Honeywell

Modbus® RTU Serial Communications User Manual

Configuration/Remote Calibration Interfaces for HercuLine Smart Actuators

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About This Document

Abstract

This document provides configuration information specific to Honeywell's Herculine Smart Actuators and should be used in conjunction with Modbus® RTU Serial Communications User Manual, document number 51-52-25-66.

Contacts

World Wide Web

The following lists Honeywell's World Wide Web sites that will be of interest to our customers.

Honeywell Organization	WWW Address (URL)
Corporate	http://www.honeywell.com
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United States and Canada	Honeywell	1-800-423-9883	Tech. Support
		1-888-423-9883	Q&A Faxback (TACFAQS)
		1-800-525-7439	Service

References

Publication Title	Publication Number
10260S Herculine Smart Actuator Installation, Operation and Maintenance Manual	62-86-25-08
11280S Herculine Smart Actuator Installation, Operation and Maintenance Manual	61-86-25-09
HercuLine™ 2000 Series Actuator Installation, Operation and Maintenance Manual	62-86-25-10
Modbus® RTU Serial Communications User Manual	51-52-25-66
Reference: Modicon Modbus Protocol Reference Guide	PI-MBUS-300

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1. Modbus Serial Comunications for Herculine Actuators

1.1 Overview

Modbus Remote Terminal Unit (RTU) protocol provides a common data exchange format for connecting field devices to both Honeywell and other master devices. This serial communication format allows field devices to act as a slave device on a data link with other field devices that employ the Modbus RTU protocol. The Honeywell Herculine Smart Actuator is capable of remote operation via an RS-485 serial communications using Modbus RTU protocol.

This reference document describes the Modbus function codes and message formats used for remote communications with the actuators. The physical and data link layers of the Modbus specificiation are maintained. The Herculine actuators use only a subset of the Modbus RTU function codes. Messages within the Modbus message frame use standard IEEE 32-bit floating point and 16-bit integer formats.

The actuators can be set up to communicate as a slave device on a RS-485 serial link that employs Modbus RTU protocol. The actuator must be set up to accept input information from a remote source. A device address must be specified, and a baud rate should be selected that is common to the master device on the data link. Refer to the *Operation and Maintenance Manual of the specific actuator model* for the details on setting up the actuator for remote operation.

Additional Information

For additional information on the Modbus RTU protocol, such as the physical and data link layers, refer to the *Modbus RTU Serial Communications User Manual* (document number 51-52-25-66), or the *Modicon Modbus Protocol Reference Guide* which is available from Modicon, Inc.

2. Modbus RTU Function Codes

2.1 General Information

The actuators use function codes **20** and **21** register addresses for read and write access of the configuration and process-related data in the actuator. Standard IEEE-32-bit floating point and 16-bit interger formats are used in transferring the message data. The register address structures for these message formats are described in Table 2-1, Table 2-2, Table 2-3. The register addresses that are specific to the actuators are explained in *Section 3.2*.

File Address Structure

Table 2-1 Integer Parameter Type

Register Address (Hex)	Name	Access	Notes
0	Type = 1	Read	16-bit Unsigned Integer
1	Attribute	Read	1 = Read Only, 2 = Read/Write
2	Value (16 bit integer)	Read / Write	
3	*Not Used*	Read	
4	Low Range (16 bit integer)	Read	
5	*Not Used*	Read	
6	High Range (16 bit Integer)	Read	
7	*Not Used*	Read	
8 to F	Description Text (ASCII string)	Read	8 characters

Table 2-2 Floating-Point Parameter Type

Register Address (Hex)	Name	Access	Notes
0	Type = 2	Read	IEEE Floating Point
1	Attribute	Read	1 = Read Only, 2 = Read/Write
2	Value (float high word)	Read / Write	
3	Value (float low word)	Read / Write	
4	Low Range (float high word)	Read	
5	Low Range (float low word)	Read	
6	High Range (float high word)	Read	
7	High Range (float low word)	Read	
8 to F	Description Text (ASCII string)	Read	8 characters

File Address Structure

Table 2-3 Enumeration Parameter Type

Register Address (Hex)	Name	Access	Notes
0	Type = 5	Read	16-bit Unsigned Integer
1	Attribute	Read	1 = Read Only, 2 = Read/Write
2	Value (16 bit integer)	Read / Write	
3	*Not Used*	Read	
4	Low Range (16 bit integer)	Read	
5	*Not Used*	Read	
6	High Range (16 bit Integer)	Read	
7	*Not Used*	Read	
8 to F	Description Text (ASCII string)	Read	8 characters

Note: Table 2-3 is only supported in the PDA interface.

Table 2-4 String Parameter Type

Register Address (Hex)	Name	Access	Notes
0	Type = 4	Read	ASCII Text String
1	Attribute	Read	1 = Read Only, 2 = Read/Write
2	Value (16 bit integer)	Read / Write	Text String Pointer, 0 = attached
3	*Not Used*	Read	
4	Pointer Low Limit (16 bit integer)	Read	Minimum String Size; 6 chars
5	*Not Used*	Read	
6	Pointer High Limit (16 bit Integer)	Read	Maximum String Size; 6chars
7	*Not Used*	Read	
8 to 8 + N	Text (ASCII string)	Read	N*2 characters

Note: Table 2-4 is only supported in the PDA interface.

2.2 Function Code 20 (14h) - Read Configuration Reference Data

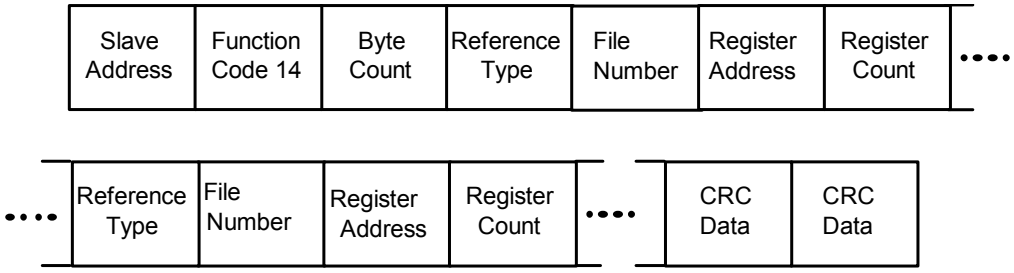
Description

Function code 20 (14 Hex) is used to read information stored in the configuration database of the actuator. Each configuration parameter is uniquely addressed by a register address, and is detailed in Section 3. The actuators configuration database is located in EEROM on the main CPU PWA.

Query and Response Formats

The Query and Response formats for Function code 20 (14 Hex) are shown below. Details for each data block (or word) is described in Table 2-5.

Query Message Format



Response Message Format

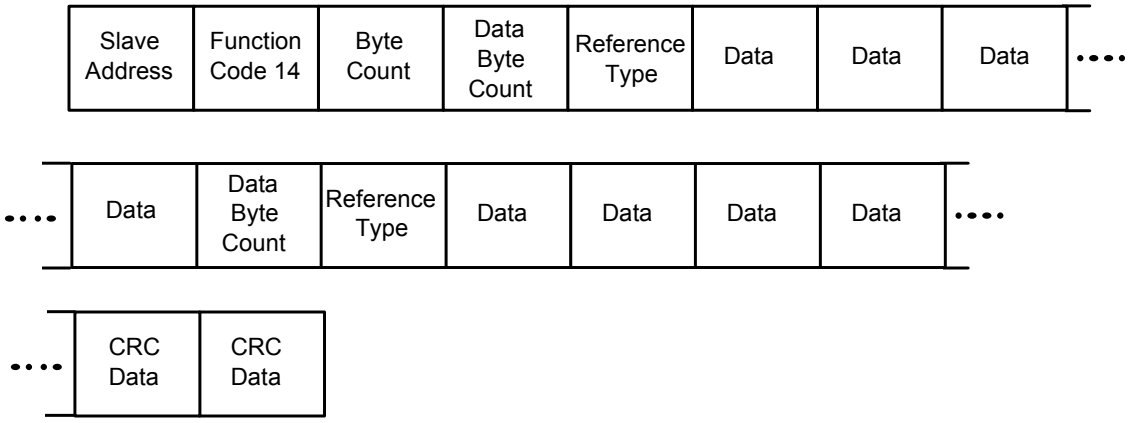


Table 2-5 Data Word Descriptions

Data Word	Description
Slave Address	The address of the device on the data link for which the message is intended.
Function Code	Tells the device what kind of action to perform.
Byte Count	Equals the number of bytes transmitted in either the query or response message and will be the minimum number required to transmit all queryed data.
Data Byte Count	The number of data bytes of the *sub response* including the Reference Type but not including itself. A sub response has four bytes of data and one byte representing the reference type making the data byte count equal to five.
Reference Type Definitions	The Reference Type definition is always 06. *See examples in Subsection 2.2.1 Read Configuration Data Examples.*
File Number	The file number word represents the device parameter(s) that are being accessed. The file number word is made up of two bytes.
Register Address	The register address word contains the register address from the file structure tables on page 3. The register address is also made up of two bytes.
CRC Data	Cyclical Redundancy Check provides error checking of the message and it is the last field in the message.

