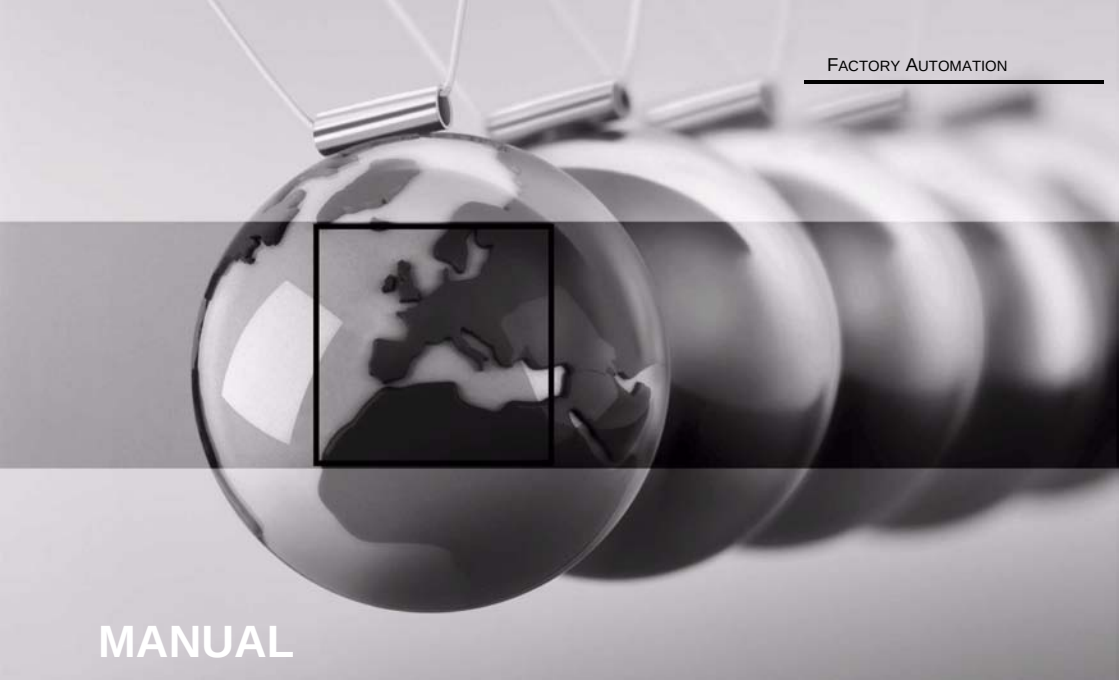

MANUAL

# AS-I 3.0 ETHERNET/IP+MODBUS TCP GATEWAY WITH INTEGR. SAFETY MONITOR

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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## AS-i 3.0 EtherNet/IP+Modbus TCP Gateway with integr. Safety Monitor

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# 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

# 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. General

## 4.1 Product information

This system manual applies to the following Pepperl+Fuchs GmbH equipment:

### 4.1.1 AS-i 3.0 EtherNet/IP+Modbus TCP Gateway with integr. Safety Monitor

| Article no. | Type | Inputs safety, expandable to | Outputs Safety, SIL 3, cat. 4 | Safety outputs, independent according to SIL 3, expandable to | Safety communication | Number of AS-i networks, number of AS-i Master | 1 power supply, 1 gateway for 2 AS-i networks, inexpensive power supplies | Diagnostic and configuration interface |
|---|---|---|---|---|---|---|---|---|
| **VBG-ENX-K30-DMD-S16-C1** | Safety, EtherNet/IP + Modbus TCP | max. 62 x 2-channels | 4 release circuits; 2 x relay, 2 x fast electronic safe outputs | max. 16 | — | 2 AS-i networks, 2 AS-i Masters | yes, max. 4A/ AS-i network | RS 232 + Ethernet |
| **VBG-ENX-K30-DMD-S16** | Safety, EtherNet/IP + Modbus TCP | max. 62 x 2-channels | 4 release circuits; 2 x relay, 2 x fast electronic safe outputs | max. 16 | — | 2 AS-i networks, 2 AS-i Masters | no, max. 8A/AS-i network, redundant supply | RS 232 + Ethernet |
| **VBG-ENX-K30-DMD-S16-EV** | Safety, EtherNet/IP + Modbus TCP | max. 62 x 2 channels, max. 1922 in max. configuration | 4 release circuits; 2 x relay, 2 x fast electronic safe outputs | max. 32, max. 992 in max. configuration | SafeLink[1] | 2 AS-i networks, 2 AS-i Masters | yes, max. 4A/ AS-i network | Ethernet |

*Tab. 4-1.*

1. SafeLink via ethernet. Please refer here to the information in the section <Safe Link>.

## 4.2 New Generation of AS-i Gateways with ethernet diagnostics interface

**The plus points of the new Gateway generation at a glance:**

- Gateways now programmable in C
- Ethernet diagnostics interface for remote diagnostics
- Integrated web server: diagnostics for the Gateways and the AS-i circuits over Ethernet possible with no additional software
- GSD configuration files already stored in the web server
- Earth fault monitor distinguishes between AS-i cable and sensor cable
- Current from both AS-i circuits in the "1 Gateway, 1 power supply for 2 AS-i circuits" version can now be read directly on the unit
- Self-resetting fuses in the "1 Gateway, 1 power supply for 2 AS-i circuits" version
- Device temperature display
- AS-i Power24V capable
- Interfaces for virtually every bus system and Ethernet solution

***Information!***

*See also section <Functions of the new generation of AS-i Gateways> for further information.*

## 4.3 Brief description

The actuator-sensor interface (AS-i) has established itself as a system for networking primarily binary sensors and actuators at the lowest level of the automation hierarchy. The high number of installed systems, the ease of use and the reliable operating behaviour also make the AS-i interesting in the area of machine safety.

The **safety** AS-i system is intended for safety applications up to Category 4/SIL 3. Mixed operation of standard components and safe components is possible.

The AS-i Safety Monitor monitors within an AS-i system the safe slaves which have been assigned according to the configuration specified by the user with the configuration software. In the event of a stop request or a defect, the AS-i Safety Monitor switches off the system in protective operation mode with a maximum reaction time of 40 ms.

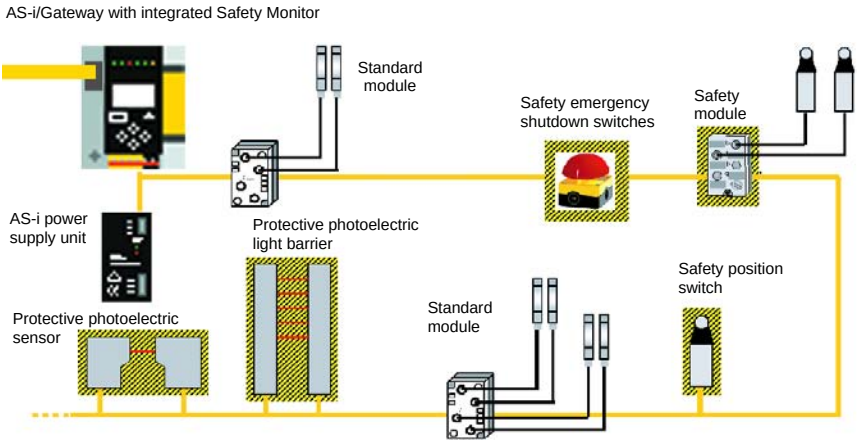



Fig. 4-1. Safe and standard components in an AS-i network

Multiple AS-i Safety Monitors can be used within an AS-i system. In this way, a safe slave can be monitored by multiple AS-i Safety Monitors.

## 4.4 Conformity statement

The device has been developed and manufactured in accordance with the applicable european standards and directives.

***Information!***

*The corresponding conformity statement can be found at the very beginning of this system manual.*

## 4.5 Certification according to DIN EN ISO 9001 : 2000

The manufacturer of the product possesses a certified quality assurance system in accordance with ISO 9001.

***Information!***

*The current certificate can be viewed in internet: http://www.pepperl-fuchs.com.*

# 5. Specifications

## 5.1 Technical data

The technical data are placed in the data sheet. Please view the current version on the web page: http://www.pepperl-fuchs.com.

***Attention!***

*The AS-I power supply for the AS-I components must have isolation per IEC 60 742 and be able to handle momentary power interruptions of up to 20 ms. The power supply for the 24 V supply must also have isolation per IEC 60 742 and be able to handle momentary power interruptions of up to 20 ms. The maximum output voltage of the power supply must also be less than 42 V in case of a fault.*

## 5.2 Safety-relevant characteristic data

| Characteristic data | Value | Standard |
|---|---|---|
| Safety category | 4 | EN 954-1 |
| Safety category | 4 | EN ISO 13849-1: 2008 |
| Performance Level (PL) | e | |
| Safety Integrity Level (SIL) | 3 | EN 61508: 2001 |
| Lifespan (TM) in years | 20 | EN ISO 13849-1: 2008 |
| Maximum switch-on time in months | 12 | EN 61508: 2001 |
| Max. system reaction time in milliseconds | 40 | EN 61508: 2001 |

*Tab. 5-2.*

***Attention!***

*In addition to the system reaction time of max. 40 ms, the reaction times of the safe AS-interface sensor slave, of the sensor being used for monitoring, of the safe AS-interface actuator slave and of the actuator used for this purpose must still be added. Please note that additional reaction times may likewise arise through the configuration of the safety monitor.*

***Notice!***

*Refer to the technical data for the slaves as well as to that for the sensors and actuators for the reaction times to be added.*

***Attention!***

*The system reaction times of the daisy-chained AS-interface components are added up.*

### 5.2.1 Overview of parameter for determining the failure rates

| nop/y | switching intervals $t_{cycle}$ [s] | B10d value | electromechanics | | Standard |
|---|---|---|---|---|---|
| | | | $MTTF_d$ [years] | PFH [1/h] | |
| 105.120 | 300 | 2.500.000 | 237,82 | $9{,}908 \times 10^{-9}$ | EN ISO 13849-1 |
| 52.560 | 600 | | 475,65 | $4{,}853 \times 10^{-9}$ | |
| 8.760 | 3600 | | 2853,88 | $9{,}054 \times 10^{-10}$ | |

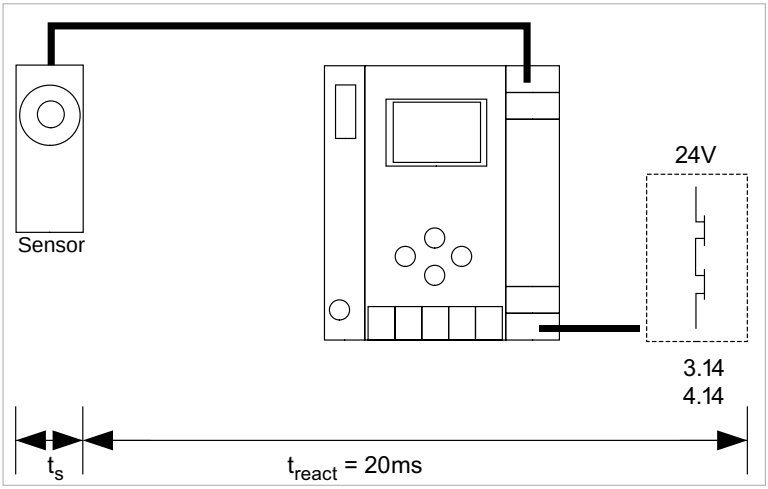
*Tab. 5-3.*

| nop/y | switching intervals $t_{cycle}$ | B10d value | electronics PFH | electromechanics | | PFH total | Standard |
|---|---|---|---|---|---|---|---|
| | | | | $MTTF_d$ | PFH | | |
| 105.120 | 300 | 2.500.000 | $4{,}76\ E^{-09}$ | 237,82 | $1{,}12 \times 10^{-8}$ | $1{,}6 \times 10^{-8}$ | EN 62061 EN 61508 |
| 52.560 | 600 | | | 475,65 | $5{,}09 \times 10^{-9}$ | $9{,}85 \times 10^{-9}$ | |
| 8.760 | 3600 | | | 2853,88 | $7{,}82 \times 10^{-10}$ | $5{,}54 \times 10^{-9}$ | |

*Tab. 5-4.*

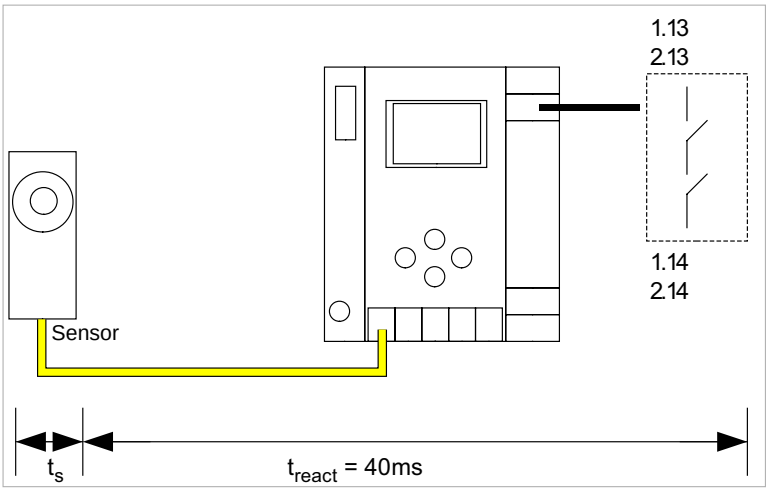
## 5.3 Reaction times

### 5.3.1 Local electronic input -> local electronic output




$t_s$ = maximal reaction time of the sensor (see data sheet)
$t_{react}$ = maximal system reaction time

### 5.3.2 Sensor -> local relay output




$t_s$ = maximal reaction time of the sensor (see data sheet)
$t_{react}$ = maximal system reaction time

