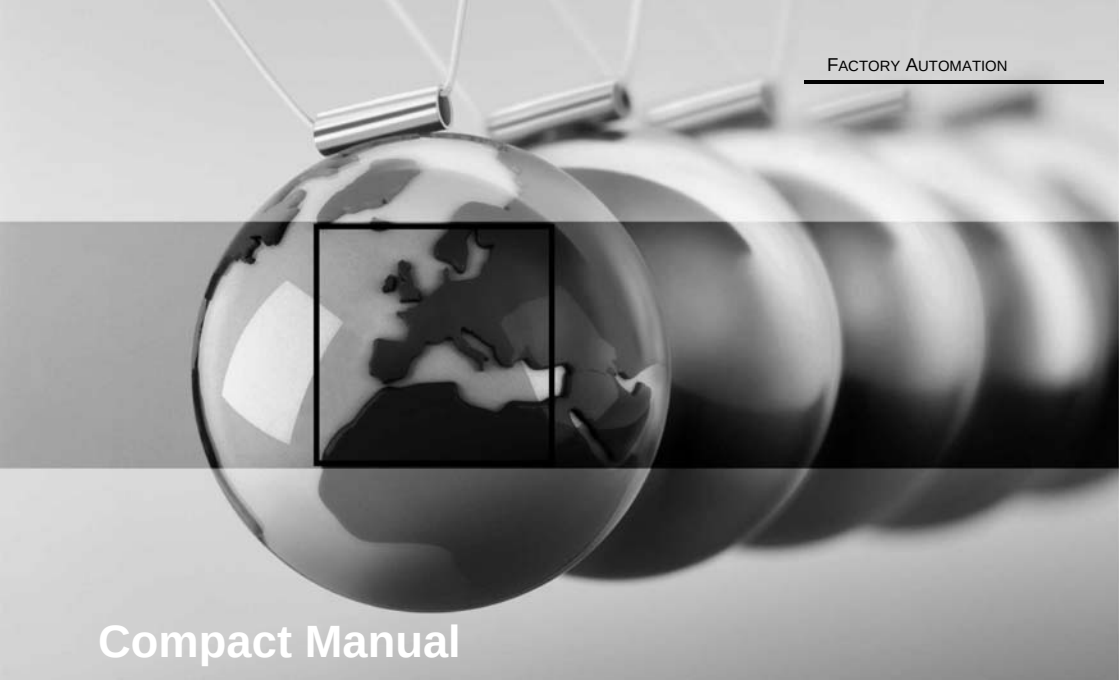
FACTORY AUTOMATION



Compact Manual

ETHERNET/IP + MODBUS TCP GATEWAYS

Part 1: EtherNet/IP

PEPPERL+FUCHS
SENSING YOUR NEEDS

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EtherNet/IP + Modbus TCP Gateways

1. Introduction

Congratulations

You have chosen a device manufactured by Pepperl+Fuchs. Pepperl+Fuchs develops, produces and distributes electronic sensors and interface modules for the market of automation technology on a worldwide scale.

Before installing this equipment and put into operation, read this manual carefully. This manual containes instructions and notes to help you through the installation and commissioning step by step. This makes sure bring such a trouble-free use of this product. This is for your benefit, since this:

- ensures the safe operation of the device
- helps you to exploit the full functionality of the device
- avoids errors and related malfunctions
- avoids costs by disruptions and any repairs
- increases the effectiveness and efficiency of your plant

Keep this manual at hand for subsequent operations on the device.

After opening the packaging please check the integrity of the device and the number of pieces of supplied.

Symbols used

The following symbols are used in this manual:

Information!

This symbol indicates important information.

Attention!

This symbol warns of a potential failure. Non-compliance may lead to interruptions of the device, the connected peripheral systems, or plant, potentially leading to total malfunctioning.

Warning!

This symbol warns of an imminent danger. Non-compliance may lead to personal injuries that could be fatal or result in material damages and destruction.

