GEFRAN

GPC 40-300A and GPC 400-600A

ADVANCED MODULAR POWER CONTROLLERS WITH PROFINET INTERFACE

CONFIGURATION AND PROFINET NETWORK INSTALLATION MANUAL

Software version: 1.0.0

Code: **81084_MSW_GPC-Profinet_01-2021_ENG**

The software version this manual refers to concerns the Modbus RTU/PROFINET Fieldbus interface board inserted in the GPC as a PORT 2 serial communication port.

CAUTION!

The manual herein should be considered

as making up an integral part of the product, and it must always be available to anyone interacting with it.

The manual must always accompany the product, even in the case of sale to another user.

Installation and/or maintenance technicians must read this manual and strictly follow the instructions herein and found in the annexes since GEFRAN cannot be held liable for personal, property and/or product damages should the following conditions

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1 • INTRODUCTION

The "**GPC**" series of modular power controllers with PROFINET Fieldbus interface is designed for rapid integration of a large quantity of compact control units for temperature regulation and heating device control, within sophisticated automation systems (such as PLC, Supervisory Systems, etc.) interconnected via communication networks and protocols defined by the standard.

This manual is not designed to describe the "PROFINET" Fieldbus, as it is presumed the user is familiar with the same and will refer if any updates are required to the above-mentioned standard or the official PROFIBUS CONSORTIUM and PROFINET International website (PI), http://www.profibus.com/.

It is also presumed that the user is already familiar with the technical characteristics of GPC products, as described in the dedicated user manuals accompanying each product, or available for download from the GEFRAN S.P.A. website. www.gefran.com.

This user's manual will refer to GPC version with ordination code E6:

- E6 - Specific 2.3 - Stack 3.12.0.5 - Card ETH6 with Netx51

Features of version E6:

FUNCTION	DESCRIPTION
Media Redundancy Protocol client di tipo Bumpless	Lets get: - a time of zero reorganization of the network - no isochronous frames lost In case of interruption of the PROFINET communication loop
Fast Forwarding	It allows a reduction of the transit delay of the PROFINET package through each node of 50%
Dynamic Frame Packaging	It allows to optimize the bandwidth, and to arrive at a theoretical cycle time for IRT traffic equal to 32.5us instead of 1ms

2 • BIBLIOGRAPHIC REFERENCES

/1/ GPC 81900, GPC INSTRUCTIONS FOR USE AND WARNINGS

/2/ GPC 81901, GPC CONFIGURATION AND PROGRAMMING MANUAL

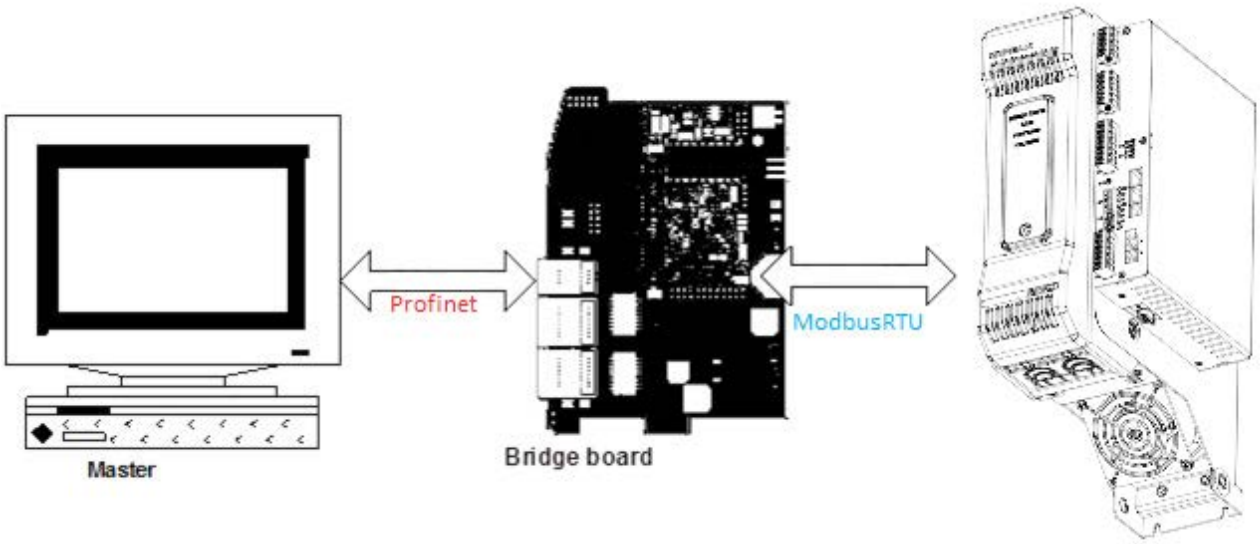
/3/ GPC 81902, GPC - MODBUS MEMORY MAP

3 • MAIN TECHNICAL CHARACTERISTICS

Ethernet Baud Rate:	100 Mbit/s ...
Data transport layer:	Ethernet II, IEEE 802.3
PNIO version:	2.2
Min. Device Interval:	8 msec
Address:	Discovery and Configuration Protocol (DCP)
Default Input size:	48 bytes, network with 1 single GPC
Default Output size:	48 bytes, network with 1 single GPC
Max Input size:	192 bytes, network with 4 GPC
Max Output size	192 bytes, network with 4 GPC
Virtual Modbus Slot:	Yes
Fast StartUp:	No, Power On to Communication Ready 15 seconds
RealTimeCyclic:	Class 1 & 2
Certified:	No
Modbus/RTU:	Master
Serial Baud Rate:	19200 bit/s
Parity:	None
Data Bits:	8
Stop Bit:	1
T.serial acquisition:	minimum 40mec for 16 words