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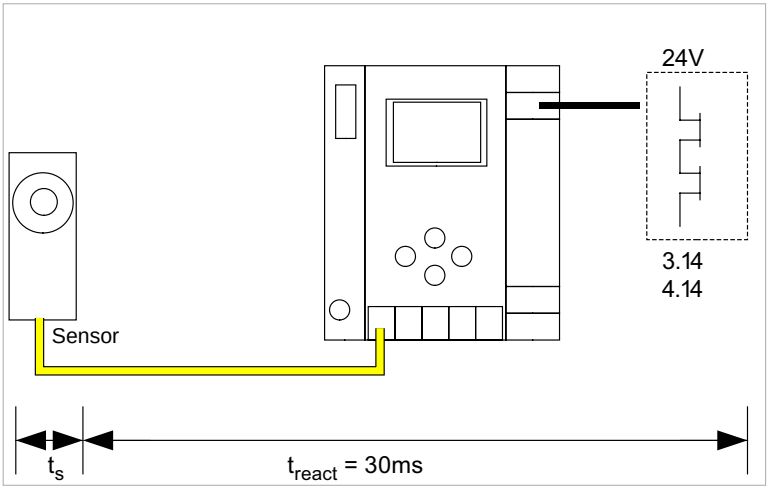
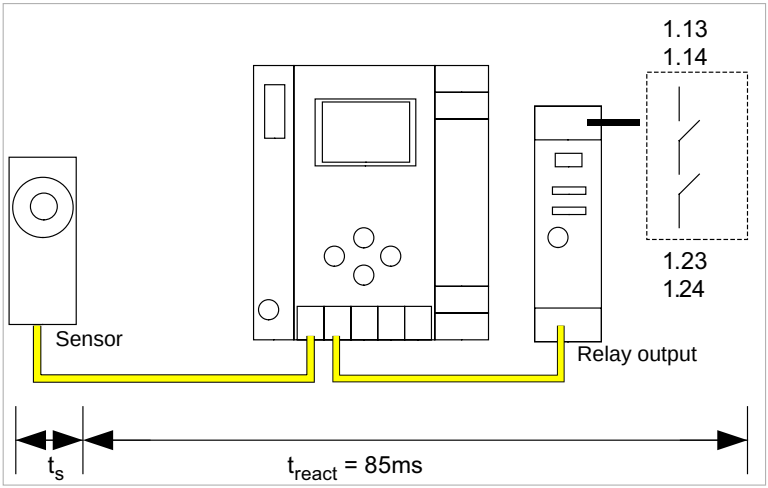
### 5.3.3 Sensor -> local electronic output



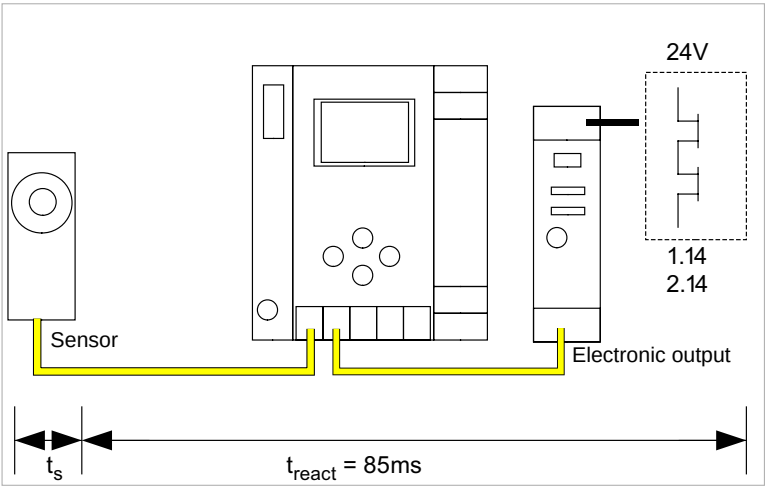

$t_s$ = maximal reaction time of the sensor (see data sheet)
$t_{react}$ = maximal system reaction time

### 5.3.4 Sensor -> AS-i relay output




$t_s$ = maximal reaction time of the sensor (see data sheet)
$t_{react}$ = maximal system reaction time

### 5.3.5 Sensor -> AS-i electronic output




$t_s$ = maximal reaction time of the sensor (see data sheet)
$t_{react}$ = maximal system reaction time

### 5.3.6 System reaction times – example calculations

| System components: | | |
|---|---|---|
| **ASI1** | AS-i network 1 | |
| **ASI2** | AS-i network 2 | |
| **S1-1** | Safe sensor slave | (EMERGENCY-OFF switch: $t_{R\ S1-1}$ = 100 ms) |
| **S1-2** | Safe sensor slave | (safety light barrier: $t_{R\ S1-2}$ = 18 ms) |
| **S2-1** | Safe sensor slave | (EMERGENCY-OFF switch: $t_{R\ S2-1}$ = 100ms) |
| **A2-1** | Safe actuator slave | (motor starter: $t_{R\ A2-1}$ = 50ms) |
| **SM1-1** | Safety monitor with 16 relais circuits and one safe AS-i output in AS-i network 1 | |
| **SM1-2** | Safety monitor with 2 relais circuits and one safe AS-i output in AS-i network 1 | |
| **SM2-1** | Safety monitor with 16 relais circuits and one safe AS-i output in AS-i network 2 | |

*Tab. 5-5.*

**System configuration - example 1: Calculation of the system reaction time**

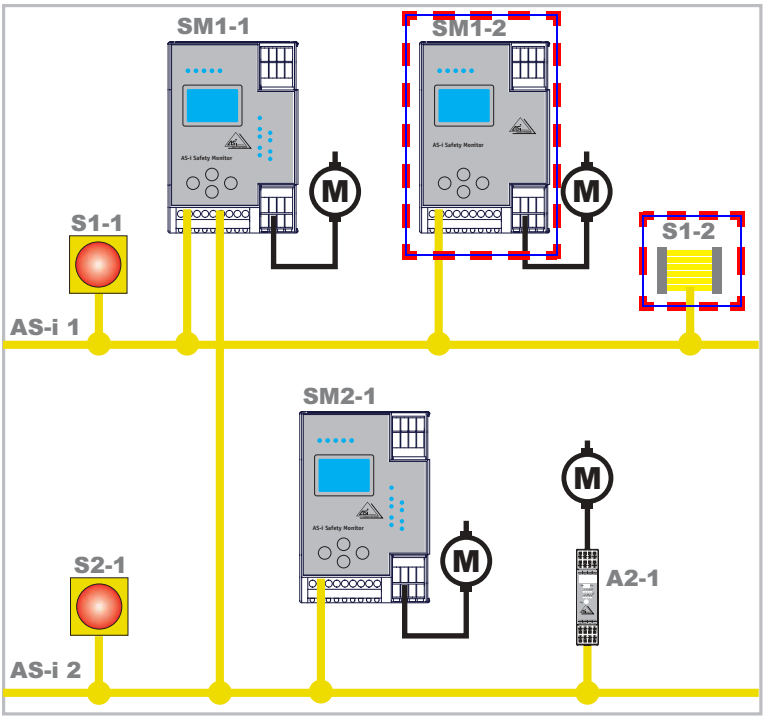



Fig. 5-2.

Upon activation of safety light barrier S1-2, the relay safety output of safety monitor SM1-2 is controlled.

Calculation of the AS-i relevant system reaction time:

$$t_{System\ total\ a)} = t_{R\ S1\text{-}2} + t_{R\ System} = 18ms + 40ms = \underline{58ms}$$

**System configuration - example 2: Calculation of the system reaction time**

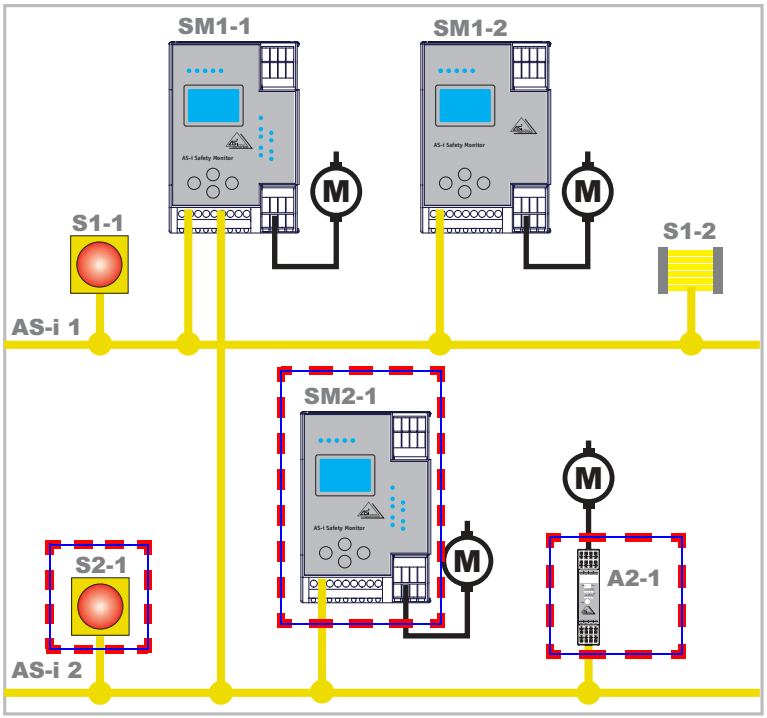



Fig. 5-3.

Upon locking of the EMERGENCY-OFF switch S2-1, the motor starter is controlled via the safe AS-interface output of safety monitor SM2-1.

Calculation of the AS-interface-relevant system reaction time:

$$t_{System\ total\ b)} = t_{R\ S2\text{-}1} + t_{R\ System} + t_{R\ A2\text{-}1} = 100ms + 40ms + 50ms = \underline{190ms}$$

**System configuration - example 3: Calculation of the system reaction time**

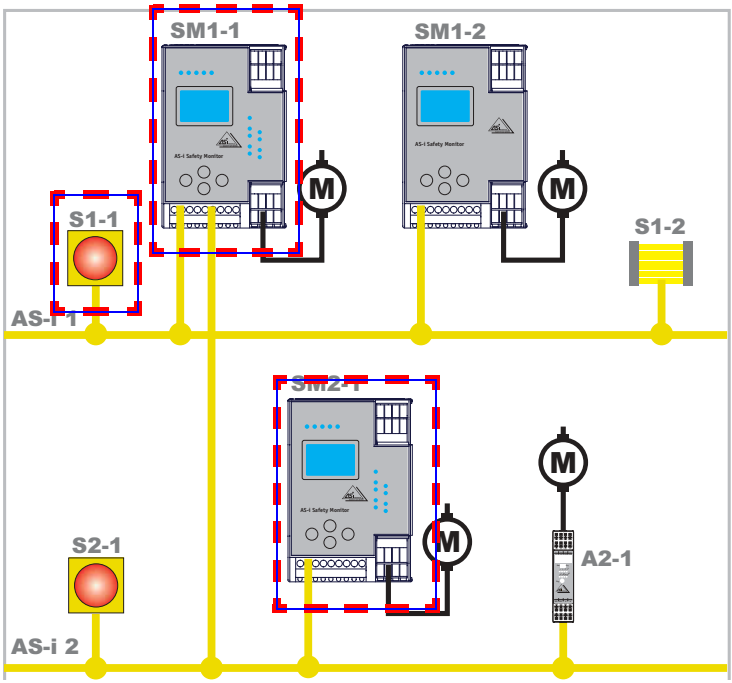



Fig. 5-4.

Upon locking of the EMERGENCY-OFF switch S1-1, the relay output of safety monitor SM2-1 is controlled via the coupling of the safe AS-interface output of safety monitor SM1-1.

Calculation of the AS-i relevant system reaction time:

$$t_{\text{System total c)}} = t_{\text{R S1-1}} + t_{\text{R System ASI1}} + t_{\text{R System ASI2}} = 100\text{ms} + 40\text{ms} + 40\text{ms} = \underline{180\text{ms}}$$

## 5.4 Scope of delivery

The **basic unit** consists of:

AS-i 3.0 EtherNet/IP+Modbus TCP Gateway with integr. Safety Monitor.

The following **accessories** are available:

Software CD with

- **ASIMON 3 G2** communication software for Microsoft® Windows 2000/XP/ Vista/Windows 7/Windows 8 ®
- System manual in PDF format (Adobe® Reader® Version 7.x or newer is required for viewing the files)

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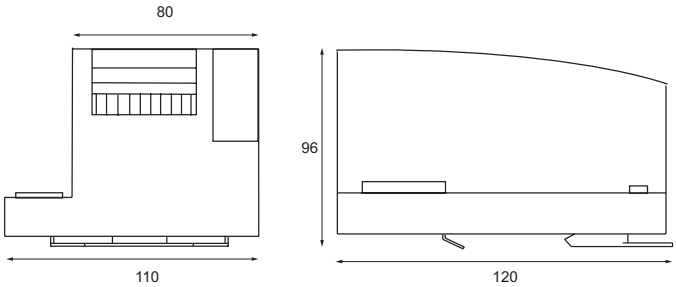
# 6. Installation

## 6.1 Dimensions




***Warning!***

*Cover the top of the gateway when doing any drilling work above the unit. No particles, especially metal chips, should be allowed to enter the housing, since this could cause a short circuit.*

***Information!***

*Please refer to installation instruction for this device for detailed mounting information.*

## 6.2 Connections

| | |
|---|---|
|   | 0,2 ... 2,5 $mm^2$ |
|   | 0,2 ... 2,5 $mm^2$ |
| AWG | 24 ... 12 |

***Attention!***

*The AS-I power supply for the AS-I components must have isolation per IEC 60 742 and be able to handle momentary power interruptions of up to 20 ms. The power supply for the 24 V supply must also have isolation per IEC 60 742 and be able to handle momentary power interruptions of up to 20 ms. The maximum output voltage of the power supply must also be less than 42 V in case of a fault.*

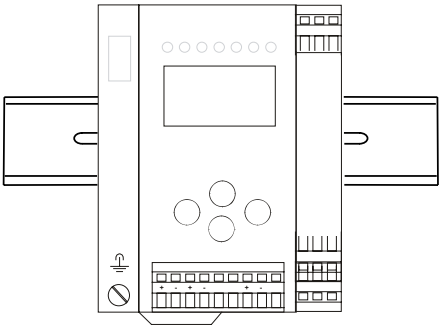
## 6.3 Installing in the control cabinet

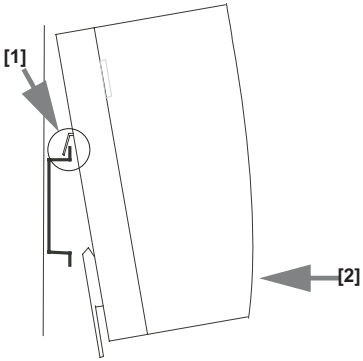
The AS-I/Gateway is installed in the control cabinet on 35mm DIN rails per DIN EN 50 022.