Table 2-6 Register Address Format for Function Code 20

File Number (Decimal)	File Number (Hex)	Format
4096 to 4214	1000 to 1146	Analog formatted data (2 registers – IEEE 32-bit floating point)
5120 to 5211	1400 to 145B	Integer formatted data (1 register – 16-bit integer value + 16 bits of zero's)

2.2.1 Read Configuration Data Examples

Example #1

The following is an example of a query to read the Input Hi Range value using Function code 20.

Query Message	02 14 07 06 10 00 00 02 00 02 (CRC16)

Where:

02	=	Address
14	=	Function Code 20 (14 hex)
07	=	Byte Count
06	=	Reference Type
10,00	=	File Number (Input Hi Range)
00,02	=	Register Address (Access Data Value)
00 02	=	Register Count (Floating Point Data)
(CRC16)		

This is the response to the above query.

Response Message	02 14 06 05 06 47 64 00 00 (CRC16)

Where:

02	=	Address
14	=	Function Code 20 (14 Hex)
06	=	Byte Count
05	=	Sub Message Length
06	=	Reference Type
47 64 00 00	=	100.0 (Value of Input Hi Range)
(CRC16)		

continued next page

Example #2

The following is another example of a query and response message using Function code 20.

(Read Input Hi and Input Lo range values)

Query Message	02 14 0E 06 10 00 00 02 00 02 06 10 02 00 02 00 02 (CRC16)

Where:

02	=	Address
14	=	Function Code 20 (14 Hex)
0E	=	Byte Count
06	=	Reference Type
10,00	=	File Number (Input Hi Range)
00,02	=	Register Address (Access Data Value)
00,02	=	Register Count to read (Floating Point Data)
06	=	Reference Type
10,02	=	File Number (Input Lo Range)
00,02	=	Register Address (Access Data Value)
00,02	=	Register Count to read (Floating Point Data)
(CRC16)		

This is the response to the above query.

Response Message	02 14 0C 05 06 43 C8 00 00 05 06 44 60 00 00 (CRC16)

Where:

02	=	Address
14	=	Function Code 20 (14 Hex)
0C	=	Byte Count
05	=	Data Byte Count (Sub Message Length)
06	=	Reference Type
43 C8 00 00	=	400.0 (Value of Input Hi Range)
05	=	Data Byte Count (Sub Message Length)
06	=	Reference Type
44 60 00 00	=	896.0 (Value of Input Lo Range)
(CRC16)		

continued next page

Example #3

The following is an example of a query to read the input actuation value using Function code 20.

Query Message	02 14 07 06 14 00 00 02 00 02 (CRC16)

Where:

02	=	Address
14	=	Function Code 20 (14 hex)
07	=	Byte Count
06	=	Reference Type
14,00	=	File Number (Input Hi Range)
00,02	=	Register Address (Access Data Value)
00 02	=	Register Count (Integer Data)
(CRC16)		

This is the response to the above query.

Response Message	02 14 06 05 06 00 02 00 00 (CRC16)

Where:

02	=	Address
14	=	Function Code 20 (14 Hex)
06	=	Byte Count
05	=	Sub Message Length
06	=	Reference Type
00 02	=	02 (Value of Input Actuation)
00 C8	=	File Number
(CRC16)		

continued next page

Example #4

The following is another example of a query and response message using Function code 20.

(Read Alarm 11 Type and Alarm 11 Event)

Query Message	02 14 0E 06 14 09 00 02 00 02 06 14 0A 00 02 00 02 (CRC16)

Where:

02	=	Address
14	=	Function Code 20 (14 Hex)
0E	=	Byte Count
06	=	Reference Type
14,09	=	File Number (Alarm 11 Type)
00,02	=	Register Address (Access Data Value)
00,02	=	Register Count to read (Integer Data)
06	=	Reference Type
14,0A	=	File Number (Alarm 11 Event)
00,02	=	Register Address (Access Data Value)
00,02	=	Register Count to read (Integer Data)
(CRC16)		

This is the response to the above query.

Response Message	02 14 0C 05 06 00 03 00 00 05 06 00 01 00 00 (CRC16)

Where:

02	=	Address
14	=	Function Code 20 (14 Hex)
0C	=	Byte Count
05	=	Data Byte Count (Sub Message Length)
06	=	Reference Type
00 03	=	03 (Value of Alarm 11 Type)
00 D2	=	File Number
05	=	Data Byte Count (Sub Message Length)
06	=	Reference Type
00 01	=	01 (Value of Alarm 11 Event)
00 D3	=	File Number
(CRC16)		

2.3 Function Code 21 (15h) - Write Configuration Reference Data

Description

Function Code 21 (15 Hex) is used to allow writes of integer and floating point values to the configuration database. Each configuration parameter is uniquely addressed by a register address, and is detailed in Section 3. The configuration database is located in EEROM on the main CPU PWA.

Integer format is used to write to "Digital" configuration items. Floating Point format is used to write to "Analog" configuration items.

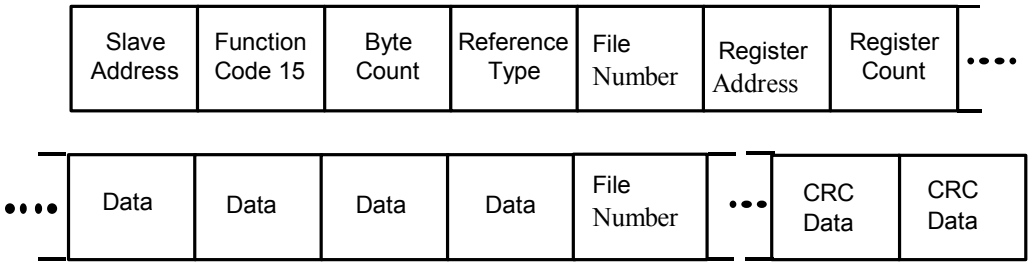
Write Restrictions

Care should be taken not to exceed the 100,000 write limit of the EEROM.

Query and Response Formats

The Query and Response formats for Function code 21 (15 Hex) are shown below. Details for each data block (or word) are described in Table 2-7.

Query Message Format



Response Message Format (echo back of query)

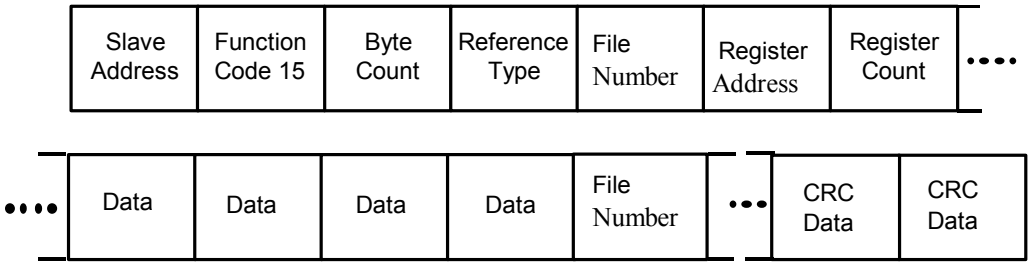


Table 2-7 Data Word Descriptions

Data Word	Description
Slave Address	The address of the device on the data link for which the message is intended.
Function Code	Tells the device what kind of action to perform. In this case, write configuration data.
Byte Count	Equals the number of bytes transmitted in either the query or response message and will be the minimum number required to transmit all queryed data.
Data Byte Count	The number of data bytes of the *sub response* including the Reference Type but not including itself. A sub response has four bytes of data and one byte representing the reference type making the data byte count equal to five.
Refernce Type Definitions	The Reference Type definition is always 06. *See examples in Subsection 2.3.1 Write Configuration Examples.*
File Number	The file number word represents the device parameter(s) that are being accessed. The file number word is made up of two bytes.
Register Address	The register address word contains the register address from the file structure tables on page 3. The register address is also made up of two bytes.
CRC Data	Cyclical Redundancy Check provides error checking of the message and it is the last field in the message.

