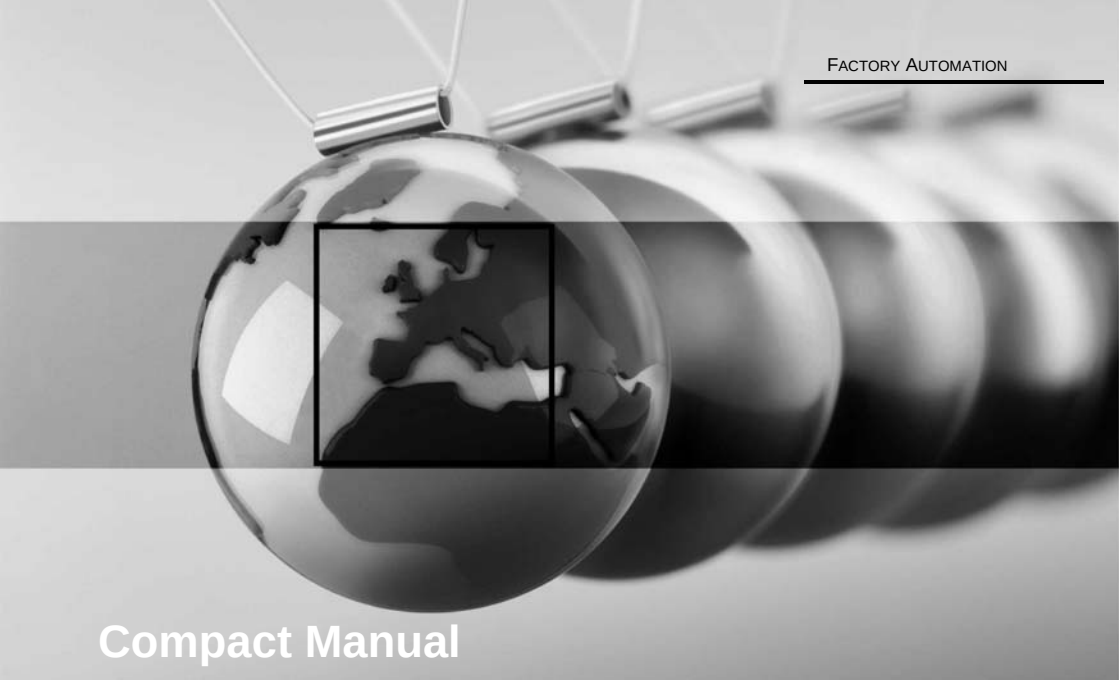

Compact Manual

ETHERNET/IP + MODBUS TCP GATEWAYS

Part 2: Modbus TCP

PEPPERL+FUCHS
SENSING YOUR NEEDS

With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship".

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EtherNet/IP + Modbus TCP Gateways

19.02.2016

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:

Pepperl+Fuchs GmbH

Lilienthalstraße 200

68307 Mannheim

Telephone: +49 621 776-4411

Fax: +49 621 776-274411

E-Mail: fa-info@pepperl-fuchs.com

19.02.2016

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 ModbusTCP address and connect the gateway to the host fieldbus controller.
   You can set the addresses directly using the option **[MODBUSTCP]** in the display menu of your gateway or through the PC using the ASIMON software with integrated AS-i Control Tools.

   The address can also be set by the host controller.

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

5. 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 configuration software.

Note!

For more detailed information please refer to the separate manual for the ASIMON 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!

Note!

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

6. ModbusTCP

6.1 Process data

Description of the ModbusTCP process data.

Information!
*The ModbusTCP interface can manage **maximum of 5** simultaneously active TCP connections on port 502.*
The number of Modbus commands that are transmitted via one IP telegram is limited only by the size of the IP packet.

6.1.1 Digital data

These data must be integrated into the control in order to access the slaves in the AS-i circuits.

6.1.1.1 Typical register

AS-i circuit 1
process data and actual configuration data

4 x reference	access	data
4097 ... 4112	r/-	input data image (IDI)
4113 ... 4128	r/w	output data image (ODI)
4225	r/-	EC flags
4226	r/w	hi flags

Tab. 6-1.

AS-i circuit 2
process data and actual configuration data

4 x reference	access	data
8193 ... 8208	r/-	input data image (IDI)
8209 ... 8224	r/w	output data image (ODI)
8321	r/-	EC flags
8322	r/w	hi flags

Tab. 6-2.

