

# SOLECTRIA COMMERCIAL PVI

## MODBUS Implementation Specification

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V1.6

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### 1 Description

MODBUS protocol is mapped onto a RS485 multidrop bus in which the system controller (RS485 gateway, industrial pc, laptop etc.) is the master (initiator) and the Solectria Renewables Commercial inverter (PVI13kW, PVI15kW, PVI60kW, PVI82kW, PVI95kW) is a slave (responder). The master initiates all communications and the slave(s) responds only to the inquiries that contain their specific id.

Slave ID must be set between 1-247. ID 0 is reserved for broadcast messages. Please refer to [Function Overview](#) for function-specific broadcast support and to [http://www.modbus-ida.org/docs/Modbus\\_Application\\_Protocol\\_V1\\_1b.pdf](http://www.modbus-ida.org/docs/Modbus_Application_Protocol_V1_1b.pdf) for official MODBUS specifications

**\*\* Abbreviations and terminology**

**MSB**=Most Significant Byte ('high' byte); **MSW**=Most Significant Word or ('high' word);

**LSB**=Least Significant Byte ('low' byte); **LSW**=Least Significant Word or ('low' word);

**Sn**=Serial number; **CRC**=Cyclic Redundancy Check; **F<sub>n</sub>**=Function;

*The term 'slave ID' may be interchanged with 'slave address', which is not to be confused with the address in 'parameter address' or 'register address'.*

**\*\* Please also note that RS485 communication can only be enabled on a Solectria Renewables PV inverter when it is provided a stable input voltage, either supplied by photovoltaic panels during daylight hours or a direct DC power source.**

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## 2 Physical Layer

The physical layer consists of an UART device in asynchronous communication mode.

Communication settings:

Modbus framing: RTU (binary)  
Baudrate: 19200 baud (fixed)  
Number of databits (fixed value): 8  
Parity (fixed value): none  
Number of stop bits (fixed value): 1

## 3 Supported MODBUS Functions

### 3.1 Function Overview

Fn	Description	Broadcast	Error Code	Exception Code	Error Description
03h	Read holding registers	No	83h	02h	Read not supported at 1+ registers
06h	Set single register	Yes	86h	03h 02h	Invalid set value Write not supported at register
11h	Report Slave ID	No	No	No	Report slave ID
xxh	Non-supported functions	No	80h+ Fn	01h	Function not supported

### 3.2 Function 03h – Read Holding Register

ID	03h	FIRST MSB	FIRST LSB	NUM MSB	NUM LSB	CRC LSB	CRC MSB
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ID = inverter address, FIRST = starting register address, NUM = number of registers to read

Example read one register from 0eh (slave address),  
Master-to-slave (ID=1):

Index	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]
	01h	03h	00h	0Eh	00h	01h	E5h	C9h

ID	Fn	Register Start	Register Start	Num Registers	Num Registers	CRC Isb	CRC msb
		msb	lsb	msb	lsb		

Response:

Index	[0]	[1]	[2]	[3]	[4]	[5]	[6]
	01h	03h	02h	00h	01h	79h	84h

ID	Fn	Num Bytes	Register Value	Register Value	CRC Isb	CRC msb
			msb	lsb		

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## 3.3 Function 06h – Set Single Register

ID	06h	ADDR MSB	ADDR LSB	VALUE MSB	VALUE LSB	CRC LSB	CRC MSB
----	-----	----------	----------	-----------	-----------	---------	---------

ID = inverter address, ADDR = register address, VALUE = value to set register

Example- Broadcast set register from 0Eh (slave ID)

Master-to-slave (broadcast, ID=0):

Index	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]
	00h	06h	00h	0eh	00h	02h	68h	19h
	ID	Fn	Register Addr msb	Register Addr lsb	Set Value msb	Set Value lsb	CRC lsb	CRC msb

Response: Message is echoed back exactly if there is no error (register writes must be supported, value set is within supported range). Ie slave ID must be between 1-247.

In the event of an exception in the message, the slave will respond with an exception message instead.

