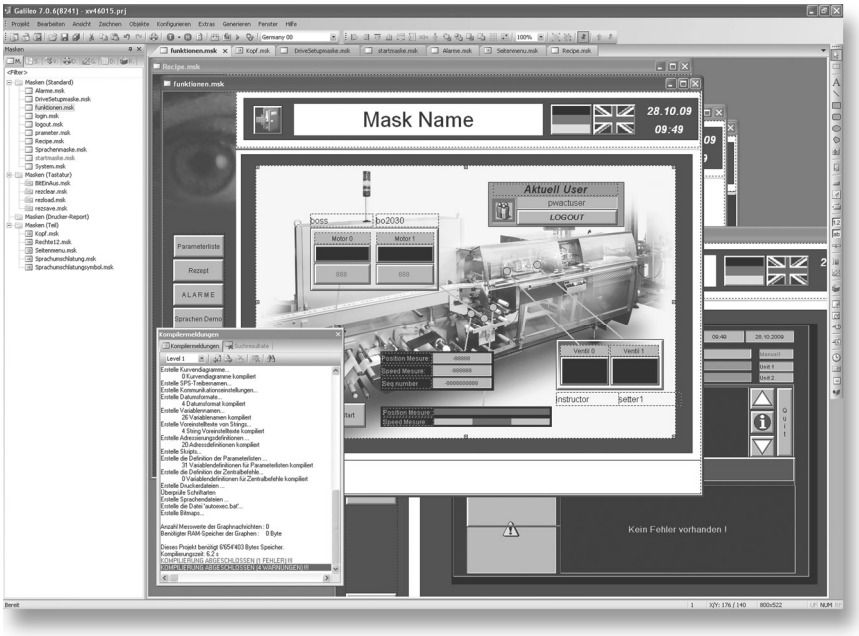
Communication
Modbus RTU



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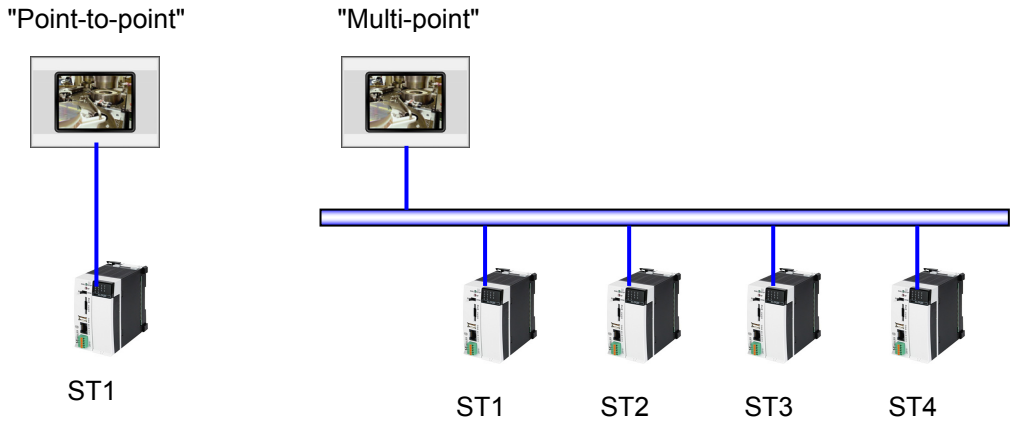
Contents

1 General

This documentation describes the connection of a MICRO PANEL to any PLC supporting the Modbus RTU protocol.

With this communication protocol, MICRO PANEL is the master and the PLC is the slave. Communication is always initiated by the MICRO PANEL and the PLC responds according to the request.



The Modbus RTU protocol uses station addresses (STx) for communication. This enables both "point-to-point" and "multi-point" connections to be used provided that the appropriate physical interface is implemented (see figure).

Note:
The Modbus RTU protocol is also available for the SYSTEM PORT of the MICRO PANEL. This is a non-isolated RS232 interface.

It also allows you to connect a standard PC via COM(x) and implement communication with GALIEO*OPEN* (GALILEO runtime system for PC).

Note:
Modbus RTU communication is only supported in the described form from GALILEO V 5.00. If possible always use the latest release.

Refer to the Galileo documentation or the Online Help for more information on Galileo and GRS.

Note:
The dialogs shown from GALILEO are from Version 7.1.4.

Refer also to your MICRO PANEL user manual for further information on connection, commissioning and operating the RS232 (SYSTEM PORT) interface.

Further additional documentation:

- "User Manual Communication module MPB1-TP / MPB2-TP" Doc. no. MN04802030Z

1.1 SUPPORTED DATA TYPES

All configurable data types from GALILEO are supported.

2 MODBUS RTU IMPLEMENTATION

The Modbus RTU protocol is the intellectual property of MODICON. The protocol description is not part of this documentation and also cannot be obtained from Eaton Automation.

The MICRO PANELs have the master function in the Modbus RTU protocol. The PLC itself cannot actively initiate communication on its own, but can only respond to the requests of the master.

2.1 ADDRESSING

The protocol contains function codes that are used for the different data areas.

For Modbus RTU communication, the MICRO PANELs support the following function codes and associated data areas.

Modbus register	GALILEO	Function code		Data type	Granularity
		Read	Write		
Coils	M	0x01	0x0F	Bit	16 Bit
Discrete inputs	MI	0x02	-	Bit	16 Bit
Input registers	RI	0x04	-	Word	16 Bit
Registers	R	0x03	0x10	Word	16 Bit

GALILEO		Modbus		PLC		Modbus		GALILEO
M	➔	0x0F	➔	Bit (read/write)	➔	0x01	➔	M
MI				Bit (read/write)	➔	0x02	➔	MI
RI				Word (read only)	➔	0x04	➔	RI
R	➔	0x10	➔	Word (read only)	➔	0x03	➔	R

Note:

Refer to your PLC documentation or the PLC specific instructions from chapter 8 for where this data is referenced in the PLC.

2.2 DATA INTERPRETER

In accordance with the original Modbus RTU specification, the data field within the protocol is interpreted "Big Endian". A lot of devices in the field don't interpret the data field this way. Therefore it is also possible to set different modes. The setting for this parameter is described under "PLC Selection" in the section "Creating GALILEO Projects".

The following table shows how the two modes determine the interpretation of the data stream according to the data type.