6.1.1.2 Input Data Image IDI (AS-i circuit 1)

Lower Register

4 x reference	contact	read access															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1 - 16	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
		(For a description of the diagnostic data see. <chap. ‘‘Device parameter and diagnostic data“>)															
2	17 - 32	slave 0/0A				slave 1/1A				slave 2/2A				slave 3/3A			
		D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3
3	33 - 48	slave 4/4A				slave 5/5A				slave 6/6A				slave 7/7A			
4	49 - 66	slave 8/8A				slave 9/9A				slave 10/10A				slave 11/11A			
5	65 - 80	slave 12/12A				slave 13/13A				slave 14/14A				slave 15/15A			
6	81 - 96	slave 16/16A				slave 17/17A				slave 18/18A				slave 19/19A			
7	97 - 112	slave 20/20A				slave 21/21A				slave 22/22A				slave 23/23A			
8	113 - 128	slave 24/24A				slave 25/25A				slave 26/26A				slave 27/27A			
9	129 - 144	slave 28/28A				slave 29/29A				slave 30/30A				slave 31/31A			
10	145 - 160	not used				slave 1B				slave 2B				slave 3B			
11	161 - 176	slave 4B				slave 5B				slave 6B				slave 7B			
12	177 - 192	slave 8B				slave 9B				slave 10B				slave 11B			
13	193 - 208	slave 12B				slave 13B				slave 14B				slave 15B			
14	209 - 224	slave 16B				slave 17B				slave 18B				slave 19B			
15	225 - 240	slave 20B				slave 21B				slave 22B				slave 23B			
16	241 - 256	slave 24B				slave 25B				slave 26B				slave 27B			
17	257 - 272	slave 28B				slave 29B				slave 30B				slave 31B			

Tab. 6-3. AS-i ciruit 1 IDI Lower Register

Higher Register

4 x reference	contact	read access															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4097	1 - 16	slave 1/1A				slave 0/0A				slave 3/3A				slave 2/2A			
		D3	D2	D1	D0	D3	D2	D1	D0	D3	D2	D1	D0	D3	D2	D1	D0
4098	17 - 32	slave 5/5A				slave 4/4A				slave 7/7A				slave 6/6A			
4099	33 - 48	slave 9/9A				slave 8/8A				slave 11/11A				slave 10/10A			
4100	49 - 66	slave 13/13A				slave 12/12A				slave 15/15A				slave 14/14A			
4101	65 - 80	slave 17/17A				slave 16/16A				slave 19/19A				slave 18/18A			
4102	81 - 96	slave 21/21A				slave 20/20A				slave 23/23A				slave 22/22A			
4103	97 - 112	slave 25/25A				slave 24/24A				slave 27/27A				slave 26/26A			
4104	113 - 128	slave 29/29A				slave 28/28A				slave 31/31A				slave 30/30A			
4105	129 - 144	slave 1B				not used				slave 3B				slave 2B			
4106	145 - 160	slave 5B				slave 4B				slave 7B				slave 6B			
4107	161 - 176	slave 9B				slave 8B				slave 11B				slave 10B			
4108	177 - 192	slave 13B				slave 12B				slave 15B				slave 14B			
4109	193 - 208	slave 17B				slave 16B				slave 19B				slave 18B			
4110	209 - 224	slave 21B				slave 20B				slave 23B				slave 22B			
4111	225 - 240	slave 25B				slave 24B				slave 27B				slave 26B			
4112	241 - 256	slave 29B				slave 28B				slave 31B				slave 30B			

Tab. 6-4. AS-i ciruit 1 IDI Higher Register

6.1.1.3 Input Data Image IDI (AS-i circuit 2)

Lower Register

4 x reference	contact	read access															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
18	273 - 288	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
		(For a description of the diagnostic data see. <chap. ‘‘Device parameter and diagnostic data“>)															
19	289 - 304	slave 0/0A				slave 1/1A				slave 2/2A				slave 3/3A			
		D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3
20	305 - 320	slave 4/4A				slave 5/5A				slave 6/6A				slave 7/7A			
21	321 - 336	slave 8/8A				slave 9/9A				slave 10/10A				slave 11/11A			
22	337 - 352	slave 12/12A				slave 13/13A				slave 14/14A				slave 15/15A			
23	353 - 368	slave 16/16A				slave 17/17A				slave 18/18A				slave 19/19A			
24	369 - 384	slave 20/20A				slave 21/21A				slave 22/22A				slave 23/23A			
25	385 - 400	slave 24/24A				slave 25/25A				slave 26/26A				slave 27/27A			
26	401 - 416	slave 28/28A				slave 29/29A				slave 30/30A				slave 31/31A			
27	417 - 432	not used				slave 1B				slave 2B				slave 3B			
28	433 - 448	slave 4B				slave 5B				slave 6B				slave 7B			
29	449 - 464	slave 8B				slave 9B				slave 10B				slave 11B			
30	465 - 480	slave 12B				slave 13B				slave 14B				slave 15B			
31	481 - 496	slave 16B				slave 17B				slave 18B				slave 19B			
32	497 - 512	slave 20B				slave 21B				slave 22B				slave 23B			
33	513 - 528	slave 24B				slave 25B				slave 26B				slave 27B			
34	529 - 544	slave 28B				slave 29B				slave 30B				slave 31B			

