1. INTRODUCTION

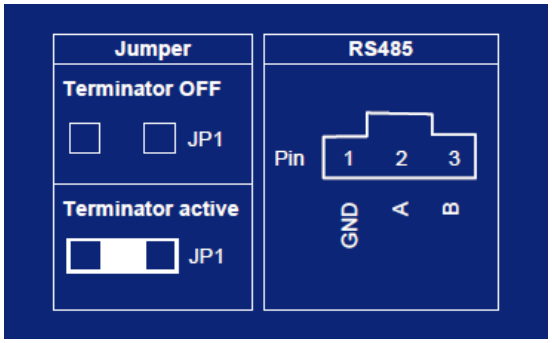
The Modbus Gateway from EC POWER A/S is a Q-network connected device that can be added, to provide the customer with system status information. A wide variety of information is available, and is constantly updated by the XRGI® system. The Modbus Gateway also provides a way to remote control the XRGI® system, which can be used e.g. by customers who wants *VHP ready* functionality.

The Modbus Gateway implements Modbus RTU on a RS485 bus.
On locations with more XRGI® systems, the Modbus Gateways connected to each XRGI® system, can share the Modbus network.

2. RS485

The Modbus Gateway uses a galvanic isolated RS485 bus as the electric interface.

When the lid is removed, the information on the inside of the lid shows how to connect the interface.



Terminator is active by default and is the setting used when the Modbus Gateway is also the bus end.
When multiple Modbus Gateway's is used, only the Modbus Gateway's at the bus ends must have the terminator active.
On all others, the jumper is removed to make the terminator inactive.

Communication settings:

Baud	9600
Start bit	1
Stop bit	1
Data bits	8
Parity	None
Default address	2

3. MODBUS FUNCTIONS

The following function codes are the ones supported by the Modbus Gateway.

3.1. FUNCTION 01H (READ COIL REGISTERS)

This function is used to read a contiguous block of coils. The request frame specifies the starting register address and the number of coils to be read.
The coils in the response message are packed as one coil per bit of the data field. Status is indicated as 1 = ON and 0 = OFF. The LSB of the first data byte contains the first coil addressed in the query, the other coils following toward the high end of the byte, and from low order to high order in the subsequent bytes.

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Request

Function code	1 Byte	**0x01**
Starting address	2 Bytes	0x0000 to 0xFFFF
Quantity of coils	2 Bytes	1 to 2000

Response

Function code	1 Byte	**0x01**
Byte count	1 Byte	**N***
Coil status	n Byte	n = N

***N** = Quantity of Outputs / 8. If the remainder is different from 0, N = N+1.

Error

Function code	1 Byte	**0x81**
Exception code	1 Byte	01, 02 or 03

Here is an example of a request to read coil 2-4

Request		Response	
Field name	Hex	Field name	Hex
Function	01	Function	01
Starting address Hi	00	Byte count	01
Starting address Lo	01	Output status 2+3+4	07
Quantity of outputs Hi	00	-	
Quantity of outputs Lo	03	-	

In the example all coils was ON, and result is 0x07. Coil 2 is on LSB. The upper 5 bits are zero filled.

3.2. FUNCTION 04H (READ INPUT REGISTERS)

This function is used to read a contiguous block of registers. The request frame specifies the starting register address and the number of registers to be read.
The register data in the response message are packed as two bytes per register, with the binary contents right adjusted within each byte. For each register, the first byte contains the high order bits and the second the low order bits.

Request

Function code	1 Byte	**0x04**
Starting address	2 Bytes	0x0000 to 0xFFFF
Quantity of input registers	2 Bytes	0x0001 to 0x007D

Response

Function code	1 Byte	**0x04**
Byte count	1 Byte	**2 x N***
Coil status	**N*** x 2 Bytes	

***N** = Quantity of input registers.

Error

Function code	1 Byte	**0x84**
Exception code	1 Byte	01, 02 or 03

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Here is an example of a request to read register 1+2

Request		Response	
Field name	Hex	Field name	Hex
Function	04	Function	04
Starting address Hi	00	Byte count	04
Starting address Lo	00	Register 1 high byte	00
Quantity of outputs Hi	00	Register 1 low byte	02
Quantity of outputs Lo	02	Register 2 high byte	00
-	-	Register 2 low byte	04

In the example, the content of register 1 was 0x0002, and register 2 was 0x0004.

3.3. FUNCTION 10H (WRITE HOLDING REGISTERS)

This function is used to write a contiguous block of registers. The request frame specifies the starting register address and the number of registers to be written, followed by the data. The normal response message returns the function code, starting address and the number of registers written.