Data byte	GALILEO	Little Endian	Big Endian	Little Endian Twisted	BigEndian Twisted
00	Byte A	Byte A	Byte A	Byte B	Byte B
01	Byte B	Byte B	Byte B	Byte A	Byte A
02	DWord	DWord[0] LSB	DWord[3] MSB	DWord[1]	DWord[2]
03		DWord[1]	DWord[2]	DWord[0] LSB	DWord[3] MSB
04		DWord[2]	DWord[1]	DWord[3] MSB	DWord[0] LSB
05		DWord[3] MSB	DWord[0] LSB	DWord[2]	DWord[1]
06	Word	Word LSB	Word MSB	Word MSB	Word LSB
07		Word MSB	Word LSB	Word LSB	Word MSB
08	Byte C	Byte C	Byte C	Byte D	Byte D
09	Byte D	Byte D	Byte D	Byte C	Byte C
10	Bit[32]	Bit 0..7	Bit 0..7	Bit 8..15	Bit 8..15
11		Bit 8..15	Bit 8..15	Bit 0..7	Bit 0..7
12		Bit 16..23	Bit 16..23	Bit 24...31	Bit 24...31
13		Bit 24...31	Bit 24...31	Bit 16..23	Bit 16..23
14	CharArray[6] (String)	CharArray[0]	CharArray[0]	CharArray[1]	CharArray[1]
15		CharArray[1]	CharArray[1]	CharArray[0]	CharArray[0]
16		CharArray[2]	CharArray[2]	CharArray[3]	CharArray[3]
17		CharArray[3]	CharArray[3]	CharArray[2]	CharArray[2]
18		CharArray[4]	CharArray[4]	CharArray[5]	CharArray[5]
19		CharArray[5]	CharArray[5]	CharArray[4]	CharArray[4]

Note:

In compliance with the specification, the Modbus RTU register always contains 16-bit values. A 32-bit value (double word or float) is therefore assigned to 2 registers.

3 Cable Assembly

General instructions concerning cable assembly, cutting to length and shielding are provided in the additional documentation stated in the section "General".

Note:
The physical interface of the MPB1(2)-TP can be configured with jumpers. For more information on this refer to the documentation of the communication card (section "General").

3.1 SYSTEM PORT and PC COM(x) variants

DSUB 9pole female — DSUB 9pole female-

MICRO PANEL SYSTEM PORT		RS232	Various -	
PIN	SIG		SIG	PIN
2	RxD		TxD	3
3	TxD		RxD	2
5	0V		0V	5
CASE	SHIELD		SHIELD	CASE

PC COM(x)		RS232	Various -	
PIN	SIG		SIG	PIN
2	RxD		TxD	3
3	TxD		RxD	2
5	0V		0V	5
CASE	SHIELD		SHIELD	CASE

The interface on the MICRO PANEL is **not** isolated, which is also the case for most PCs. Use a cable as shown in the figure or a standard zero modem cable.

3.2 MPB1(2) – RS232 variant

DSUB 9pole male — -

MPB1/MPB2 COM PORT		RS232	Various -	
PIN	SIG		SIG	PIN
2	RxD		TxD	
3	TxD		RxD	
5	0V		0V	
CASE	SHIELD		SHIELD	

The RS232 interface of the MPB1(2) **is** isolated.

3.3 MPB1(2) – RS485 VARIANT

DSUB 9pole male

-

MPB1/MPB2 COM PORT		RS232	Various -	
PIN	SIG		SIG	PIN
3	A		A	
7	B		B	
5	0V		0V	
CASE	SHIELD		SHIELD	

The RS485 interface of the MPB1(2) **is** isolated.

3.4 MPB1(2) – RS422 VARIANT

DSUB 9pole male

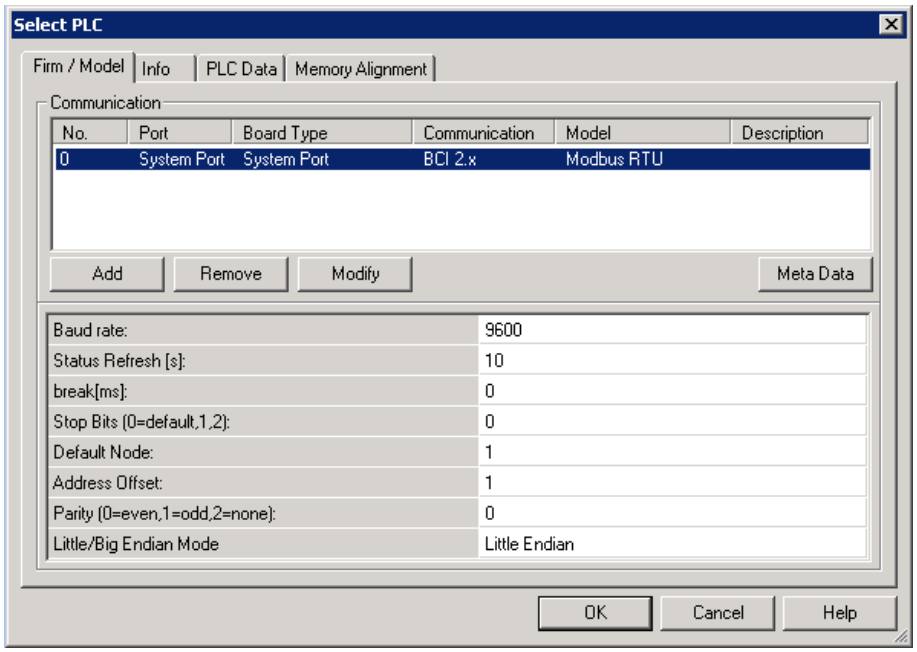
-

MPB1/MPB2 COM PORT		RS232	Various -	
PIN	SIG		SIG	PIN
2	TX+		RX+	
3	RX+		TX+	
5	0V		0V	
7	TX-		RX-	
8	RX-		TX-	
CASE	SHIELD		SHIELD	

The RS422 interface of the MPB1(2) **is** isolated.

