



TrueString™ Inverter MODBUS Map

*August 2016
Version 1.1*



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Introduction

HiQ Solar inverters may be ordered with an optional RS485 port. The port is electrically isolated and “floating” with respect to the inverter and ground. The port provides 2 wire, half-duplex communications based on the RS485 standard, as well as a small amount of regulated and unregulated power.

By default, the port implements the MODBUS RTU serial protocol and responds as a slave device, allowing an external master to read a variety of measured values and perform basic control functions.

Physical Interface

The optional inverter aux connector is located between the AC connector and button. The connector is shipped with a protective cap.



Cable - Physical

A cable with an appropriate mating connector is supplied with each unit with the aux port option. It has the following characteristics:

Parameter	Value
Length	2m
Outer sheath diameter	8.4mm
Wire gauge	20 AWG

Cable - Wiring Color Code

The cable has the following wiring color code:

Wire Color	Function	Details
WHITE	VP	8-12V, unregulated Max $I_{VP} = 125\text{mA} - I_{VP5}$ (Typical 9.5V @ 50mA, 8.2V @ 125mA, assuming no load on VP5.)
BROWN	VP5	5V +/- 4%, regulated Max $I_{VP5} = 40\text{mA}$
GREY	RS485+	
GREEN	RS485-	
YELLOW	GND	Power and signal ground reference

The lines on the port are isolated from the power conversion circuitry and float with respect to both inverter and earth ground. The RS485+/- lines are un-terminated and unbiased internally.

MODBUS Serial Settings

	Supported	Default
MODBUS Address	1-254	200
MODBUS Protocol	RTU	RTU
Data Rate	2400-500Kbps	19200
Parity	none, even, odd, mark	even
Data Bits	8	8
Stop Bits	1	1

Notes:

1. Parity "none" results in a 10-bit serial word of 1 start bit, 8 data bits, and 1 stop bit
2. Parity "mark" results in a 11-bit serial word with the parity bit always set to 1 and is equivalent to the MODBUS spec's parity "none" that is described as having two stop bits.

Supported MODBUS Function Codes

Code	Description
3	Read Holding Registers
4	Read Input Registers
6	Write Single Register
16	Write Multiple Registers
17	Report Slave ID
23	Read/Write Multiple Registers

Notes:

- Writes to non-writable registers will be ignored.
- The same registers are mapped into both Holding and Input register space.

Supported MODBUS Exception Codes

Code	Description
1	Illegal Function
2	Illegal Data Address
3	Illegal Data Value
4	Illegal Response Length

Supported MODBUS Data Types

SINT16	Signed 16-bit integer
SINT32	Signed 32-bit integer, split between two registers
ASCII	ASCII characters, two per register, padded with null (0) at the end.

Note:

- When accessing data types that span more than one register (ASCII strings, 32-bit values), partial reads of the data type are not allowed and will result in undefined values being returned for the entire transaction.

Per the MODBUS standard, all data types transmitted in big-endian format. For example:

Data Type	Example Value	Byte Offset / Transmission Order			
		0	1	2	3
SINT16	0x1234	0x12	0x34		
SINT32	0x12345678	0x12	0x34	0x56	0x78
ASCII	"ABC"	'A'	'B'	'C'	0x00

MODBUS Register Addressing

The Gateway uses extended addressing in order to fit all supported inverters into the address space. Note that, per the MODBUS standard, the supplied register addresses must be translated into data addresses in the request by removing the address space prefix (4) and subtracting 1. Effectively, subtract decimal 40001 from the supplied Register Address to get the required data address.