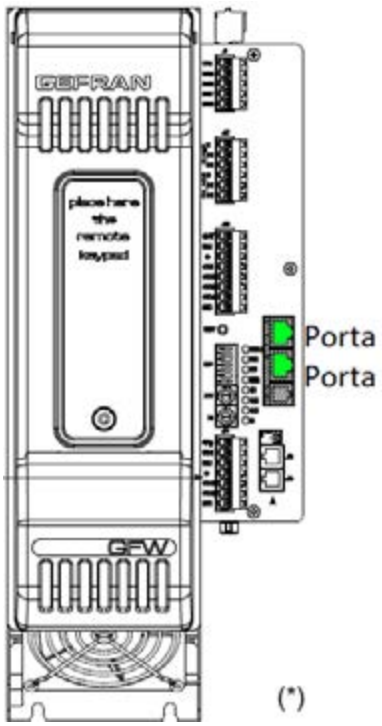
4 • OVERALL COMMUNICATION ARCHITECTURE

The communication structure implemented in the GPC communication board ensures the PROFINET network dialog data are converted into modbus rtu packages which are sent and received via the serial line. The diagram to keep in mind is as follows:

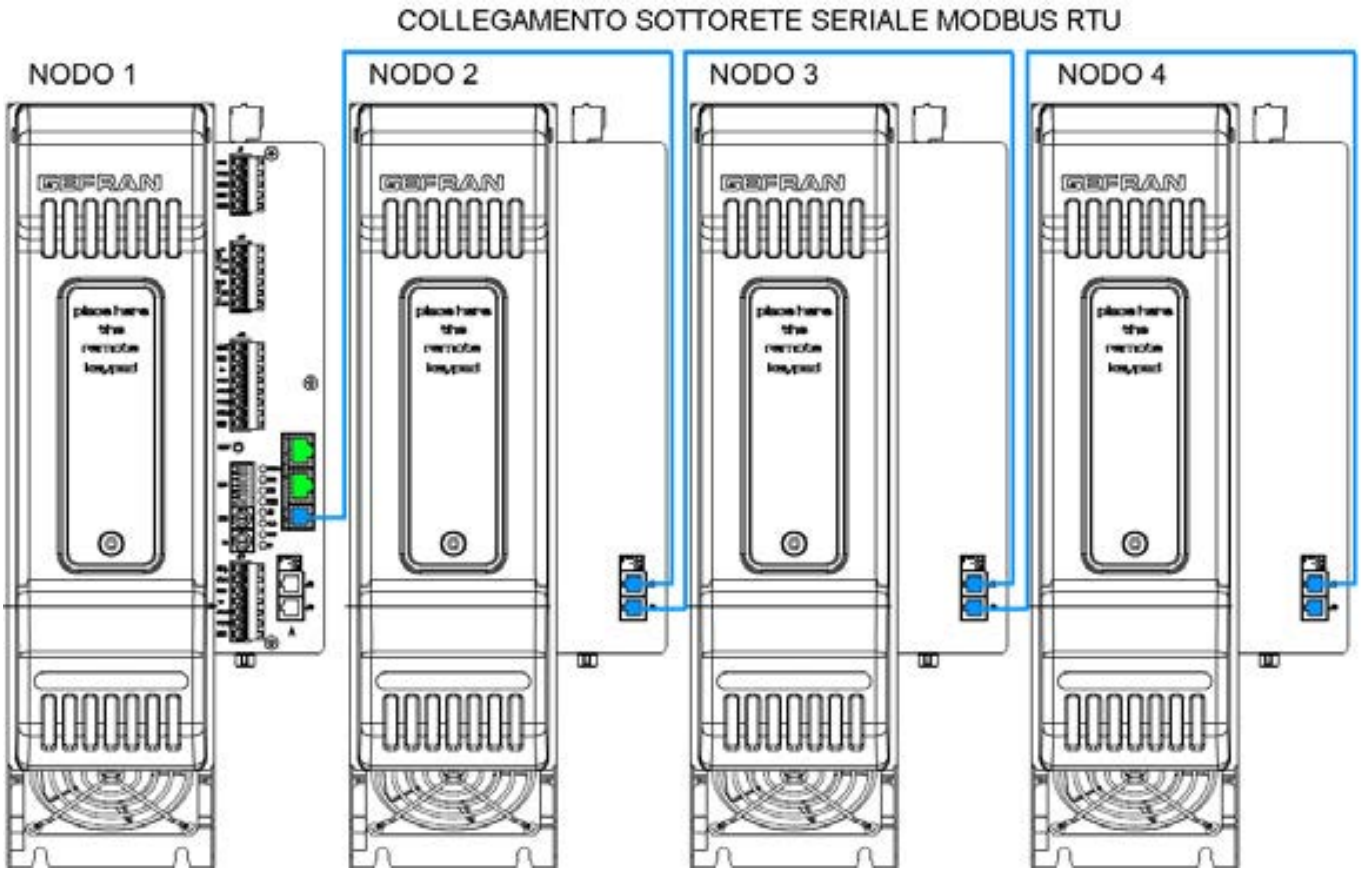


5 • INSTALLATION

5.1. Profinet network connection and serial sub-net setup



To connect the devices in a PROFINET network, use the ETH0 and/or ETH1 connectors of the integrated switch. To connect the sub-net of the slaves unit, please refer to the diagram in the figure



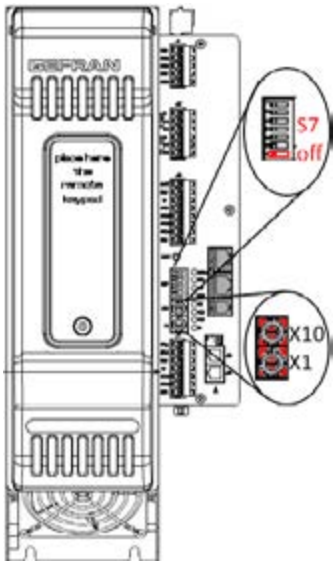
We recommend the use of a CAT5 Ethernet cable or above STP or UTP. The minimum distance between two Ethernet network nodes must be less than 100m

5.2. Rotary switch and dip switch selection

The hexadecimal **rotary** switches found on the GPC indicate the node address of the slave Modbus/RTU network that is acquired when the instrument is switched on.