Contact

If you have any questions about the device, its functions, or accessories, please contact us at:

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68307 Mannheim
Telephone: +49 621 776-4411
Fax: +49 621 776-274411
E-Mail: fa-info@pepperl-fuchs.com

2. Declaration of conformity

2.1 Declaration of conformity

This product was developed and manufactured under observance of the applicable European standards and guidelines.

Information!

A Declaration of Conformity can be requested from the manufacturer.

The product manufacturer, Pepperl+Fuchs GmbH, D-68307 Mannheim, has a certified quality assurance system that conforms to ISO 9001.

3. Safety

3.1 Symbols relevant to safety

Information!

This symbol indicates important information.

Attention!

This symbol warns of a potential failure. Non-compliance may lead to interruptions of the device, the connected peripheral systems, or plant, potentially leading to total malfunctioning.

Warning!

This symbol warns of an imminent danger. Non-compliance may lead to personal injuries that could be fatal or result in material damages and destruction.

3.2 General notes on safety

Only instructed specialist staff may operate the device in accordance with the operating manual.

User modification and or repair are dangerous and will void the warranty and exclude the manufacturer from any liability. If serious faults occur, stop using the device. Secure the device against inadvertent operation. In the event of repairs, return the device to your local Pepperl+Fuchs representative or sales office.

The connection of the device and maintenance work when live may only be carried out by a qualified electrical specialist.

The operating company bears responsibility for observing locally applicable safety regulations.

Store the not used device in the original packaging. This offers the device optimal protection against impact and moisture.

Ensure that the ambient conditions comply with regulations.

3.3 Disposal

Information!

Electronic waste is hazardous waste. Please comply with all local ordinances when disposing this product!

The device does not contain batteries that need to be removed before disposing it.

4. Setting up the AS-i bus

1. Connect the unit to power.
2. Connect the AS-i cable to the unit.
3. One after the other connect the AS-i slaves to the AS-i cable and set the slave addresses.
   You may set the addresses directly on the slave using a portable addresser or by using the option **[SLAVE ADR TOOL]** in the display menu of your gateway.
4. In the display menu select **[QUICK SETUP]** to use the configuration of all AS-i circuits connected to the unit.
   Confirm with **[STORE+RUN]**.
5. Set the EtherNet/IP address and connect the gateway to the host fieldbus controller.
   You can set the addresses directly using the option **[ETHERNET/IP]** in the display menu of your gateway or through the PC using the ASIMON 3 G2 software with integrated AS-i Control Tools.

For more detailed information please refer to the installation guide for your gateway which is included with the unit.

5. EtherNet/IP

5.1 Overview of the main connections

	Assembly Instance				Data Item					
	Input	Length (byte)	Output	Length (byte)	Digital	Analog	Fieldbus bits	Safety Status	min. RPI (ms)[1]	min. RPI (ms) mit DLR
Single Gateway	109 (0x6D)	32	145 (0x91)	32	AS-i circuit 1, all slaves				6	12
	112 (0x70)	56	148 (0x94)	56		AS-i circuit 1, analog slaves 29 ... 31			7	15
Double Gateway	127 (0x7F)	64	163 (0xA3)	64	AS-i circuits 1+2, all slaves				8	16
	133 (0x85)	112	169 (0xA9)	112		AS-i circuits 1+2, analog slaves 29 ... 31			11	24
Double Gateway with Safety Monitor	180 (0xB4)	146	181(0xB5)	114	AS-i circuit 1 + 2, all slaves	AS-i circuit 1+2, analog slaves 29 ... 31	2 bytes In / Out	32 byte In	13	26

Tab. 5-1. Connections

1. The minimum times for the RPI shown in the table do not represent the worst case values. Depending on the Gateway load greater minimum times for the RPI than indicated here may be needed.