4 Creating GALILEO Projects

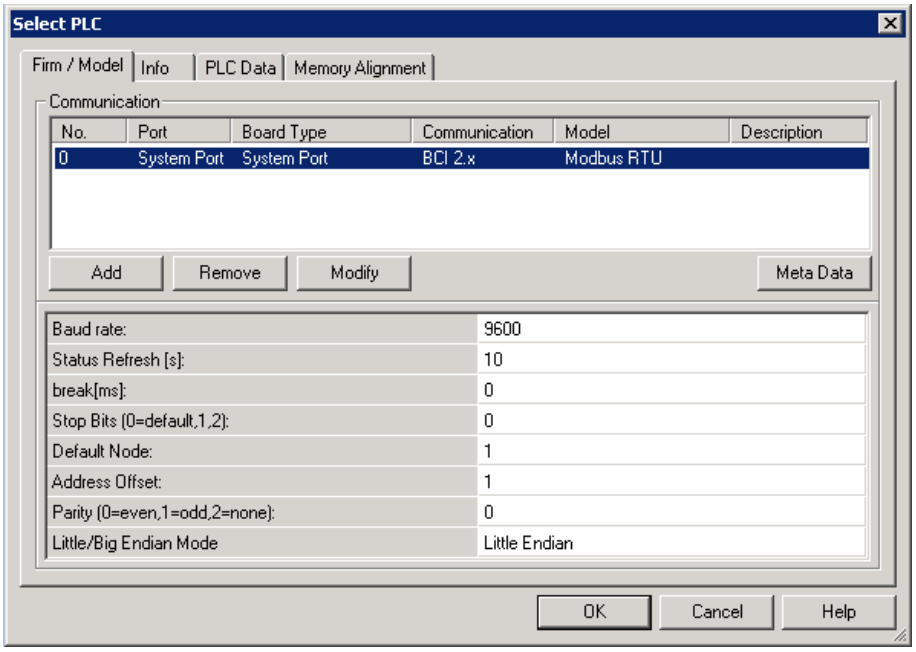
Start GALILEO and create a new project suitable for your MICRO PANEL.



In the Select PLC dialog, select for Port and Type "SYSTEM PORT", "Modbus RTU" for MPB1(2)-TP or "Modbus TCP" for communication via Ethernet as shown in the figure.

<table>
<tr><th>Communication</th><th>RTU</th><th>MPB</th><th>TCP</th></tr>
<tr><td>"Baud rate"
Select one of the baud rates provided for selection and suitable for your PLC.</td><td>✓</td><td>✓</td><td>✘</td></tr>
<tr><td>"Status Refresh [s]"
Refer to the GALILEO documentation for a description of this parameter.</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>"Pause [ms]"
This can be used to define a pause that will occur after an active data exchange with the PLC.</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>"Stopbits (0=standard, 1, 2)"
Select the Stopbits suitable for your PLC.

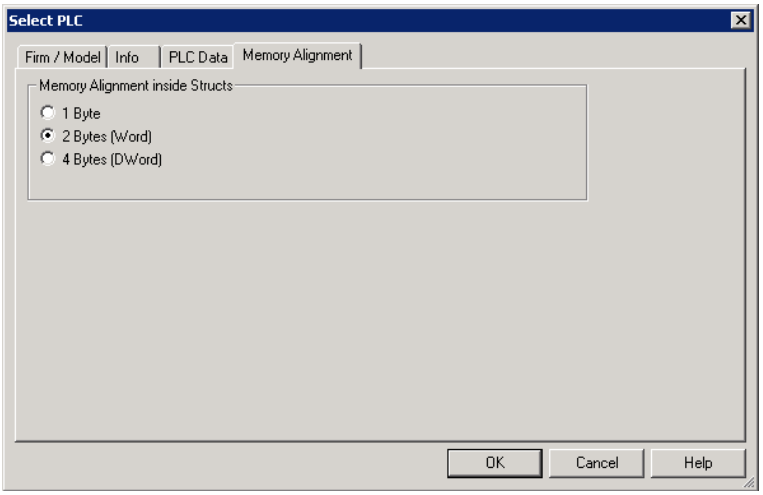
<table><tr><th>Parity</th><th>stop bit</th></tr><tr><td>even</td><td>1</td></tr><tr><td>odd</td><td>1</td></tr><tr><td>none</td><td>2</td></tr></table></td><td>✓</td><td>✘</td><td>✘</td></tr>
<tr><td>"Standard Node"
Enter the station number of the standard PLC.</td><td>✓</td><td>✓</td><td>✘</td></tr>
</table>



Communication	**RTU**	**MPB**	**TCP**
"Address offset" In compliance with the Modbus RTU Specification, the start address of a data packet is transferred minus 1 (address offset) (GALILEO address 5 = Protocol address 4). Select 0 for this parameter if this is not defined in your PLC.	✓	✓	✓
"Parity" Set here the parity according to your PLC. With Modbus RTU the default setting is 0 (even parity).	✓	✓	✘
"Little/Big Endian Mode" This parameter defines how the data is organised in the protocol. Further information on this is provided in the section "Data interpreter".	✓	✓	✓
"IP address or network name" The IP address or network name of your PLC. Further information on the use of network names is provided in the Windows CE documentation.	✘	✘	✓
"Port number" This sets the port number via which your PLC is to communicate. (default 502)	✘	✘	✓

MEMORY ALIGNMENT

The memory alignment determines the granularity (8, 16 or 32 bit) of the data combined within structures.