The GPC is factory-set with the rotary switches in the “0” position and it is the customer's task to put them in the correct position, considering that ONLY the following combinations apply for PROFINET:

- **Rotary X 10=0, Rotary X1=1 for node 1**
- **Rotary X 10=0, Rotary X1=2 for node 2**
- **Rotary X 10=0, Rotary X1=3 for node 3**
- **Rotary X 10=0, Rotary X1=4 for node 4**



The other rotary switch positions concern specific functions.

The GPC configuration **dip-switch**, as described in manual /2/ in the chapter entitled “Description of Dip-Switches” is designed to define the operating mode of the instrument.

Dip “6”, in particular, when in the “ON” position, allows the factory-set values to be restored upon “POWER ON”.

AFTER RESTARTING THE INSTRUMENT WITH THE FACTORY-SET PARAMETERS, REMEMBER TO SET “6” TO THE “OFF” POSITION, SWITCH THE DEVICE OFF AND BACK ON AGAIN.

DIP “7” MUST UNDER ALL CIRCUMSTANCES BE IN THE “OFF” POSITION BEFORE YOU SWITCH ON THE DEVICE!

Serial communication time constraints in Modbus RTU

The following time constraints must be complied with in order to allow correct serial data exchange with the device:

Reading Word/Register parameters: Reading N consecutive parameters, with N from 1 to 16, requires a time of almost 50 ms. In this case the following read and write Modbus command, to the same node, must be sent after this interval time.

Writing Word/Register parameters: Writing N consecutive parameters, with N ranging from 1 to 16, if all values (maximum 16) on the device are updated, will take a time of:50ms + N x 80ms(*) with N from 1 to 16.

The times reported refer to the case in which the Baudrate of the serial line (parameter bAu Modbus address 45) is 19200.

(*) If STATUS_W parameters (Modbus address 305) are included in the write request and their value is different from the one currently present in the slave, the time required to write each one will be 240ms (instead of 80ms).

6 • PROCESS DATA STRUCTURE

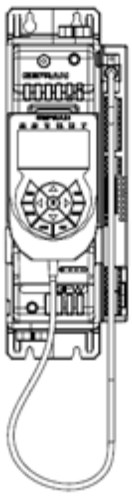
3 input records and 3 output records of 8 words are provided for the process data exchange. These words are always allocated in the PROFINET -Io Controller device, but in order to speed up the data exchange that occurs on the serial line, they are handled by the PROFINET -Io slave device only if the respective field **enable record is set to true. Furthermore, within each individual record, the variable End Of Record is used further to reduce the sending and receiving of data present in the individual record**

6.1. Process data with only 1 device (slot 1)

This configuration comprises only 1 GPC with a fieldbus expansion board. The following configurations are considered:

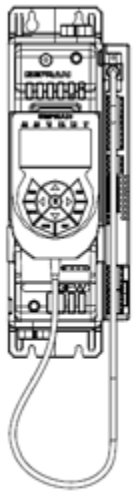
1. **GPC-M** the following input data are considered by default (Slave to Master):

Input Data Mapping Proposed for Record 1		
GPC-M module		
Record 1	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUS3_1	1657	Yes
STATUS4_1	1658	Yes
STATUS_W_RO_1	1487	Yes
LD.V_1	1775	Yes
LD.A_1	1777	Yes
LD.P_1	1904	Yes
OU.P_1	1026	Yes
IN.A1	1596	Yes
Input Data Mapping Proposed for Record 2		
Module 2 -		
Record 2	Enable = False	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUS3_2	2681	No
STATUS4_2	2682	No
STATUS_W_RO_2	2511	No
LD.V_2	2799	No
LD.A_2	2801	No
LD.P_2	2767	No
OU.P_2	2050	No
IN.A2	1860	No
Input Data Mapping Proposed for Record 3		
Module 3 -		
Record 3	Enable = False	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUS3_3	4729	No
STATUS4_3	4730	No
STATUS_W_RO_3	4559	No
LD.V_3	4847	No
LD.A_3	4849	No
LD.P_3	4815	No
OU.P_3	4098	No
IN.A3	1867	No



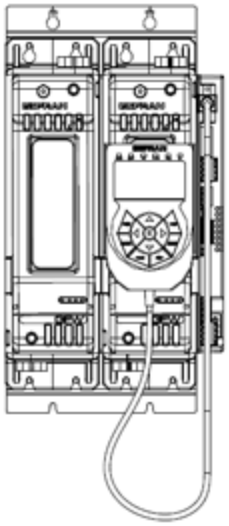
2. **GPC-M** the following output data are considered by default (Master to slave):

Output Data Mapping Proposed for Record 1		
GPC-M module 1		
Record 1	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUSW_1	1329	Yes
MAN.P_1	1276	Yes
End of record	-	No
SP for GPC	1040 / -	No
SP.1 for GPC	1254/ -	No
SP.2 for GPC	1255/ -	No
End of record	-	No
End of record	-	No
Output Data Mapping Proposed for Record 2		
Module 2 -		
Record 2	Enable = False	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUSW_2	2353	No
MAN.P_2	2300	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
Output Data Mapping Proposed for Record 3		
Module 3 -		
Record 3	Enable = False	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUSW_3	4401	No
MAN.P_3	4348	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No