The data blocks (digital data, analog data, ...) are arranged one after another in the input data image (IDI). Their order is according to the arrangment of Tab. 5-1.<Connections> from left to right.:

Byte 0 ... 31	Byte 32 ... 55
digital data	analog data
AS-i circuits 1+2 all slaves	AS-i circuits 1+2 analog slaves 29 ... 31

Byte 0 ... 63	Byte 64 ... 111	Byte 112 ... 113	Byte 114 ... 145
digital data	analog data	fieldbus bits	safety status
AS-i circuits 1+2 all slaves	AS-i circuits 1+2 analog slaves 29 ... 31	2 bytes In / Out	32 bytes In

Tab. 5-2. Data blocks

5.2 Digital data

In- and output data

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	F3	F2	F1	F0	D3	D2	D1	D0
	flags				Slave 1/1A			
1	slave 2/2A				slave 3/3A			
2	slave 4/4A				slave 5/5A			

Tab. 5-3.

In- and output data

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
3	slave 6/6A				slave 7/7A			
4	slave 8/8A				slave 9/9A			
5	slave 10/10A				slave 11/11A			
6	slave 12/12A				slave 13/13A			
7	slave 14/14A				slave 15/15A			
8	slave 16/16A				slave 17/17A			
9	slave 18/18A				slave 19/19A			
10	slave 20/20A				slave 21/21A			
11	slave 22/22A				slave 23/23A			
12	slave 24/24A				slave 25/25A			
13	slave 26/26A				slave 27/27A			
14	slave 28/28A				slave 2929A			
15	slave 30/30A				slave 31/31A			
16	reserviert				slave 1B			
17	slave 2B				slave 3B			
18	slave 4B				slave 5B			
19	slave 6B				slave 7B			
20	slave 8B				slave 9B			
21	slave 10B				slave 11B			
22	slave 12B				slave 13B			
23	slave 14B				slave 15B			
24	slave 16B				slave 17B			
25	slave 18B				slave 19B			
26	slave 20B				slave 21B			
27	slave 22B				slave 23B			
28	slave 24B				slave 25B			
29	slave 26B				slave 27B			
30	slave 28B				slave 29B			
31	slave 30B				slave 31B			

Tab. 5-3.

Flags

	Input data	Output data
F0	ConfigError	Offline
F1	APF	LOS MasterBit
F2	PeripheryFault	→ ConfigurationMode
F3	ConfigurationActive	→ ProtectedMode

Tab. 5-4.

ConfigError:	0 = ConfigOK	1 = ConfigError
APF:	0 = AS-i Power OK	1 = AS-i Power Fail
PeripheryFault:	0 = PeripheryOK	1 = PeripheryFault
ConfigurationActive:	0 = ProtectedMode	1 = ConfigurationMode

Offline:	0 = Online	1 = Offline
LOS-Master-Bit:	0 = Offline by ConfigError deactivated	1 = Offline by ConfigError activated

5.3 Analog data

Analog data for slaves 29 … 31

Byte	Data item
0	slave 31 channel 1 high byte
1	slave 31 channel 1 low byte
2	slave 31 channel 2 high byte
3	slave 31 channel 2 low byte
4	slave 31 channel 3 high byte
5	slave 31 channel 3 low byte
6	slave 31 channel 4 high byte
7	slave 31 channel 4 low byte
8	slave 30 channel 1 high byte
9	slave 30 channel 1 low byte
10	slave 30 channel 2 high byte
11	slave 30 channel 2 low byte
12	slave 30 channel 3 high byte
13	slave 30 channel 3 low byte
14	slave 30 channel 4 high byte
15	slave 30 channel 4 low byte
16	slave 29 channel 1 high byte
17	slave 29 channel 1 low byte
18	slave 29 channel 2 high byte
19	slave 29 channel 2 low byte
20	slave 29 channel 3 high byte
21	slave 29 channel 3 low byte
22	slave 29 channel 4 high byte
23	slave 29 channel 4 low byte

Tab. 5-5.