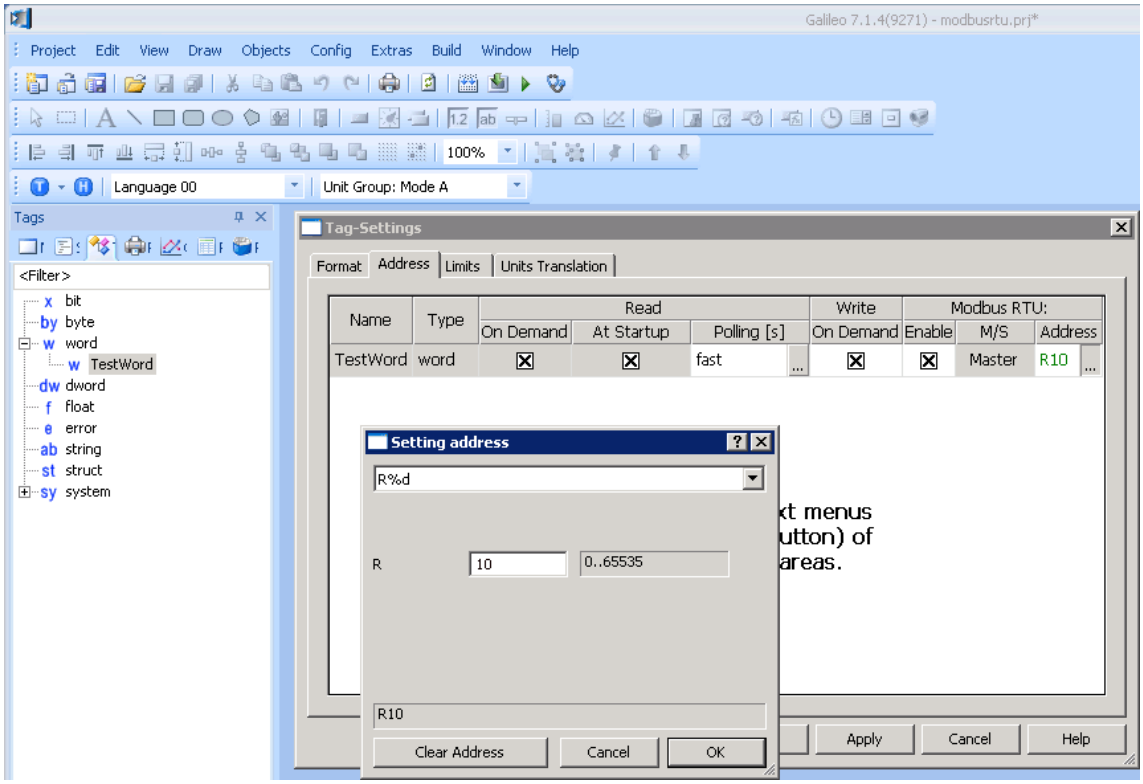


The following table shows how the memory alignment of structures and the set granularity define the data image and the data volume in the PLC.

Data byte	GALILEO structure	Memory alignment		
		1 Byte	2 Byte (Word)	4 Byte (DWord)
00	Byte_a	Byte_a	Byte_a	Byte_a
01	Word_a	Word_a		
02			Word_a	Word_a
03	Byte_b	Byte_b		
04	DWord	DWord	Byte_b	Byte_b
05				
06			DWord	
07				
08	Byte_c	Byte_c		DWord
09	Word_b	Word_b		
10			Byte_c	
11				
12			Word_b	Byte_c
13				
14				Word_b
15				

4.1 Defining tag variables

Now create a "TestWord" tag variable in GALILEO as shown in the following example and assign this tag with an address in your PLC.

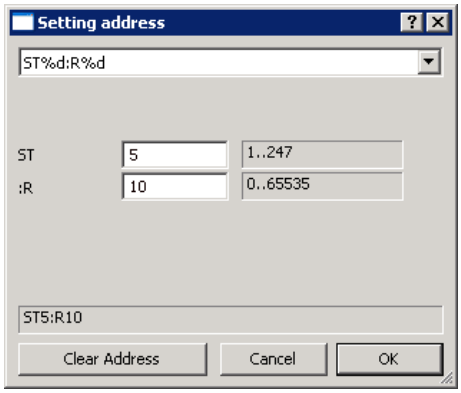


The GALILEO tag "TestWord" in the example is referenced to address R10.

Note:

The "Standard Node" (section "Creating GALILEO Projects") is addressed if no station number is entered for the PLC.

The station number of the PLC can also be defined explicitly for every tag as follows.



The addressing in GALILEO requires each memory location of types "R" and "RI" to contain a 16-bit value.

PLC address	Byte (8-bit value)	Word (16-bit value)	DWord (32-bit value)
R10.0	**Byte[0]** Bit 00..07	**Word[0]** Bit 00..07	**DWord[0]** Bit 00..07
R10.8	Byte[1] Bit 00..07	**Word[0]** Bit 08..15	**DWord[0]** Bit 08..15
R11.0	Byte[2] Bit 00..07	Word[1] Bit 00..07	**DWord[0]** Bit 16..23
R11.8	Byte[3] Bit 00..07	Word[1] Bit 08..15	**DWord[0]** Bit 24..31
R12.0	Byte[4] Bit 00..07	Word[2] Bit 00..07	DWord[1] Bit 00..07
R12.8	Byte[5] Bit 00..07	Word[2] Bit 08..15	DWord[1] Bit 08..15
R13.0	Byte[6] Bit 00..07	Word[3] Bit 00..07	DWord[1] Bit 16..23
R13.8	Byte[7] Bit 00..07	Word[3] Bit 08..15	DWord[1] Bit 24..31

Table of examples for linear data types with start address R10

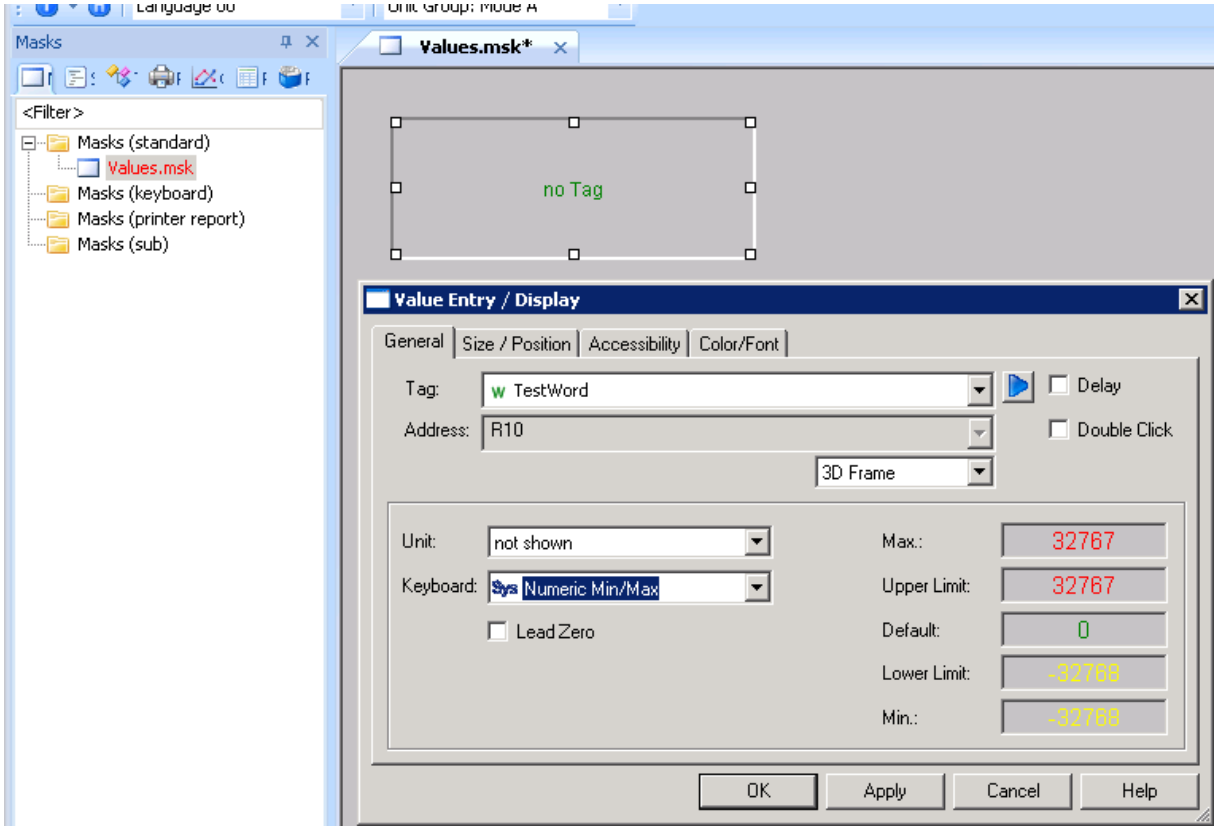
With types "M" and "MI", on the other hand, each memory location is only 1 bit.