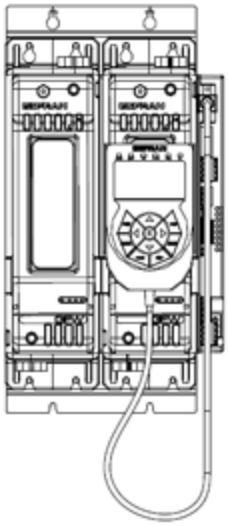
3. **GPC-M+GPC-E1** the following input data are considered by default (Slave to Master):

Input Data Mapping Proposed for Record 1		
GPC-M module 1		
Record 1	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUS3_1	1657	Yes
STATUS4_1	1658	Yes
STATUS_W_RO_1	1487	Yes
LD.V_1	1775	Yes
LD.A_1	1777	Yes
LD.P_1	1904	Yes
OU.P_1	1026	Yes
IN.A1	1596	Yes
Input Data Mapping Proposed for Record 2		
GPC-E1 module 2		
Record 2	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUS3_2	2681	Yes
STATUS4_2	2682	Yes
STATUS_W_RO_2	2511	Yes
LD.V_2	2799	Yes
LD.A_2	2801	Yes
LD.P_2	2767	Yes
OU.P_2	2050	Yes
IN.A2	1860	Yes
Input Data Mapping Proposed for Record 3		
Module 3 -		
Record 3	Enable = False	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUS3_3	4729	No
STATUS4_3	4730	No
STATUS_W_RO_3	4559	No
LD.V_3	4847	No
LD.A_3	4849	No
LD.P_3	4815	No
OU.P_3	4098	No
IN.A3	1867	No



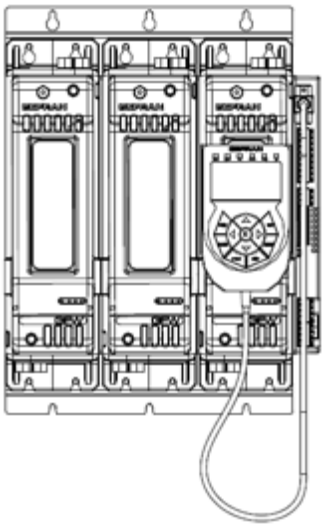
4. **GPC-M+GPC-E1** the following output data are considered by default (Master to slave):

Output Data Mapping Proposed for Record 1		
GPC-M module 1		
Record 1	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUSW_1	1329	Yes
MAN.P_1	1276	Yes
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
Output Data Mapping Proposed for Record 2		
GPC-E1 module 2		
Record 2	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUSW_2	2353	Yes
MAN.P_2	2300	Yes
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
Output Data Mapping Proposed for Record 3		
Module 3 -		
Record 3	Enable = False	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUSW_3	4401	No
MAN.P_3	4348	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No



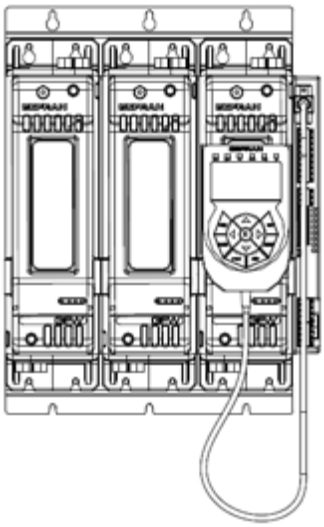
5. **GPC-M+GPC-E1+GPC-E2** the following input data are considered by default (Slave to Master):

Input Data Mapping Proposed for Record 1		
GPC-M module 1		
Record 1	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUS3_1	1657	Yes
STATUS4_1	1658	Yes
STATUS_W_RO_1	1487	Yes
LD.V_1	1775	Yes
LD.A_1	1777	Yes
LD.P_1	1904	Yes
OU.P_1	1026	Yes
IN.A1	1596	Yes
Input Data Mapping Proposed for Record 2		
GPC E1 module 2		
Record 2	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUS3_2	2681	Yes
STATUS4_2	2682	Yes
STATUS_W_RO_2	2511	Yes
LD.V_2	2799	Yes
LD.A_2	2801	Yes
LD.P_2	2767	Yes
OU.P_2	2050	Yes
IN.A2	1860	Yes
Input Data Mapping Proposed for Record 3		
3 GPC-E2 module		
Record 3	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUS3_3	4729	Yes
STATUS4_3	4730	Yes
STATUS_W_RO_3	4559	Yes
LD.V_3	4847	Yes
LD.A_3	4849	Yes
LD.P_3	4815	Yes
OU.P_3	4098	Yes
IN.A3	1867	Yes



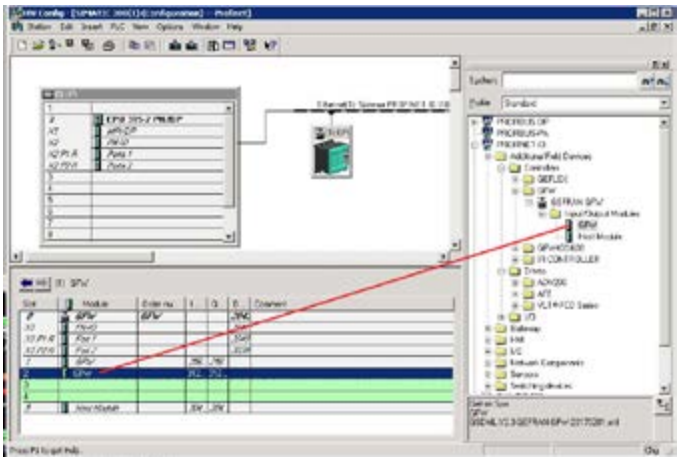
6. **GPC-M+GPC-E1+GPC-E2** the following output data are considered by default (Master to slave):