***Information!***

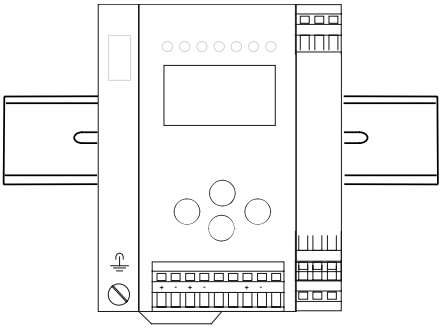
*The enclosure of the* AS-I/Gateway *is made of stainless steel. The unit is also suitable for exposed wall mounting.*

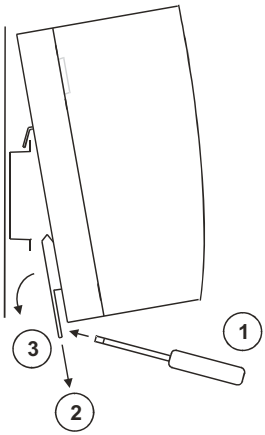
To install, place the unit on the upper edge of the DIN rail and then snap in the lower edge.






## 6.4 Removing






To remove, press the holding clamps [2] down using a screwdriver [1], press the unit firmly against the upper rail guide and lift out.

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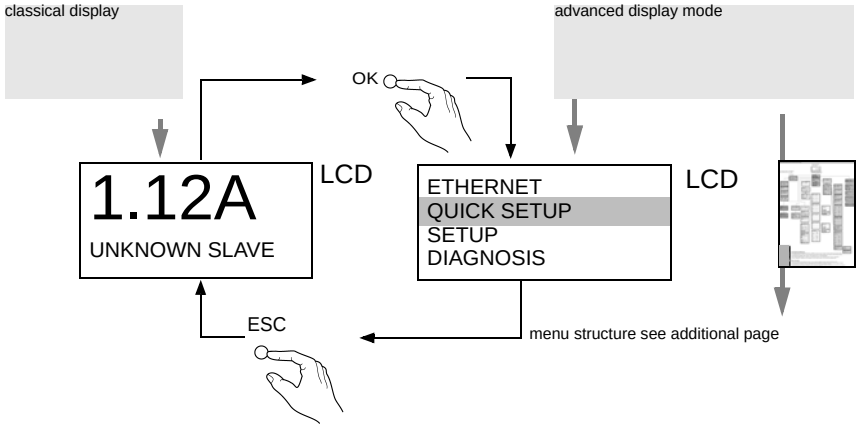
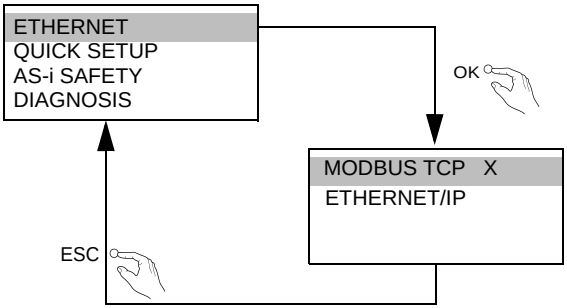
## 6.5 Startup

### 6.5.1 Switching to advanced display mode

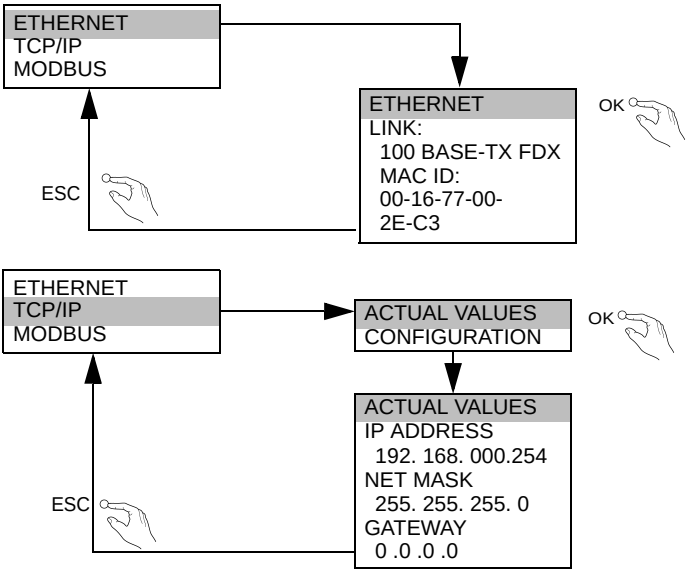



***The device handels multiple protocols! Please select one of them during the initial operation.***

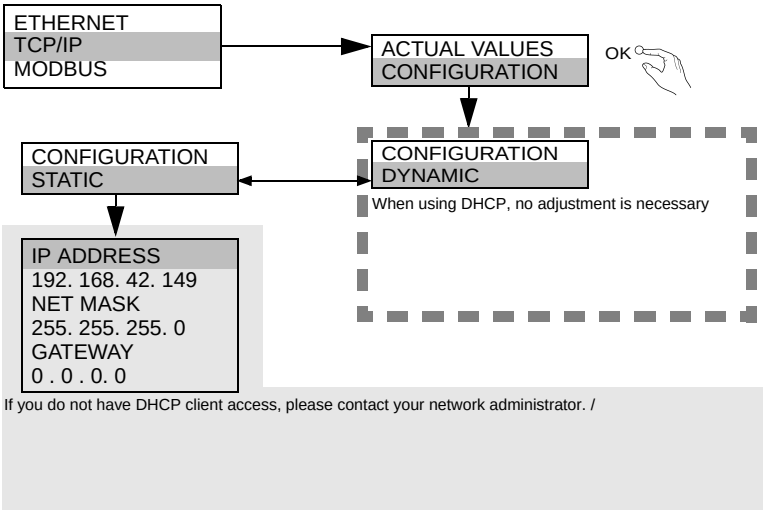
### 6.5.2 Select Modbus TCP



### 6.5.2.1 Displaying of Ethernet properties




### 6.5.2.2 Setting of Ethernet properties

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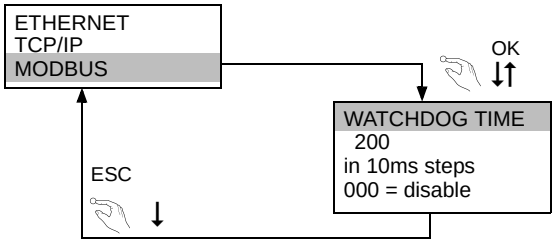
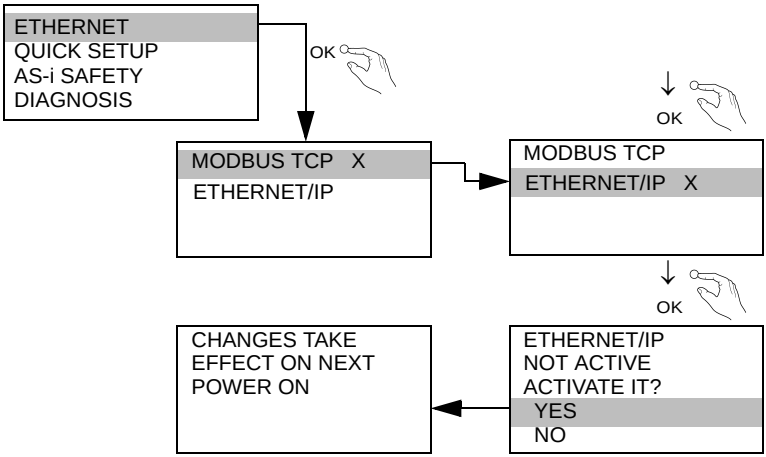
### 6.5.2.3 Setting of watchdog time