General Registers

Register	Number of Registers	Description	Units	Format	Multiplier	Comments
40100	1	MODBUS Map Version		SINT16	1	Version = 1
40101	8	Inverter Serial		ASCII		"MIBB001234" for example
40109	3	Reserved		ASCII		
40112	1	Max Number of Strings		SINT16	1	
40113	1	PLC Signal		SINT16	1	
40114	1	PLC Noise		SINT16	1	
40115	2	Active Faults 0		SINT32	1	
40117	2	Active Faults 1		SINT32	1	
40119	1	Temperature 1	degC	SINT16	0.1	
40120	1	Temperature 2	degC	SINT16	0.1	
40121	1	Temperature 3	degC	SINT16	0.1	
40122	1	Temperature 4	degC	SINT16	0.1	
40123	1	Temperature 5	degC	SINT16	0.1	

Production Registers

Register	Number of Registers	Description	Units	Format	Multiplier	Comments
40200	2	Reserved		SINT32	1	
40202	1	Inverter Mode		SINT16	1	See Inverter Mode Table
40203	1	Inverter Status		SINT16	1	See General Status Table
40204	2	Net Output Power	Watts	SINT32	0.1	
40206	2	Total Energy Produced	KWh	SINT32	1	
40208	1	Voltage RMS L1-N	Volts	SINT16	0.1	
40209	1	Voltage RMS L2-N	Volts	SINT16	0.1	
40210	1	Voltage RMS L3-N	Volts	SINT16	0.1	
40211	1	Current RMS L1	Amps	SINT16	0.01	
40212	1	Current RMS L2	Amps	SINT16	0.01	
40213	1	Current RMS L3	Amps	SINT16	0.01	
40214	2	Power RMS L1	Watts	SINT32	0.1	
40216	2	Power RMS L2	Watts	SINT32	0.1	
40218	2	Power RMS L3	Watts	SINT32	0.1	
40220	1	Line Frequency	Hz	SINT16	0.01	
40221	1	String 1 Voltage	Volts	SINT16	0.1	
40222	1	String 1 Current	Amps	SINT16	0.01	
40223	2	String 1 Power	Watts	SINT32	0.1	
40225	1	String 1 Status		SINT16	1	See String Status Table
40226	1	String 2 Voltage	Volts	SINT16	0.1	
40227	1	String 2 Current	Amps	SINT16	0.01	
40228	2	String 2 Power	Watts	SINT32	0.1	
40230	1	String 2 Status		SINT16	1	See String Status Table
...		...				
40301	1	String 16 Voltage	Volts	SINT16	0.1	
40302	1	String 16 Current	Amps	SINT16	0.01	
40303	2	String 16 Power	Watts	SINT32	0.1	
40305	1	String 16 Status		SINT16	1	See String Status Table

Writable Control Registers

Register	Number of Registers	Description	Units	Format	Multiplier	Comments
40400	2	Reserved		SINT32	1	
40402	2	Discovery Serial		SINT32	1	Read returns the numeric portion of the inverter serial number. Write does nothing.
40404	2	Discovery Serial Min		SINT32	1	Sets the minimum inverter serial number that can respond. Used to discover inverters when MODBUS addresses have not been assigned.
40406	2	Discovery Serial Max		SINT32	1	Sets the maximum inverter serial number that can respond.
40408	1	Serial Protocol		SINT16	1	0 = Port Disabled 1 = MODBUS RTU
40409	1	MODBUS Address		SINT16	1	Write to set MODBUS address. Range is 1 to 254.
40410	2	MODBUS Data Rate	bps	SINT32	1	Write to set MODBUS Data Rate. Range is 2400 to 500000 bps.
40412	1	MODBUS Parity		SINT16	1	Write to set MODBUS parity. 0 = NONE 1 = MARK 2 = EVEN 3 = ODD
40413	1	Special System Mode		SINT16	1	Specialized system modes. 0 = Normal PV Inverter 1 = Power Supply
40414	1	Requested Inverter Mode		SINT16	1	A write requests an inverter mode change. Requested modes include: 0 = Generate Off (auto restart) 2 = Generate On 5 = Generation Locked Off See Inverter Mode Table.

