

# HIQ PM1-E-D-CT Modbus RTU Protocol

## HIQ PM1-E-D-CT Power Sensor Modbus Protocol Implementation V2.2

### 1 MODBUS Protocol Message Format

The MODBUS Protocol defines the format for the master's query and the slave's response.

The query contains the device (or broadcast) address, a function code defining the requested action, any data to be sent, and an error-checking field.

The response contains fields confirming the action taken, any data to be returned, and an error-checking field. If an error occurred in receipt of the message then the message is ignored, if the slave is unable to perform the requested action, then it will construct an error message and send it as its response. The MODBUS Protocol functions used by the Robotina HIQ Digital sensors copy 16 bit register values between master and slaves. However, the data used by the Robotina HIQ Digital sensors is in 32 bit IEEE 754 floating point format. Thus each instrument parameter is conceptually held in two adjacent MODBUS Protocol registers. Query The following example illustrates a request for a single floating point parameter i.e. two 16-bit Modbus Protocol Registers.

First Byte

Last Byte

Slave Address	Function Code	Start Address (Hi)	Start Address (Lo)	Number of Points (Hi)	Number of Points (Lo)	Error Check (Lo)	Error Check (Hi)

Slave Address: 8-bit value representing the slave being addressed (1 to 247), 0 is reserved for the broadcast address. The Robotina HIQ Digital sensors meters do not support the broadcast address.

Function Code: 8-bit value telling the addressed slave what action is to be performed. (3, 4, 8 or 16 are valid for Robotina HIQ Digital sensors)

Start Address (Hi): The top (most significant) eight bits of a 16-bit number specifying the start address of the data being requested.

Start Address (Lo): The bottom (least significant) eight bits of a 16-bit number specifying the start address of the data being requested. As registers are used in pairs and start at zero, then this must be an even number.

Number of Points (Hi): The top (most significant) eight bits of a 16-bit number specifying the number of registers being requested.

Number of Points (Lo): The bottom (least significant) eight bits of a 16-bit number specifying the number of registers being requested. As registers are used in pairs, then this must be an even number.

Error Check (Lo): The bottom (least significant) eight bits of a 16-bit number representing the error check value.

Error Check (Hi): The top (most significant) eight bits of a 16-bit number representing the error check value.

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### Response

The example illustrates the normal response to a request for a single floating point parameter i.e. two 16-bit Modbus Protocol Registers.

#### First Byte

#### Last Byte

Slave Address	Function Code	Byte Count	First Register (Hi)	First Register (Lo)	Second Register (Hi)	Second Register (Lo)	Error Check (Lo)	Error Check (Hi)
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Slave Address: 8-bit value representing the address of slave that is responding.

Function Code: 8-bit value which, when a copy of the function code in the query, indicates that the slave recognised the query and has responded. (See also Exception Response).

Byte Count: 8-bit value indicating the number of data bytes contained within this response

First Register (Hi)\*: The top (most significant) eight bits of a 16-bit number representing the first register requested in the query.

First Register (Lo)\*: The bottom (least significant) eight bits of a 16-bit number representing the first register requested in the query.

Second Register (Hi)\*: The top (most significant) eight bits of a 16-bit number representing the second register requested in the query.

Second Register (Lo)\*: The bottom (least significant) eight bits of a 16-bit number representing the second register requested in the query.

Error Check (Lo): The bottom (least significant) eight bits of a 16-bit number representing the error check value.

Error Check (Hi): The top (most significant) eight bits of a 16-bit number representing the error check value.

### Exception Response

If an error is detected in the content of the query (excluding parity errors and Error Check mismatch), then an error response (called an exception response), will be sent to the master. The exception response is identified by the function code being a copy of the query function code but with the most-significant bit set. The data contained in an exception response is a single byte error code.

#### First Byte

#### Last Byte

Slave Address	Function Code	Error Code	Error Check (Lo)	Error Check (Hi)
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Slave Address: 8-bit value representing the address of slave that is responding.