Table 2-8 Register Address Format for Function Code 21

File Number (Dec)	File Number (Hex)	Format
4096 to 4214	1000 to 1146	Analog formatted data (2 registers – IEEE 32-bit floating point)
5120 to 5211	1400 to 145B	Integer formatted data (1 register – 16 bit integer value)

2.3.1 Write Configuration Data Examples

Example #1

The following is an example of a query to write the Deadband value using Function code 21 (15 Hex).

Query Message 02 15 0B 06 10 06 00 02 00 02 3F C0 00 00 (CRC16)

Where:

02	=	Address
15	=	Function Code 21 (15 Hex)
0B	=	Byte Count
06	=	Reference Type
10 06	=	File Number (Deadband)
00 02	=	Register Address (Access Data Value)
00 02	=	Register Count (Floating Point Data)
3F C0 00 00	=	Data Value = (1.50)
(CRC16)		

This is the response to the above query.

Response Message (The response is an echo of the query)

02 15 0B 06 10 06 00 02 00 02 3F C0 00 00 (CRC16)

Example #2

The following is an example of a query to write the Deadband value and the Alarm SP1 value using Function code 21 (15 Hex).

Query Message

02 15 0B 06 10 06 00 02 00 02 3F C0 00 00 06 10 36 00 02 00 02 3F C0 00 00 (CRC16)

Where:

02	=	Address
15	=	Function Code 21 (15 Hex)
0B	=	Byte Count
06	=	Reference Type
10 06	=	File Number (Deadband)
00 02	=	Register Address (Access Data Value)
00 02	=	Register Count (Floating Point Data)
3F C0 00 00	=	Data Value = (1.50)
06	=	Reference Type
10 36	=	File Number (Alarm SP1)
00 02	=	Register Address (Access Data Value)
00 02	=	Register Count (Floating Point Data)
3F C0 00 00	=	Data Value = (1.50)
(CRC16)		

This is the response to the above query.

Response Message (The response is an echo of the query)

02 15 0B 06 10 06 00 02 00 02 3F C0 00 00 06 10 36 00 02 00 02 3F C0 00 00 (CRC16)

Example #3

The following is an example of a query to write the Motor Direction value using Function code 21 (15 Hex).

Query Message 02 15 0B 06 14 02 00 02 00 01 00 01 (CRC16)

Where:

02	=	Address
15	=	Function Code 21 (15 Hex)
0B	=	Byte Count
06	=	Reference Type
14 02	=	File Number (Motor Direction)
00 02	=	Register Address (Access Data Value)
00 01	=	Register Count (Integer Data)
00 01	=	Data Value = (1)
(CRC16)		

This is the response to the above query.

Response Message (The response is an echo of the query) 02 15 0B 06 14 02 00 02 00 02 00 01 (CRC16)

Example #4

The following is an example of a Query to write the Failsafe Type value and the Alarm 11 Event type value using Function code 21 (15 Hex).

Query Message 02 15 0B 06 14 03 00 02 00 01 00 02 06 14 0A 00 02 00 01 00 00 (CRC16)

Where:

02	=	Address
15	=	Function Code 21 (15 Hex)
0B	=	Byte Count
06	=	Reference Type
14 03	=	File Number (Failsafe Type)
00 02	=	Register Address (Access Data Value)
00 01	=	Register Count
00 02	=	Data Value = (2)
06	=	Reference Type
14 0A	=	File Number (Alarm 11 Event Type)
00 02	=	Register Address (Access Data Value)
00 01	=	Register Count
00 00	=	Data Value = (0)
(CRC16)		

This is the response to the above query.

Response Message (The response is an echo of the query) 02 15 0B 06 14 03 00 02 00 01 00 02 06 14 0A 00 02 00 01 00 00 (CRC16)

3. Parameters and Register Addresses

3.1 Overview

Introduction

This section provides maps of the configuration parameters in the Herculine actuator. Using Function codes 20 and 21 you can read and write configuration values to the actuator. The configuration parameters are arranged according to the set up groups in which they appear when using the local display and keypad interface.

Each parameter is listed with its register address, data format type (32-bit floating point or 16-bit integer) and available selections.

General Information

Analog / Digital Parameters

Whenever configuration parameter values are changed via communications, a write cycle occurs after the response is returned acknowledging receipt of the message.

3.2 Configuration Parameters

Overview

Listed on the following pages are the parameters in the various set-up groups within the actuator. The set-up groups and their table numbers are listed below. Most of the parameters are configurable through the hosts. Some parameters are read only and are indicated as such and therefore cannot be changed.

Reading or Writing

Do a read or write, depending on your requirements, using the format code listed in the tables. The range or selection available for each range is listed in the tables.

3.2.1 Input

Table 3-1lists all the register addresses with ranges or selections for parameters in the Input set-up group.

Table 3-1 Input Setup Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Input Type **Note**: If input type from model selection guide is: 0/4-20mA, 0/1-5Vdc, 0-10Vdc	1400	5120	INT	R/W	0 = 4-20 mA 1 = 0-20 mA 2 = 1-5 Vdc 3 = 0-5 Vdc 4 = 0-10 Vdc 5 = R_SP **Note**: Changing the Input Type will result in the loss of field calibration values for the old input type; and will restore the factory calibration values for the new selected input type.
Input Type (SA2000 Models Only) **Note**: If input type from model selection guide is: Series 90 control	1400	5120	INT	R	6 = Series 90 (Read Only) **Note**: Input Type can not be changed.
Input Hi Range Value	1000	4096	FP	R/W	10.0 to 100.0 %
Input Lo Range Value	1002	4098	FP	R/W	0.0 to 90.0 %
Input Filter Type	1401	5121	INT	R/W	0 = None 1 = Spike Only 2 = Spike + Low Pass 3 = Low Pass Only
Low Pass Value	1004	4100	FP	R/W	0.0 to 50.0 Seconds
Direction	1402	5122	INT	R/W	0 = CCW 1 = CW
Deadband	1006	4102	FP	R/W	0.2 to 5.0 %
Failsafe Type	1403	5123	INT	R/W	0 = Last 1 = Up 2 = Down 3 = User Defined
Failsafe User Defined Value	1008	4104	FP	R/W	0.0 to 100.0 %
Characterization Type	1404	5124	INT	R/W	0 = Linear 1 = Square Root 2 = Custom

Table 3-1 Input Setup Group, continued

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Custom Characterization Type	145A	5210	INT	R/W	0 = Equal Percentage 1 = Quick Openning 2 = User Configurable
X0 Value	100A	4106	FP	R/W	0.0 to 100.0 %
X1 Value	100C	4108	FP	R/W	0.0 to 100.0 %
X2 Value	100E	4110	FP	R/W	0.0 to 100.0 %
X3 Value	1010	4112	FP	R/W	0.0 to 100.0 %
X4 Value	1012	4114	FP	R/W	0.0 to 100.0 %
X5 Value	1014	4116	FP	R/W	0.0 to 100.0 %
X6 Value	1016	4118	FP	R/W	0.0 to 100.0 %
X7 Value	1018	4120	FP	R/W	0.0 to 100.0 %
X8 Value	101A	4122	FP	R/W	0.0 to 100.0 %
X9 Value	101C	4124	FP	R/W	0.0 to 100.0 %
X10 Value	101E	4126	FP	R/W	0.0 to 100.0 %
X11 Value	1078	4216	FP	R/W	0.0 to 100.0 %
X12 Value	107A	4218	FP	R/W	0.0 to 100.0 %
X13 Value	107C	4220	FP	R/W	0.0 to 100.0 %
X14 Value	107E	4222	FP	R/W	0.0 to 100.0 %
X15 Value	1080	4224	FP	R/W	0.0 to 100.0 %
X16 Value	1082	4226	FP	R/W	0.0 to 100.0 %
X17 Value	1084	4228	FP	R/W	0.0 to 100.0 %
X18 Value	1086	4230	FP	R/W	0.0 to 100.0 %
X19 Value	1088	4232	FP	R/W	0.0 to 100.0 %
X20 Value	108A	4234	FP	R/W	0.0 to 100.0 %
Y0 Value	1020	4128	FP	R/W	0.0 to 100.0 %
Y1 Value	1022	4130	FP	R/W	0.0 to 100.0 %
Y2 Value	1024	4132	FP	R/W	0.0 to 100.0 %
Y3 Value	1026	4134	FP	R/W	0.0 to 100.0 %
Y4 Value	1028	4136	FP	R/W	0.0 to 100.0 %
Y5 Value	102A	4138	FP	R/W	0.0 to 100.0 %