5.4 Fieldbus bits

Output data (function block fieldbus bit in ASIMON)

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	FB7	FB6	FB5	FB4	SI 4	SI 3	SI 2	SI 1
					FB3	FB2	FB1	FB0
1	FB15	FB14	FB13	FB12	FB11	FB10	FB9	FB8

Tab. 5-6.

The bits of the output data bytes are ORed with the real and homonymous hardware inputs of the device.

Input data (output assignment for fieldbus bit in ASIMON)

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	FB7	FB6	FB5	FB4	FB3	FB2	FB1	FB0
1	FB15	FB14	FB13	FB12	FB11	FB10	FB9	FB8

Tab. 5-7.

FB: fieldbus bit
SI 4, SI 3, SI 2, SI 1 monitor inputs

5.5 Safety control/status

Byte	Meaning
0	Safety status OSSD 1
1	Safety status OSSD 2
...	...
31	Safety status OSSD 32

Safety status per OSSD (release circuit)

Bit [0 ... 3]	Status or color	Description
0 (0x0)	continuous green	output on
1 (0x1)	flashing green	Wait time for **Stop cat. 1** running
2 (0x2)	continuous yellow	Start-up / Restart block active
3 (0x3)	flashing yellow	External test required / Acknowledgement / Turn-on delay active
4 (0x4)	continuous red	output off
5 (0x5)	flashing red	error
6 (0x6)	grey or off	output not projected

Tab. 5-8.

Safety status per OSSD (release circuit)

7 (0x7)	reserved	
Bit [6]	**status or color**	
0 (0x0)	no device flashing yellow	
1 (0x1)	at least one device flashing yellow	
Bit [7]	**status or color**	
0 (0x0)	no device flashing red	
1 (0x1)	at least one device flashing red	

Tab. 5-8.

6. CIP Safety via EtherNet/IP

6.1 Overview of CIP Safety Connections

Assembly Instance		Data Item		
Input	**Output**	**Length (byte)**	**Data**	**Min. RPI (ms)[1]**
1024	1279	8	8 byte safety input	10
1279	1056	8	8 byte safety output	10
–	1088	–	configuration	–

Tab. 6-9.

1. The minimum times for the RPI shown in the table do not represent the worst case values. Depending on the Gateway load greater minimum times for the RPI than indicated here may be needed.

6.2 CIP Safety in- and output data (8 bytes)

The assignment of the in- and output data bits depends on the configuration of the Safety Monitor. We recommend to use automatic configuration.

With automatic configuration the data are assigned as follows:

Input data

	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
AS-i circuit 1	0	slave 7	slave 6	...	...	...	slave 2	slave 1	-
	1	slave 15	slave 14	...	...	...	...	slave 9	slave 8
	2	slave 23	slave 22	...	...	...	...	slave 17	slave 16
	3	slave 31	slave 30	slave 29	...	...	...	slave 25	slave 24
AS-i circuit 2	4	slave 7	slave 6	...	...	...	slave 2	slave 1	-
	5	slave 15	slave 14	...	...	...	...	slave 9	slave 8
	6	slave 23	slave 22	...	...	...	...	slave 17	slave 16
	7	SI 1,2	SI 3,4	SI 5,6	...	...	...	slave 25	slave 24
		slave 31	slave 30	slave 29					

Output data

	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
AS-i circuit 1	0	slave 7	SO 6	SO 5	SO 4	SO 3	SO 2	SO 1	-
			slave 6	slave 5	slave 4	slave 3	slave 2	slave 1	
	1	slave 15	slave 14	...	...	...	...	slave 9	slave 8
	2	slave 23	slave 22	...	...	...	...	slave 17	slave 16
	3	slave 31	slave 30	...	...	...	...	slave 25	slave 24
AS-i circuit 2	4	slave 7	slave 6	...	...	...	slave 2	slave 1	-
	5	slave 15	slave 14	...	...	...	...	slave 9	slave 8
	6	slave 23	slave 22	...	...	...	...	slave 17	slave 16
	7	slave 31	slave 30	slave 29	...	...	...	slave 25	slave 24

7. Configuration and Start-up of the Safety Monitor

Configuration and start-up of the AS-i Safety Monitor is accomplished using a PC/ notebook running the ASIMON 3 G2 configuration software.