Tab. 6-5. AS-i circuit 2 IDI Lower Register

Higher Register

4 x reference	contact	read access															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
8193	257 - 272	slave 1/1A				slave 0/0A				slave 3/3A				slave 2/2A			
		D3	D2	D1	D0	D3	D2	D1	D0	D3	D2	D1	D0	D3	D2	D1	D0
8194	273 - 288	slave 5/5A				slave 4/4A				slave 7/7A				slave 6/6A			
8195	289 -304	slave 9/9A				slave 8/8A				slave 11/11A				slave 10/10A			
8196	305 - 320	slave 13/13A				slave 12/12A				slave 15/15A				slave 14/14A			
8197	321 - 336	slave 17/17A				slave 16/16A				slave 19/19A				slave 18/18A			
8198	337 - 352	slave 21/21A				slave 20/20A				slave 23/23A				slave 22/22A			
8199	353 - 368	slave 25/25A				slave 24/24A				slave 27/27A				slave 26/26A			
8200	369 - 384	slave 29/29A				slave 28/28A				slave 31/31A				slave 30/30A			
8201	385 - 400	slave 1B				not used				slave 3B				slave 2B			
8202	401 - 416	slave 5B				slave 4B				slave 7B				slave 6B			
8203	417 - 432	slave 9B				slave 8B				slave 11B				slave 10B			
8204	433 - 448	slave 13B				slave 12B				slave 15B				slave 14B			
8205	449 - 464	slave 17B				slave 16B				slave 19B				slave 18B			
8206	465 - 480	slave 21B				slave 20B				slave 23B				slave 22B			
8207	481 - 496	slave 25B				slave 24B				slave 27B				slave 26B			
4208	497 - 512	slave 29B				slave 28B				slave 31B				slave 30B			

Tab. 6-6. AS-i circuit 2 IDI Higher Register

19.02.2016

6.1.1.4 Output Data Image ODI (AS-i circuit 1)

Lower Register

4 x reference	contact	write access															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1 - 16	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
		(For a description of the diagnostic data see. <chap. “Device parameter and diagnostic data”>)															
2	17 - 32	slave 0/0A				slave 1/1A				slave 2/2A				slave 3/3A			
		D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3
3	33 - 48	slave 4/4A				slave 5/5A				slave 6/6A				slave 7/7A			
4	49 - 66	slave 8/8A				slave 9/9A				slave 10/10A				slave 11/11A			
5	65 - 80	slave 12/12A				slave 13/13A				slave 14/14A				slave 15/15A			
6	81 - 96	slave 16/16A				slave 17/17A				slave 18/18A				slave 19/19A			
7	97 - 112	slave 20/20A				slave 21/21A				slave 22/22A				slave 23/23A			
8	113 - 128	slave 24/24A				slave 25/25A				slave 26/26A				slave 27/27A			
9	129 - 144	slave 28/28A				slave 29/29A				slave 30/30A				slave 31/31A			
10	145 - 160	not used				slave 1B				slave 2B				slave 3B			
11	161 - 176	slave 4B				slave 5B				slave 6B				slave 7B			
12	177 - 192	slave 8B				slave 9B				slave 10B				slave 11B			
13	193 - 208	slave 12B				slave 13B				slave 14B				slave 15B			
14	209 - 224	slave 16B				slave 17B				slave 18B				slave 19B			
15	225 - 240	slave 20B				slave 21B				slave 22B				slave 23B			
16	241 - 256	slave 24B				slave 25B				slave 26B				slave 27B			
17	257 - 272	slave 28B				slave 29B				slave 30B				slave 31B			