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Table 3-1 Input Setup Group , continued

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Y6 Value	102C	4140	FP	R/W	0.0 to 100.0 %
Y7 Value	102E	4142	FP	R/W	0.0 to 100.0 %
Y8 Value	1030	4144	FP	R/W	0.0 to 100.0 %
Y9 Value	1032	4146	FP	R/W	0.0 to 100.0 %
Y10 Value	1034	4148	FP	R/W	0.0 to 100.0 %
Y11 Value	108C	4236	FP	R/W	0.0 to 100.0 %
Y12 Value	108E	4238	FP	R/W	0.0 to 100.0 %
Y13 Value	1090	4240	FP	R/W	0.0 to 100.0 %
Y14 Value	1092	4242	FP	R/W	0.0 to 100.0 %
Y15 Value	1094	4244	FP	R/W	0.0 to 100.0 %
Y16 Value	1096	4246	FP	R/W	0.0 to 100.0 %
Y17 Value	1098	4248	FP	R/W	0.0 to 100.0 %
Y18 Value	109A	4250	FP	R/W	0.0 to 100.0 %
Y19 Value	109C	4252	FP	R/W	0.0 to 100.0 %
Y20 Value	109E	4254	FP	R/W	0.0 to 100.0 %

Note: The X and Y value addresses shown above are for the User Configurable Custom Characterization selection.

Address tables for the Equal Percentage and the Quick Openning can be found in the appendix at the rear of

this document.

3.2.2 Relay1 / Alarms

Table 3-2 lists all the register addresses and ranges or selections for function parameters in the Relay1 set-up group.

Table 3-2 Relay1 / Alarms Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Relay1 SP1 Type	140A	5130	INT	R/W	0 = None 1 = Input Range 2 = Position Range 3 = Deviation 4 = Upper Travel Limit 5 = LowerTravel Limit 6 = Temperature Hi 7 = Temperature Lo 8 = Starts 9 = Stalled Motor 10 = Manual Mode 11 = Power Up Test Fail 12 = Input Signal Fail 13 = Position Sensor Fail 14 = Digital Input Activated 15 = Total Degrees Traveled
Relay1 SP1 Value	1036	4150	FP	R/W	Within the range for the selected relay type.
Relay1 SP1 Event	140B	5131	INT	R/W	0 = Low Alarm 1 = High Alarm
Relay1 SP1 Scale	140C	5132	INT	R/W	0 = x 1 1 = x 10K
Relay1 SP2 Type	140D	5133	INT	R/W	0 = None 1 = Input Range 2 = Position Range 3 = Deviation 4 = Upper Travel Limit 5 = LowerTravel Limit 6 = Temperature Hi 7 = Temperature Lo 8 = Starts 9 = Stalled Motor 10 = Manual Mode 11 = Power Up Test Fail 12 = Input Signal Fail 13 = Position Sensor Fail 14 = Digital Input Activated 15 = Total Degrees Traveled
Relay1 SP2 Value	1038	4152	FP	R/W	Within the range of the selected relay type

Relay1 SP2 Event	140E	5134	INT	R/W	0 = Low Alarm 1 = High Alarm
Relay1 SP2 Scale	140F	5135	INT	R/W	0 = x 1 1 = x 10K
Relay1 Hysteresis	103A	4154	FP	R/W	0.0 to 100%

3.2.3 Relay2 / Alarms

Table 3-3 lists all the register addresses and ranges or selections for function parameters in the Relay2 set-up group.

Table 3-3 Relay2 / Alarms Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Relay2 SP1 Type	1410	5136	INT	R/W	0 = None 1 = Input Range 2 = Position Range 3 = Deviation 4 = Upper Travel Limit 5 = LowerTravel Limit 6 = Temperature Hi 7 = Temperature Lo 8 = Starts 9 = Stalled Motor 10 = Manual Mode 11 = Power Up Test Fail 12 = Input Signal Fail 13 = Position Sensor Fail 14 = Digital Input Activated 15 = Total Degrees Traveled
Relay2 SP1 Value	103C	4156	FP	R/W	Within the range for the selected relay type.
Relay2 SP1 Event	1411	5137	INT	R/W	0 = Low Alarm 1 = High Alarm
Relay2 SP1 Scale	1412	5138	INT	R/W	0 = x 1 1 = x 10K
Relay2 SP2 Type	1413	5139	INT	R/W	0 = None 1 = Input Range 2 = Position Range 3 = Deviation 4 = Upper Travel Limit 5 = LowerTravel Limit 6 = Temperature Hi 7 = Temperature Lo 8 = Starts 9 = Stalled Motor 10 = Manual Mode 11 = Power Up Test Fail 12 = Input Signal Fail 13 = Position Sensor Fail 14 = Digital Input Activated 15 = Total Degrees Traveled

Relay2 SP2 Value	103E	4158	FP	R/W	Within the range of the selected relay type
Relay2 SP2 Event	1414	5140	INT	R/W	0 = Low Alarm 1 = High Alarm
Relay2 SP2 Scale	1415	5141	INT	R/W	0 = x 1 1 = x 10K
Relay2 Hysteresis	1040	4160	FP	R/W	0.0 to 100%

3.2.4 Relay3 / Alarms

Table 3-4 lists all the register addresses and ranges or selections for function parameters in the Relay3 set-up group.

Table 3-4 Relay3 / Alarms Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Relay3 SP1 Type	1416	5142	INT	R/W	0 = None 1 = Input Range 2 = Position Range 3 = Deviation 4 = Upper Travel Limit 5 = LowerTravel Limit 6 = Temperature Hi 7 = Temperature Lo 8 = Starts 9 = Stalled Motor 10 = Manual Mode 11 = Power Up Test Fail 12 = Input Signal Fail 13 = Position Sensor Fail 14 = Digital Input Activated 15 = Total Degrees Traveled
Relay3 SP1 Value	1042	4162	FP	R/W	Within the range for the selected relay type.
Relay3 SP1 Event	1417	5143	INT	R/W	0 = Low Alarm 1 = High Alarm
Relay3 SP1 Scale	1418	5144	INT	R/W	0 = x 1 1 = x 10K

Relay3 SP2 Type	1419	5145	INT	R/W	0 = None 1 = Input Range 2 = Position Range 3 = Deviation 4 = Upper Travel Limit 5 = LowerTravel Limit 6 = Temperature Hi 7 = Temperature Lo 8 = Starts 9 = Stalled Motor 10 = Manual Mode 11 = Power Up Test Fail 12 = Input Signal Fail 13 = Position Sensor Fail 14 = Digital Input Activated 15 = Total Degrees Traveled
Relay3 SP2 Value	1044	4164	FP	R/W	Within the range of the selected relay type
Relay3 SP2 Event	141A	5146	INT	R/W	0 = Low Alarm 1 = High Alarm
Relay3 SP2 Scale	141B	5147	INT	R/W	0 = x 1 1 = x 10K
Relay3 Hysteresis	1046	4166	FP	R/W	0.0 to 100%

3.2.5 Relay4 / Alarms

Table 3-5 lists all the register addresses and ranges or selections for function parameters in the Relay4 set-up group.

Table 3-5 Relay4 / Alarms Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Relay4 SP1 Type	141C	5148	INT	R/W	0 = None 1 = Input Range 2 = Position Range 3 = Deviation 4 = Upper Travel Limit 5 = LowerTravel Limit 6 = Temperature Hi 7 = Temperature Lo 8 = Starts 9 = Stalled Motor 10 = Manual Mode 11 = Power Up Test Fail 12 = Input Signal Fail 13 = Position Sensor Fail 14 = Digital Input Activated 15 = Total Degrees Traveled
Relay4 SP1 Value	1048	4168	FP	R/W	Within the range for the selected relay type.
Relay4 SP1 Event	141D	5149	INT	R/W	0 = Low Alarm 1 = High Alarm

Relay4 SP1 Scale	141E	5150	INT	R/W	0 = x 1 1 = x 10K
Relay4 SP2 Type	141F	5151	INT	R/W	0 = None 1 = Input Range 2 = Position Range 3 = Deviation 4 = Upper Travel Limit 5 = LowerTravel Limit 6 = Temperature Hi 7 = Temperature Lo 8 = Starts 9 = Stalled Motor 10 = Manual Mode 11 = Power Up Test Fail 12 = Input Signal Fail 13 = Position Sensor Fail 14 = Digital Input Activated 15 = Total Degrees Traveled
Relay4 SP2 Value	104A	4170	FP	R/W	Within the range of the selected relay type
Relay4 SP2 Event	1420	5152	INT	R/W	0 = Low Alarm 1 = High Alarm
Relay4 SP2 Scale	1421	5153	INT	R/W	0 = x 1 1 = x 10K
Relay4 Hysteresis	104C	4172	FP	R/W	0.0 to 100%

3.2.6 Current Output

Table 3-6 lists all the register addresses and ranges or selections for function parameters in the Current Output set-up group.

