAT 32 BIT
I-Pentane LCL	R	FLOAT 32 BIT
N-Pentane LCL	R	FLOAT 32 BIT
Hexane LCL	R	FLOAT 32 BIT
Heptane LCL	R	FLOAT 32 BIT
Octane LCL	R	FLOAT 32 BIT
Nonane LCL	R	FLOAT 32 BIT
Decane LCL	R	FLOAT 32 BIT
Helium LCL	R	FLOAT 32 BIT
Argon LCL	R	FLOAT 32 BIT

Table 6-32 Custom map Calendar Event parameters

Parameter Name	Access	Notes
SetPoint Request	R	UNSIGNED 16 BIT 1 - 5
Display Event Type 1 Thru Display Event Type 8	R	UNSIGNED 16 BIT 0 = disable 1 = 5 day week 2 = 7 day week 3 = day of week 4 = monthly 5 = yearly
Display Hour 1 Thru Display Hour 8	R	UNSIGNED 16 BIT 0 - 23
Display Minute 1 Thru Display Minute 8	R	UNSIGNED 16 BIT 0 - 59

**Parameters accessible with Function Code 03, 06,10h
Custom map parameters**

Parameter Name	Access	Notes
Display Month 1 Thru Display Month 8	R	UNSIGNED 16 BIT 1 - 12
Display Day 1 Thru Display Day 8	R	UNSIGNED 16 BIT Day of month: 1 – 31 Day of week: 1 – 7 where 1 = Sunday
Event Type Grp-1 Evt-1 Thru Event Type Grp-1 Evt-8	R/W	UNSIGNED 16 BIT 0 = disable 1 = 5 day week 2 = 7 day week 3 = day of week 4 = monthly 5 = yearly
Event Type Grp-2 Evt-1 Thru Event Type Grp-2 Evt-8	R/W	UNSIGNED 16 BIT 0 = disable 1 = 5 day week 2 = 7 day week 3 = day of week 4 = monthly 5 = yearly
Event Type Grp-3 Evt-1 Thru Event Type Grp-3 Evt-8	R/W	UNSIGNED 16 BIT 0 = disable 1 = 5 day week 2 = 7 day week 3 = day of week 4 = monthly 5 = yearly
Event Type Grp-4 Evt-1 Thru Event Type Grp-4 Evt-8	R/W	UNSIGNED 16 BIT 0 = disable 1 = 5 day week 2 = 7 day week 3 = day of week 4 = monthly 5 = yearly
Event Type Grp-5 Evt-1 Thru Event Type Grp-5 Evt-8	R/W	UNSIGNED 16 BIT 0 = disable 1 = 5 day week 2 = 7 day week 3 = day of week 4 = monthly 5 = yearly
Event Hour Grp-1 Evt-1 Thru Event Hour Grp-1 Evt-8	R/W	UNSIGNED 16 BIT 0 - 23
Event Hour Grp-2 Evt-1 Thru Event Hour Grp-2 Evt-8	R/W	UNSIGNED 16 BIT 0 - 23

Parameters accessible with Function Code 03, 06,10h
Custom map parameters

Parameter Name	Access	Notes
Event Hour Grp-3 Evt-1 Thru Event Hour Grp-3 Evt-8	R/W	UNSIGNED 16 BIT 0 - 23
Event Hour Grp-4 Evt-1 Thru Event Hour Grp-4 Evt-8	R/W	UNSIGNED 16 BIT 0 - 23
Event Hour Grp-5 Evt-1 Thru Event Hour Grp-5 Evt-8	R/W	UNSIGNED 16 BIT 0 - 23
Event Min Grp-1 Evt-1 Thru Event Min Grp-1 Evt-8	R/W	UNSIGNED 16 BIT 0 - 59
Event Min Grp-2 Evt-1 Thru Event Min Grp-2 Evt-8	R/W	UNSIGNED 16 BIT 0 - 59
Event Min Grp-3 Evt-1 Thru Event Min Grp-3 Evt-8	R/W	UNSIGNED 16 BIT 0 - 59
Event Min Grp-4 Evt-1 Thru Event Min Grp-4 Evt-8	R/W	UNSIGNED 16 BIT 0 - 59
Event Min Grp-5 Evt-1 Thru Event Min Grp-5 Evt-8	R/W	UNSIGNED 16 BIT 0 - 59
Event Month Grp-1 Evt-1 Thru Event Month Grp-1 Evt-8	R/W	UNSIGNED 16 BIT 1 - 12
Event Month Grp-2 Evt-1 Thru Event Month Grp-2 Evt-8	R/W	UNSIGNED 16 BIT 1 - 12