PLC address	Byte (8-bit value)	Word (16-bit value)	DWord (32-bit value)
M17..24	**Byte[0]** Bit 00..07	**Word[0]** Bit 00..07	**DWord[0]** Bit 00..07
M25..32	Byte[1] Bit 00..07	**Word[0]** Bit 08..15	**DWord[0]** Bit 08..15
M33..40	Byte[2] Bit 00..07	Word[1] Bit 00..07	**DWord[0]** Bit 16..23
M41..48	Byte[3] Bit 00..07	Word[1] Bit 08..15	**DWord[0]** Bit 24..31
M49..56	Byte[4] Bit 00..07	Word[2] Bit 00..07	DWord[1] Bit 00..07
M57..64	Byte[5] Bit 00..07	Word[2] Bit 08..15	DWord[1] Bit 08..15
M65..72	Byte[6] Bit 00..07	Word[3] Bit 00..07	DWord[1] Bit 16..23
M73..80	Byte[7] Bit 00..07	Word[3] Bit 08..15	DWord[1] Bit 24..31

Table of examples for linear data types with start address R10

4.2 CREATING THE TEST SCREEN

Now create a new screen and position a value entry element that is assigned with "TestWord".

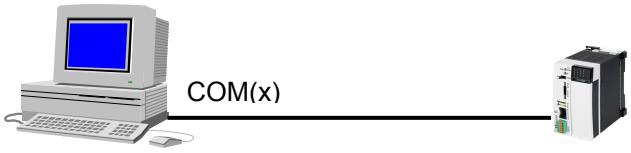


The project is now completed and communication with the PLC can now be tested.

5 Testing the GALILEO Project

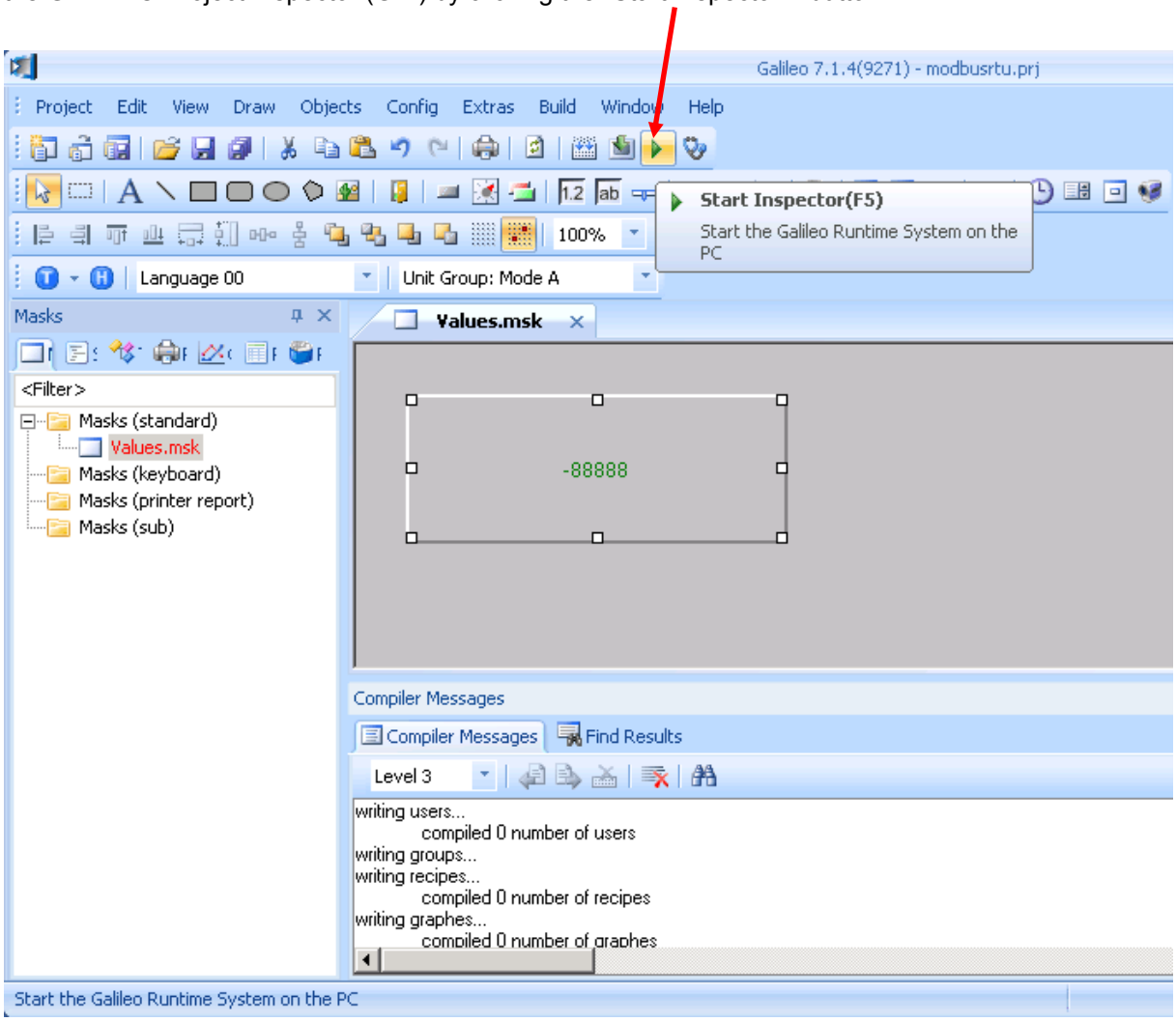
As the Modbus RTU protocol is available both for the SYSTEM PORT and for the MPB1(2)-TP, you can test your project directly on the PC.

Requirements:
The interface of the PLC supports the RS232 standard and you have selected "Modbus RTU (OnBoard)" in the PLC selection dialog!