Higher Register

4 x reference	contact	write access															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4113	1 - 16	slave 1/1A				slave 0/0A				slave 3/3A				slave 2/2A			
		D3	D2	D1	D0	D3	D2	D1	D0	D3	D2	D1	D0	D3	D2	D1	D0
4114	17 - 32	slave 5/5A				slave 4/4A				slave 7/7A				slave 6/6A			
4115	33 - 48	slave 9/9A				slave 8/8A				slave 11/11A				slave 10/10A			
4116	49 - 66	slave 13/13A				slave 12/12A				slave 15/15A				slave 14/14A			
4117	65 - 80	slave 17/17A				slave 16/16A				slave 19/19A				slave 18/18A			
4118	81 - 96	slave 21/21A				slave 20/20A				slave 23/23A				slave 22/22A			
4119	97 - 112	slave 25/25A				slave 24/24A				slave 27/27A				slave 26/26A			
4120	113 - 128	slave 29/29A				slave 28/28A				slave 31/31A				slave 30/30A			
4121	129 - 144	slave 1B				not used				slave 3B				slave 2B			
4122	145 - 160	slave 5B				slave 4B				slave 7B				slave 6B			
4123	161 - 176	slave 9B				slave 8B				slave 11B				slave 10B			
4124	177 - 192	slave 13B				slave 12B				slave 15B				slave 14B			
4125	193 - 208	slave 17B				slave 16B				slave 19B				slave 18B			
4126	209 - 224	slave 21B				slave 20B				slave 23B				slave 22B			
4127	225 - 240	slave 25B				slave 24B				slave 27B				slave 26B			
4128	241 - 256	slave 29B				slave 28B				slave 31B				slave 30B			

6.1.1.5 Output Data Image ODI (AS-i circuit 2)

Lower Register

4 x reference	contact	write access															
bit value		**2^{15}**	**2^{14}**	**2^{13}**	**2^{12}**	**2^{11}**	**2^{10}**	**2^{9}**	**2^{8}**	**2^{7}**	**2^{6}**	**2^{5}**	**2^{4}**	**2^{3}**	**2^{2}**	**2^{1}**	**2^{0}**
„bit“		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
18	273 - 288	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
		(For a description of the diagnostic data see. <chap. “Device parameter and diagnostic data“>)															
19	289 - 304	slave 0/0A				slave 1/1A				slave 2/2A				slave 3/3A			
		D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3
20	305 - 320	slave 4/4A				slave 5/5A				slave 6/6A				slave 7/7A			
21	321 - 336	slave 8/8A				slave 9/9A				slave 10/10A				slave 11/11A			
22	337 - 352	slave 12/12A				slave 13/13A				slave 14/14A				slave 15/15A			
23	353 - 368	slave 16/16A				slave 17/17A				slave 18/18A				slave 19/19A			
24	369 - 384	slave 20/20A				slave 21/21A				slave 22/22A				slave 23/23A			
25	385 - 400	slave 24/24A				slave 25/25A				slave 26/26A				slave 27/27A			
26	401 - 416	slave 28/28A				slave 29/29A				slave 30/30A				slave 31/31A			
27	417 - 432	not used				slave 1B				slave 2B				slave 3B			
28	433 - 448	slave 4B				slave 5B				slave 6B				slave 7B			
29	449 - 464	slave 8B				slave 9B				slave 10B				slave 11B			
30	465 - 480	slave 12B				slave 13B				slave 14B				slave 15B			
31	481 - 496	slave 16B				slave 17B				slave 18B				slave 19B			
32	497 - 512	slave 20B				slave 21B				slave 22B				slave 23B			
33	513 - 528	slave 24B				slave 25B				slave 26B				slave 27B			
34	529 - 544	slave 28B				slave 29B				slave 30B				slave 31B			

Higher Register

4 x reference	contact	write access															
bit value		**2^{15}**	**2^{14}**	**2^{13}**	**2^{12}**	**2^{11}**	**2^{10}**	**2^{9}**	**2^{8}**	**2^{7}**	**2^{6}**	**2^{5}**	**2^{4}**	**2^{3}**	**2^{2}**	**2^{1}**	**2^{0}**
„bit“		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
8209	257 - 272	slave 1/1A				slave 0/0A				slave 3/3A				slave 2/2A			
		D3	D2	D1	D0	D3	D2	D1	D0	D3	D2	D1	D0	D3	D2	D1	D0
8210	273 - 288	slave 5/5A				slave 4/4A				slave 7/7A				slave 6/6A			
8211	289 -304	slave 9/9A				slave 8/8A				slave 11/11A				slave 10/10A			
8212	305 - 320	slave 13/13A				slave 12/12A				slave 15/15A				slave 14/14A			
8213	321 - 336	slave 17/17A				slave 16/16A				slave 19/19A				slave 18/18A			
8214	337 - 352	slave 21/21A				slave 20/20A				slave 23/23A				slave 22/22A			
8215	353 - 368	slave 25/25A				slave 24/24A				slave 27/27A				slave 26/26A			
8216	369 - 384	slave 29/29A				slave 28/28A				slave 31/31A				slave 30/30A			
8217	385 - 400	slave 1B				not used				slave 3B				slave 2B			
8218	401 - 416	slave 5B				slave 4B				slave 7B				slave 6B			
8219	417 - 432	slave 9B				slave 8B				slave 11B				slave 10B			
8220	433 - 448	slave 13B				slave 12B				slave 15B				slave 14B			
8221	449 - 464	slave 17B				slave 16B				slave 19B				slave 18B			
8222	465 - 480	slave 21B				slave 20B				slave 23B				slave 22B			
8223	481 - 496	slave 25B				slave 24B				slave 27B				slave 26B			
8224	497 - 512	slave 29B				slave 28B				slave 31B				slave 30B			