Output Data Mapping Proposed for Record 1		
GPC M module 1		
Record 1	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUSW_1	1329	Yes
MAN.P_1	1276	Yes
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
Output Data Mapping Proposed for Record 2		
GPC-E1 module 2		
Record 2	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUSW_2	2353	Yes
MAN.P_2	2300	Yes
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
Output Data Mapping Proposed for Record 3		
3 GPC-E2 module		
Record 3	Enable = True	Data Exchanged on serial?
Variable Name	Modbus Address (High Performance)	
STATUSW_3	4401	Yes
MAN.P_3	4348	Yes
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No
End of record	-	No



6.2. Process data with 2 devices (slot 1 + slot 2)

All the previous configurations for only 1 device apply, keeping in mind that the operations should be carried out in slot 2. Physically, the physical connections shown in the figure opposite are obtained. A GPC device is added to slot 2 of the master system configurator



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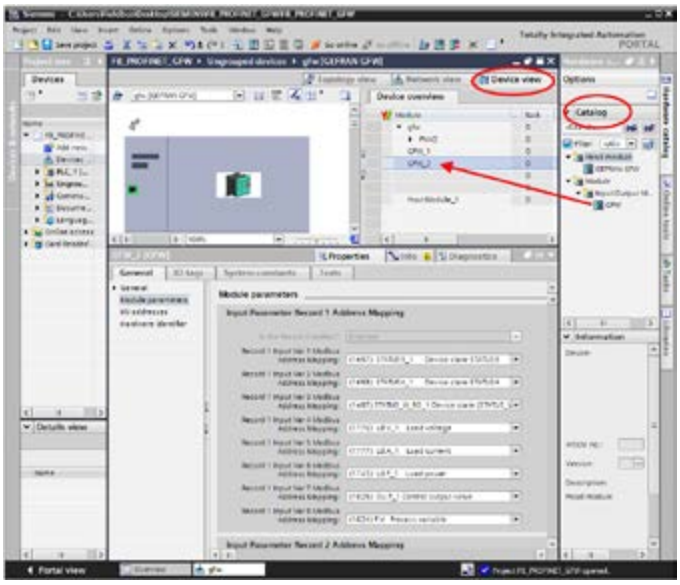

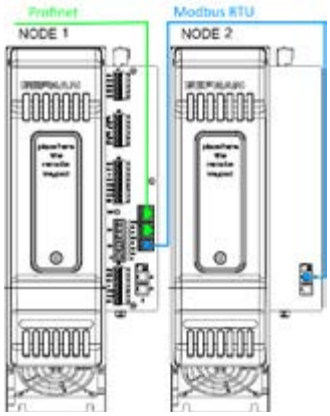

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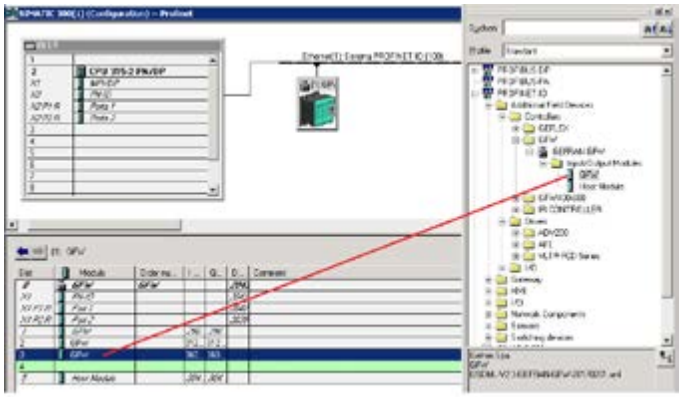
6.3. Process data with 3 devices (slot 1 + slot 2 + slot 3)

All the previous configurations for only 1 device apply, keeping in mind that the operations should be carried out in slot 3. Physically, the physical connections shown in the figure opposite are obtained. A GPC device is added to slot 3 of the master system configurator



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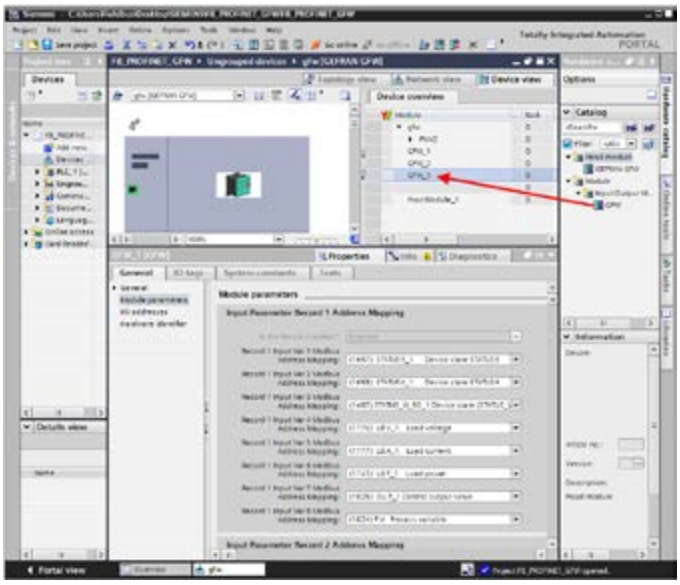