Note!

For more detailed information please refer to the separate manual for the ASIMON 3 G2 configuration software.

Configuration should be performed only by a safety specialist. All safety-related commands are password protected.

The correct safety functioning of the unit must absolutely be verified in the system!

8. Troubleshooting and Remedies

8.1 System diagnostics on the PC

8.1.1 Software for diagnostics, service and release measurements

The intuitively constructed software for diagnostics, service and release measurements enables PC-assisted measurement using the high-level measuring technology built into the masters.

This specially developed software assists both machine and systems builders in release measurements and preventive troubleshooting as well as end users in preventive maintenance and fast, self-performed error elimination. As an option the analysis data can also be sent to our technical support group and used as the basis for fast, reliable help with problem handling.

8.1.2 AS-i Control Tools

The Software AS-i Control Tools provide you with all the key testing and configuration possibilities of your AS-i circuit in organized fashion on your PC.

A graphic representation of your AS-i network provides you with a quick overview of the system status, showing for example any missing or unprojected slaves. In addition, peripheral errors and the status of the "AS-i Monitors" integrated into the Masters. The AS-i Control Tools software also provides a simple and convenient way to configure new AS-i circuits or modify already existing configurations. This software is also a component of the ASIMON 3 G2 software.

8.1.3 ASIMON 3 G2

The ASIMON 3 G2 software is used to configure the safety unit. Already configured systems can be diagnosed live using the software. The status of all in- and outputs is graphically represented as are the results of the preparatory processing.

When projecting the user has the ability to assign unique identifiers to the individual components. These also appear in the device displays in connection with error messages. To prevent errors in the projecting stage the ASIMON 3 G2 software provides advance warning at the relevant points.

The AS-i Control Tools software is also part of the ASIMON 3 G2.

8.1.4 Web server

Units having an Ethernet port provide all the diagnostics data through a web server. If necessary this also allws the system information to be viewed from any PC connected to the network without any additional software, simply using a standard internet browser and Java.

To be able to take advantage of the full scope of diagnostics functions and configuration possibilities of the AS-i Masters, you will however need the ASIMON 3 G2 software with integrated AS-i Control Tools and ideally also the software for diagnostics, service and release measurement.

8.2 Diagnostics on the host controller

All the diagnostics information is also provided on the host controller.

Note!
Refer here to the tables showing the digital flags in sec. <Digital data> the fieldbus bits in sec. <Fieldbus bits> and the Safety Control Status in sec. <Safety control/status>.

8.2.1 Safety diagnostics in the Input Data Image (IDI)

Representation of the diagnostics information

Diagnostics in the IDI is a way of sending the key diagnostics functions to the controller without a command interface (Mailbox) or any additional effort. The diagnostics information is sent in the input data image, coded for the input bits of the address of the safety input slave.

The switching state of Channels 1 and 2 of the safety input is shown with negligible time lag in bits 0 and 1 and can be directly read:

Bit3	Bit2	Bit1	Bit0	Description
X	X	0	0	Both channels open
X	X	0	1	2nd channel open, 1st channel closed
X	X	1	0	2nd channel closed, 1st channel open
X	X	1	1	Both channel closed

Tab. 8-10.

Bits 2 and 3 are used to send the status of the safety input (the device color of the ASIMON 3 G2):

Bit3	Bit2	Bit1	Bit0	Description
0	0	X	X	Device color: red, green or gray
0	1	X	X	Device color: yellow ("waiting")
1	0	X	X	Device color: yellow flashing ("testing")
1	1	X	X	Device color: red flashing ("Error")

Tab. 8-11. Stae of safety input

Safety diagnostics of safe AS-i outputs via the Input Data Image (IDI)

The diagnostic informations are transfered via the Input Data Image, coded to the input bits of the diagnostic address (diagnostic slave) of an AS-i safety slave.