6.1.2 Analog Data

This section describes the analog process data. If you have analog slaves in your AS-i network, incorporate them as described in the following.

6.1.2.1 Input data

AS-i circuit 1

4x reference	word	data															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
5253	1	slave at address 1, channel 1															
5254	2	slave at address 1, channel 2															
...	...	...															
5376	124	slave at address 31, channel 4															

Tab. 6-7. 16 bit input data of the AS-i slaves at AS-i circuit 1

AS-i circuit 2

4x reference	word	data															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
9349	1	slave at address 1, channel 1															
9350	2	slave at address 1, channel 2															
...	...	...															
9472	124	slave at address 31, channel 4															

Tab. 6-8. 16 bit input data of the AS-i slaves at AS-i circuit 2

Note!

A-Slaves map the data on channels 1 and 2.

B-Slaves map the data on channels 3 and 4.

6.1.2.2 Output data

AS-i circuit 1

4x reference	word	data															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
5125	1	slave at address 1, channel 1															
5126	2	slave at address 1, channel 2															
...	...	...															
5248	124	slave at address 31, channel 4															

Tab. 6-9. 16 bit output data of the AS-i slaves at AS-i circuit 1

AS-i circuit 2

4x reference	word	data															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
9221	1	slave at address 1, channel 1															
9222	2	slave at address 1, channel 2															
...	...	...															
9344	124	slave at address 31, channel 4															

Tab. 6-10. 16 bit output data of the AS-i slaves at AS-i circuit 2

Note!

A-Slaves map the data on channels 1 and 2.

B-Slaves map the data on channels 3 and 4.

6.1.3 Fieldbus Bits

Note!

Available only with gateways with integrated safety monitor.

The fieldbus bits enable communication between the controller and the safety program. The fieldbus bits can be used to pass any acknowledgment signals or similar to the safety program and provide status information to the controller.

The states of the AS-i Safety in- and outputs are sent to the controller via the input data image (see par. <Safety diagnostics in the Input Data Image (IDI)>).

Safety Fieldbus Bits (data for read/write access)

4 x reference	contact	read/write access															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
51	801 - 816	fieldbus bits															

Tab. 6-11. Safety Fieldbus Bits (data for read/write access)

6.1.4 Safety Control/Status

Note!

Available only with gateways with integrated safety monitor.

Safety Status (data for read access)

4 x reference	contact	read access															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit"		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
35	545 - 560	safety status OSSD 1								safety status OSSD 2							
36	561 - 576	safety status OSSD 3								safety status OSSD 4							
37	577 - 592	safety status OSSD 5								safety status OSSD 6							
38	593 - 608	safety status OSSD 7								safety status OSSD 8							
39	609 - 624	safety status OSSD 9								safety status OSSD 10							
40	625 - 640	safety status OSSD 11								safety status OSSD 12							
41	641 - 656	safety status OSSD 13								safety status OSSD 14							
42	657 - 672	safety status OSSD 15								safety status OSSD 16							
43	673 - 688	safety status OSSD 17								safety status OSSD 18							
44	689 - 704	safety status OSSD 19								safety status OSSD 20							
45	705 - 720	safety status OSSD 21								safety status OSSD 22							
46	721 - 736	safety status OSSD 23								safety status OSSD 24							
47	737 - 752	safety status OSSD 25								safety status OSSD 26							
48	753 - 768	safety status OSSD 27								safety status OSSD 28							
49	769 - 784	safety status OSSD 29								safety status OSSD 30							
50	785 - 800	safety status OSSD 31								safety status OSSD 32							

The table shows the color coding as represented in the ASIMON software.