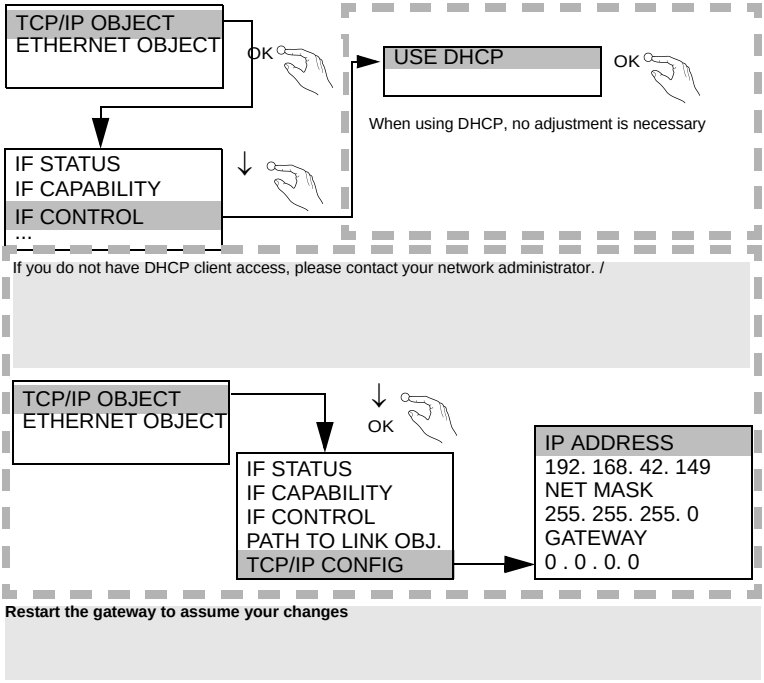



### 6.5.3 Select EtherNet/IP

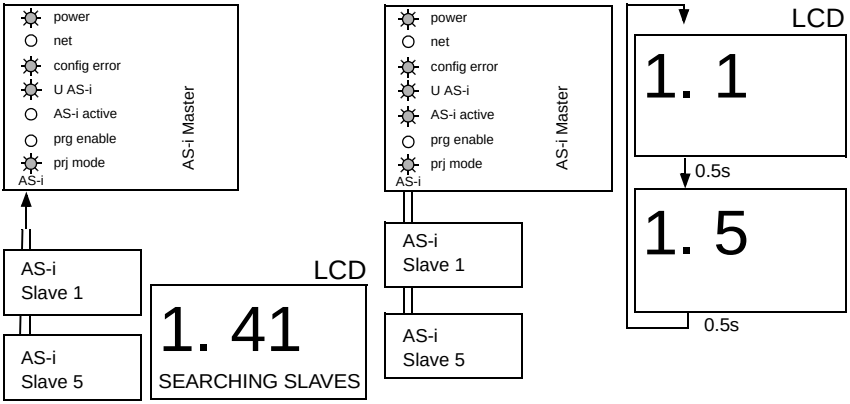



Restart the gateway to assume your changes

### 6.5.3.1 Setting of EtherNet/IP properties




### 6.5.4 Connecting AS-i Slaves

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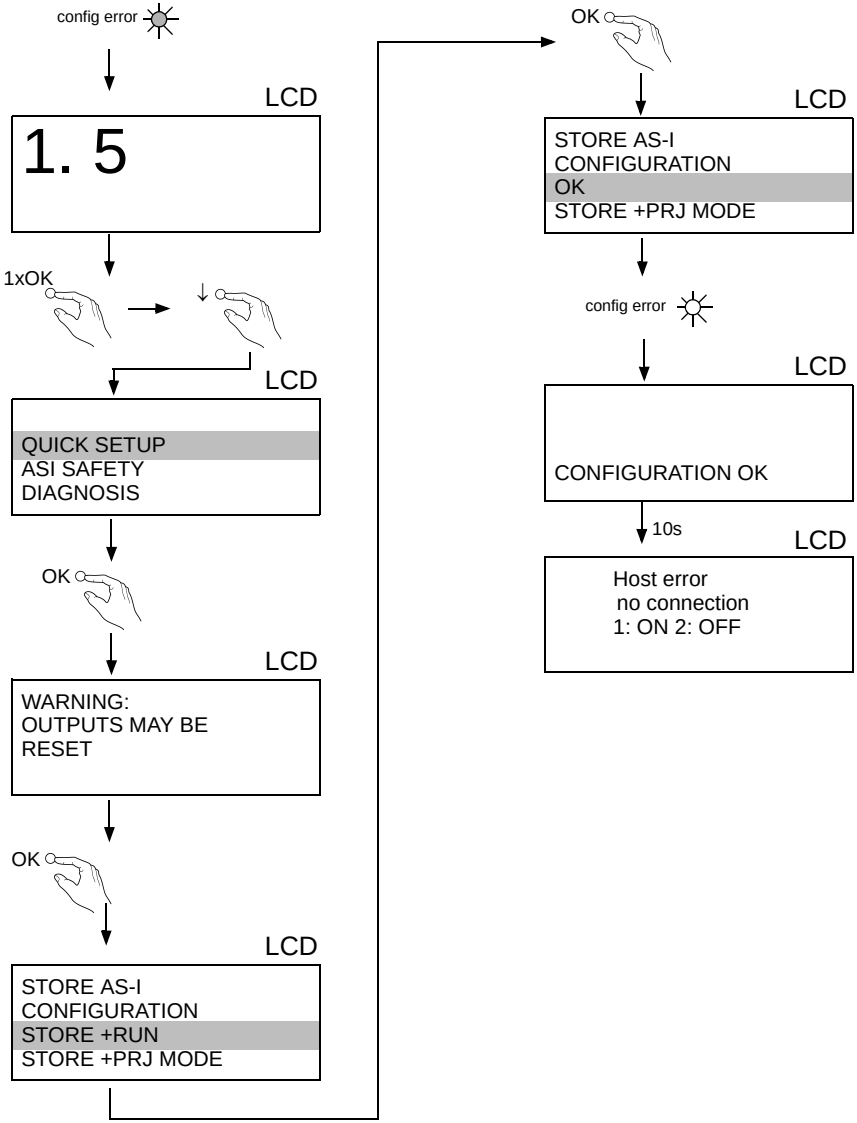
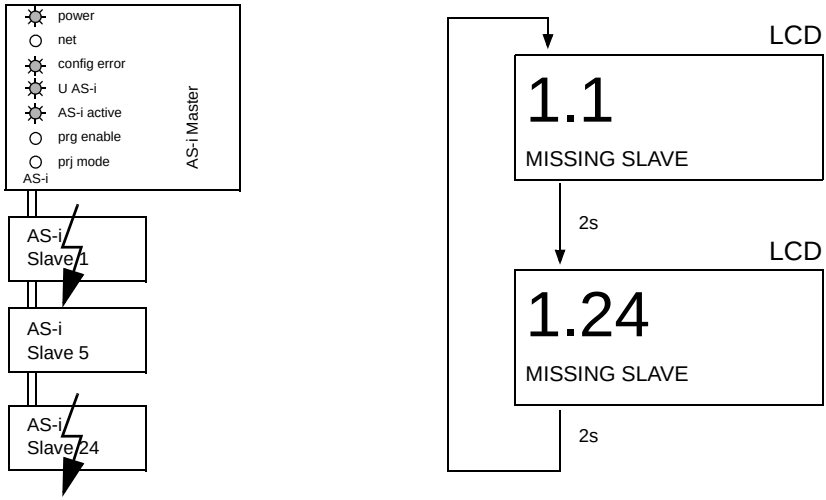
### 6.5.5 Quick setup

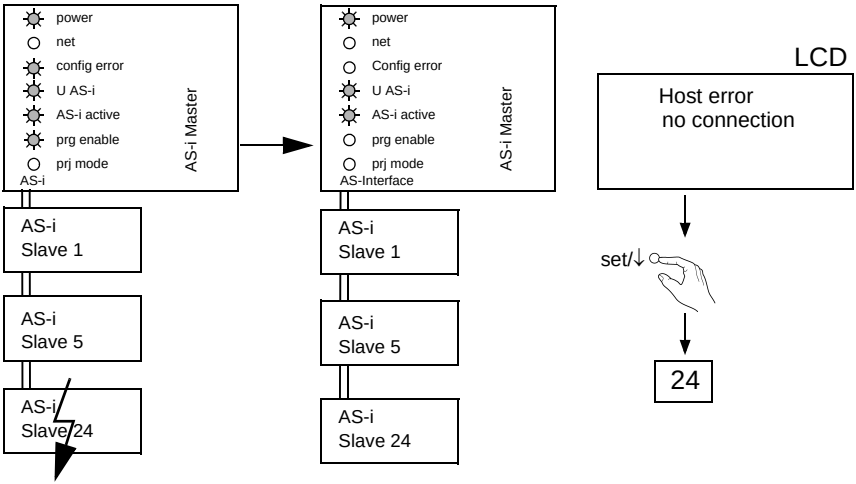


## 6.6 Error tracing

### 6.6.1 Faulty slaves




### 6.6.2 Error display (last error)

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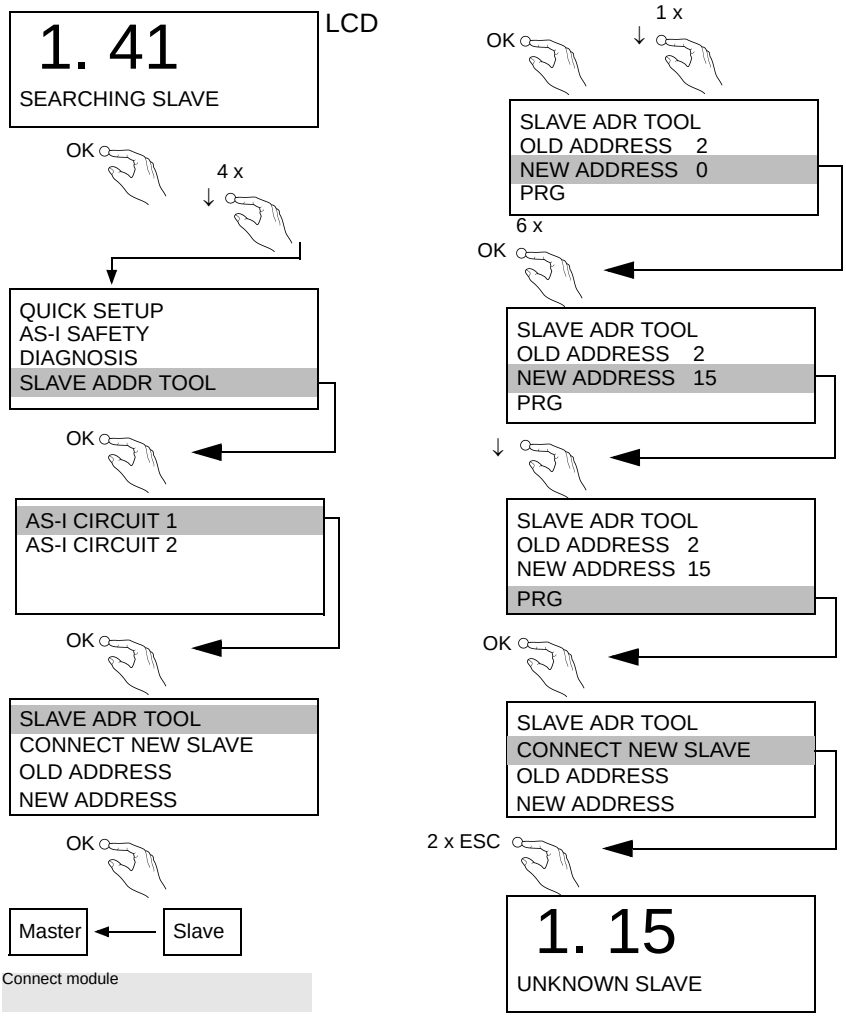
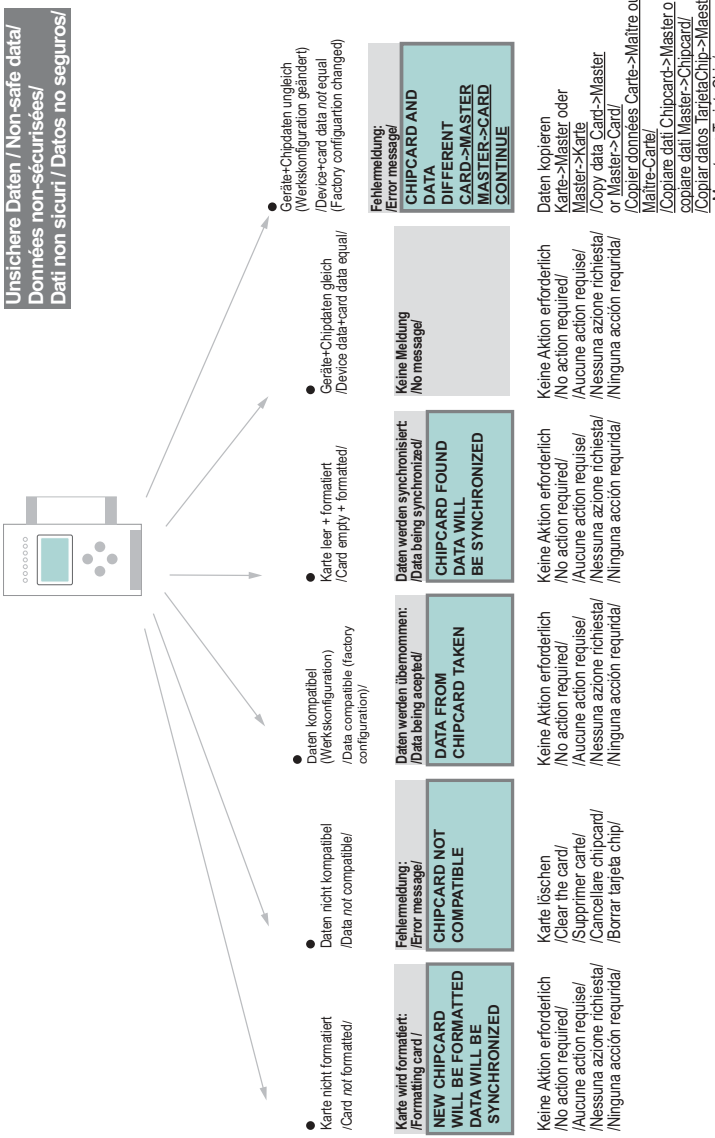
## 6.7 Addressing

### 6.7.1 Assigning address 15 to slave currently at address 2



## 6.8 Local parameter setting of safe AS-i Gateways and Monitors

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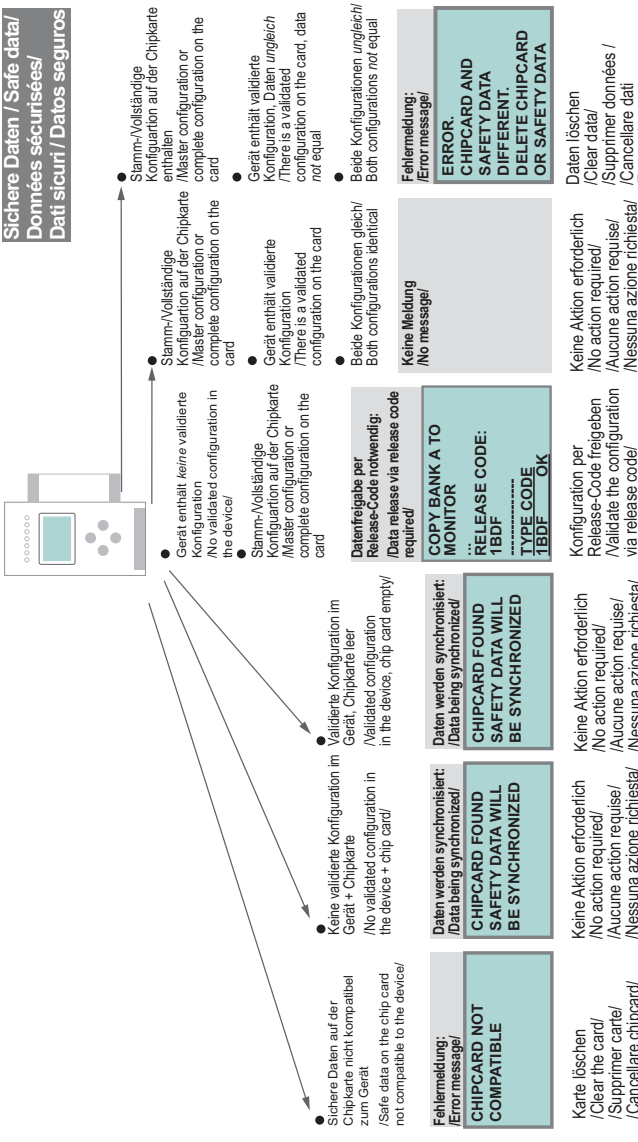


