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MODbus-to-Open Therm Gateway

MB-OT1 and MB-OT4

Technical Manual

Revision 1

Rev.	Date
0	10/04/2014
1	24/04/2015



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1 Introduction

MB-OT Gateways are used to interface systems that use MODbus protocol (PLCs, Industrial PCs, SCADA systems, ecc..) with Boilers (sometimes in this manual, it is used the annotation *Blr*) that use OpenTherm protocol.

There are two available Gateway models:

- MB-OT1, to interface 1 Blr
- MB-OT4, to interface up to 4 Blr

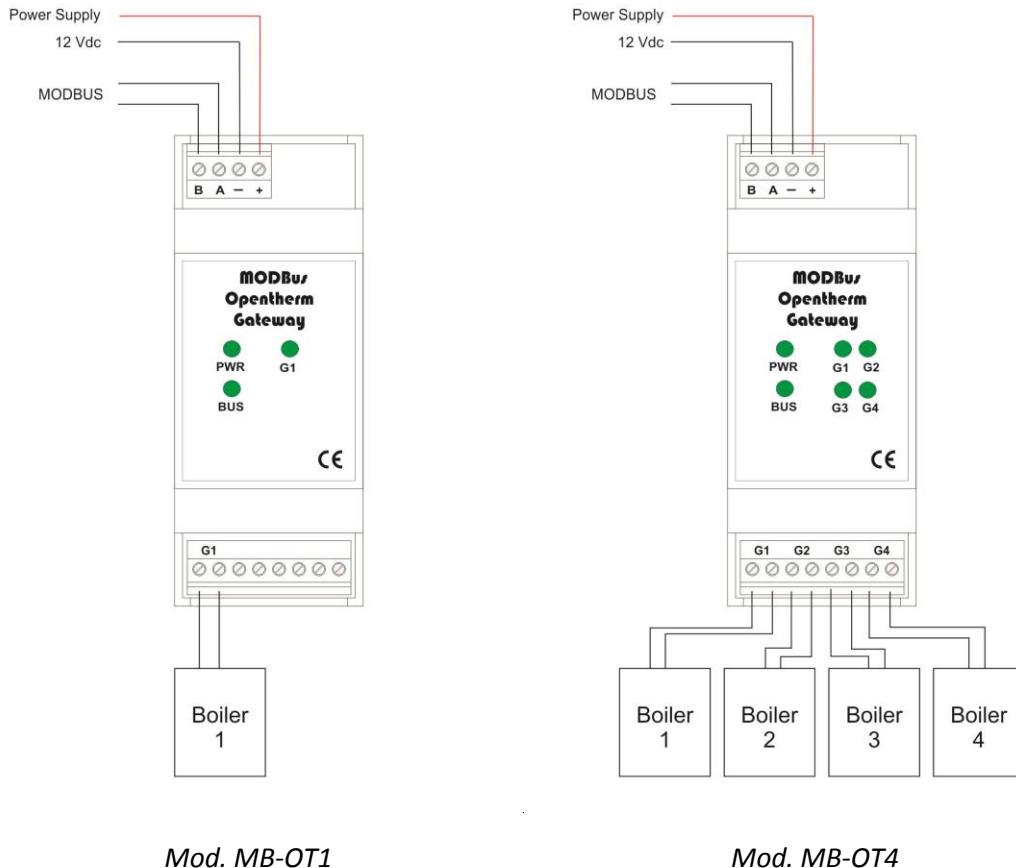
Every Gateway is assigned to a MODbus address (by two rotative switch) from 1 to 63; is it possible to use more than a Gateway on the same bus, if you have the necessity to control more than 4 Boilers.