Safety Status per OSSD (release circuit)

Bit value [0 ... 2]	**Status or color**	**Description**
0	continuous green	output on
1	flashing green	Wait time for **Stop cat. 1** running
2	continuous yellow	Start-up / Restart block active
3	flashing yellow	External test required / Acknowledgment / Turn-on delay active
4	continuous red	output off
5	flashing red	error
6	grey or off	output not projected
7	reserved	
Bit value [3 ... 5]	**status or color**	
	reserved	
Bit value [6]	**status or color**	
0	no device flashing yellow	
1	at least one device flashing yellow	
Bit value [7]	**status or color**	
0	no device flashing red	
1	at least one device flashing red	

Tab. 6-12. Coding of status bytes

The cyclical output identifier contains the 4 Safety Monitor bits 1.Y1, 1.Y2, 2.Y1 and 2.Y2. The monitoring element “Monitor input” and the start elements “Monitor Start-Monitor Input” and “Activation using Monitor Input” access these data. In contrast, the “Feedback circuit” element always accesses the EDM input. The bits of the output bytes are ORed with the real and the homonymous hardware inputs of the device.

Safety Control (data for write access)

4 x reference	**contact**	**write access**															
bit value		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„bit“		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
35	545 - 560	reserved												2.Y2	2.Y1	1.Y2	1.Y1

Tab. 6-13. Safety Control Internal Monitor (data for write access)

6.1.5 Monitor and I/O data

Note!

Available only with gateways with integrated safety monitor.

In the fieldbus configuration the designator Monitor and I/O Data can be added as cyclical data. The designator contains 6 bytes of information about the current switching states of the local in- and outputs as well as 1 byte of monitor information. These are encoded as follows:

4x reference	read access															
Bit value	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„Bit“	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
52	Monitor Info								Status SI1/SI2[1] or S11-S22[2]							
53	Status SI3/SI4[1] or S31-S42[2]								Status SI5/SI6[1] or S51-S62[2]							
54	Status SO1/SO2								Status SO3/SO4[1] or reserved[2]							
55	Status SO5/SO6[1] or reserved[2]								reserved							

Tab. 6-14.

1. Devices with 6 local I/Os
2. Safety Basic Monitors with ethernet interface

Coding of the monitor info

Bit 0	Description
0	Monitor in configuration mode
1	Monitor in protection mode
Bit 1	Description
0	24V missing
1	24V o. k.
Bit [2 … 5]	Reserved
Bit 6	Description
0	No component in the Test state (yellow flashing)
1	At least one component in the Test state (yellow flashing)
Bit 7	Description
0	No component in the Error state (red flashing)
1	At least one component in the Error state (red flashing)

Coding the status byte

Bit 0	Description
0	Depending on byte SI 1/3/5 or SO 1/3/5 Off
1	Depending on byte SI 1/3/5 or SO 1/3/5 On
Bit 1	Description
0	Depending on byte SI 2/4/6 or SO 2/4/6 Off
1	Depending on byte SI 2/4/6 or SO 2/4/6 On
Bit [2 … 3]	Description (only if clamping terminals are used as a safety input)
0	Color of the associated safety-relevant component: red, green or gray
1	Color of the associated safety-relevant component: yellow ("wait")
2	Color of the associated safety-relevant component: yellow flashing ("test")
3	Color of the associated safety-relevant component: red flashing ("error")
Bit 4	Description
0	Clamping terminals configured as outputs or standard inputs
1	Clamping terminals configured for safety-relevant input
Bit [5 … 7]	Reserved

6.1.6 Diagnostics Safe Link

Note!

Available only with gateways with integrated safety monitor.

The Safe Link process data diagnostics allows you to visualize the status of the safe link between the various gateways in the controller.

10 Byte SafeLink.Diag.

4x reference	read access															
Bit value	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
„Bit“	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
56	St.Addr. 4		St.Addr. 3		St.Addr. 2		St.Addr. 1		St.Addr. 8		St.Addr. 7		St.Addr. 6		St.Addr. 5	
57	St.Addr. 12		St.Addr. 11		St.Addr. 10		St.Addr 9		St.Addr. 16		St.Addr. 15		St.Addr. 14		St.Addr. 13	
58	St.Addr. 20		St.Addr. 19		St.Addr. 18		St.Addr.17		St.Addr. 24		St.Addr. 23		St.Addr. 22		St.Addr. 21	
59	St.Addr. 28		St.Addr. 27		St.Addr. 26		St.Addr. 25		reserviert		St.Addr. 31		St.Addr. 30		St.Addr. 29	
60	Node Status				Node Addr.				Domain no.				Manager Addr.			

Tab. 6-15.