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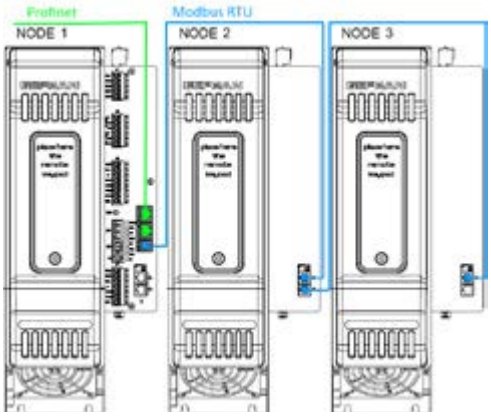
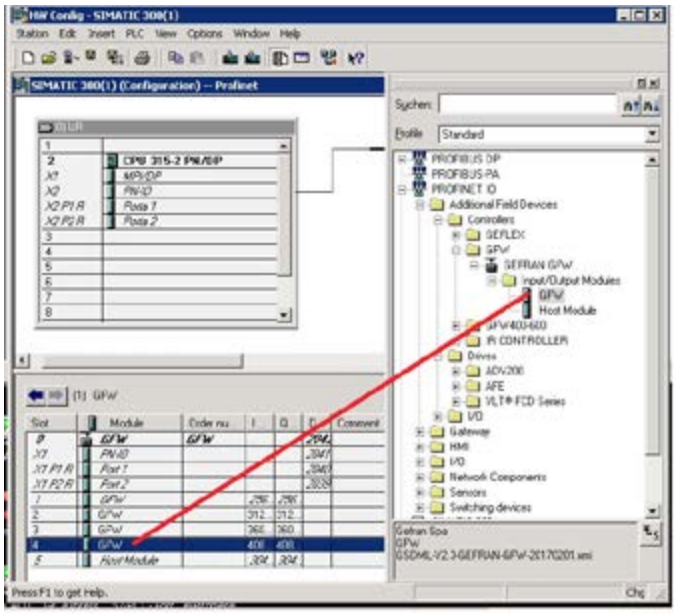


6.4. Process data with 4 devices (slot 1 + slot 2 + slot 3 + slot 4)

All the previous configurations for only 1 device apply, keeping in mind that the operations should be carried out in slot 4. Physically, the physical connections shown in the figure opposite are obtained. A GPC device is added to slot 4 of the master system configurator



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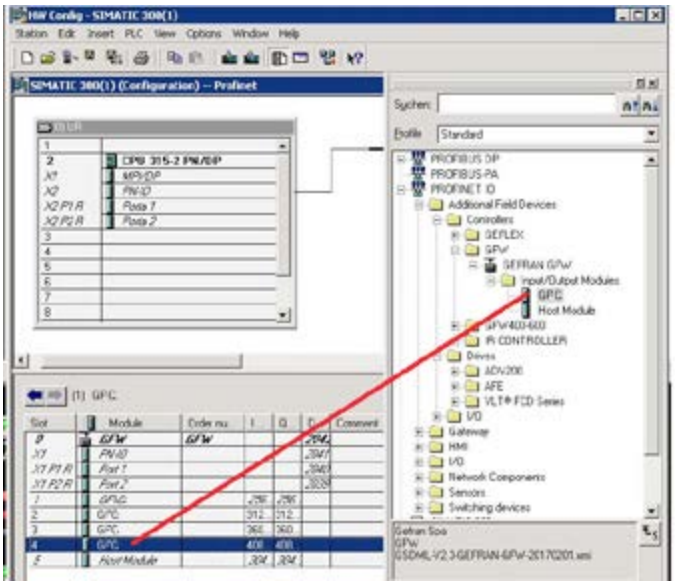

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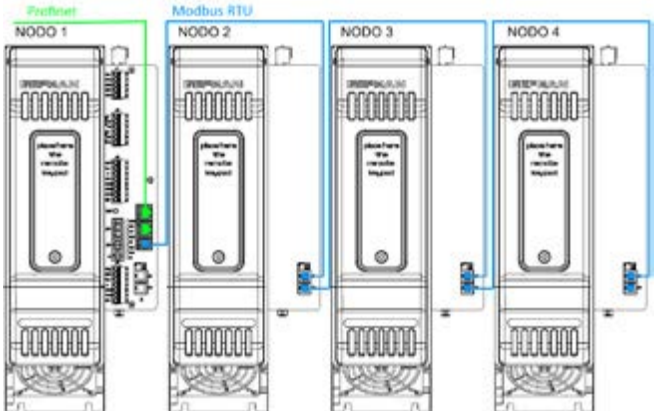


7 • MODBUS PROTOCOL USE (SLOT 5 HOST COMMAND/RESPONSE)

In slot 5, 8 bytes are available in input and 8 bytes are available in output in order to encapsulate the modbus rtu protocol in the process data.

These data contain:

7.1. Request channel

SLOT 5 HOST COMMAND		
Offset	Item Name	Meaning
0	Host Command byte 0-1	Command Trigger word
2	Host Command byte 2	Node address
3	Host Command byte 3	Modbus Function Code
4	Host Command byte 4	Data 1
5	Host Command byte 5	Data 2
6	Host Command byte 6	Data 3
7	Host Command byte 7	Data 4

7.2. Response channel

HOST RESPONSE		
Offset	Item Name	Meaning
0	Host Response byte 0-1	Response Trigger word
2	Host Response byte 2	Node address
3	Host Response byte 3	Modbus Function Code
4	Host Response byte 4	Data 1
5	Host Response byte 5	Data 2
6	Host Response byte 6	Data 3
7	Host Response byte 7	Data 4

7.3. Command trigger word

Normally, in idle condition, the value of this word is the same as the RESPONSE TRIGGER WORD.