Bit value of the input bits of the diagnostic slaves

Bit	AS-i input
E0	diagnostics (see table device colors)
E1	
E2	
E3	reserved for EDM input

Tab. 8-12. Bit value of input bits of the diagnostic slaves

Device colors

Value	Color	Description	state change	LED "OUT"[1]
0	green	output on	–	on
1	green flashing	–	–	–
2	yellow	restart inhibit	auxiliary signal 2	1 Hz
3	yellow flashing	–	–	–
4	red	output off	–	off
5	red flashing	waiting for reset of error condition	auxiliary signal 1	8 Hz
6	gray	connection or internal error	only via **Power On** on device	all LEDs flashing
7	green/yellow	output released, but not switched on	switched on by setting the output bit[1]	off

Tab. 8-13. Device colors

1. See documentation of the AS-i slave.

Important!

The following points must be noted for processing:

- The information for switching state and error status are not processed time-synchronous.
- When there is a configuration error all bits having value 0 are sent; this must be noted when processing the data.
- When the Monitor is stopped the device color is "gray".
- When regularly switching, the status "yellow flashing" can be recognized as a transition status. This depends on the component model set. This status cannot be understood as a testing request until it is stably reported (see Monitor Info and Safety Control/Status Byte). This is not the case until bit ’6’ is set in the Monitor Info and Safety Control/Status Byte ("At least one module in Test status"). This means the diagnostics information in the input data image does not serve as a trigger for the testing request, but rather only as detailed information after the Monitor Info and Safety Control/Status byte have indicated that at least one component has reported a testing request.

Other display variants

In addition to the diagnostics representation the following variants are possible:

- Safety code sequence:
  Code sequence is sent, no evaluation of the data; the current status is sent for each bit. Sending of a code sequence for safety slaves means there is a continuous alternation between the states ’1’ and ’0’.
- Substitution values:
  Substitution of the code sequences by the status of the input (Safe Subst Val). Here the following values are sent:

Bit3	Bit2	Bit1	Bit0	Description
0	0	0	0	Both channels open
0	0	1	1	2nd channel open, 1st channel closed
1	1	0	0	2nd channel closed, 1st channel open
1	1	1	1	Both channels closed

Tab. 8-14.

Changing the base setting

Setting and changing the diagnostics type is done using the device display (**`[SAFETY]->[AS-I SAFETY]->[SAFE SUBST VAL]`**)

8.2.2 Diagnosing the safety unit using the command interface

All the diagnostics data can also be queried individually and acyclic using the command interface commands. This procedure, however, involves a large outlay.

8.3 Error indication directly on the device

8.3.1 LEDs

The LEDs located on the device allow you to quickly see the status of the main function parameters, such as power, communication with the host controller, communication on the AS-i circuit and state of the safety in- and outputs.

8.3.2 LC-Display

In the display of the Gateways plain text messages are shown spontaneously for any detected errors (e.g. missing slaves, earth fault, duplicate address…).

8.3.3 AS-i Monitor

Comprehensive, standard measuring technology built into the AS-i Masters make it possible to simply localize even sporadically occurring configuration errors and interference sources affecting AS-i communication.

8.3.3.1 Duplicate address detection

The Master detects when two slaves having the same address are present in the AS-i circuit.

8.3.3.2 Earth fault monitor

The earth fault monitor checks the symmetry of the AS-i voltage. If the voltage is no longer sufficiently symmetrical, the noise immunity of data transmission is compromised.

8.3.3.3 Noise voltage detection

Noise voltages on the AS-i cable can cause telegram errors. The noise voltage detector monitors the AS-i circuit for AC voltages which have been generated by neither the AS-i Master nor the slaves.

8.3.3.4 Overvoltage detection

Normally UASi+ and UASi- are in symmetry with system ground. If this potential rises significantly, the overvoltage detector reports this anomaly.

9. Appendix

Quick Start Guides for commissioning and service are provided on the website available for download.

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