St. addr: node status of an address, from the ’node overview’ list:

Bit-combination	Meaning
11	active
01	*not* active
10	*not* taught (only in the manager, message with the highest priority)
00	*not* used

node address:	node address within the Safe Link cluster
manager address:	node address of the Safe Link cluster manager
domain no.:	Safe Link cluster address *Only the 3 rear bits of the address are specified in the 'domain no.' !*

6.2 Device parameter and diagnostic data

The bits within the words of this block are arranged appropriate for the BLKM (Block Move) function in Modicon's 984 Ladder Language (as proposed in the Open Modbus Specification, Release 1.0). The bits are numbered from most signicant bit to least signicant bit:

Flags

flag	bit	bit value	write	read
F1	1	32768 (0x8000)	Data_Exchange_Active	Config_OK
F2	2	16384 (0x4000)	Off-Line	LDS.0
F3	3	8192 (0x2000)	Auto_Address_Enable	Auto_Address_Assign
F4	4	4096 (0x1000)	Configuration Mode on	Auto_Address_Available
F5	5	2048 (0x800)	Configuration Mode off	Conguration_Active
F6	6	1024 (0x400)		Normal_Operation_Active
F7	7	512 (0x200)		APF/not APO
F8	8	256 (0x100)		Offline_Ready
F9	9	128 (0x80)		Periphery_OK
F10	10	64 (0x40)		
F11	11	32 (0x20)		
F12	12	16 (0x10)		
F13	13	8 (0x8)		Earth Fault
F14	14	4 (0x4)		Overvoltage
F15	15	2 (0x2)		Noise
F16	16	1 (0x1)		Duplicate Address

Data_Exchange_Active:	If this output is set, no data transmisson between the gateway and the AS-i slaves is possible. *0: Data exchange is active* *1: Data exchange is not active*
Off-line:	This output sets the master into the off-line phase
Auto_Address_Enable:	This output blocks the automatic slave-address pro-gramming. *0: Auto-address is enabled* *1: Auto-address is disabled*
Configuration_Mode_on:	Configuration mode is on
Configuration_Mode_off:	Configuration mode is off
Config_OK:	Configuration error: *0: no error* *1: error*
LDS.0:	An AS-i slave with address zero exists
Auto_Address_Assign:	Automatic programming is allowed
Auto_Address_Available:	Automatic programming is possible *0: Auto-address is possible* *1: Auto-address is not possible*
Configuration_Active:	The configuration mode is active

Normal_Operation_Active:	The normal operation mode is active *0: normal operation is active* *1: normal operation is not active*
APF/not APO:	An AS-i power fail occured
Offline_Ready:	The off-line phase is active
Periphery_OK:	Periphery is OK *0: Periphery is OK* *1: Periphery is not OK*
Earth Fault:	AS-i earth fault detection *0: no earth fault* *1: earth fault*
Overvoltage:	AS-i overvoltage detection *0: no overvoltage* *1: overvoltage fault*
Noise:	AS-i noise detection *0: no noise* *1: noise fault*
Duplicate Address:	ASi duplicate address detection *0: no duplicate address* *1: duplicate address*

4 x reference 4225

bit value	execution control flags
1 (0x1)	Config_OK
2 (0x2)	LDS.0
4 (0x4)	Auto_Address_Assign
8 (0x8)	Auto_Address_Available
16 (0x10)	Configuration_Active
32 (0x20)	Normal_Operation_Active
64 (0x40)	APF/not APO
128 (0x80)	Offline_Ready
256 (0x100)	Periphery_OK
4096 (0x1000)	Earth Fault
8192 (0x2000)	Overvoltage
16384 (0x4000)	Noise
32768 (0x8000)	Duplicate Address

Tab. 6-16. Reference 4225

Config_OK:	Configuration error *0: error* *1: no error*
LDS.0:	An AS-i slave with address zero is existing
Auto_Address_Assign:	Automatic programming is allowed
Auto_Address_Available:	Automatic programming is possible *0: Auto-address is not possible* *1: Auto-address is possible*
Configuration_Active:	The configuration-mode is active
Normal_Operation_Active:	The normal operation mode is active *0: normal operation is not active* *1: normal operation is active*
APF/not APO:	An AS-i power fail occured
Offline_Ready:	The off-line phase is active
Periphery_OK:	Periphery is OK *0: Periphery is not OK* *1: Periphery is OK*
Earth Fault:	AS-i earth fault detection *0: no earth fault* *1: earth fault*
Overvoltage:	AS-i overvoltage detection *0: no overvoltage* *1: overvoltage fault*
Noise:	AS-i noise detection *0: no noise* *1: noise fault*
Duplicate Address:	AS-i duplicate address detection *0: no duplicate address* *1: duplicate address*