*For further information see manual, section <Chip card>*

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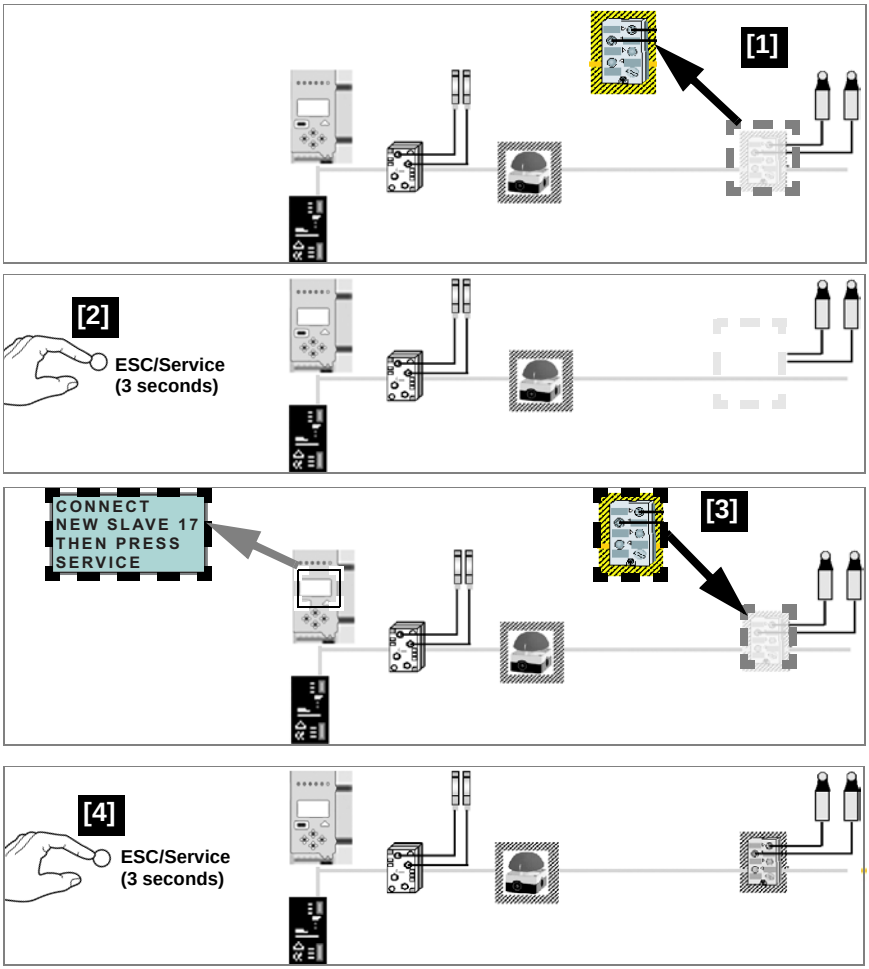
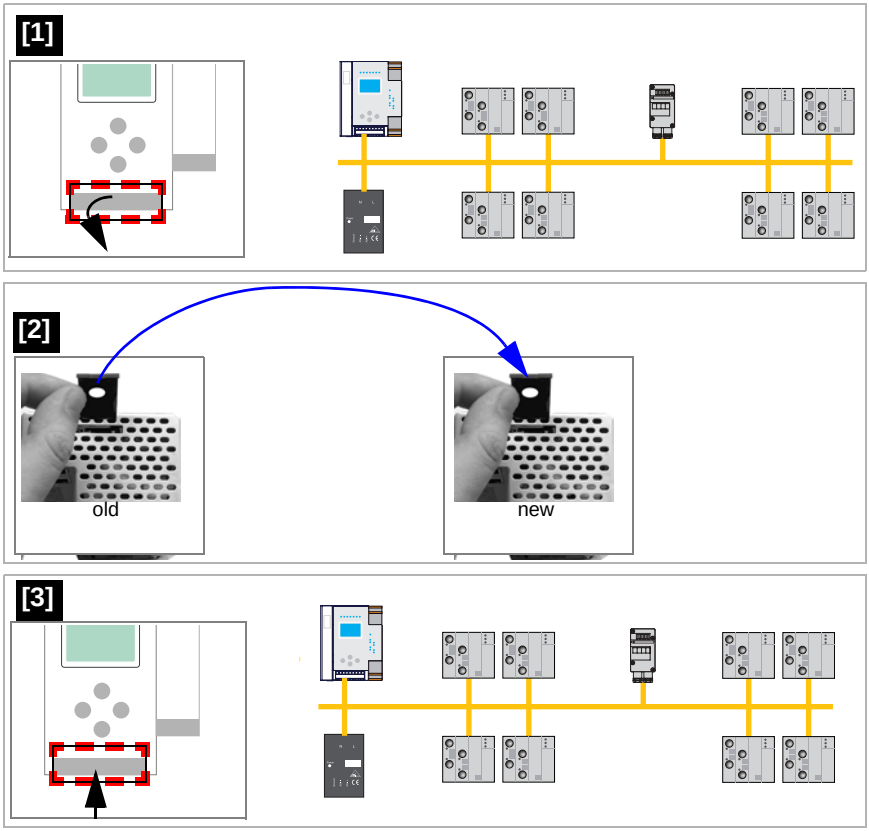
## 6.9 Replacing a defective safety-related AS-i slave

*The new slave must be able to send code sequences and must have the same address as the old one. The addressing of the new slave is carried out automatically by default for all Pepperl+Fuchs AS-i Masters. Only one missing slave is allowed!*



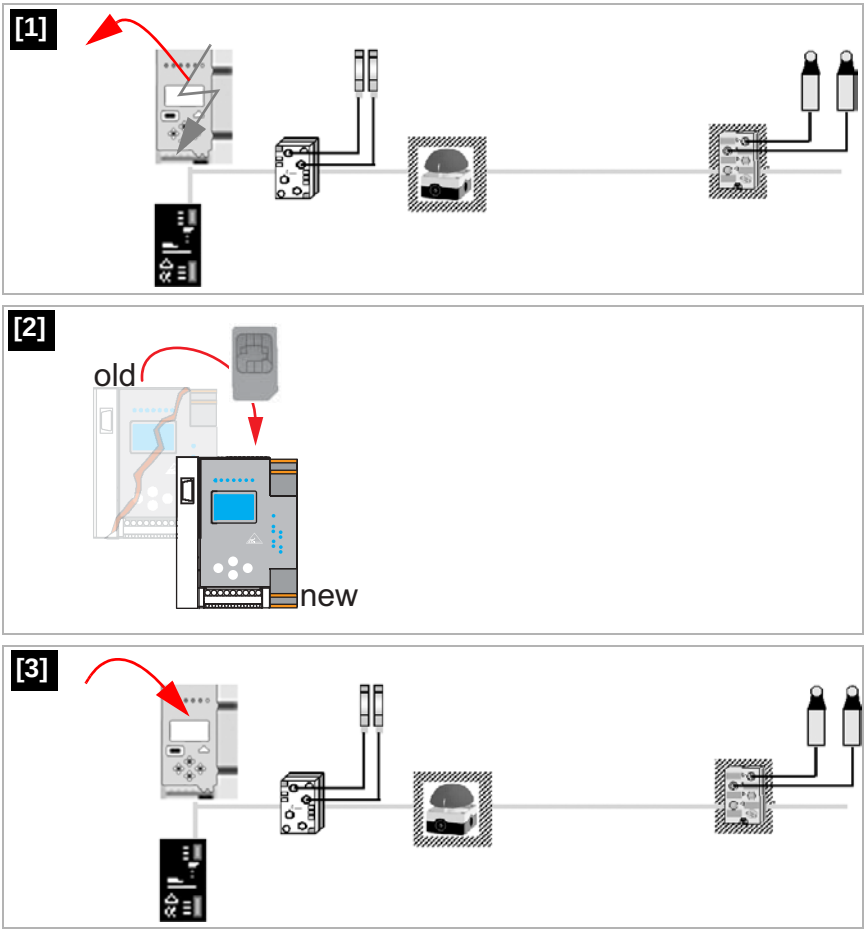
## 6.10 Replacing the chip card

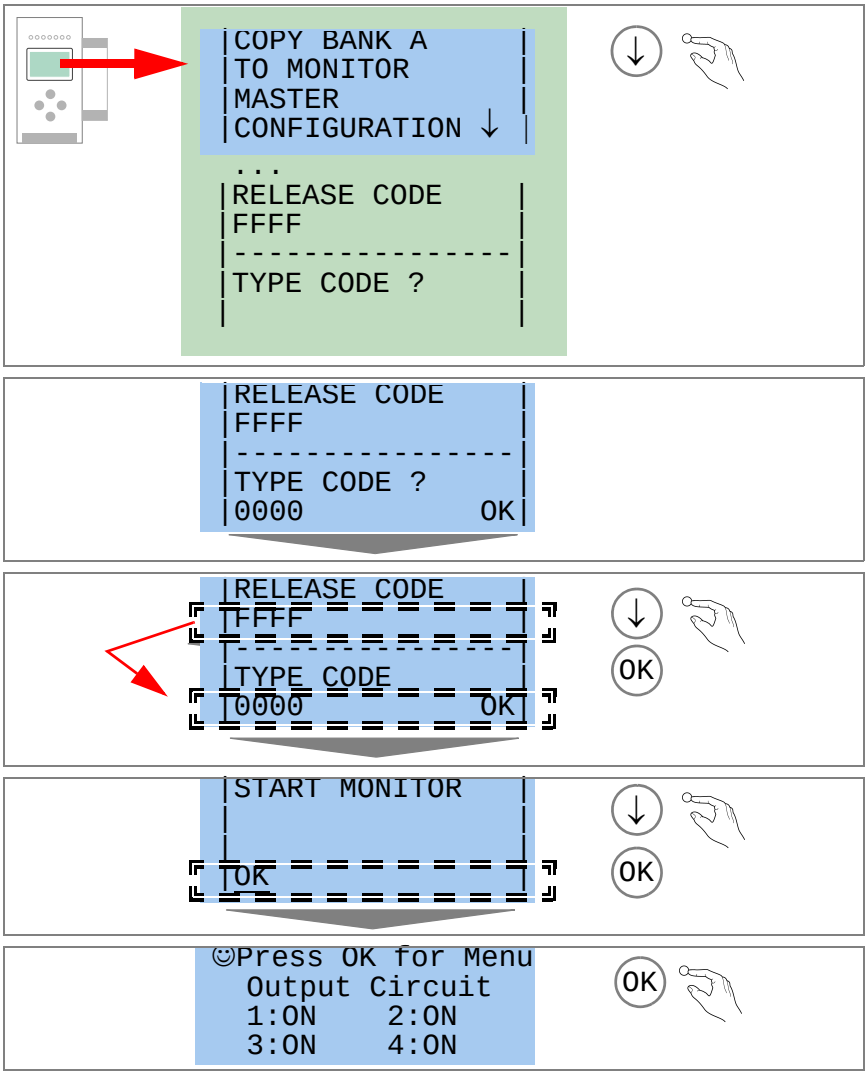
*Always turn off power before inserting or removing the card!*



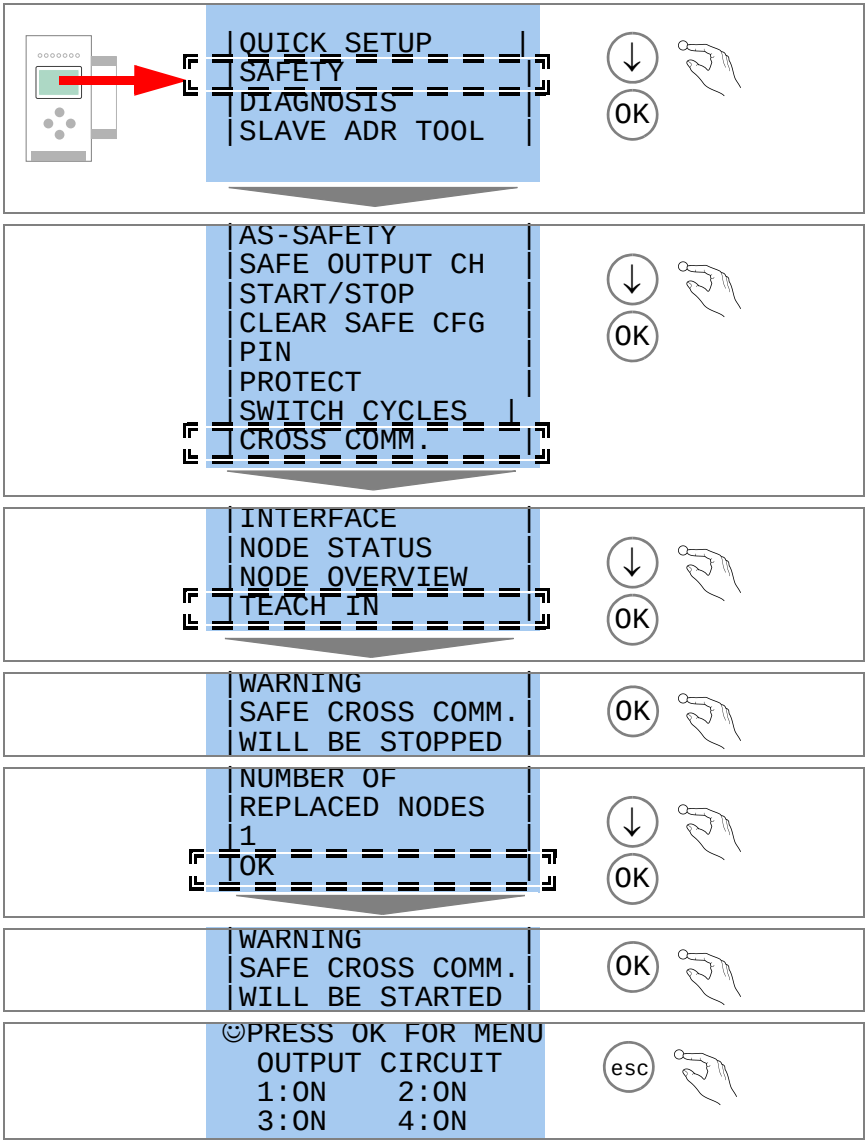
## 6.11 Replacing a defective device

*If Safe Link is used, it is necessary to teach the group manager after replacing a defective device (see next section)!*




COPY BANK A
TO MONITOR
MASTER
CONFIGURATION ↓
...
RELEASE CODE
FFFF
TYPE CODE ?
RELEASE CODE
FFFF
TYPE CODE ?
0000 OK
RELEASE CODE
FFFF
TYPE CODE
0000 OK
OK
START MONITOR
OK
OK
☺Press OK for Menu
Output Circuit
1:ON 2:ON
3:ON 4:ON
OK