Parameters accessible with Function Code 03, 06,10h
Custom map parameters

Parameter Name	Access	Notes
Event Month Grp-3 Evt-1 Thru Event Month Grp-3 Evt-8	R/W	UNSIGNED 16 BIT 1 - 12
Event Month Grp-4 Evt-1 Thru Event Month Grp-4 Evt-8	R/W	UNSIGNED 16 BIT 1 - 12
Event Month Grp-5 Evt-1 Thru Event Month Grp-5 Evt-8	R/W	UNSIGNED 16 BIT 1 - 12
Event Day Grp-1 Evt-1 Thru Event Day Grp-1 Evt-8	R/W	UNSIGNED 16 BIT Day of month: 1 – 31 Day of week: 1 – 7 where 1 = Sunday
Event Day Grp-2 Evt-1 Thru Event Day Grp-2 Evt-8	R/W	UNSIGNED 16 BIT Day of month: 1 – 31 Day of week: 1 – 7 where 1 = Sunday
Event Day Grp-3 Evt-1 Thru Event Day Grp-3 Evt-8	R/W	UNSIGNED 16 BIT Day of month: 1 – 31 Day of week: 1 – 7 where 1 = Sunday
Event Day Grp-4 Evt-1 Thru Event Day Grp-4 Evt-8	R/W	UNSIGNED 16 BIT Day of month: 1 – 31 Day of week: 1 – 7 where 1 = Sunday
Event Day Grp-5 Evt-1 Thru Event Day Grp-5 Evt-8	R/W	UNSIGNED 16 BIT Day of month: 1 – 31 Day of week: 1 – 7 where 1 = Sunday
Special Day Mode	R/W	UNSIGNED 16 BIT 0 = disable outputs 1 = use alternate time
Special Day Out 1 Thru Special Day Out 8	R/W	FLOAT 32 BIT 0 = normal behavior 1 = do what Special Day mode specifies

Parameters accessible with Function Code 03, 06,10h
Custom map parameters

Parameter Name	Access	Notes
Special Day Day-1 Thru Special Day Day-16	R/W	UNSIGNED 16 BIT Day of month: 1 – 31 Day of week: 1 – 7 where 1 = Sunday
Special Day Month-1 Thru Special Day Month-16	R/W	UNSIGNED 16 BIT 1 - 12
Special Day Alt Hour-1 Thru Special Day Alt Hour-8	R/W	UNSIGNED 16 BIT 0 - 23
Special Day Alt Min-1 Thru Special Day Alt Min-8	R/W	UNSIGNED 16 BIT 0 - 59

Table 6-33 Custom map XYR5000 Base Station block parameters

Parameter Name	Access	Notes
Base Radio Status	R	unsigned 16
Expected Transmitter Count	R	unsigned 16
Transmitter Count	R	unsigned 16
Transmitter Status 1-16	R	unsigned 16
Transmitter Status 17-32	R	unsigned 16
Transmitter Status 33-48	R	unsigned 16
Transmitter Status 49-64	R	unsigned 16
Transmitter Status 65-80	R	unsigned 16
Transmitter Status 81-96	R	unsigned 16
Transmitter Status 97-100	R	unsigned 16

Table 6-34 Custom map XYR5000 Transmitter block parameters

Parameter Name	Access	Notes
Primary Sensor	R	float 32
Secondary Sensor	R	float 32
Tertiary Sensor	R	float 32
Transmitter Online	R	unsigned 16
Low Battery	R	unsigned 16
Alarm Condition	R	unsigned 16
Sensor Error	R	unsigned 16
Sensor Overload	R	unsigned 16
System Error	R	unsigned 16

Parameter Name	Access	Notes
Switch Input 1 Closed	R	unsigned 16
Switch Input 2 Closed	R	unsigned 16
Square Root Function	R	unsigned 16
Device Type	R	float 32
Device Status	R	float 32

Table 6-35 Custom map XYR6000 Transmitter block parameters

Parameter Name	Access	Notes
PV1	R	float 32
PV2	R	float 32
PV3	R	float 32
PV4	R	float 32
Elec Failure	R	unsigned 16
Mech Failure	R	unsigned 16
Input Failure	R	unsigned 16
Output Failure	R	unsigned 16
Low Battery	R	unsigned 16
External Power	R	unsigned 16
Config Error	R	unsigned 16
Calibration Error	R	unsigned 16
Radio Error	R	unsigned 16
Memory Error	R	unsigned 16
Firmware Error	R	unsigned 16
Watchdog Error	R	unsigned 16
Diagnostic	R	unsigned 16
Device Status	R	unsigned 32

Table 6-36 Custom map UDC Loop block parameters

Parameter Name	Access	Notes
Loop1 PV	R	float 32
Loop1 WSP	R	float 32
Loop1 Output	R/W	float 32
Loop1 LSP1	R/W	float 32
Loop1 LSP2	R/W	float 32
Loop1 LSP3	R/W	float 32
Loop1 LSP4	R/W	float 32
Loop1 Mode Auto/Manual	W	unsigned 16
Loop1 Mode Local/Remote	W	unsigned 16
Loop1 Mode A/M/L/R	R	unsigned 16
Loop1 Ramp SP	R/W	float 32
Loop1 LSP Select	R/W	unsigned 16

Table 6-37 Custom map UDC Loop 2 block parameters

Parameter Name	Access	Notes
Loop2 PV	R	float 32
Loop2 WSP	R	float 32
Loop2 OUT	R/W	float 32
Loop2 Mode A/M/L/R	R	unsigned 16
Loop2 LSP1	R/W	float 32
Loop2 LSP2	R/W	float 32
Loop2 LSP3	R/W	float 32
Loop2 LSP4	R/W	float 32
Loop2 Auto/Manual	W	unsigned 16
Loop2 Local/Remote	W	unsigned 16
Loop2 Ramp SP	R/W	float 32
Loop2 LSP Select	R/W	unsigned 16

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