Function Code: 8 bit value which is the function code in the query OR'ed with 80 hex, indicating that the slave either does not recognize the query or could not carry out the action requested.

Error Code: 8-bit value indicating the nature of the exception detected.

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(See “Table Of Exception Codes“ later).

Error Check (Lo): The bottom (least significant) eight bits of a 16-bit number representing the error check value.

Error Check (Hi): The top (most significant) eight bits of a 16-bit number representing the error check value.

### 2 Read Input Registers

2.1 MODBUS Protocol code 04 reads the contents of the 3X registers.

Example

The following query will request ‘Volts 1’ from an instrument with node address 1:

Field Name	Example(Hex)
Slave Address	01
Function	04
Starting Address High	00
Starting Address Low	00
Number of Points High	00
Number of Points Low	02
Error Check Low	71
Error Check High	CB

Note: Data must be requested in register pairs i.e. the “Starting Address“ and the “Number of Points“ must be even numbers to request a floating point variable. If the “Starting Address“ or the “Number of points“ is odd then the query will fall in the middle of a floating point variable the product will return an error message.

The following response returns the contents of Volts 1 as 230.2. But see also “Exception Response“ later.

Field Name	Example (Hex)
Slave Address	01
Function	04
Byte Count	04
Data, High Reg, High Byte	43
Data, High Reg, Low Byte	66
Data, Low Reg, High Byte	33
Data, Low Reg, Low Byte	34
Error Check Low	1B
Error Check High	38

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### 2.2 Read Holding Registers

MODBUS Protocol code 03 reads the contents of the 4X registers.

Example

The following query will request the prevailing 'Network Node':

Field Name	Example (Hex)
Slave Address	01
Function	03
Starting Address High	00
Starting Address Low	00
Number of Points High	00
Number of Points Low	14
Error Check Low	C4
Error Check High	0B

Note: Data must be requested in register pairs i.e. the "Starting Address" and the "Number of Points" must be even numbers to request a floating point variable. If the "Starting Address" or the "Number of points" is odd then the query will fall in the middle of a floating point variable the product will return an error message.

The following response returns the contents of Demand Time as 1, but see also "Exception Response" later.

Field Name	Example (Hex)
Slave Address	01
Function	03
Byte Count	04
Data, High Reg, High Byte	3F
Data, High Reg, Low Byte	80
Data, Low Reg, High Byte	00
Data, Low Reg, Low Byte	00
Error Check Low	F7
Error Check High	CF

### 2.3 Write Holding Registers

MODBUS Protocol code 10 (16 decimal) writes the contents of the 4X registers.

Example

The following query will set the Network Node to 60:

Field Name	Example (Hex)
Slave Address	01
Function	10
Starting Address High	00
Starting Address Low	14
Number of Registers High	00
Number of Registers Low	02
Byte Count	04

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Data, High Reg, High Byte	42
Data, High Reg, Low Byte	70
Data, Low Reg, High Byte	00
Data, Low Reg, Low Byte	00
Error Check Low	67
Error Check High	D5

Note: Data must be written in register pairs i.e. the “Starting Address” and the “Number of Points” must be even numbers to write a floating point variable. If the “Starting Address” or the “Number of points” is odd then the query will fall in the middle of a floating point variable the product will return an error message. In general only one floating point value can be written per query

The following response indicates that the write has been successful. But see also “Exception Response “later.

Field Name	Example (Hex)
Slave Address	01
Function	10
Starting Address High	00
Starting Address Low	14
Number of Registers High	00
Number of Registers Low	02
Error Check Low	E0
Error Check High	08

### 2.4 Exception Response

If the slave in the “Write Holding Register” example above, did not support that function then it would have replied with an Exception Response as shown below. The exception function code is the original function code from the query with the MSB set i.e. it has had 80 hex logically ORed with it. The exception code indicates the reason for the exception. The slave will not respond at all if there is an error with the parity or CRC of the query. However, if the slave can not process the query then it will respond with an exception. In this case a code 01, the requested function is not support by this slave.