### 6.11.1 Teaching the group manager after replacing a device

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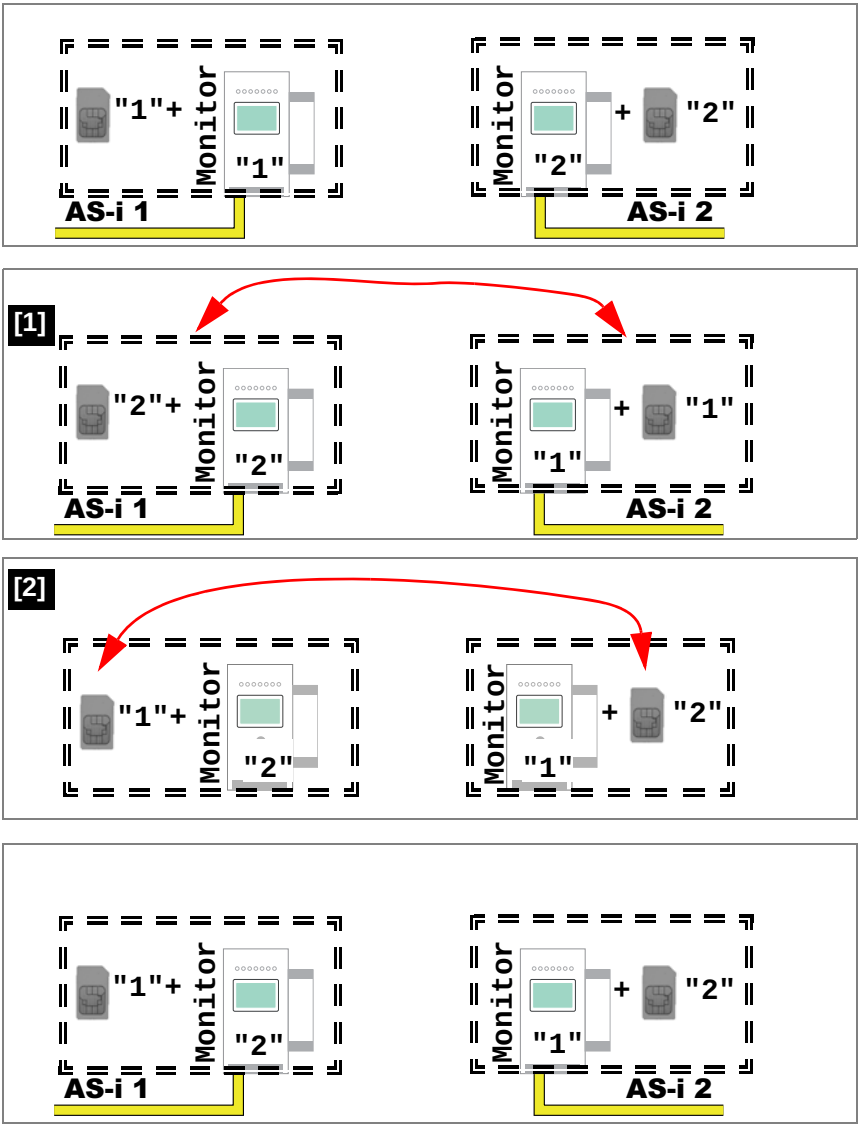
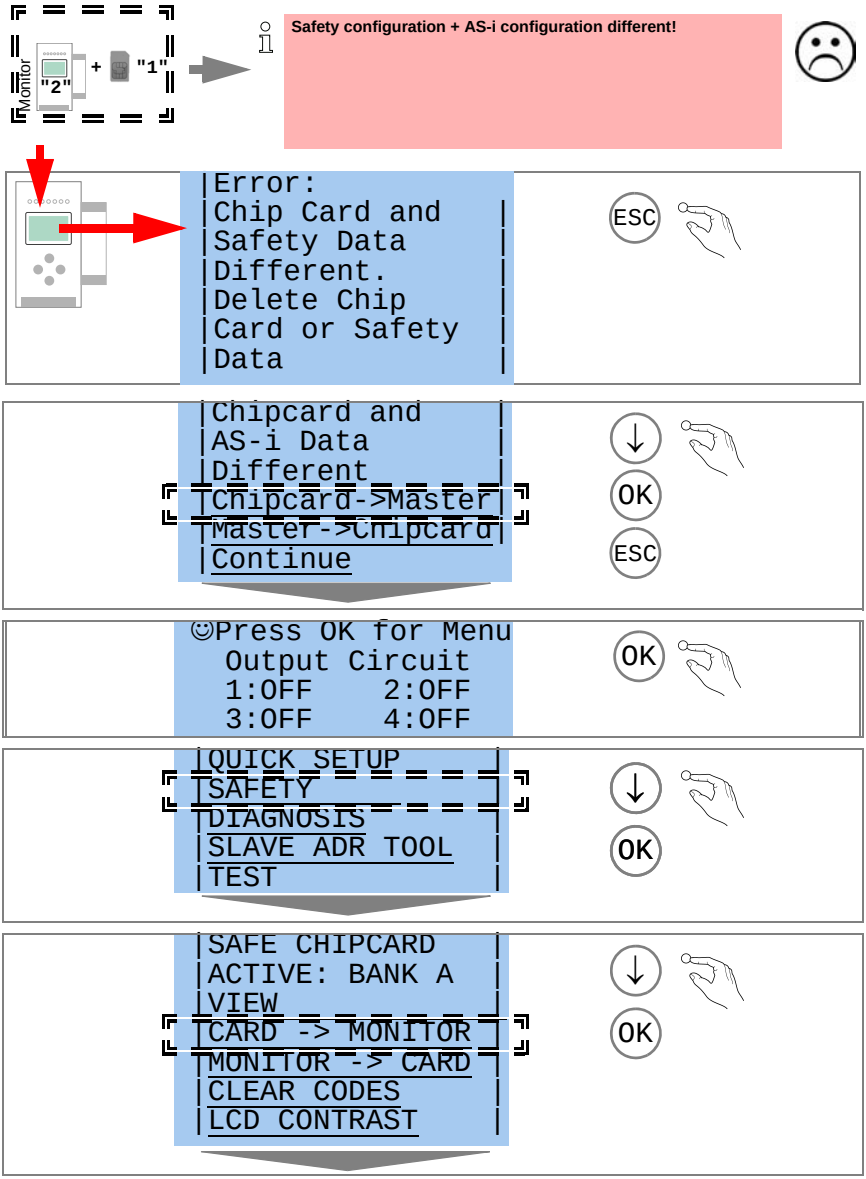
## 6.12 Replacing the monitor



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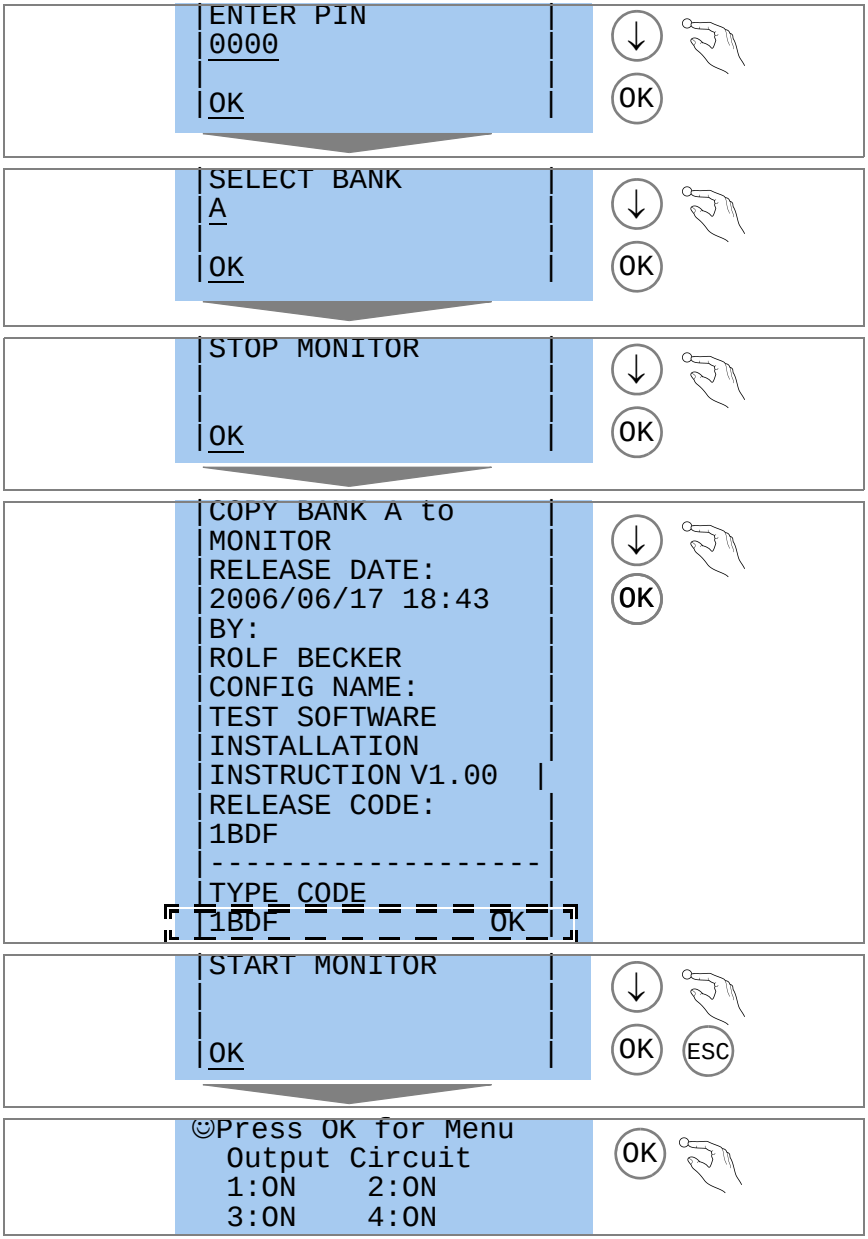
ENTER PIN
0000
OK
OK
SELECT BANK
A
OK
OK
STOP MONITOR
OK
OK
COPY BANK A to
MONITOR
RELEASE DATE:
2006/06/17 18:43
BY:
ROLF BECKER
CONFIG NAME:
TEST SOFTWARE
INSTALLATION
INSTRUCTION V1.00
RELEASE CODE:
1BDF
TYPE CODE
1BDF OK
OK
START MONITOR
OK
OK
ESC
☺Press OK for Menu
Output Circuit
1:ON 2:ON
3:ON 4:ON
OK

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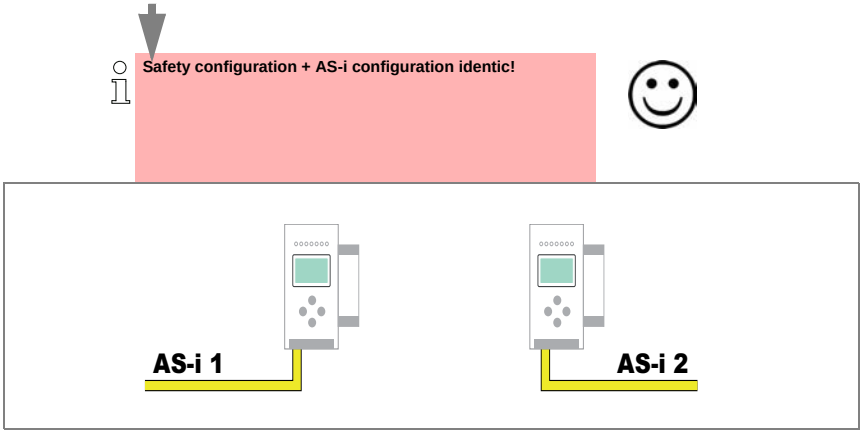
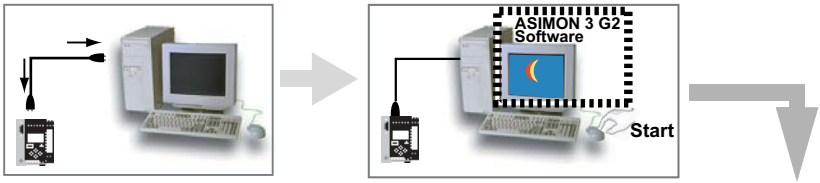



## 6.13 Safe configuration using ASIMON 3 G2




*Before commissioning the safety unit, put the gateway into operation!*

**ASIMON 3 G2 Software**

Change the preset password during the first use of the device (Monitor/change password)!

**ASIMON 3 G2 Software**

Create the desired configuration.

**ASIMON 3 G2 Software**

Download the configuration with MONITOR / PC-> MONITOR into the device. Enter the password for this purpose.

**ASIMON 3 G2 Software**

You can acknowledge the request TEACH CODE SEQUENCES? selecting "Yes", or you can do it later via display selecting "No".

**ASIMON 3 G2 Software**

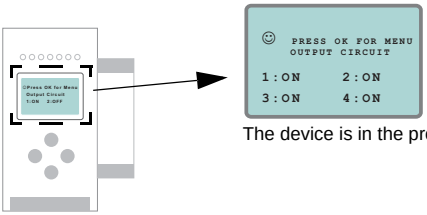
Check the configuration log (respect instructions in <chap. 5.8> of the ASIMON manual!).

**ASIMON 3 G2 Software**

Validate the configuration with MONITOR –> VALIDATION.

**ASIMON 3 G2 Software**

Start the monitor with MONITOR–> START.




The device is in the protected mode now.

*If you have assigned the safety monitor its own address in the software ASIMON 3 G2, adjust the configuration in the AS-i master (Quick Setup)! This is also valid when using simulated slaves.*

*Please consider notes on safety in the software manual ASIMON 3 G2!*

# 7. Maintenance

## 7.1 Checking for safe turn-off

The safety representative is responsible for checking flawless function of the AS-i Safety Monitor within the safety system.

Safe turn-off when an associated safe sensor or switch is triggered must be checked at least once a year.