The common features to the two models are:

- Plastic case for installation on DIN guide.
- Width 35 mm (equivalent to 2 DIN modules)
- 12 Vdc Power Supply
- RS485 Interface to the MODbus Master
- Optoisolated channels to the Boilers

2 Installation

The gateway must be installed on DIN guide, the connections must be done as indicated in the following scheme:



Mod. MB-OT1

Mod. MB-OT4

Notes:

- OpenTherm connections **are not** polarized, so the respective cables can be inverted.
- Gateway's OpenTherm channels are optoisolated between them and also from the MODbus Interface.
- MODbus interface **is not** optoisolated respect to the Gateway's Power Supply, so typically the Master and Gateway are powered by the same Power Supply, or from two Power Supplies with shorted references.
- The polarity definition on the "A" and "B" wires is arbitrary because it does not exist a unique standard for the MODbus poles name; other companies may use different conventions (for example, "+" and "-" signature). Therefore, in case of no communication, try to invert the connection on the two poles "A" and "B" and check the communication state by controlling the "BUS" LED (for more information read paragraph . 3.3).

Attention !

The OpenTherm protocol is a point-to-point: only 1 Boiler must be connected to a channel; the connection of two or more Boilers in parallel on the same channel may cause damage to the Boiler and/or the Gateway interface.

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3 Integration

3.1 Communication to the MODbus

The protocol is MODbus RTU over Serial Line, (EIA-485).

The communication parameters changes according to the position assumed by the two rotative switches on the device. The number of data bits and stop bits remains constant (8 data bits and 1 Stop bit), but is it possible to set the speed (available values *19200* or *9600* baud) and the parity (*Even* or *None*). Please read the table shown at the paragraph 3.4 for more information.

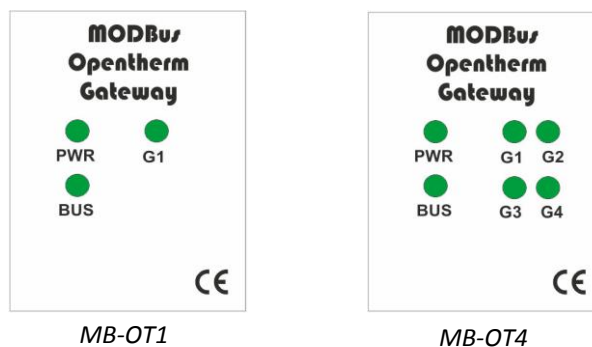
3.2 Use of the Rotative Switch

The rotative switches are placed below the front panel. In the following it is shown their position and the associated functions.



3.3 LED Meaning and Functions

On the Gateway's front panel there are some leds that show the functioning state of the device. In the following it will be indicated their position and the associated information.



LED	STATUS	MEANING
PWR	ON	Gateway correctly Powered
BUS	Blinking	Writing/Reading data correctly transmitted to the Master
G1	ON	Boiler 1 communicates correctly with the Gateway
G2	ON	Boiler 2 communicates correctly with the Gateway
G3	ON	Boiler 3 communicates correctly with the Gateway
G4	ON	Boiler 4 communicates correctly with the Gateway

NOTE: We remember that the blinking of the “BUS” LED happens only if data is correctly received/transmitted by Gateway, therefore if the data transmission between Gateway and Master rarely happens, the blinking of the LED will rarely happen too; vice versa if the Master frequently exchanges data with the Gateway, the “BUS” led will be always on.

3.4 MODBus Address setup

The MODbus address of the Gateway is set by two rotative switches placed under the front panel.

IMPORTANT NOTE: After changes to the switches it is necessary to Power Off and Power On the gateway, in order to permit to modification to take effect.

In the following it is shown the complete correspondence between the switches’ position and the associated address (decimal value):

		Right Switch	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Left Switch	Commun. Paramet.		MODbus Gateway address															
0	19200 baud, Even parity		N/A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1			16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2			32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
3			48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
4	19200 baud, None Parity		N/A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
5			16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
6			32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
7			48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
8	9600 baud, Even parity		N/A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
9			16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
A			32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
B			48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
C	9600 baud, None Parity		N/A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D			16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
E			32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
F			48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63


NOTE: the caption “N/A” indicates that the address is Not Admitted.