Device parameter

Device-relevant references		
4 x reference	**access**	**data**
2087	r/w	default value for watchdog timeout in 10 msec units range 0 ... 999 (this value overwrites the value written in the reference 61441)
61441	r/w	timeout in 10 msec units default 100 (≡ 1 sec) range 0 ... 65535

Tab. 6-17. Device-relevant references 2087 ... 61441

6.2.1 Modbus watchdog

The watchdog is set by default to 1000 msec (= 100 in register 61441). This value will be automaticly set after POWER ON of the gateway. Every write access on any Modbus registers reloads the watchdog timer. If no values are written before the watchdog timer is counted to zero the gateway will automatically put all AS-i circuits that are not in conguration mode in a safe state by clearing the outputs. This means they are reseted.

The timeout period can be adjusted if necessary at the address 61441 (in 10 ms units, range 1 ... 65536) but it will return to the default value on power cycle.

If zero is written to the address 61441, the watchdog is disabled.

The reference 2087 holds the default value for the watchdog timeout. This value is set in the register 61441 after power on of the gateway. This period can be adjusted from 0 ... 999 (0 = watchdog disabled). Writing to this register also writes to the register 61441.

Reading the address 61441 returns the watchdog holdup time remaining (reset to value written at each output operation).

4 x reference 4226

bit value	host interface flags
1 (0x1)	Data_Exchange_Active
2 (0x2)	Off_Line
4 (0x4)	Auto_Address_Enable

Tab. 6-18. Reference 4226

Data_Exchange_Active:	If this output is set, no data transmisson between the gateway and the AS-i slaves is possible. *0: Data exchange is not active* *1: Data exchange is active*
Off-line:	This output sets the master into the off-line phase. 0: on-line 1: off-line
Auto_Address_Enable:	This output blocks automatic slave-address programming. *0: Auto-address is disabled* *1: Auto-address is enabled*

7. Diagnostics

7.1 System diagnostics on the PC

7.1.1 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.

7.1.2 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 **diagnostic buffer** (not available with all devices!) stores with a time stamp in a ring buffer up to 1024 events. 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 software.

7.1.3 ASIMON

The ASIMON 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 software provides advance warning at the relevant points.

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

7.1.4 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 software with integrated AS-i Control Tools and ideally also the software for diagnostics, service and release measurement.

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7.2 Diagnostics on the host controller

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

7.2.1 Diagnostics through process data

Diagnostics through the process data provides a very simple means of incorporating diagnostics information into the controller program and displaying it on a control panel.

For useful diagnostics we recommend use of the following modules:

7.2.1.1 Diagnosing the AS-i circuits

- Device parameter and diagnostic data (see chap. 6.2).

When a configuration error is reported, e.g. because an AS-i slave has failed, the AS-i master continues to communicate with the remaining slaves. In many cases however a good and simple solution is to terminate running of the PLC program in case of a configuration error.

7.2.1.2 Diagnosing the Safety Monitor

- Safety diagnostics in the Input Data Image
  Diagnostics for the states of the safety AS-i in- and outputs. To obtain diagnostics information for a safety AS-i output the associated diagnostics slave address must be incorporated (see par. <A>).
- Safety Control/Status
  Diagnosing the states of the release circuits (see chap. 6.1.4)
- Monitor and I/O Data
  Status of the safety monitor and of the local safety in- and outputs (see chap. 6.1.5)
- Fieldbus bits
  Manufacturer specific diagnostics (see chap. 6.1.3)
- Diagnostics Safe Link
  In case safe coupling of multiple safety monitors is used via Safe Link (see chap. 6.1.6).

Paragraph A: Safety diagnostics in the Input Data Image (IDI)

□ Safety diagnostics of safe AS-i inputs

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. 7-19.

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

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. 7-20. Stae of safety input

☐ Safety diagnostics of safe AS-i outputs

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. The diagnostics information for the safety output is encoded to the input data of the diagnostics slave of the respective safety output.

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. 7-21. Bit value of input bits of the diagnostic slaves

Device colors

The colors refer to the diagnostics in the ASIMON.

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. 7-22. 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.

Changing the base setting

Note!

Available only with gateways.

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

7.2.2 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 method does however involve greater programming effort.

7.3 Error indication directly on the device

Note!
Available only with gateways.

7.3.1 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.

7.3.2 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…).

7.3.3 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.

7.3.3.1 Duplicate address detection

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

7.3.3.2 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.

7.3.3.3 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.

7.3.3.4 Overvoltage detection

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

8. Appendix

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

19.02.2016

FACTORY AUTOMATION – SENSING YOUR NEEDS

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