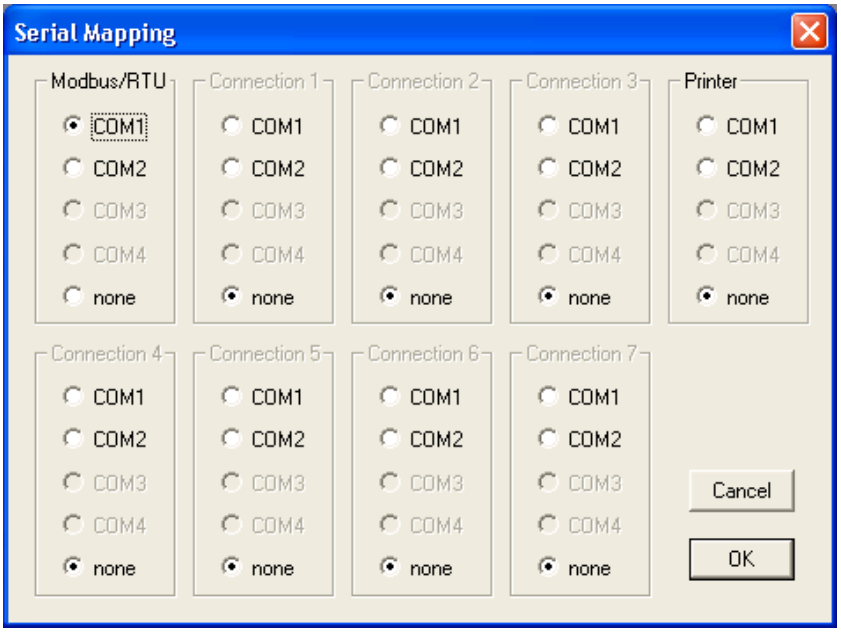


For the connection between the PC and PLC use a communication cable as described in the section "SYSTEM PORT and PC COM(x) variants".

Now compile the project that you have created in the section "Creating GALILEO Projects" and start the **G**ALILEO **P**roject **I**nspector (GPI) by clicking the “Start Inspector – button”.

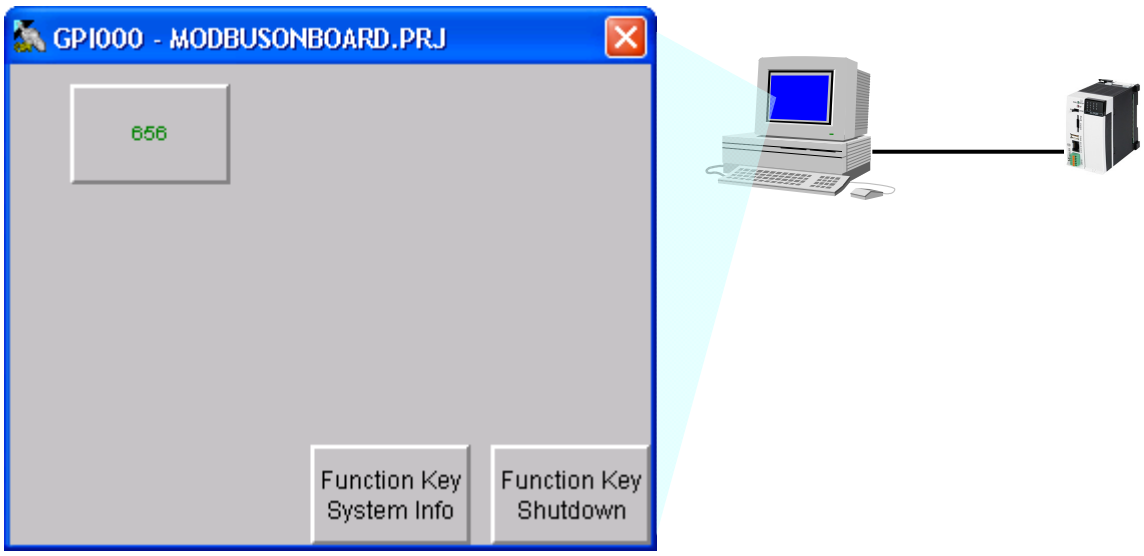


The first time the GPI is started, you must specify the COM interface of the PC that is connected with the PLC.



The GPI will then establish an active connection to the PLC and you can then set the "TestWord" tag as required.

Close the GPI by pressing "Q" or a configured "Shutdown" function and start this again. If the last entered value is shown again, everything has been configured correctly.



You can now transfer the project to your MICRO PANEL and then start it again. Refer to the GALILEO documentation for further information.

Note:

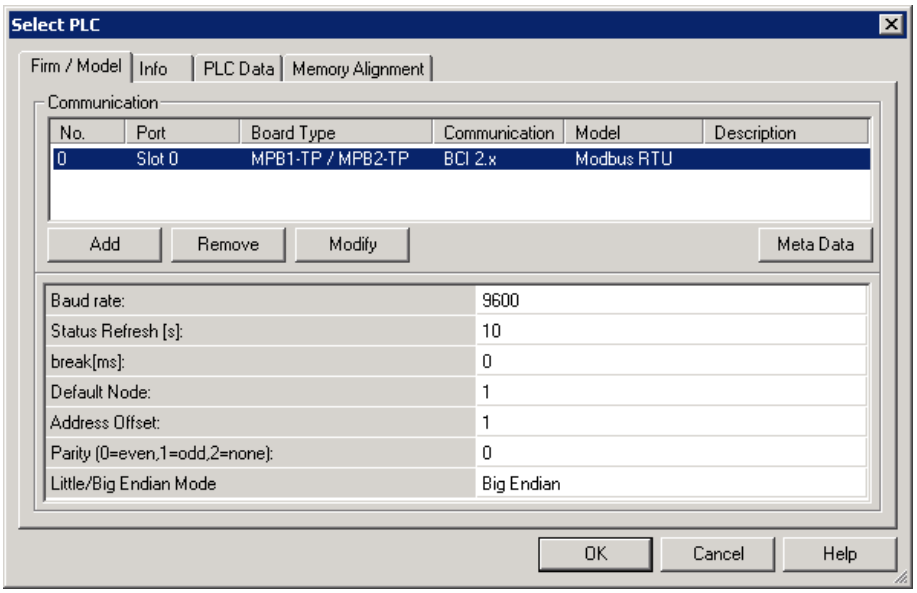
The plug and pin assignment of the SYSTEM PORT on the MICRO PANEL is the same as the standard RS232 PC interface. In this case, you can use the same communication cable!