As previously shown in the paragraph 3.1 and in the table above, the address may assume a value from 1 to 63, but for the same address are available 4 variations of the communication parameters, according to the position of the left switch. For example, is it possible to set the address “10” in 4 different modes:

LEFT SWITCH	RIGHT SWITCH	ADDRESS	COMMUNICATION PARAMETERS
0	A	10	19200 baud, Even, 8 data bits, 1 stop bit
4	A	10	19200 baud, None, 8 data bits, 1 stop bit
8	A	10	9600 baud, Even, 8 data bits, 1 stop bit
C	A	10	9600 baud, None, 8 data bits, 1 stop bit

EXAMPLES OF SETTING ADDRESS / COMMUNICATION PARAMETERS

- Left Switch positioned on “6”, Right switch positioned on “B”:
 - MODbus address 43
 - Communication at 19200 baud, None parity, 8 data bits and 1 stop bit
- Left Switch positioned on “A”, Right switch positioned on “4”:
 - MODbus address 36
 - Communication at 9600 baud, Even parity, 8 8 data bits and 1 stop bit
- Left Switch positioned on “6”, Right switch positioned on “4”:
 - MODbus address 36
 - Communication at 19200 baud, None parity, 8 data bits and 1 stop bit

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3.5 MODbus Register and OpenTherm protocol Mapping

We assume that the reader has a certain familiarity with OpenTherm protocol.

The Gateway maps the exchanged informations (some information read, other written) with the Boiler in as many Register or Coils of the MODbus protocol.

IMPORTANT NOTE: The Gateway starts to communicate with a Boiler only if from the MODbus master it is read or written a Register or a Coil associated to the Boiler itself; when the communication with the Boiler is “triggered” by a read/write command from the Master, the communication proceed automatically.

This fact has the consequence that although if a Boiler is correctly connected to the Gateway, the corresponding LED (G1, G2, etc.) DOES NOT turn on if from the Master does not arrive at least one read/write request relative to that Boiler.

(note: this behavior has been introduced because if the model MB-OT4 is used to control less than 4 Boilers, the Gateway does not try to communicate with not present Boilers, so the Gateway does not pointlessly attend answers that will never arrive, speeding up the system functioning)

In particular, the Gateway recognize the following MODbus protocol commands:


- 0x01: Read Coil (Reading of one or more “coil” – values on/off, true/false)
- 0x03: Read Holding Register (Reading of one or more registers)
- 0x05: Write Single Coil (Writing of a “coil”)
- 0x06: Write Single Register (Writing of a single register)

The gateway reads from the Boiler the information by using the OpenTherm protocol and memorize those data in Holding Registers or Coils (depending if the read value is scalar or Boolean type), that are readable by MODbus; the holding registers and the coils writable by using MODbus are transmitted in their turn to the Boiler.

The mapping between Register/Coil and OpenTherm function is the following:

Readable Modbus Registers (by using MODbus function 0x03)	Corresponding OpenTherm ID	Format	Register Number (address)				NOTES
			Blr 1	Blr 2	Blr 3	Blr 4	
Slave Config	3		2	34	66	98	
Fault Flag (OEM Fault Code)	5		3	35	67	99	
RBP Flags	6		4	36	68	100	
Maximum boiler capacity (kW) / Minimum Modulation Level (%)	15		5	37	69	101	
Relative Modulation Level (%)	17	tenth of %	6	38	70	102	
Water Pressure in CH Circuit (bar)	18	tenth of bar	7	39	71	103	
Boiler Flow Water Temperature (°C)	25	tenth of °C	8	40	72	104	
DHW Temperature (°C)	26	tenth of °C	9	41	73	105	
Outside Temperature (°C)	27	tenth of °C	10	42	74	106	
Return Water Temperature (°C)	28	tenth of °C	11	43	75	107	
Boiler Exhaust Temperature (°C)	33	tenth of °C	12	44	76	108	
Boiler Fan Speed Setpoint and Actual Value	35		13	45	77	109	
Electrical current through burner flame (uA)	36		14	46	78	110	
DHW Setpoint bounds	48		15	47	79	111	
CH Setpoint bounds	49		16	48	80	112	
Burner operation hours	120	integer number	17	49	81	113	
CH Pump operation hours	121	integer number	18	50	82	114	
Number of Communication Error on OpenTherm side	n/a	integer number	22	54	86	118	
OpenTherm communication failed	n/a	If=1, communication KO	23	55	87	119	
Writable MODbus register (by using MODbus function 0x05)							
CH Water temperature setpoint	1	tenth of °C	25	57	89	121	
DHW Setpoint	56	tenth of °C	26	58	90	122	
Maximum relative modulation level setting	14	tenth of %	27	59	91	123	
Coil Number (address)							
Readable Coils (by using MODbus function 0x01)	Bit of OpenTherm ID 0		GdC 1	GdC 2	GdC 3	GdC 4	
Fault indication	0 (reading)		0	64	128	192	
CH Mode	1 (reading)		1	65	129	193	
DHW Mode	2 (reading)		2	66	130	194	
Flame Status	3 (reading)		3	67	131	195	
Writable Coils (by using MODbus function 0x05)							
CH Enable	0 (writing)		48	112	176	240	
DHW Enable	1 (writing)		49	113	177	241	

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NOTE: For the MB-OT1 model, consider only for the column "Blr 1".

Examples:

- To activate the "Central Heating" (CH) function on the Boiler 1, set to value "1" the coil number 48.
- To activate the "Central Heating" function (CH) on the Boiler 2, set to value "550" the holding register number 57.
- To set the Power limit at 70% for the Boiler 4, set to value "700" the holding register number 123.

Attention: To control the temperature boiler, the parameter "Maximum relative modulation level setting" (holding register 27, 59, etc.), corresponding to OpenTherm ID nr. 14, must be set out at value 1000 (corresponding at the percentage value 100,0%). By inserting different values, the Boiler won't probably start.

IMPORTANT NOTE: The OpenTherm standard does not require that the Boiler uses all the protocol IDs, so it's probable that one Boiler will not return all the previously shown information; in that case will be returned a fixed value that means that the data is not used.

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4 Trouble Shooting

4.1 The Gateway Does not Power ON

- Check the Power supply value and the polarity applied on the contacts “+” and “-” of the Gateway; if the poles have been inverted, the Gateway doesn’t Power ON.
- The Gateway is equipped with self-resetting fuses: if has been applied an high value of Voltage or in over-voltage case, this fuses may should have intervened. In that case it is necessary to disconnect the Gateway from the power supply, waiting for the Fuse cooling and then reconnect the Gateway to the Power Supply.

4.2 The Gateway does not communicate with the Master device.

The LED “BUS” placed on the Front panel of the Gateway, turns ON and remain in this state for some seconds when the Gateway receive a valid command from the MODbus.

In presence of Communication errors, first check if the LED “BUS” turns on (if the MODbus communication is frequent, the led will be always on, on the contrary if the communication happens periodically the led will turn on and then turn off again at every valid data received from MODbus).

If the “BUS” LED does not turn on:

- Check if the communication parameters on the MASTER device are correctly set, for more information read paragraph 3.1 at page 5.
- Check if the address number set on the Gateway (more information at paragraph 3.4, page 6) corresponds with the address request from the Master device. *We remember that the Gateway must be turned off and on, to make the changes made effective.*
- Check that the Master is using the correct MODbus functions during the communication with the Gateway.
- Check if the polarity of MODbus connection is correct: because a unique standard of the Poles labelling does not exist, it is possible that the poles on the Master device are not defined as “A” and “B”, but as “+” and “-” or with other label. In each case, try to invert the connection on the Gateway and verify, by checking the “BUS” LED, if the communication starts; you should note that even if on the Master the poles are marked as “A” and “B”, it may be an inverted convention unlike the Gateway. So, in case of communication error, we always recommend to try to exchange the connection on the MODbus poles.