Table 3-6 Current Output Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Current Output Type **Note**: If output type from model selection guide is: 0/4-20mA, 0/1-5Vdc	1406	5126	INT	R/W	0 = 4-20mA 1 = 0-20mA 2 = 1-5vdc 3 = 0-5vdc
Current Output Type **Note**: If output type from model selection guide is: Slidewire Emulation	1406	5126	INT	R	4 = Slidewire Emulation
Current Output Type **Note**: If output type from model selection guide is: None	1406	5126	INT	R	5 = None (Read Only)

3.2.7 Communications

Table 3-7 lists all the register addresses and ranges or selections for function parameters in the Communications set-up group.

Table 3-7 Communications Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Comm Address	104E	4174	FP	R/W	1 to 99
Baud Rate	1451	5201	INT	R/W	0 = 2400 1 = 4800 2 = 9600 3 = 19200
Transmit Delay	1408	5128	INT	R/W	0 = None 1 = 10mS 2 = 20mS 3 = 30mS 4 = 40mS 5 = 50mS

Floating Point Byte Order	1409	5129	INT	R/W	0 = FP_B 1 = FP_BB 2 = FP_L 3 = FP_LB

3.2.8 Digital Input

Table 3-8 lists all the register addresses and ranges or selections for function parameters in the Digital Input set-up group.

Table 3-8 Digital Input Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Digital Input Type	1422	5154	INT	R/W	0 = None 1 = Up 2 = Down 3 = User
User Defined Position	1050	4176	FP	R/W	0.0 to 100.0 %

3.2.9 Display

Table 3-9 lists all the register addresses and ranges or selections for function parameters in the Display set-up group.

Table 3-9 Display Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Decimal Point Location	1423	5155	INT	R/W	0 = XXXX 1 = XXX.X
Engineering Units	1424	5156	INT	R/W	0 = Percent 1 = Degrees
Display Units	1425	5157	INT	R/W	0 = SI 1 = English

3.2.10 Lockout

Table 3-10 lists all the register addresses and ranges or selections for function parameters the Lockout set-up group.

Table 3-10 Lockout Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Keyboard Lockout	1426	5158	INT	R/W	0 = None 1 = Calibration 2 = Configuration 3 = Full
Auto/Man Lockout	144C	5196	INT	R/W	0 = Locked 1 = Unlocked

3.2.11 Read Status

Table 3-11 lists all the register addresses and ranges or selections for function parameters the Read Status set-up group.

Table 3-11 Read Status Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Software Status	1427	5159	INT	R	**Bit Packed** Bit0 = Failsafe Bit1 = RAM Test Bit2 = Config. Checksum Bit3 = Working Calibration Checksum Bit4 = SEE Test 0 = OK 1 = Failure
Hardware Status	144D	5197	INT	R	**Bit Packed** Bit0 = Relay Board1 Bit1 = Relay Board2 Bit2 = Display / Keypad 0 = Not Installed 1 = Installed

3.2.12 Drive Information

Table 3-12 lists all the register addresses and ranges or selections for function parameters in the Drive Information set-up group.

Table 3-12 Drive Information Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Firmware Version #	142E	5166	INT	R	ASCII character '0-9' only
Motor Speed (10260S Model)	142F	5167	INT	R	60HZ 50HZ 0 = 10 Seconds / 12 Seconds 1 = 20 Seconds / 24 Seconds 2 = 40 Seconds / 48 Seconds 3 = 60 Seconds / 72 Seconds 4 = 20 Seconds / 24 Seconds 5 = 40 Seconds / 48 Seconds 6 = 60 Seconds / 72 Seconds 7 = 40 Seconds / 48 Seconds 8 = 60 Seconds / 72 Seconds
Motor Speed (11280S Models)	142F	5167	INT	R	0 = 10 Second 1 = 30 Second 2 = 60 Second
Motor Speed SA2000 150° Models	142F	5167	INT	R	60 HZ 50 HZ 0 = 06 Second / 7.5 Seconds 1 = 12 Second / 15 Seconds 2 = 25 Second / 30 Seconds 3 = 50 Second / 60 Seconds 4 = 75 Second / 90 Seconds
Motor Speed SA2000 90° Models	142F	5167	INT	R	60HZ 50HZ 0 = 3.6 Second / 4.5 Seconds 1 = 7.2 Second / 9 Seconds 2 = 15 Second / 18 Seconds 3 = 30 Second / 36 Seconds 4 = 45 Second 54 Seconds
Power (For 10260S & SA2000 Models)	1430	5168	INT	R	0 = 120 Volts @ 60 Hz 1 = 120 Volts @ 50 Hz 2 = 220 Volts @ 60 Hz 3 = 220 Volts @ 50 Hz
Power (11280S Models)	1430	5168	INT	R	0 = 120 Volts @ 60 Hz Single 1 = 240 Volts @ 60 Hz Single 2 = 240 Volts @ 60 Hz Three 3 = 480 Volts @ 60 Hz Three 4 = 575 Volts @ 60 Hz Three

Table 3-12 Drive Information Set-up Group, continued

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Rotation (SA2000 Models)	144E	5198	INT	R	0 = 90 Degrees 1 = 150 Degrees
Rotation (10260S / 11280S Models)	144E	5198	INT	R	0 = 90 Degrees
Torque (SA2000 Models)	144F	5199	INT	R	0 = 50 lb-in / 6.0 N-M 1 = 100 lb-in / 11.5 N-M 2 = 200 lb-in / 22.5 N-M 3 = 400 lb-in / 45.0 N-M 4 = 400 lb-in / 45.0 N-M
Torque (10260S Models)	144F	5199	INT	R	0 = 10 lb-ft / 15 N-M 1 = 20 lb-ft / 27 N-M 2 = 40 lb-ft / 55 N-M 3 = 60 lb-ft / 80 N-M 4 = 40 lb-ft / 55 N-M 5 = 80 lb-ft / 110 N-M 6 = 150 lb-ft / 200 N-M 7 = 200 lb-ft / 270 N-M 8 = 300 lb-ft / 400 N-M
Torque (11280S Models)	144F	5199	INT	R	0 = 425 lb-ft / 575 N-M 1 = 850 lb-ft / 1150 N-M 2 = 1500 lb-ft / 2025 N-M 3 = 2500 lb-ft / 3400 N-M 4 = 4000 lb-ft / 5425 N-M 5 = 5500 lb-ft / 7450 N-M
Tag1	1431	5169	INT	R/W	ASCII character '0-9' or 'A-Z' or 'a-z' or a 'space'
Tag2	1432	5170	INT	R/W	ASCII character '0-9' or 'A-Z' or 'a-z' or a 'space'
Tag3	1433	5171	INT	R/W	ASCII character '0-9' or 'A-Z' or 'a-z' or a 'space'
Tag4	1434	5172	INT	R/W	ASCII character '0-9' or 'A-Z' or 'a-z' or a 'space'
Tag5	1435	5173	INT	R/W	ASCII character '0-9' or 'A-Z' or 'a-z' or a 'space'
Tag6	1436	5174	INT	R/W	ASCII character '0-9' or 'A-Z' or 'a-z' or a 'space'

Table 3-12 Drive Information Set-up Group, continued

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Last Cal Date Digit 1	1443	5187	INT	R/W	ASCII character '0 – 9' only
Last Cal Date Digit 2	1444	5188	INT	R/W	ASCII character '0 – 9' only
Last Cal Date Digit 3	1445	5189	INT	R/W	ASCII character '0 – 9' only
Last Cal Date Digit 4	1446	5190	INT	R/W	ASCII character '0 – 9' only
Last Cal Date Digit 5	1447	5191	INT	R/W	ASCII character '0 – 9' only
Last Cal Date Digit 6	1448	5192	INT	R/W	ASCII character '0 – 9' only
Repair Type	1449	5193	INT	R	0 = None 1 = Communications Board 2 = NCS 3 = CPU 4 = Motor 5 = Power Board 6 = Switch 7 = Relay 8 = Gears 9 = Water Damage 10 = Heat Damage 11 = Over Voltage Damage 12 = Model Reconfigured 13 = Warranty Repair

3.2.13 Maintenance

Table 3-13 lists all the register addresses and ranges or selections for function parameters in the Maintenance set-up group.