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Register	Number of Registers	Description	Units	Format	Multiplier	Comments
40415	1	Set Power Limit	Watts	SINT16	1	Maximum inverter power limit. Range is 500W to normal power limit.
40416	1	Power Factor Shift		SINT16	0.01	-0.20 to 0.20 in 0.01 steps -0.20 = Inductive, V leads I 0.00 = Unity Power Factor +0.20 = Capacitive, I leads V
40417	1	Set String 1 Voltage	Volts	SINT16	1	Sets string 1 target voltage when inverter is in power supply mode.
40418	1	Set String 2 Voltage	Volts	SINT16	1	Sets string 2 target voltage when inverter is in power supply mode.

MODBUS Device Discovery

When shipped, HiQ inverters default to a MODBUS address of 200, unless another address has been requested. MODBUS addresses can also be set by HiQ tech support using a HiQ Gateway using Power Line Communications (PLC). In cases where the customer would like to discover inverters and assign addresses on their own using MODBUS, a discovery mechanism has been provided.

In the case of only one device on the bus, discovery is trivial. Use the MODBUS broadcast address (0) to address the inverter and read/write its MODBUS address register.

In the case of two or more devices on the bus that share the same MODBUS address, three “Discovery” registers have been provided to allow unique identification and addressing of devices even if their MODBUS addresses are the same.

Each inverter has a unique, factory assigned serial number. The numeric portion of that serial number can be read in the “Discovery Serial” register. The “Discovery Serial Min” and “Discover Serial Max” registers provide a filter based on that serial number. The inverter will only respond to MODBUS reads and writes if its serial number falls between the min and max serial numbers (inclusive) defined by those registers. The min and max registers are an exception to the filter, with writes always being accepted. By default, the registers are set to a range that includes all possible serial numbers.

To discover inverters, either use the MODBUS broadcast address (0) or the inverter default MODBUS address (200) to attempt to read the “Discovery Serial” register. If you get a “clean” MODBUS response, only one inverter was present. If you get a garbled response (CRC or other protocol failure), then more than one inverter responded at the same time. Write to the discovery min and max registers to narrow down the range of possibly responding inverters until you get a clean response. At that point, you can assign a unique MODBUS address, if desired.

Example:

Imagine that you have three inverters on the bus with serial numbers 3210, 5000, and 6100. All are assigned the default MODBUS address of 200, and, as such, cannot be uniquely addressed using the normal MODBUS protocol. The following discovery sequence can then be used:

Try reading from MODBUS address 200.

=> We get a garbled response, as 3210, 5000, and 6100 all respond.

Write Discovery_Min = 1 and Discover_Max = 5000, and try reading again.

=> We get a garbled response, as both 3210 and 5000 respond.

Write Discovery_Min = 1 and Discover_Max = 2500, and try reading again.

=> We get no response. There are no inverters in this range.

Write Discovery_Min = 2501 and Discover_Max = 5000, and try reading again.

=> We get a garbled response, as both 3210 and 5000 respond.

Write Discovery_Min = 2501 and Discover_Max = 3725, and try reading again.

=> We get a clean response, as only 3210 responds. Assign 3210 a MODBUS address other than 200.

Write Discovery_Min = 3726 and Discover_Max = 5000, and try reading again.

=> We get a clean response, as only 5000 responds. Assign 5000 a MODBUS address other than 200.

Write Discovery_Min = 5001 and Discover_Max = 10000, and try reading again.

=> We get a clean response, as only 6100 responds. Assign 6100 a MODBUS address other than 200.

Write Discovery_Min = 1 and Discover_Max = 10000000, and try reading again.

=> We get no response. There are no inverters in this range. All inverters have been discovered.

Inverter Mode Table

Code	Description
0	Idle
1	Safety Check
2	Generating
3	Low Light
4	Sleeping
5	Locked Off
6+	Reserved

General Status Table

Code	Description
0	Healthy
1	Fault
2	Warning
3	Unknown
4	Reserved
5	Reserved
6	Missing
7+	Reserved

Continues...

String Status Table

Code	Description
0	Not Available
1	Not Detected
2	Idle
3	Low Light
4	Safety Check
5	Generating
6	Reverse Voltage
7	RCD Fault
8	ARC Fault
9	General Fault
10+	Reserved

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