To enable the command, proceed in sequence:

1. prepare the command in the fields from Host Command byte 2 to Host Command byte 7 according to need
2. increase the value of the command trigger word
3. wait for the value of the response trigger word to be the same as the command trigger word

7.4. Response trigger word

When the command is complete or in idle condition, its value is the same as the command trigger word

7.5. Command node address/response node address

Identifies the node number of the slave concerned

7.6. Command Modbus Function Code

Supports commands 1, 2 (read bit); 3, 4 (read a word); 5 (write 1 bit); 6 (write a word)

7.7. Response Modbus Function Code

Supports commands 1, 2 (read bit); 3, 4 (read a word); 5 (write 1 bit); 6 (write a word). If the most significant bit is set to 1, this indicates an error in the command execution

7.8. Data1, data2, data3, data4 command

The contents of these bytes depends on the command modbus function code

7.9. Data1, data2, data3, data4 response

The contents of these bytes depends on the response modbus function code

7.10. Example of command 1-2 read bit towards node 3

The example shows command and response messages

HOST COMMAND						
Host command byte 0-1	Host command byte 2	Host command byte 3	Host command byte 4	Host command byte 5	Host command byte 6	Host command byte 7
Trigger++	3	1 or 2	Bit address to read. Top	Bit address to read. Bottom	0	Number of bits to read.

HOST RESPONSE						
Host response byte 0-1	Host response byte 2	Host response byte 3	Host response byte 4	Host response byte 5	Host response byte 6	Host response byte 7
Trigger = Command trigger	3	1 or 2	Number of bits read	Bits read	Bits read	--

7.11. Example of command 3-4 read 1 word

The example shows command and response messages

HOST COMMAND						
Host command byte 0-1	Host command byte 2	Host command byte 3	Host command byte 4	Host command byte 5	Host command byte 6	Host command byte 7
Trigger++	1	3 or 4	Word address to read. Top	Word address to read. Bottom	0	1

HOST RESPONSE						
Host response byte 0-1	Host response byte 2	Host response byte 3	Host response byte 4	Host response byte 5	Host response byte 6	Host response byte 7
Trigger = Command trigger	1	3 or 4	Number of bytes read	Word read - top	Word read - bottom	--

7.12. Example of command 5 write 1 word

The example shows command and response messages

HOST COMMAND						
Host command byte 0-1	Host command byte 2	Host command byte 3	Host command byte 4	Host command byte 5	Host command byte 6	Host command byte 7
Trigger++	1	5	Bit address to write. Top	Bit address to write. Bottom	0 or 255	0

HOST RESPONSE						
Host response byte 0-1	Host response byte 2	Host response byte 3	Host response byte 4	Host response byte 5	Host response byte 6	Host response byte 7
Trigger = Command trigger	1	5	Bit address written. Top	Bit address written. Bottom	0 or 255	0

7.13. Example of command 6 write 1 word

The example shows command and response messages

HOST COMMAND						
Host command byte 0-1	Host command byte 2	Host command byte 3	Host command byte 4	Host command byte 5	Host command byte 6	Host command byte 7
Trigger++	1	6	Word address to write. Top	Word address to write. Bottom	Data - top	Data - bottom

HOST RESPONSE						
Host response byte 0-1	Host response byte 2	Host response byte 3	Host response byte 4	Host response byte 5	Host response byte 6	Host response byte 7
Trigger = Command trigger	1	6	Word address written. Top	Word address written. Bottom	Data written - top	Data written - bottom

7.14. Modbus error management

In the event of an error in the execution of a modbus command, the response in the byte host response byte 2 will be the value of the host command byte 2 plus 128:

host response byte 2=host command byte 2+128

HOST COMMAND						
Host command byte 0-1	Host command byte 2	Host command byte 3	Host command byte 4	Host command byte 5	Host command byte 6	Host command byte 7
Trigger++	1	X	Not significant	Not significant	Not significant	Not significant

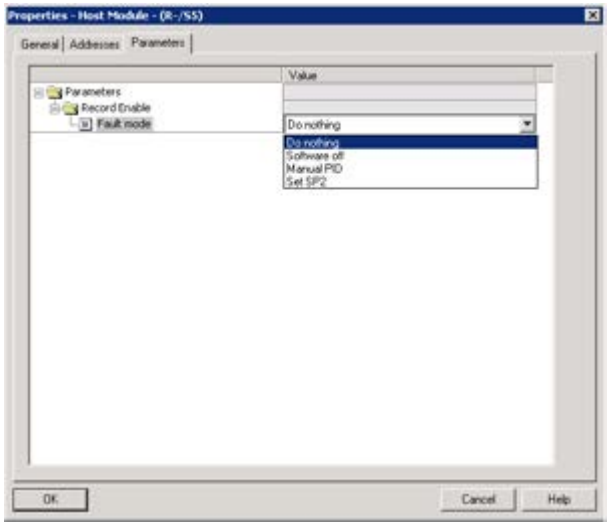
HOST RESPONSE						
Host response byte 0-1	Host response byte 2	Host response byte 3	Host response byte 4	Host response byte 5	Host response byte 6	Host response byte 7
Trigger = Command trigger	1	X+128	Error code^			

N.B.^: The possible values for the Error code field are:

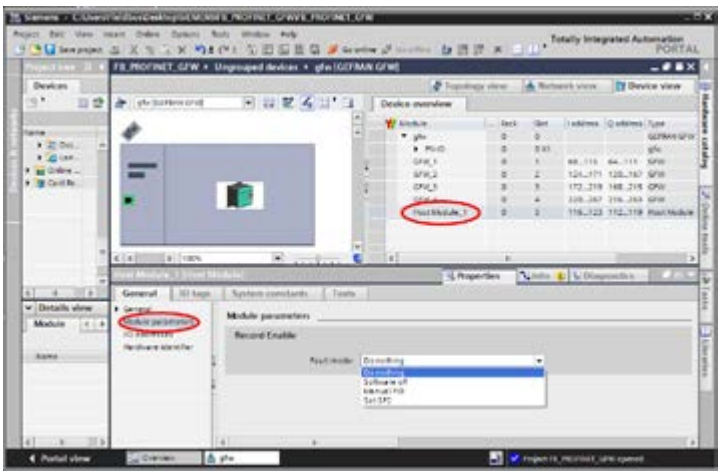
- 1 = illegal function
- 2 = illegal address
- 3 = illegal data
- 9 = illegal number of data
- 10 = data is read only

Also available (**only for the GPC device**) in the case of loss of PROFINET communication, is the possibility to set the devices connected to the following status

Fault mode	Value	Description
	0	Default No Action
	1	Pid Controller in software shutdown
	2	Pid Controller in manual status
	3	Pid Controller with set point equal to SP2



S7



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8 • DIAGNOSTIC MESSAGE

The system is capable of generating diagnostic messages following the presence of faults related to the serial communication.

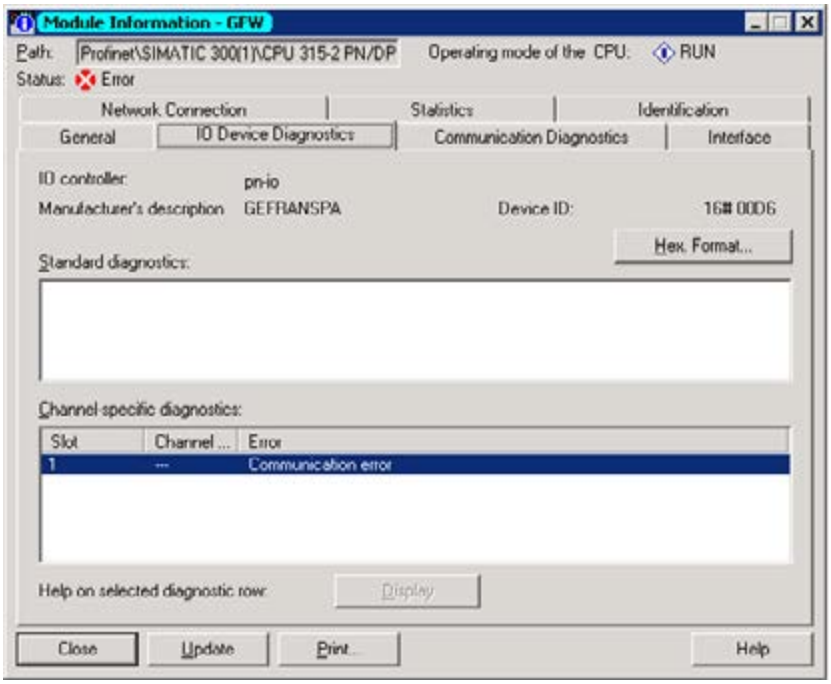
8.1. Serial reading error

In the case of problems in reading the data contained in the process data, an emergency message such as the one shown in the figure is emitted:

Slot = 1, in the example, indicates the device node number that features serial communication problems

Error = shows the type of error, in the example, communication failure

This error disappears if the communication resumes normally



8.2. Serial writing error

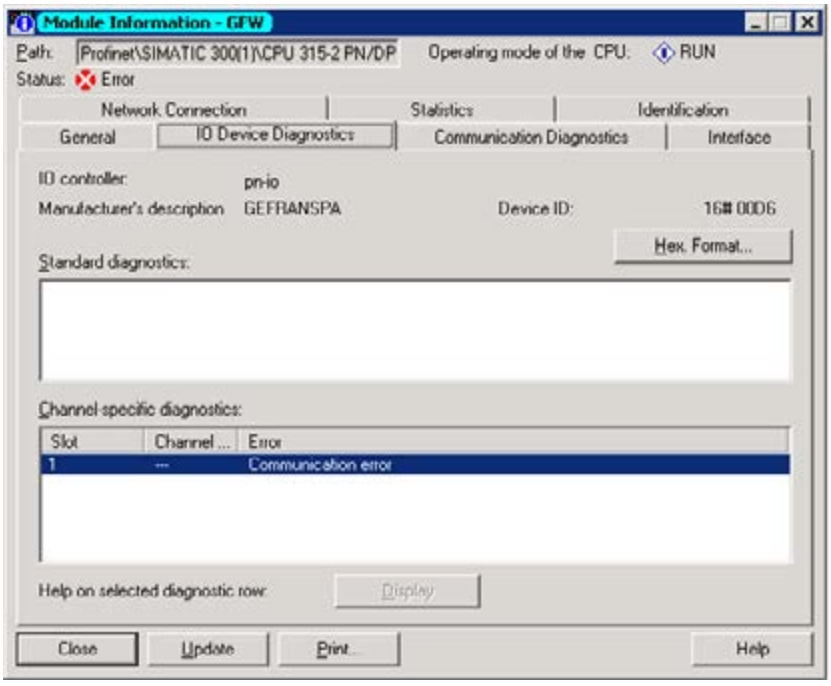
In the event of writing problems, the diagnostic message shown in the figure will appear, highlighting the following information, for instance

Slot = 1 (the error occurred on the device with node = 1)

Error = Error writing Output record 1 (data present in the package of record 1 is illegal or outside the limits or there was an error due to lack of response from the slave)

The error disappears if:

- **At least one variable inside the output record package is changed/ corrected**
- **All the data in the package are written correctly**



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