Table 3-13 Maintenance Set-up Group

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Temperature Actual	1052	4178	FP	R	
Temperature Max	1054	4180	FP	R	
Temperature Min	1056	4182	FP	R	
Accumulated Stall Time	144A	5194	INT	R	0 to 6000 minutes
Accumulated Starts	1058	4184	FP	R	0 to 99,990,000
Relay1 Cycle Count	105A	4186	FP	R	0 to 99,990,000
Relay2 Cycle Count	105C	4188	FP	R	0 to 99,990,000
Relay3 Cycle Count	105E	4190	FP	R	0 to 99,990,000
Relay4 Cycle Count	1060	4192	FP	R	0 to 99,990,000
Region0 Count	1062	4194	FP	R	0 to 99,990,000
Region1 Count	1064	4196	FP	R	0 to 99,990,000
Region2 Count	1066	4198	FP	R	0 to 99,990,000
Region3 Count	1068	4200	FP	R	0 to 99,990,000
Region4 Count	106A	4202	FP	R	0 to 99,990,000
Region5 Count	106C	4204	FP	R	0 to 99,990,000
Region6 Count	106E	4206	FP	R	0 to 99,990,000
Region7 Count	1070	4208	FP	R	0 to 99,990,000
Region8 Count	1072	4210	FP	R	0 to 99,990,000
Region9 Count	1074	4212	FP	R	0 to 99,990,000
Total Degrees	1076	4214	FP	R	0 to 99,990,000
Save Maintenance Data	1452	5202	INT	R/W	0 = Disabled 1 = Enabled

Continued on next page ⇒

Table 3-13 Maintenance Set-up Group, continued

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Reset Type	144B	5195	INT	R/W	0 = None 1 = Accumulated Stall Time 2 = Cycle Count 3 = Region 0 Count 4 = Region 1 Count 5 = Region 2 Count 6 = Region 3 Count 7 = Region 4 Count 8 = Region 5 Count 9 = Region 6 Count 10 = Region 7 Count 11 = Region 8 Count 12 = Region 9 Count 13 = Temperature 14 = Total Degrees 15 = Relay 1 Count 16 = Relay 2 Count 17 = Relay 3 Count 18 = Relay 4 Count 19 = All 20 = System
Factory Cal Restore	1405	5125	INT	R/W	0 = None 1 = Input 2 = Motor 3 = Current Output 4 = All 5 = NCS
Factory Config Restore	1450	5200	INT	R/W	0 = Disabled 1 = Enable Restore Default Factory Cfg.
System Restart Note*	145B	5211	INT	R/W	0 = Disabled 1 = Enable System Restart

*Note: This function can only be accessed when the Reset Type function has been set to System (#20).

4. Remote Calibration Function Code

4.1 Function Code 57 (39h) - Remote Calibration Reference Data

Description

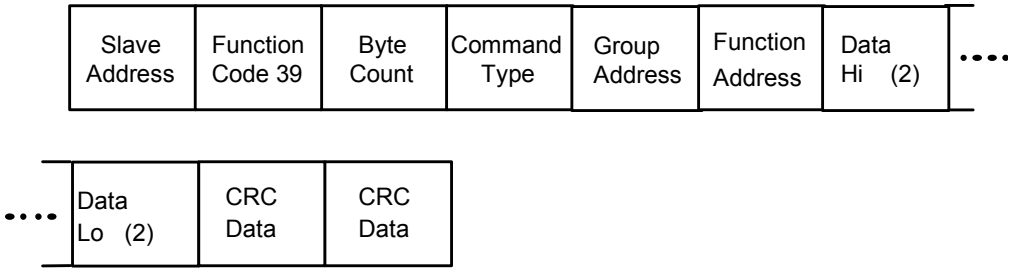
Function code 57 (39 Hex) is used in the Herculine Actuator to perform field calibration of the input, output and motor circuits remotely through Modbus communications.

Each calibration type is uniquely addressed by a code that is representative of the code created when the calibration is performed using the local display/keypad on the actuator. The calibration routines are state driven (using group and function address), meaning there's a sequence that must be followed to successfully complete the calibration. If the state requests (function addresses) being transmitted to the unit become out of sequence, the unit will respond with an error message. If the same state request (function address) is sent more than once, the unit will respond with an error message. Any request to the unit that results in an error response is interpreted as illegal request.

Query and Response Formats

The Query and Response formats for Function code 57 (39 Hex) are shown below. Details for each data block (or word) are described in Table 4-1.

Query Message Format



Response Message Format (echo back of query)

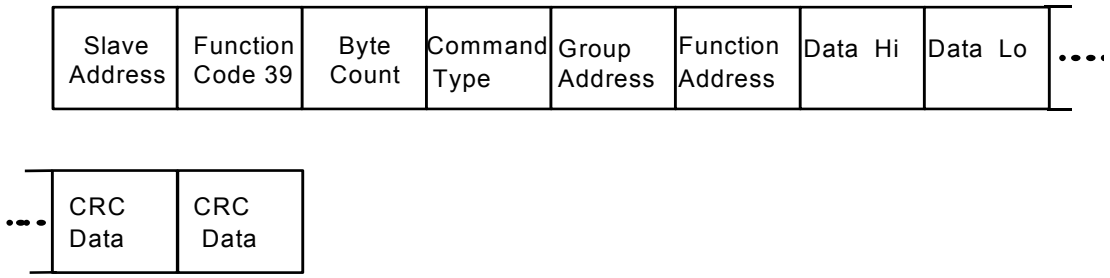


Table 4-1 Data Word Descriptions

Data Word	Description
Slave Address	The address of the device on the data link for which the message is intended. (1 byte)
Function Code	Tells the device what kind of action to perform. (1 byte)
Byte Count	Equals the number of bytes transmitted in either the query or the response message and will be the minimum number required to transmit all data. (1 byte)
Command Type	This byte should always be 1. (1 byte)
Setup Group Address	This is the code that represents the Group I.D. # that is generated when the group is accessed from the keypad/display using the setup key. The Group I.D. Codes are as follows: 9 = Calibrate Input 10 = Calibrate Motor 11 = Calibrate Output 16 = NCS Calibrator (1 byte)
Group Function Address	This is the code that represents the Function I.D. # that is generated when the functions of the selected group are accessed from the keypad/display using the function key. This will also be used to indicate increment and decrement functionality. The Function I.D. codes (States) are as follows: 0 = Select the Calibration Group 1 = Invoke the Selected Calibration Group 2 = Enable the Calibration Function 3 = Activate the Calibration Lo Function 4 = Activate the Calibration Hi Function * 5 = Terminate the Calibration ** 6 = Increment the Function Value ** 7 = Decrement the Function Value ** 8 = Abort the Calibration * Note: This state acts as the termination state for the NCS calibrator. ** Note: These states are not used during the Input Calibration and the NCS calibrator functions. (1 byte)
Data Hi	This is the upper word of the 4-byte integer data value. (2 bytes) Note: These 2 bytes are always 00 00
Data Lo	This is the lower word of the 4-byte integer data value. (2 bytes) Note: These 2 bytes can only be non zero during the increment/decrement functions used during the motor field calibration.
CRC Data	Cyclical Redundancy Check provides error checking of the message and it is the last field in the message. (2 bytes)

4.1.1 Remote Calibration Examples

Remote Current Input Field Calibration

Below is an example of how to field calibrate the current input using modbus communications. This example assumes the current input type has already been configured and an external current/voltage source is connected to the current input terminals. The current input calibration routine does not use the hi and lo data fields. They should always be set to zeros.

