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Elettronica per il Comfort

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PRODUCT CODE: MB-OT4

Gateway MODBUS-to-Opentherm 4 channels

Technical Manual

Release 3.0

Rel.	FW Release	Data
1.0	1.1	14/09/2016
2.0	1.2	17/03/2021
3.0	1.3	14/12/2022

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1 Introduction

MB-OT4 Gateway is used to interface systems that use Modbus protocol (PLCs, Industrial PCs, SCADA systems, etc.) with Boilers (sometimes in this manual, it is used the annotation *Blr*) that use OpenTherm protocol.

Every Gateway can have a different Modbus address (using two rotative switches) from 1 to 63; so, it is possible to use more than a Gateway on the same bus, if it is necessity to control more than 4 Boilers.

The main features 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

Figure 1:MB-OT4 device close

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2 Installation

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

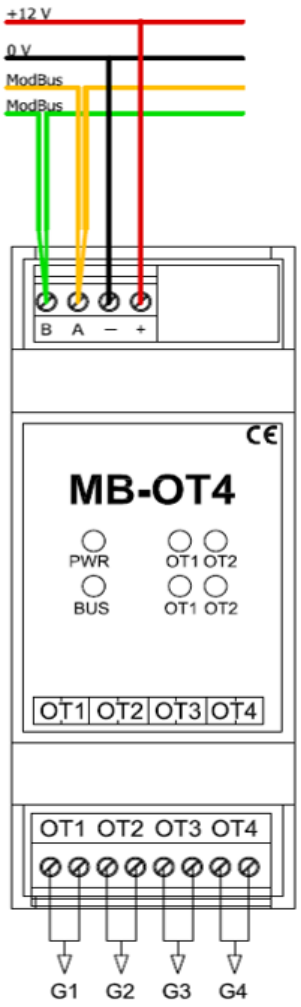

Figure 2: MB-OT4 connections

Notes:

- OpenTherm connections **are not** polarized, so the two boiler cables can be inverted.
- Gateway OpenTherm channels are optoisolated between them and from the Modbus Interface.
- Modbus interface **is not** optoisolated respect to the Gateway 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).

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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 with Modbus

3.1 Communication Modbus side

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

The communication parameters change according to the position of 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 How to use the rotative switches

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

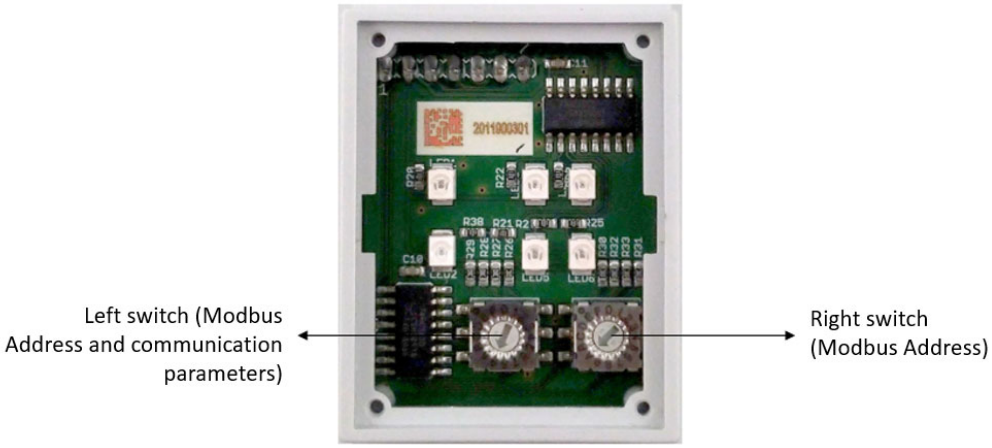

Figure 3: Rotative switches below the MB-OT4 mask

3.3 LED Meaning and function

On the Gateway front panel there are some LEDs that show the functioning state of the device. In the following image it will be indicated their colors/status and the associated information.