Request

Function code	1 Byte	**0x10**
Starting address	2 Bytes	0x0000 to 0xFFFF
Quantity of registers	2 Bytes	0x0001 to 0x007B
Byte count	1 Byte	2 x **N***
Register values	**N*** x 2 Bytes	Value

Response

Function code	1 Byte	**0x10**
Starting address	2 Bytes	0x0000 to 0xFFFF
Quantity of registers	2 Bytes	0x0001 to 0x007B

***N** = Quantity of input registers.

Error

Function code	1 Byte	**0x90**
Exception code	1 Byte	01, 02 or 03

Here is an example of a request to read register 1+2

Request		Response	
Field name	Hex	Field name	Hex
Function	10	Function	10
Starting address Hi	00	Starting address Hi	00
Starting address Lo	01	Starting address Lo	01
Quantity of registers Hi	00	Quantity of registers Hi	00
Quantity of registers Lo	02	Quantity of registers Lo	02
Byte count	04	-	-
Register Value Hi	01	-	-
Register Value Lo	02	-	-
Register Value Hi	03	-	-
Register Value Lo	04	-	-

In the example, 0x0102 are written to register address 01 and 0x0304 are written to register address 02

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4. DATA FORMAT REPRESENTATION

Format	Description	Bits	Range
BOOL	Boolean	1	0 .. 1
INT16	Integer	16	-32768 .. 32767
UINT16	Unsigned integer	16	0 .. 65535
UINT32	Unsigned long	32	0 .. 4294967295

For all formats, the byte order inside a 16 bit word is MSB at lowest address.
The word order of UINT32 is LSW followed by MSW. BOOL, is packed in 8bit bytes.

5. VARIABLES

5.1. VARIABLES READ WITH FUNCTION CODE 1

Physical address	Length (bits)	Variable name	Data format	Description
0x0000	1	Error	BOOL	
0x0001	1	Running	BOOL	
0x0002	1	CHP ready	BOOL	
0x0003	1	CHP not ready	BOOL	

5.2. VARIABLES READ WITH FUNCTION CODE 4

Physical address	Length (words)	Variable name	Data format	Unit
0x0000	1	Storage top temperature	INT16	Value weight: °C x 100
0x0001	1	Storage bottom temperature	INT16	Value weight: °C x 100
0x0002	1	Flow forward temperature	INT16	Value weight: °C x 100
0x0003	1	Flow return temperature	INT16	Value weight: °C x 100
0x0004	1	CHP to net temperature	INT16	Value weight: °C x 100
0x0005	1	Outside temperature	INT16	Value weight: °C x 100
0x0006	1	Current electric production	UINT16	Value weight: kW x 10
0x0007	1	Cooling capacity	UINT16	%
0x0008	2	∑ Electric production	UINT32	kWh
0x000A	2	∑ Heat production	UINT32	kWh
0x000C	1	Electric production last 15min	UINT16	kWh
0x000D	1	Heat production last 15min	UINT16	kWh
0x000E	2	∑ Fuel consumption	UINT32	kWh
0x0010	1	∑ Running Hours	UINT16	Hours
0x0011	1	∑ Hours to service	UINT16	Hours
0x0012	1	Error code	UINT16	Number
0x0013	1	∑ Generator starts	UINT16	Count.

5.3. VARIABLES WRITTEN WITH FUNCTION CODE 10

Physical address	Length (words)	Variable name	Data format	Description
0x0000	1	VPP mode	UINT16	Mode number.
0x0001	1	CHP load level	UINT16	%

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5.4. VARIABLE EXPLANATION

Error:	if ON, the XRGI system is in alarm stop and needs a visit from a service technician
Running:	If ON, XRGI system is running.
CHP Ready:	If ON and Running = OFF, XRGI system is expected to start, when allowed by VPP mode.
CHP not ready:	If ON and Running = OFF, XRGI system will not start even if allowed by VPP mode, but is expected to be ready later, when e.g. cooling capacity is reestablished.
Storage top temperature	Temperature at the first temperature sensor in the top of the storage tank.
Storage Bottom temperature	Temperature at the last temperature sensor in the bottom of the storage tank.
Flow forward temperature	Sensor after the mixing point, measuring the temperature on the water flowing into the central heating system
Flow return temperature	Sensor before the mixing point, measuring the temperature on the water coming back from the central heating system
CHP to net temperature	Temperature available from CHP to net.
Outside temperature	Temperature measured outside the building
Current electric production	Current measured electric production
Cooling capacity	0 – 100% of water in storage tank, with temperature low enough to cool the engine.
∑ Electric production	Total measured electric production
∑ Heat production	Total produced heat (calculated)
Electric production last 15min	Measured electric production, averaged over a 15min period. Value is updated according to the control panel clock at 00, 15, 30 and 45 minutes
Heat production last 15min	Heat production, averaged over a 15min period. Value is updated according to the control panel clock at 00, 15, 30 and 45 minutes
∑ Fuel consumption	Total fuel consumption (calculated)
∑ Running Hours	Total running hours
∑ Hours to service	Hours to service
Error code	Get the full list at www.service.ecpower.dk
∑ Generator starts	Count of generator starts
VPP mode	Mode 0: Heat controlled mode, production at CHP load level from storage empty until storage full, and standby until storage empty. Mode 1: CHP runs maximal. Starts when T2 gets cold and stops when T3 gets hot. Mode 2: CHP runs minimum. Starts when T1 get cold and stops when T1 gets hot. Mode 3: CHP stopped. Mode 4: CHP stopped, Electric heater runs minimum, starts when T1 gets cold and starts when T1 gets hot. Mode 5: CHP stopped, Electric heater runs maximal, starts when second last storage sensor gets cold and stops when last storage sensor gets hot.
CHP load level	0 - 100% of the nominal max power of the XRGI system. If load is dropping below the XRGI system's minimum load. The XRGI system will produce the minimum load.

6. APPENDIX

For more information on Modbus protocol, see link below: www.modbus.org

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