5.1 TEST WITH MPB1(2)-TP COMMUNICATION CARD

Prepare a cable beforehand that fits the physical interface of your PLC, as described in "Cable Assembly".

The physical interface (COM PORT) of the MPB1(2)-TP communication card can be set with jumpers. For more information on this refer to documentation of the communication card (section "General").

Ensure that the "Modbus RTU" type has been selected in the Select PLC dialog.



Now transfer the compiled project to the MICRO PANEL. The driver for the MPB1(2)-TP communication card is also transferred with it.

You then have to program this driver once on the communication card. Refer to the GALILEO documentation on how to do this.

Note:
Ensure that the STD/ALT jumper of the communication card is set to position ALT.

After successfully completing programming, start the MICRO PANEL again. Active communication with the PLC is established after the device startup.

6 MOVISTO

A dedicated communications driver was implemented for the Movisto controller. Select ‘Movisto’ instead of ‘Modbus RTU’ in GALILEO. The programming is identical to the standard Modbus drivers.

This communications driver does not immediately generate an error message on the absence of a response telegram. If there is no response after multiple retries, an error is reported.

We do not recommend using this communications driver. The sporadic absence of response is an indication for serious problems in the controller. If so, consult the manufacturer of the controller.

7 Older Modbus RTU Drivers

If you have previously used an older Modbus RTU driver, the following table shows how to set the parameters for the conversion.

Parameters of new drivers	Modbus RTU (PTP)…	Modbus RTU (MP)…
Status Refresh [s]	Ditto	Ditto
Pause [ms]	50	Ditto
Baud rate	9600	Ditto
Standard Node	= PLC station no.	Optional (section "4.1")
Address offset	1	1
Parity	0	Ditto
Little/Big Endian Mode	Little Endian Twisted	Little Endian Twisted
Stopbits (0=default, 1, 2)	0	0

Ditto = Setting as per previous driver

Note:

In both cases you must load the new driver (MODB32.BIN) onto the communication card. If you have previously used "Modus RTU (PTP) ...", you must also move the STD/ALT jumper to ALT.

8 HIMA

The general requirements described in the previous sections apply here also. The following only describes specific instructions and settings applicable to the HIMatrix and H51/H41 and A1 PLC systems from HIMA.

Eaton Automation offers no support for the ELOP programming environment. Please send your enquiries directly to the manufacturer.

8.1 CABLE ASSEMBLY

DSUB 9pole male DSUB 9pole male

MPB1/MPB2 COM PORT		RS485	HIMatrix FB1	
PIN	SIG		SIG	PIN
3	A		A	3
7	B		B	8
5	0V		0V	5
CASE	SHIELD		SHIELD	CASE

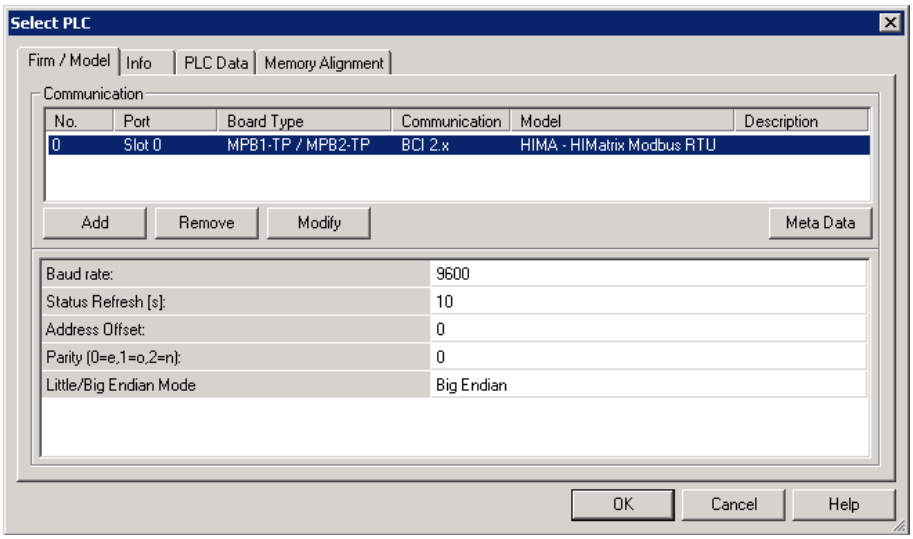
MPB1/MPB2 COM PORT		RS485	A1 SIO1	
PIN	SIG		SIG	PIN
3	A		A	3
7	B		B	8
5	0V		0V	5
CASE	SHIELD		SHIELD	CASE

MPB1/MPB2 COM PORT		RS485	H51/H41 F865x	
PIN	SIG		SIG	PIN
3	A		A	3
7	B		B	8
5	0V		0V	5
CASE	SHIELD		SHIELD	CASE

8.2 GALILEO PLC SELECTION

Select one of the following types in GALILEO under "Select PLC":

➔ MPB1(2)-TP : "HIMA – HIMatrix Modbus RTU"
➔ MPB1(2)-TP : "HIMA – H51/H41/A1"



Ensure that the baud rate and parity match the setting in the PLC.

Note:
Set the "Address offset" parameter to 0 regardless of the PLC type (see also section "Creating GALILEO Projects").

8.3 ADDRESSING

For Modbus RTU communication with the HIMA PLCs, the MICRO PANELs support the following function codes and associated data areas.

H51/H41/A1

Modbus register	GALILEO	Function code		Data type	Granularity
		Read	Write		
Coils	BO	0x01	0x0F	Bit	16 Bit
Discrete inputs	BI	0x01	0x0F	Bit	16 Bit
Input registers	WI	0x03	0x10	Word	16 Bit
Registers	WO	0x03	0x10	Word	16 Bit

GALILEO		Modbus		H51/H41/A1		Modbus		GALILEO
BO	→	0x0F	→	BOOL	→	0x01	→	BO
BI	→	0x0F	→		→	0x01	→	BI
WO	→	0x10	→	WORD	→	0x03	→	WO
WI	→	0x10	→		→	0x03	→	WI

HIMatrix

Modbus register	GALILEO	Function code		Data type	Granularity
		Read	Write		
Coils	BO		0x0F	Bit	16 Bit
Discrete inputs	BI	0x02	-	Bit	16 Bit
Input registers	WI	0x04	-	Word	16 Bit
Registers	WO		0x10	Word	16 Bit

GALILEO		Modbus		HIMatrix		Modbus		GALILEO
BO	→	0x0F	→	BOOL	→	0x02	→	BI
WO	→	0x10	→	WORD	→	0x03	→	WI

Note:

The signal allocation must be completed in the ELOP programming environment beforehand for active communication with the PLC. For this ensure that coils (BIT/BOOL) are always available in multiples of 16.