Example 1: Invoke Current Input Field Calibration

Query	04 39 07 01 09 00 00 00 00 00 CRC CRC	Select Cal Input Group
Resp	04 39 07 01 09 00 00 00 00 00 CRC CRC	
Query	04 39 07 01 09 01 00 00 00 00 CRC CRC	Invoke Cal Input Group
Resp	04 39 07 01 09 01 00 00 00 00 CRC CRC	
Query	04 39 07 01 09 02 00 00 00 00 CRC CRC	Enable Calibration Function
Resp	04 39 07 01 09 02 00 00 00 00 CRC CRC	
Query	04 39 07 01 09 03 00 00 00 00 CRC CRC	Activate Zero Cal Function *
Resp	04 39 07 01 09 03 00 00 00 00 CRC CRC	
Query	04 39 07 01 09 04 00 00 00 00 CRC CRC	Activate Span Cal Function **
Resp	04 39 07 01 09 04 00 00 00 00 CRC CRC	
Query	04 39 07 01 09 05 00 00 00 00 CRC CRC	Terminate Input Calibration
Resp	04 39 07 01 09 05 00 00 00 00 CRC CRC	

*Note: After the activate Zero Cal Function has been sent; set the external input source to the low calibration point.

**Note: After the activate Span Cal Function has been sent, set the external input source to the high calibration point.

Below is an example of the abort input calibration command string:

Query	04 39 07 01 09 08 00 00 00 00 CRC CRC	Abort the Input Calibration
Resp	04 39 07 01 09 08 00 00 00 00 CRC CRC	

Remote Motor Field Calibration

Below is an example of how to field calibrate the motor using modbus communications. This example assumes the direction and engineering units have already been configured. This calibration routine **does** use the data lo field within the *decrement* and *increment* functions to communicate the desired motor lo and motor hi setpoint positions. The data hi field should always be set to zero.

Example 2: Invoke Motor Field Calibration

Query	04 39 07 01 0A 00 00 00 00 00 CRC CRC	Select Cal Motor Group
Resp	04 39 07 01 0A 00 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 01 00 00 00 00 CRC CRC	Invoke Cal Motor Group
Resp	04 39 07 01 0A 01 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 02 00 00 00 00 CRC CRC	Enable Calibration Function
Resp	04 39 07 01 0A 02 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 03 00 00 00 00 CRC CRC	Activate Motor Lo Cal Function
Resp	04 39 07 01 0A 03 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 07 00 00 **00 00** CRC CRC	Decrement motor position to 0% *
Resp	04 39 07 01 0A 07 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 04 00 00 00 00 CRC CRC	Activate Motor Hi Cal Function
Resp	04 39 07 01 0A 04 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 06 00 00 **00 64** CRC CRC	Increment motor position to 100% *
Resp	04 39 07 01 0A 06 00 00 00 64 CRC CRC	
Query	04 39 07 01 0A 05 00 00 00 00 CRC CRC	Terminate Motor Calibration
Resp	04 39 07 01 0A 05 00 00 00 00 CRC CRC	

*Note1: The motor will attempt to drive to the value in the request, but due to the possibility of an undershoot of the setpoint; the final position may have to be set with the handwheel or the external Auto/Manual switch. If the position is short of the desired setpoint, it can also be nudged in by just resending the same command again. If the position has overshot the desired setpoint, it can be nudged in by resending the command again but instead of the increment code use the decrement code. Also if the Actuator's engineering unit is configured for DEGREES, the maximum data value that can be requested in the Increment Motor Position command is 90 for the 10260s and 11280s. For the SA2001 and SA2002 it is based upon the factory configured degrees of rotation (90 or 150).

Note2: Should the motor calibration be terminated abnormally, it is posible for the motor to be in manual mode after the termination state (function address code 5) has been sent. If the unit has no display/keypad there is no visible indication this condition is present. If after the aborted motor calibration the motor won't drive from an input signal change, perform a read request of the Mode Status @ 1AFD using FC03. This information is shown on page 57 of the 51-52-25-66I manual. If a 0 value is returned, the unit is in manual mode. Send a write request using FC06 or FC16 to place the unit in Auto mode (write a value

of 1) to 1AFD. If the display/keypad is present then the Manual Mode LED will be lit. Press the AUTO/MAN key to place in auto mode.

Below is an example of the abort motor calibration command string:

Query 04 39 07 01 0A 08 00 00 00 00 CRC CRC Abort the Motor Calibration

Resp 04 39 07 01 0A 08 00 00 00 00 CRC CRC

Remote Motor Factory Calibration

Below is an example of how to use modbus communications to factory calibrate a Non Contact Sensor that has been replaced in the field. **WARNING: performing this proceedure will destroy the original factory motor calibration.** This example assumes the direction (CCW) and engineering units (%) have already been configured. This calibration **MUST BE A FULL 100% SPAN** calibration and in the **CCW direction**. This calibration routine **does** use the data lo field within the *decrement* and *increment* functions to communicate the desired motor lo and motor hi setpoint positions. The data hi field should always be set to zero.

Example 3: Invoke Motor Factory Calibration

Query	04 15 09 06 14 05 00 02 00 02 00 05 CRC CRC	Set factory restore of NCS
Resp	04 15 09 06 14 05 00 02 00 02 00 05 CRC CRC	
Query	04 39 07 01 0A 00 00 00 00 00 CRC CRC	Select Cal Motor Group
Resp	04 39 07 01 0A 00 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 01 00 00 00 00 CRC CRC	Invoke Cal Motor Group
Resp	04 39 07 01 0A 01 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 02 00 00 00 00 CRC CRC	Enable Calibration Function
Resp	04 39 07 01 0A 02 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 03 00 00 00 00 CRC CRC	Activate Motor Lo Cal Function *
Resp	04 39 07 01 0A 03 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 07 00 00 **00 00** CRC CRC	Decrement motor position to 0% **
Resp	04 39 07 01 0A 07 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 04 00 00 00 00 CRC CRC	Activate Motor Hi Cal Function *
Resp	04 39 07 01 0A 04 00 00 00 00 CRC CRC	
Query	04 39 07 01 0A 06 00 00 **00 64** CRC CRC	Increment motor position to 100% **
Resp	04 39 07 01 0A 06 00 00 00 64 CRC CRC	
Query	04 39 07 01 0A 05 00 00 00 00 CRC CRC	Terminate Motor Calibration
Resp	04 39 07 01 0A 05 00 00 00 00 CRC CRC	

*Note: Caution must be used to make sure the motor lo and motor hi positions are correct. These functions will not allow advancement to the next state if the measured positions are not acceptable to the unit. If the unit returns an error response when trying to sequence from the Cal Motor Lo Position state to the Cal Motor Hi Position state; it means the lo position setting is not close enough to 0%. Adjust the 0% position and re-send the command to advance to the Cal Motor Hi Position state. If the unit returns an error response when trying to sequence from the Cal Motor Hi Position state to the Terminate Calibration state; it means the hi position setting is not close enough to 100%. Adjust the 100% position and re-send the command to advance to the Terminate Calibration state.

**Note1: The motor will attempt to drive to the value in the request, but due to the possibility of an undershoot of the setpoint; the final position may have to be set with the handwheel or the external Auto/Manual switch. If the position is short of the desired setpoint, it can also be nudged in by just resending the same command again. If the position has overshot the desired setpoint, it can be nudged in by resending the command again but instead of the increment code use the decrement code. Also if the Actuator's engineering unit is configured for DEGREES, the maximum data value that can be requested in the Increment Motor Position command is 90 for the 10260s and 11280s. For the SA2001 and SA2002 it is based upon the factory configured degrees of rotation (90 or 150).

Remote Current Output Field Calibration

Below is an example of how to field calibrate the current output using modbus communications. This example assumes the current output type has already been configured and a voltmeter is connected across a 250-ohm resistor connected across the current output terminals of the actuator. The current output calibration routine **does not** use the hi and lo data fields of the protocol to perform an adjustment of the current output value. The *decrement* and *increment* functions are used to lower and raise the current output value. The hi and lo data fields should always be set to zeros.