***Attention!***

*To do this, actuate each safe AS-i slave and observe the switching behavior of the output circuits of the AS-i Safety Monitor.*

***Attention!***

*Note the maximum turn-on duration and the overall turn-on operating duration. These values depend on the PFD value selected (see section <Safety-relevant characteristic data>).*

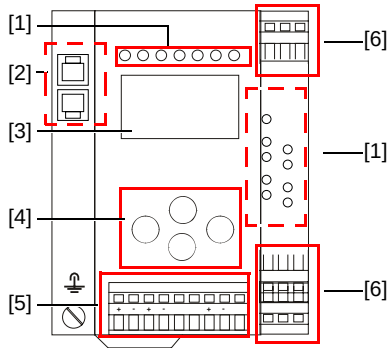
*When the maximum turn-on duration is reached (three, six or twelve months), check the complete safety system and its proper function.*

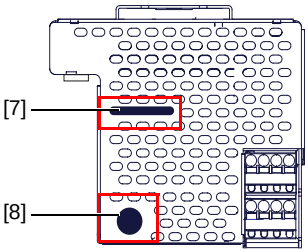
*When the total operating time (20 years) has been reached, the device must be returned to the manufacturer to check for proper function.*

# 8. Electrical connection

## 8.1 Overview of terminals, indicators and operating elements

### 8.1.1 VBG-ENX-K30-DMD-S16-C1, VBG-ENX-K30-DMD-S16



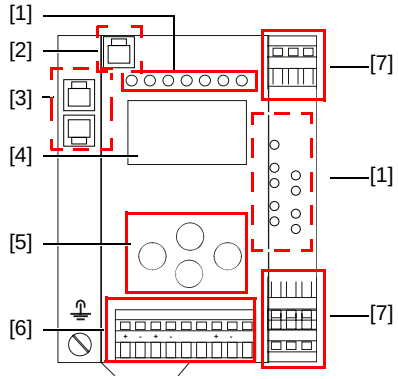

| | |
|---|---|
| 10 | 0,2 ... 2,5 mm$^2$ |
| 10 | 0,2 ... 2,5 mm$^2$ |
| AWG | 24 ... 12 |

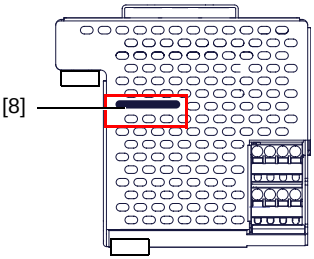
***Legend:***

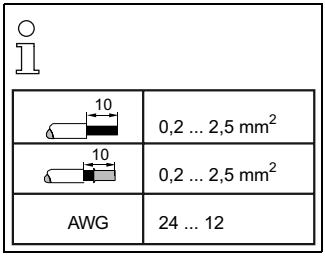
[1] LEDs
[2] Ethernet interface
[3] LC display
[4] Buttons
[5] Terminals: Supply voltage and AS-i circuit
[6] Terminals: Safety unit
[7] Chip card slot
[8] RS 232 diagnostics port[1]

1. Only together with ASIMON 3 G2 Software or AS-i Control Tools

### 8.1.2 VBG-ENX-K30-DMD-S16-EV



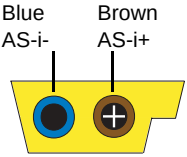




***Legend:***

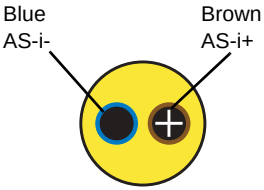
[1] LEDs
[2] Ethernet diagnostic port[1]
[3] RJ45 ports for Ethernet
[4] LC display
[5] Buttons
[6] Terminals: Supply voltage and AS-i circuit
[7] Terminals: Safety unit
[8] Chip card slot

1. Only together with ASIMON 3 G2 Software or AS-i Control Tools

## 8.2 AS-i bus connection




Yellow ASi ribbon cable




2-conductor AS-i round cable
(Recommended: flexible power cable
H05VV-F2x1,5 per DIN VDE 0281)

***Information!***

*Electrical work is to be performed only by electrical technicians.*

## 8.3 Information about the device types

***Information!***

*A listing of the individual devices and their features can be found in section <Product information>.*

## 8.4 AS-i and power supply terminal assignments

***Information!***

*The cable indicated by grey must not have slaves or repeaters connected to it.*

*The yellow cable must not have AS-i power suppliers or additional masters connected to it.*

***Information!***

*The function ground can be connected either to the grounding screw or to the terminal.*

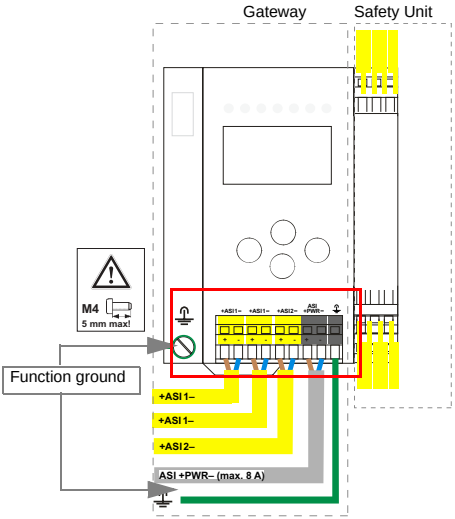
*The function ground should be made with as short a cable as possible to ensure good EMC characteristics.*

*Therefore function grounding using the grounding screw is preferred.*

***Attention!***

*The AS-I power supply for the AS-I components must have isolation per IEC 60 742 and be able to handle momentary power interruptions of up to 20 ms. The power supply for the 24 V supply must also have isolation per IEC 60 742 and be able to handle momentary power interruptions of up to 20 ms. The maximum output voltage of the power supply must also be less than 42 V in case of a fault.*

### 8.4.1 Electrical connection VBG-ENX-K30-DMD-S16-C1, VBG-ENX-K30-DMD-S16-EV




| Terminal | Signal / Description |
|---|---|
| +ASI 1– | Connection to AS-i Circuit 1 |
| +AS-i 2– | Connection to AS-i Circuit 2 |
| ASI +PWR– | Supply voltage for AS-i Circuits (max. 8 A) |
| FG | Function ground |

***Information!***

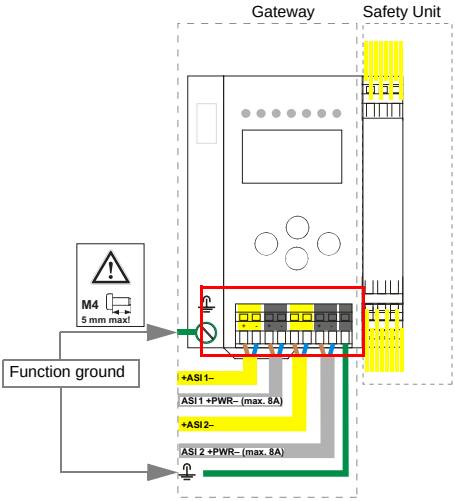
*AS-i Circuit 1 and 2 are both powered from a Pepperl+Fuchs power supply!*

*No other power supplies are approved!*

***Information!***

*For additional information, please refer to the section <AS-i and power supply terminal assignments>.*

### 8.4.2 Electrical connection VBG-ENX-K30-DMD-S16




| Terminal | Signal / Description |
|---|---|
| +ASI 1– | Connection to AS-i Circuit 1 |
| +ASI 2– | Connection to AS-i Circuit 2 |
| ASI 1 +PWR– | Supply voltage for AS-i Circuit 1 (max. 8 A) |
| ASI 2 +PWR– | Supply voltage for AS-i Circuit 2 (max. 8 A) |
| FG | Function ground |

***Information!***

*AS-i Circuits 1 and 2 are powered by separate power supplies.*

***Information!***

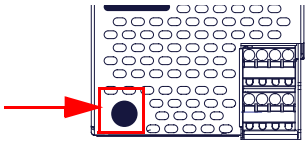
*For additional information, please refer to the section <AS-i and power supply terminal assignments>.*

## 8.5 Diagnostics interface

The service and diagnostics interface (in conjunction with **AS-i Control Tools** or **ASIMON 3 G2** software) is used for communication between the PC and the unit.

### 8.5.1 VBG-ENX-K30-DMD-S16-C1, VBG-ENX-K30-DMD-S16

The service and diagnostics interface is configured as a mini DIN-6 female and it is placed on the front plate, on the left hand side.

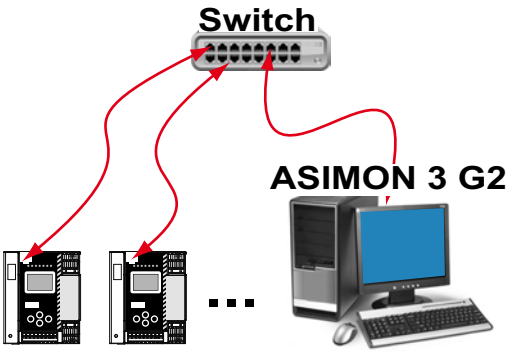


### 8.5.2 VBG-ENX-K30-DMD-S16-EV

The service and diagnostics interface in these devices is as RJ45 female configured and it is placed on the front plate, on the left hand side.

### 8.5.3 SafeLink via ethernet (VBG-ENX-K30-DMD-S16-EV)

The device supports SafeLink via Ethernet. In order to establish a safe coupling between several devices, they should be connected via the ethernet diagnostics interface to a switch.




***Information!***

*Please refer here to the information in the section <Safe Link>.*

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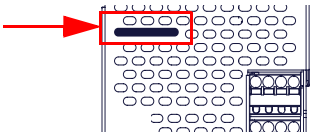
## 8.6 Chip card

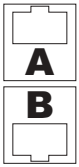


The configuration is stored in a fixed installed EEPROM and can be overwritten by the chip card. The chip card does not have to be inserted in operation.

***Warning!***

*Power must always be turned off when removing or inserting the chip card!*

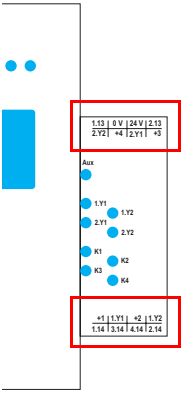
## 8.7 Ethernet interface




The ethernet interface consists of two RJ-45 sockets. It is placed on the left housing side (see section <Overview of terminals, indicators and operating elements>). The ethernet interface is driven according to the IEEE 802.3

## 8.8 Release circuits

### 8.8.1 Wiring overview of safety unit




**1.Y1 (EDM 1/Start 1), 2.Y1 (EDM 2/Start 2), 1.Y2 (EDM 3/Start 3), 2.Y2 (EDM 4/Start 4)**

The safety unit provides 4 inputs. The EDM & START inputs can be defined freely. The inputs may not be connected to other potentials, but rather only directly or through potential-free switches to + (for EDM/START).
Switching current static 4 mA at 24 V, dynamic 30 mA at 24 V (T=100 µs).

**3.14, 4.14**

Semiconductor outputs. Max. contact load: 0.5 A DC-13 at 30 V.

**1.13, 1.14; 2.13, 2.14**

Potential-free relay contacts. Safety relay with one contact set for read-back. Max. contact load: 3 A AC-15 at 30 V, 3 A DC-13 at 30 V.

**0 V, 24 V**

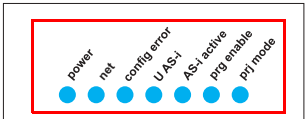
Semiconductor outputs are powered by separate 24 V DC.

**+1, +2, +3, +4 (for EDM/Start)**

Output supply, powered by AS-i. May not be connected to other potentials, but rather only directly or through potential-free switches to one of the EDM or START inputs. Voltage 30 ... 15 $V_{DC}$.

## 8.9 Indicators and operating elements

### 8.9.1 LED indicators – master




The LED's on the front panel of the device indicate:

**Power**

The master is receiving sufficient power.

**net** (the bi-color LED indicates the state of the ethernet port)

LED red: no valid ENIP- or CIP connection.
LED green: at least one ENIP- or CIP connection present

**config error**

Configuration error.
At least one configured slave is missing, or at least one detected slave is not configured, or for at least one configured and detected slave the actual configuration data does not match the nominal configuration data, or the master is in the startup process.
This LED flashes if a peripheral fault has been detected for at least one AS-i slave on the AS-i network. If there are configuration errors as well as periphery faults, only the configuration error is displayed.

**U AS-i**

The AS-i network is sufficiently powered.

**AS-i active**

Normal operation is active

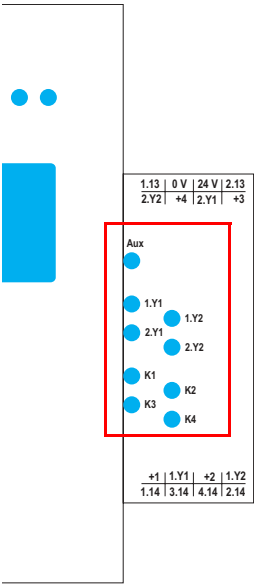
**prg enable**

Automatic single node replacement is enabled.
Exactly one slave is missing in the protected operating mode. The slave can be replaced by another slave of the same type with address zero. The master automatically addresses the new slave to the faulty address and thus corrects the configuration error

**prj mode**

The AS-i master is in configuration mode.

### 8.9.2 LED indicators - safety unit




The LED's on the safety unit indicate:

| |
|---|
| **Aux**<br>24 V supply for the semiconductor outputs is present. |
| **1Y.1, 1Y2, 2Y.1, 2Y.2**<br>Input 1.Y1 (EDM 1/Start 1), 2.Y1 (EDM 2/Start 2), 1.Y2 (EDM 3/Start 3), 2.Y2 (EDM 4/Start 4) is turned on. |
| **K1, K2**<br>Contact sets 1.13, 1.14 (K1) resp. 2.13, 2.14 (K2) closed. |
| **K3, K4**<br>semiconductor output 3.14 (K3) resp.4.14 (K4) is turned on. |

***Information!***

*If there is no auxiliary voltage connection available, LEDs are turned off, even if the corresponding release circuit is turned on.*

### 8.9.3 Buttons

The buttons are used for the following:

| |
|---|
| **Mode/⇑**<br>Switching between configuration mode and protected operating mode, and saving the current AS-i configuration as the nominal configuration. |
| **Set/⇓**<br>Selecting the address of and assigning an address to a slave. |
| **OK**<br>Change to extended mode. |
| **ESC/Service**<br>For teaching the code table for a new safe slave, when exactly one safe slave is being replaced, and for unlocking the Safety Monitor. This button is also used to exit extended mode. |

For additional information see:

- <Section <Function of the ESC/Service key>
- <Section <Replacing a defective safety-configured AS-i slave>
- <Section <Operation in advanced display mode>.

# 9. Function and startup of the Safety Monitor

Configuration and startup of the AS-i Safety Monitor is accomplished using a PC/ Notebook and the **ASIMON 3 G2** configuration software.