Refer to the documentation of ELOP or the PLC for further information.

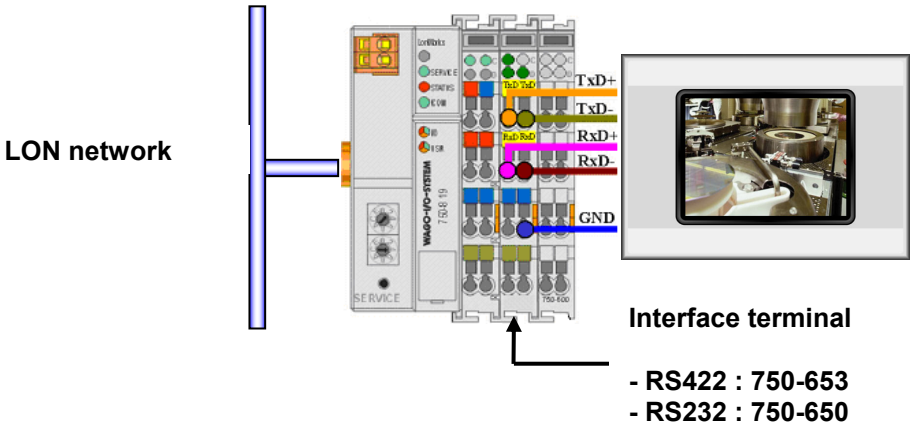
9 WAGO I/O System

The general requirements described in the previous sections apply here also. The following only describes specific instructions and settings for WAGO I/O System.

Eaton Automation offers no support for the WAGO programming environment. Please send your enquiries directly to the manufacturer.

9.1 Operating principle

The type of coupling described here is only supported by programmable WAGO fieldbus controllers such as the LON coupler 750-819.



9.2 Cable assembly

DSUB 9pole male

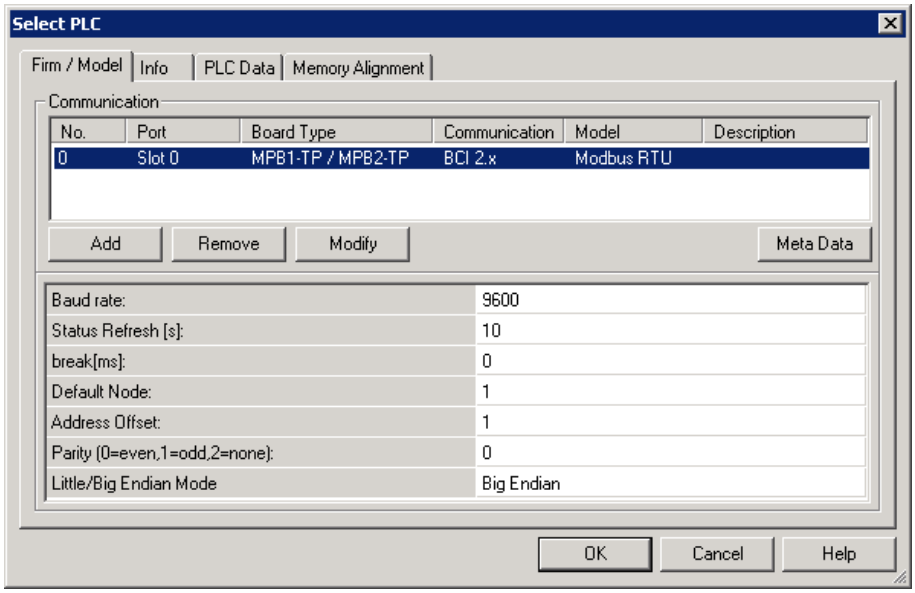
MPB1/MPB2 COM PORT		RS422	WAGO modules 750-653	
PIN	SIG		SIG	PIN
2	TxD+		RxD+	2
3	RxD+		TxD+	1
7	TxD-		RxD-	6
8	RxD-		TxD-	5
5	0V		0V	7
CASE	SHIELD		SHIELD	

MPB1/MPB2 COM PORT		RS232	WAGO modules 750–650	
PIN	SIG		SIG	PIN
2	RxD		TxD	1
3	TxD		RxD	5
5	0V		0V	3
CASE	SHIELD		SHIELD	

9.3 GALILEO PLC SELECTION

Select one of the following types in GALILEO under "Select PLC":

➔ MPB1(2)-TP : "Modbus RTU"
➔ SYSTEM PORT : "Modbus RTU (OnBoard)"



Set the parameters as shown in the figure. Follow the instruction on "Standard Node" in the section "Defining tag variables".

Note:
The "Pause[ms]" parameter should be set higher (+10ms) than the timeout set on the WAGO function block (TERMINAL_MODBUSSLAVE_RTU).

For further information on this refer to the WAGO documentation "Connecting a Eaton Automation Touch Panel to a WAGO Controller 750-8xx".

9.4 ADDRESSING

For Modbus RTU communication with the WAGO controllers, the MICRO PANELs support the following function codes and associated data areas.

Modbus register	GALILEO	Function code		Data type	Granularity
		Read	Write		
Coils	M	0x01	0x0F	Bit	16 Bit
Registers	R	0x03	0x10	Word	16 Bit

GALILEO		Modbus		WAGO Controller		Modbus		GALILEO
M	➔	0x0F	➔	aDATA[BIT_OFFSET]	➔	0x01	➔	M
R	➔	0x10	➔	aDATA[0]	➔	0x03	➔	R

Note:

The TERMINAL_MODBUSSLAVE_RTU function block from WAGO defines an ARRAY for up to 256 Modbus registers (aDATA).

The BIT_OFFSET parameter is used to define from which index the coils are stored in the ARRAY.

10 Error Messages

The following system messages may be generated if communication is faulty:

System message (Status)	Possible cause
"..... CONNECTION" "..... CABLE"	There is no bus connection or the connection cable was incorrectly prepared.
"..... TIMEOUT"	The PLC is sending an incomplete data stream.
"..... ADDRESS” "..... ILLEGAL DATA ADDRESS”	The requested address is not available in the PLC.
"..... STATION”	The response was not generated by the addressed PLC.
"..... PROTOCOL” "..... ILLEGAL FUNCTION”	The response of the PLC does not comply with the Modbus RTU Specification or the Modbus function (function code) is not available.
"..... CHECKSUM?”	The checksum of the data packet is not correct.