Example 4: Invoke Current Output Field Calibration

Query	04 39 07 01 0B 00 00 00 00 00 CRC CRC	Select Cal Current Output Group
Resp	04 39 07 01 0B 00 00 00 00 00 CRC CRC	
Query	04 39 07 01 0B 01 00 00 00 00 CRC CRC	Invoke Cal Current Output Group
Resp	04 39 07 01 0B 01 00 00 00 00 CRC CRC	
Query	04 39 07 01 0B 02 00 00 00 00 CRC CRC	Enable Calibration Function
Resp	04 39 07 01 0B 02 00 00 00 00 CRC CRC	
Query	04 39 07 01 0B 03 00 00 00 00 CRC CRC	Activate Zero Cal Function
Resp	04 39 07 01 0B 03 00 00 00 00 CRC CRC	
Query	04 39 07 01 0B 06 00 00 00 00 CRC CRC	Increment count value by 1
Resp	04 39 07 01 0B 06 00 00 00 00 CRC CRC	
Query	04 39 07 01 0B 04 00 00 00 00 CRC CRC	Activate Span Cal Function
Resp	04 39 07 01 0B 04 00 00 00 00 CRC CRC	
Query	04 39 07 01 0B 07 00 00 00 00 CRC CRC	Decrement count value by 1
Resp	04 39 07 01 0B 07 00 00 00 00 CRC CRC	
Query	04 39 07 01 0B 05 00 00 00 00 CRC CRC	Terminate Current Output Calibration
Resp	04 39 07 01 0B 05 00 00 00 00 CRC CRC	

Below is an example of the abort output calibration command string:

Query	04 39 07 01 0B 08 00 00 00 00 CRC CRC	Abort the Output Calibration
Resp	04 39 07 01 0B 08 00 00 00 00 CRC CRC	

Remote Use of the Position Sensor Field Calibrator

Below is an example of how to use the position sensor field calibrator to access the sensor output voltage using modbus communications. This example assumes the new sensor has already been installed and the motor is positioned at the 50% midpoint.

Example 5: Invoke the Position Sensor Field Calibrator

Query	04 39 07 01 10 00 00 00 00 00 CRC CRC	Select Position Sensor Calibrator Group
Resp	04 39 07 01 10 00 00 00 00 00 CRC CRC	
Query	04 39 07 01 10 01 00 00 00 00 CRC CRC	Invoke Position Sensor Calibrator Group
Resp	04 39 07 01 10 01 00 00 00 00 CRC CRC	
Query	04 39 07 01 10 02 00 00 00 00 CRC CRC	Enable Position Sensor Calibrator Function
Resp	04 39 07 01 10 02 00 00 00 00 CRC CRC	
Query	04 39 07 01 10 03 00 00 00 00 CRC CRC	Activate Position Sensor Calibrator Readings
Resp	04 39 07 01 10 03 00 00 00 00 CRC CRC	
Query	04 04 18 C2 00 02 CRC CRC	Request sensor output voltage reading *
Resp	04 04 04 40 20 52 00 CRC CRC	Ex: 40 20 52 00 = 2.505 Vdc
Query	04 39 07 01 10 04 00 00 00 00 CRC CRC	Terminate Position Sensor Calibrator Function **
Resp	04 39 07 01 10 04 00 00 00 00 CRC CRC	

*Note: This function state is not necessary if the display/keypad is present, otherwise it is the only means available to obtain the Sensor voltage reading.

**Note: Caution must be used to make sure the Sensor voltage reading is correct (2.500 +/- 0.010 Vdc). This function will not allow advancement to the next state to occur if the measured voltage is not acceptable to the unit. If the unit returns an error response when trying to sequence from the Activate Position Sensor Calibrator Reading or Request sensor Output Voltage Reading to the Terminate Calibration state; it means the sensor voltage reading is not close enough to 2.500 Vdc. Adjust the position using the handwheel until the display reads 2.500 +/- 0.010 V and re-send the command to advance to the Terminate Calibration state.

Below is an example of the abort position sensor calibration command string:

Query	04 39 07 01 10 08 00 00 00 00 CRC CRC	Abort the position sensor Calibration
Resp	04 39 07 01 10 08 00 00 00 00 CRC CRC	

5. Appendix

Table 5-1 Equal Percentage Custom Characterization Parameter Addresses

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
X0 Value	10A0	4256	FP	R	0.0 %
X1 Value	10A2	4258	FP	R	5.0 %
X2 Value	10A4	4260	FP	R	10.0 %
X3 Value	10A6	4262	FP	R	15.0 %
X4 Value	10A8	4264	FP	R	20.0 %
X5 Value	10AA	4266	FP	R	25.0 %
X6 Value	10AC	4268	FP	R	30.0 %
X7 Value	10AE	4270	FP	R	35.0 %
X8 Value	10B0	4272	FP	R	40.0 %
X9 Value	10B2	4274	FP	R	45.0 %
X10 Value	10B4	4276	FP	R	50.0 %
X11 Value	10B6	4278	FP	R	55.0 %
X12 Value	10B8	4280	FP	R	60.0 %
X13 Value	10BA	4282	FP	R	65.0 %
X14 Value	10BC	4284	FP	R	70.0 %
X15 Value	10BE	4286	FP	R	75.0 %
X16 Value	10C0	4288	FP	R	80.0 %
X17 Value	10C2	4290	FP	R	85.0 %
X18 Value	10C4	4292	FP	R	90.0 %
X19 Value	10C6	4294	FP	R	95.0 %
X20 Value	10C8	4296	FP	R	100.0 %
Y0 Value	10CA	4298	FP	R	0.0 %
Y1 Value	10CC	4300	FP	R	0.80 %
Y2 Value	10CE	4302	FP	R	2.1 %
Y3 Value	10D0	4304	FP	R	3.2 %
Y4 Value	10D2	4306	FP	R	4.9 %
Y5 Value	10D4	4308	FP	R	6.5 %
Y6 Value	10D6	4310	FP	R	8.4 %
Y7 Value	10D8	4312	FP	R	10.7 %
Y8 Value	10DA	4314	FP	R	13.2 %
Y9 Value	10DC	4316	FP	R	15.7 %
Y10 Value	10DE	4318	FP	R	18.7 %

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Y11 Value	10E0	4320	FP	R	22.6 %
Y12 Value	10E2	4322	FP	R	27.2 %
Y13 Value	10E4	4324	FP	R	33.4 %
Y14 Value	10E6	4326	FP	R	40.0 %
Y15 Value	10E8	4328	FP	R	46.0 %
Y16 Value	10EA	4330	FP	R	53.8 %
Y17 Value	10EC	4332	FP	R	63.2 %
Y18 Value	10EE	4334	FP	R	73.7 %
Y19 Value	10F0	4336	FP	R	86.2 %
Y20 Value	10F2	4338	FP	R	100.0 %

Table 5-2 Quick Opening Custom Characterization Parameter Addresses

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
X0 Value	10F4	4340	FP	R	0.0 %
X1 Value	10F6	4342	FP	R	5.0 %
X2 Value	10F8	4344	FP	R	10.0 %
X3 Value	10FA	4346	FP	R	15.0 %
X4 Value	10FC	4348	FP	R	20.0 %
X5 Value	10FE	4350	FP	R	25.0 %
X6 Value	1100	4352	FP	R	30.0 %
X7 Value	1102	4354	FP	R	35.0 %
X8 Value	1104	4356	FP	R	40.0 %
X9 Value	1106	4358	FP	R	45.0 %
X10 Value	1108	4360	FP	R	50.0 %
X11 Value	110A	4362	FP	R	55.0 %
X12 Value	110C	4364	FP	R	60.0 %
X13 Value	110E	4366	FP	R	65.0 %
X14 Value	1110	4368	FP	R	70.0 %
X15 Value	1112	4370	FP	R	75.0 %
X16 Value	1114	4372	FP	R	80.0 %
X17 Value	1116	4374	FP	R	85.0 %
X18 Value	1118	4376	FP	R	90.0 %
X19 Value	111A	4378	FP	R	95.0 %
X20 Value	111C	4380	FP	R	100.0 %
Y0 Value	111E	4382	FP	R	0.0 %

Parameter Description	File Number		Data Type	Access	Data Range or Enumerated Selection
	Hex	Decimal			
Y1 Value	1120	4384	FP	R	10.0 %
Y2 Value	1122	4386	FP	R	20.0 %
Y3 Value	1124	4388	FP	R	30.0 %
Y4 Value	1126	4390	FP	R	40.0 %
Y5 Value	1128	4392	FP	R	50.0 %
Y6 Value	112A	4394	FP	R	60.0 %
Y7 Value	112C	4396	FP	R	70.0 %
Y8 Value	112E	4398	FP	R	77.0 %
Y9 Value	1130	4400	FP	R	82.0 %
Y10 Value	1132	4402	FP	R	86.0 %
Y11 Value	1134	4404	FP	R	88.0 %
Y12 Value	1136	4406	FP	R	90.0 %
Y13 Value	1138	4408	FP	R	92.0 %
Y14 Value	113A	4410	FP	R	94.0 %
Y15 Value	113C	4412	FP	R	95.0 %
Y16 Value	113E	4414	FP	R	96.0 %
Y17 Value	1140	4416	FP	R	97.5 %
Y18 Value	1142	4418	FP	R	98.5 %
Y19 Value	1144	4420	FP	R	99.5 %
Y20 Value	1146	4422	FP	R	100.0 %

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