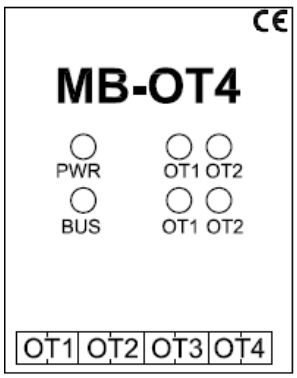

Figure 4: MB-OT4 led status

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LED	STATUS	MEANING
PWR	ON	Gateway correctly Powered
BUS	Blinking	Writing/Reading data correctly transmitted to the Master
OT1	ON	Boiler 1 communicates correctly with the Gateway
OT2	ON	Boiler 2 communicates correctly with the Gateway
OT3	ON	Boiler 3 communicates correctly with the Gateway
OT4	ON	Boiler 4 communicates correctly with the Gateway

NOTE: 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 slave Address setting

The Gateway Modbus address is set using two rotative switches placed under the front panel.

IMPORTANT NOTE: After changing the switches it is necessary to Power Off and Power On the gateway, to allow the modification to take effect.

In the following table 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.		Gateway Modbus Slave 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

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

As shown in 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 set on "6", Right switch set on "B":
  - Modbus address 43
  - Communication at 19200 baud, NONE parity, 8 data bits and 1 stop bit
- Left Switch set on "A", Right switch set on "4":
  - Modbus address 36
  - Communication at 9600 baud, EVEN parity, 8 8 data bits and 1 stop bit
- Left Switch set on "6", Right switch set on "4":
  - Modbus address 36
  - Communication at 19200 baud, NONE parity, 8 data bits and 1 stop bit

3.5 Modbus registers and Opentherm Protocol mapping

The Gateway maps the exchanged information (some information read, other written) with the Boiler in as many Registers 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 (OT1, OT2, 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 recognizes 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")
- 0x05: Write Single Register (Writing of a single register)

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

From version 1.30 onwards it is possible to make a maximum of 12 consecutive readings for the holding registers and 32 for the coil registers.

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

			Register Number (address)				NOTES
Holding Register READABLE (using Modbus function 0x03)	**Corresponding ID OpenTherm**	**Format**	**BLR 1**	**BLR 2**	**BLR 3**	**BLR 4**	
Slave Configuration	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 Water Outlet Temperature	25	Tenth of °C	8	40	72	104	
DHW Temperature (°C)	26	Tenth of °C	9	41	73	105	
Outdoor Temperature (°C)	27	Tenth of °C	10	42	74	106	
Inlet 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 limit	48	Tenth of °C	15	47	79	111	
CH Setpoint limit	49	Tenth of °C	16	48	80	112	
Burner working time	120	Integer Number (h)	17	49	81	113	
CH Pump working time	121	Integer Number (h)	18	50	82	114	
Number of Communication Error on Opentherm side	n/a	Integer Number	22	54	86	118	
Opentherm communication status	n/a	If=1, communication KO	23	55	87	119	
Firmware Release	n/a	0x130	128				Release 1.30 *
Holding Register WRITABLE (using Modbus function 0x06)							
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	Default 100%
Maximum heating set point	57	Tenth of °C	28	60	92	124	Default 95°C *
Coil Number (address)							
Coils WRITABLE (using Modbus function 0x01)	**Bit of Opentherm ID 0**		**BLR 1**	**BLR 2**	**BLR 3**	**BLR 4**	
Fault Indication	0 (reading)		0	64	128	192	
Heating mode	1 (reading)		1	65	129	193	
DHW mode	2 (reading)		2	66	130	194	
Flame status	3 (reading)		3	67	131	195	
Coils WRITABLE (using Modbus function 0x05)							
Heating Enable	0 (writing)		48	112	176	240	
DHW Enable	1 (writing)		49	113	177	241	
Reset request	-		56	120	184	248	*

*Note: the parameters with an * are available from version 1.30 onwards.*

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Examples:

- To active 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 possible that one Boiler will not return all the previously shown information; in that case it will return a fixed value that means that the data is not used.

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4 Troubleshooting

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 a high value of Voltage or in over-voltage case, these fuses may should have intervened. In that case it is necessary to disconnect the Gateway from the power supply, waiting for the Fuse to cool down 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 receives 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 other side if the communication happens periodically this 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 3.4 (page 7).
- Check if the address number set on the Gateway corresponds with the address request from the Master device. *Remember to power OFF and then ON the gateway if the switch position has been changed.*
- Check that the Master is using the correct Modbus functions during the communication with the Gateway (especially the 0x03 for reading registers).
- 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 another 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 trying to exchange the connection on the Modbus poles.