Exception message format:

[0]	[1]	[2]	[6]	[7]
xxh	86h	xxh	xxh	xxh
ID	Error Code	Exception Code	CRC lsb	CRC msb

## 3.4 Function 11h – Report Slave ID

ID	11h	CRC LSB	CRC MSB
----	-----	---------	---------

ID = inverter address

Response:

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]
xxh	11h	0Ch	(ID)		00h	00h	00h	00h	00h	xxh	xxh	xxh	xxh	xxh	xxh	xxh
ID	Fn	Byte Count	Slave ID	Run Status	[..	Zero-filled		..	]	Sn Year msb	Sn Year lsb	Sn Month	Sn Day	Sn Running Num	CRC lsb	CRC msb

For further explanation of the serial number, please see to [Serial Number Format](#).

## 4 MODBUS Holding Registers

Please refer to speech sheet (revision number may vary):

Solectria Commercial-Modbus Register Table V1\_6.xls

## 5 CRC-16 calculation

The following 'C' code listing implements the CRC-16 calculation intended to guarantee a distortion-proof data transfer between master and slave. This CRC-16 implementation is consistent with the most commonly used CRC-16 'standard'.

```
unsigned short int calc_crc(unsigned char *sop, unsigned char *eop){
    unsigned int crc;
    unsigned char bit_count;
    unsigned char *char_ptr;

    char_ptr = sop;

    crc = 0xffff; //initialize all 1's
    do{
        crc^=((*char_ptr)&0x00ff); //make sure only 8-bits get modified
        bit_count = 0;
        do{
            if(crc&0x0001){ //test before shifting
                crc>>=1;
                crc^=0xA001; //reflected version of poly:0x8005
            }else{
                crc>>=1;
            }
        }while(bit_count++ < 7); //for every bit
    }while(char_ptr++ < eop); //for every byte
    return crc; //return 16 bits of crc
}
```

In the serial data frame, the CRC span ranges from the slave address (byte index 0) to the last byte of message NOT including the CRC bytes.

## 6 MODBUS RTU Timing

Each message must be framed by a minimum 3.5 bytes of silence. At the fixed baud rate of 19200, this yields a minimum silent time of 1.75 (~2) ms.

If N = total size of message:

	[0]	[1]	...	[N-2]	[N-1]	
~2 ms silence	xxh	xxh	..	xxh	xxh	~2 ms silence
	ID	Fn	..	CRC lsb	CRC msb	

For each message, the master must not transmit anything (stay silent) until the required silent time is reached at both the beginning and end of message.

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For further information about MODBUS RTU timing consult the "Modicon Modbus Protocol Reference Guide", PI-MBUS-300, Rev J, which is available online:  
[http://www.modbus-ida.org/docs/Modbus\\_Application\\_Protocol\\_V1\\_1b.pdf](http://www.modbus-ida.org/docs/Modbus_Application_Protocol_V1_1b.pdf)

### 7 Serial Number Format

Each inverter is assigned a unique serial number before deployment.

Polled structure format (5 bytes):

[0]    [1]    [2]    [3]    [4]

xxh   xxh   xxh   xxh   xxh

<i>Sn</i>	<i>Sn</i>	<i>Sn</i>	<i>Sn</i>	<i>Sn</i>
<i>Year</i>	<i>Year</i>	<i>Month</i>	<i>Day</i>	<i>Running</i>
<i>msb</i>	<i>lsb</i>			<i>Num</i>
				<i>(RN)</i>

<i>Year-Month-Day is the date configured. Running num is the inverter index built for the day.</i>
--

String representation (9 characters total): **YYMMDD-RN**

Structure value can be retrieved with function 11h, see [Function 11h – Report Slave ID](#)

### 8 More Example Messages

The following messages (all in hexadecimal) are composed from master to slave unit with ID 1 to read holding registers.

Read 1 register data point from address 40001 (+00h)

01,03,00,**00**,00,**01**,84,0A

Read 2 register data points from address 40001 (+00h)

01,03,00,**00**,00,**02**,C4,0B

Read 7 register data points from address 40001 (+00h)

01,03,00,**00**,00,**07**,04,08

Read 4 register data points from address 40009 (+08h)

01,03,00,**08**,00,**04**,C5,CB

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### Revision History

Revision #	Update time	Update Person	Brief Description
1.4.1	2/18/09	MZM, FY	
1.5	9/4/09	Lu J.	Added features for PVI500KW software release.
1.6	9/8/10	LJ	Removed register table and put it in another document: Solectria Commercial-Modbus Register Table V1_6.xls