Field Name	Example (Hex)
Slave Address	01
Function	10 OR 80 = 90
Exception Code	01
Error Check Low	8D
Error Check High	C0

### 2.5 Exception Codes

#### 2.5.1 Table of Exception Codes

Robotina HIQ Digital sensors support the following function codes:

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Exception Code	MODBUS Protocol name	Description
01	Illegal Function	The function code is not supported by the product
02	Illegal Data Address	Attempt to access an invalid address or an attempt to read or write part of a floating point value
03	Illegal Data Value	Attempt to set a floating point variable to an invalid value
05	Slave Device Failure	An error occurred when the instrument attempted to store an update to it's configuration

Register Map:

Function code 04 to read input parameters:

Address Register	Input Register Parameter				Modbus Protocol Start Address Hex	
	Parameter	Length (bytes)	Units	Format	Hi byte	Lo byte
30001	Voltage	4	Volts	Float	00	00
30007	Current	4	Amps	Float	00	06
30013	Active power	4	Watts	Float	00	0C
30019	Apparent power	4	VA	Float	00	12
30025	Reactive power	4	VAr	Float	00	18
30031	Power factor	4	None	Float	00	1E
30071	Frequency	4	Hz	Float	00	46
30073	Import active energy	4	kWh	Float	00	48
30075	Export active energy	4	kWh	Float	00	4A
30077	Import reactive energy	4	kvarh	Float	00	4C
30079	Export reactive energy	4	kvarh	Float	00	4E
30085	Total system power demand	4	W	Float	00	54
30087	Maximum total system power demand	4	W	Float	00	56
30089	Current system positive power demand	4	W	Float	00	58
30091	Maximum system positive power demand	4	W	Float	00	5A

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30093	Current system reverse power demand	4	W	Float	00	5C
30095	Maximum system reverse power demand	4	W	Float	00	5E
30259	Current demand.	4	Amps	Float	01	02
30265	Maximum current demand.	4	Amps	Float	01	08
30343	Total active energy	4	kWh	Float	01	56
30345	Total reactive energy	4	Kvarh	Float	01	58

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Function code 10 to set holding parameter , function code 03 to read holding parameter

Address Register	Holding Register Parameter		Modbus Protocol Start Address Hex		Description
	Parameters	Format	Hi byte	Lo byte	
40003	Demand Period	Float	00	02	Write demand period: 0, 5,8, 10, 15, 20, 30 or 60 minutes, default 60. Setting the period to 0 will cause the demand to show the current parameter value, and demand max to show the maximum parameter value since last demand reset.
40013	Relay Pulse Width	Float	00	0C	Write relay on period in milliseconds: 60, 100 or 200, default 100ms.
40019	Network Parity Stop	Float	00	12	Write the network port parity/stop bits for MODBUS Protocol, where: 0 = One stop bit and no parity, default. 1 = One stop bit and even parity. 2 = One stop bit and odd parity.3 = Two stop bits and no parity.Requires a restart to become effective.
40021	Modbus Address	Float	00	14	Ranges from 1 to 247, .Default ID is 1.
40029	Baud rate	Float	00	1C	0:2400bps(default) 1:4800bps 2:9600bps 5:1200bps
40087	Pulse 1 output mode	Hex	00	56	0001: Import active energy, 0002: Import + export active energy, 0004: Export active energy, (default). 0005: Import reactive energy, 0006: Import + export reactive energy, 0008: Export reactive energy,
461457	Reset	Hex	F0	10	00 00 : reset the Maximum demand <b>Length : 2 byte</b> <b>Data Format:Hex</b>
463745	Time of scroll display	BCD	F9	00	0-30s Default 0:does not display in turns
463761	Pulse 1 output	Hex	F9	10	0000:0.001kWh/imp(default) 0001:0.01kWh/imp 0002:0.1kWh/imp 0003:1kWh/imp
463777	Measurement	Hex	F9	20	Data Format: Hex



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	mode				0001:mode 1(total = import) 0002:mode 2 (total = import + export) (default) 0003:mode 3 (total = import - export)
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