The operating language of the device can be set for the respective country (see section <Operation in advanced display mode>).

***Information!***

*The description of the **ASIMON 3 G2** software and startup of the AS-i Safety Monitor can be found in the manual "**ASIMON 3 G2** AS-i Safety Monitor Configuration Software for Microsoft®-Windows®".*

*The software manual is an important component of the operating manual for the AS-i Safety Monitor. It is not possible to configure and start up the AS-i Safety Monitor without the **ASIMON 3 G2** software.*

Configuration may be performed only by a safety authorized person. All safety-related commands are password protected.

## 9.1 Powering up the device

As soon as supply voltage is present on the device an internal system test is started. This operating state is indicated by lighting of the upper LED row.

## 9.2 Configuration of the safety functions

The device can be configured in several ways:

1. Using **ASIMON 3 G2** software
   The **ASIMON 3 G2** software represents the most universal method of configuring the Safety Monitor. Here the behavior of the Safety Monitor can be determined by linking various monitoring modules. After being sent to the Safety Monitor, this configuration is verified and can then be validated.
   For additional information, refer to the separate manual for the **ASIMON 3 G2** configuration software.
2. Using a chip card with the master configuration
   Configurations stored on the chip card, which are validated but which do not contain any code sequences, can be sent to the device. The code sequences must then be taught to the corresponding safety AS-i slaves. This procedure is useful when you want to use a safety program in several safety monitors without any changes.

***Information!***

*For additional information refer to section <Description of configuration using chip card with master configuration>.*

3. Using a chip card with complete configuration
   In contrast to the master configuration, the complete configuration also contains the code sequences for all included slaves. Sending the complete configuration from the chip card to the Safety Monitor can make replacement of the device enormously simpler and faster.

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***Information!***

*For additional information refer to <Configuration using a chip card with complete configuration>.*

### 9.2.1 Description of configuration using ASIMON 3 G2 software

The following description represents a short guide to configuring the AS-i Safety Monitor. For a detailed description of the **ASIMON 3 G2** software, refer to the corresponding manual for the **ASIMON 3 G2** configuration software.

The **ASIMON 3 G2** software is responsible for the following:

- Configuring the AS-i Safety Monitor
- Documenting the device configuration
- Starting up the AS-i Safety Monitor
- Diagnosing the AS-i Safety Monitor

***Information!***

*The description of the **ASIMON 3 G2** program can be found in the separate software manual.*

Proceed as follows:

- Install the program on your PC.
- Apply power to the AS-i Safety Monitor

***Information!***

*To prevent ESD damage, we recommend grounding at an appropriate location before plugging in the interface cable to the Safety Monitor.*

- Connection of monitors with a RS 232 diagnostics interface
  - To connect, plug the diagnostic cable end with the PS2 connector into the socket of the diagnostic interface (RS 232) of the monitor and the other end with the 9-pin Sub-D socket connector to a free COM port (serial RS232 interface) on your PC (see section “Connection between the AS-i Safety Monitor and the PC" in the software manual).
- Configure the AS-i Safety Monitor and start it up as described in the software manual.

***Attention!***

*Before starting up the device you must adapt the device configuration to your application. This means configuring the AS-i Safety Monitor according to the software manual so that the location to be protected is in fact protected by the device.*

### 9.2.2 Description of configuration using chip card with master configuration

Generating a master configuration:

- Generate a configuration using the **ASIMON 3 G2** software
- Load the configuration into the device
- Release (validate) the configuration, but do not teach the code sequences
- The code sequences will be taught on the physical AS-i circuit

***Attention!***

*Safety advisory:*

*Ensure that the chip card contains the configuration intended for and released for the application!*

*This can be done by comparing the release codes on the display (section <Operation in advanced display mode>):*

- The safety representative who generated and validated the release code stores the release code for the master configuration and approves use of the configuration for specific equipment.
- The person performing the startup reads out the release code on the display before teaching the code and compares it with the release code stored and approved for the equipment.

*After the chip card has been used to load the configuration into the device, the safety functions of the device must be checked in the equipment.*

*Checking of the release code and testing the system must be documented in writing and is part of the system documentation.*

### 9.2.3 Configuration using a chip card with complete configuration

The chip card contains the complete configuration if:

- An empty chip cared is plugged into an AS-i Safety Monitor which already contains a complete configuration, or
- The chip card is already inserted while the configuration is being written into the device using **ASIMON 3 G2** software and before validating the code sequences.

If the AS-i Safety Monitor needs to be replaced, the stored configuration can be transferred by simply plugging the chip card from the old device into the new one.

***Attention!***

*Safety advisory:*

*Power must always be turned off when removing or inserting the chip card!*

*Ensure that the chip card contains the configuration intended for and released for the application!*

*This can be done by comparing the release codes on the display (section <Operation in advanced display mode>):*

- The safety representative who generated and validated the release code stores the release code for the master configuration and approves use of the configuration for specific equipment.
- The person performing the startup reads out the release code on the display before starting the equipment and compares it with the release code stored and approved for the equipment.

*After the chip card has been used to load the configuration into the device, the safety functions of the device must be checked in the equipment.*

*Checking of the release code and testing the system must be documented in writing and is part of the system documentation.*

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## 9.3 Safety-relevant documentation of the application

***Information!***

*The detailed description of the safety-relevant documentation of the configuration for your application can be found in the separate software manual.*

Proceed as follows:

- Create the configuration of the AS-i Safety Monitor for your application.
- Validate the configuration (done by the safety supervisor).
- Print out the final configuration protocol and optionally the configuration overview (see Section "Configuration documentation" in the software manual).
- Sign the final configuration protocol (done by the safety supervisor).
- Take the protocol for the safety-relevant documentation for your application (machine documentation) and keep it in a safe place.

## 9.4 Diagnostic data

***Information!***

*A detailed description of the setting for diagnostics mode is described in the section "Setting diagnostics type" in the separate manual "AS-i 3.0 Command Inteface".*

Diagnostics data can be obtained in any of 4 ways:

- Display
- Ethernet
- **ASIMON 3 G2** software via diagnostic interface
- AS-i Control Tools via diagnostic interface or Ethernet

The following diagnostics can be displayed (see section <INT MON (internal monitor)>):

- Display of the switching state of the outputs
- State ("color") of the devices and sub-devices[1]; distinction when turning off only half ("Category 2")
- Error history for finding the cause of sporadic errors

## 9.5 Switch-off history

The switch-off history, accessible from the menu DIAGNOSTICS->INT MONITOR->LAST DIAGNOSTIC, is intended to make reconstruction of the reason for switch-off easier for the user. The states of all safety-relevant AS-i slaves and all devices at the time the state change on the output device (change from green to another color) are stored.

1. For the sake of better diagnostics thet procedure is being expanded using a Device/Device Color for adding diagnostics based on AS-i addresses (sub-devices) and their states.

## 9.6 Diagnostic values in the IDI

**IDI diagnostics can be optionally enabled for the following devices:**

- VBG-ENX-K30-DMD-S16-C1 ident. no. ≥ 15211
- VBG-ENX-K30-DMD-S16 ident. no. ≥ 15210
- VBG-ENX-K30-DMD-S16-EV ident. no. ≥ 15186

The input values for safety-relevant input slaves can be substituted in various ways. This makes the diagnostics information available directly in the cyclical I/O data. The default setting is the "substitution values" for the two input channels. Setting diagnostics values also sends 2 bits of color information for the associated safety-relevant component in addition to the input channels. The substitution possibilities are defined in the following tables:

| Bit 3 | Bit 2 | Bit 1 | Bit 0 | Description |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | Both channels off |
| 0 | 0 | 1 | 1 | 2nd channel off, 1st channel on |
| 1 | 1 | 0 | 0 | 2nd channel on, 1st channel off |
| 1 | 1 | 1 | 1 | Both channels on |

*Tab. 9-6. Default status substitution values*

| Bit 3 | Bit 2 | Bit 1 | Bit 0 | Description |
|---|---|---|---|---|
| | | 0 | 0 | Both channels off |
| | | 0 | 1 | 2nd channel off, 1st channel on |
| | | 1 | 0 | 2nd channel on, 1st channel off |
| | | 1 | 1 | Both channels on |
| 0 | 0 | | | Device color: red, green or blue |
| 0 | 1 | | | Device color yellow: ("wait") |
| 1 | 0 | | | Device color: yellow flashing ("test") |
| 1 | 1 | | | Device color: red flashing ("error") |

*Tab. 9-7. Diagnostic values*

***Information!***

*The switching state of channel 1 and channel 2 (channel 1, channel 2 'on' or 'off', bit 0, bit 1) is sent at optimal speed. The device colors (bit 2, bit 3) have device-internal lower priority and can be sent slower.*

*The diagnostic values bit 0/1 and 2/3 are not synchronized. The states of the input channels and the resulting color can be sent at different times.*

***Information!***

*The color and thereby the status of the component do not always have to agree with the switching state of the input channels. In case of lost telegrams, untaught slaves or non-synchronous switching of the two channels, error and test states may result (red flashing and yellow flashing).*

## 9.7 Password protection

All safety-related commands are password protected. These include:

- Loading configurations into the Monitor
- Stopping
- Learning code sequences
- Releasing
- Changing the password

***Information!***

*No new release is necessary if when using safety-configured AS-i slaves code sequences have been newly learned using the ESC/Service key.*

### 9.7.1 Procedure for configuring and teaching code sequences

The configuration is created using **ASIMON 3 G2** software, loaded into the safety unit and released. The name of the person releasing and the date are stored at this moment. If code sequences controlled through the display are newly taught, this is secured by a PIN to prevent unintended/unauthorized changing of the code sequences.

***Information!***

*For additional information see section<Replacing a defective safety-configured AS-i slave>.*

- A PIN is a 4-digit number and can only be changed from the display, not via the **ASIMON 3 G2** software.
- After entering the PIN, the display can be used to start a teaching procedure for the code sequences. The monitor stops immediately after entering the PIN. After teaching, the monitor starts after a prompt and acknowledgement on the display.

| Action | ASIMON Software | On AS-i Safety Monitor |
|---|---|---|
| Configure and load into Safety Monitor | • | • *(only from chip card)* |
| Stopping | • | • |
| Releasing | • | – |
| Starting | • | • |
| Teaching code sequences | • | • |
| Changing the password | • | • *(only from chip card)* |

*Tab. 9-8.*

| Action | ASIMON Software | On AS-i Safety Monitor |
|---|---|---|
| Changing the PIN | – | • |

*Legend:*
*"•" = possible;*
*"–" = not possible*

*Tab. 9-8.*

Code sequences for releasing a configuration do not necessarily have to have been successfully learned. It is also possible to release without code sequences, which must then be learned at a later time.

Teaching the code sequences is simple to perform:

- Using the ESC/Service key (See section <Replacing a defective safety-configured AS-i slave>)

or

- Using the display (See section <Operation in advanced display mode>).

### 9.7.2 Function of the ESC/Service key

In traditional (classical) display mode, the ESC/Service key takes on two kinds of functions:

- Briefly pressing the ESC/Service key unlocks the Safety Monitor when red is flashing
- A longer press (3s) starts the teach procedure for a slave.

***Information!***

*For additional information see section <Replacing a defective safety-configured AS-i slave>.*

## 9.8 Safe coupling slaves on the AS-i circuits

The two AS-i circuits are capable of emulating a total of up to sixteen safe coupling slaves.

The assignment of the coupling slaves addresses to the release circuits is made using the ASIMON software.

## 9.9 Chip card

The chip card is divided into two areas. One area is reserved for unsafe data and administration, the other for safe data.

***Warning!***

*Always turn off power before inserting or removing the card.*

### 9.9.1 Unsafe data

This section describes the system behavior of the unsafe system section when using the chip card.

#### 9.9.1.1 Card unformatted

If an unformatted card is found when the device is started, the following is displayed:

```
NEW CHIPCARD
WILL BE FORMATED
AS-I DATA WILL
BE SYNCHRONIZED
```

The chip card is formatted and then the data copied to the chip card.

#### 9.9.1.2 Data not compatible

If a card is found whose data are incompatible with the device, the following error message is displayed:

```
CHIPCARD NOT
COMPATIBLE
```

#### 9.9.1.3 Card empty

The following message is displayed for an empty card:

```
CHIPCARD FOUND
AS-I DATA WILL
BE SYNCHRONIZED
```

From this time on all changes are made both in the device and on the chip card.

#### 9.9.1.4 Data compatible

When starting with an empty device (e.g. after a factory reset) a non-empty card is found whose data are compatible with the device, the following message is displayed:

```
AS-I DATA FROM
CHIPCARD TAKEN
```

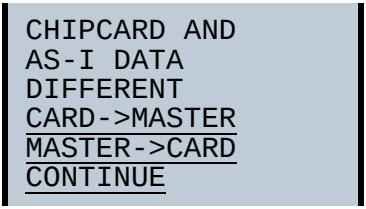
The card configuration is written to the device. From this time on all changes are made both in the device and on the chip card.

#### 9.9.1.5 Data in the device and on the chip card identical

If the card and device are not empty at start and the data are identical, no message is displayed.

#### 9.9.1.6 Data in the device and on the chip card not identical

If the card and device are not empty at start and the data are not identical, an error message is displayed and the card is not synchronized with the device. The following menu is then automatically opened:




**Description**

CHIP CARD>MASTER: Chip card data are copied to the master
MASTER->CHIPCARD: Master data are copied to the chip card
NEXT: No change to the data

The menu can be exited by pressing the ESC/Service key without changing the data.

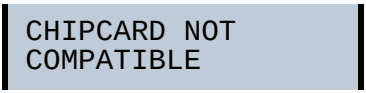
### 9.9.2 Safe data

This section describes the system behavior of the safe unit when using the chip card.

In general the safe part of the chip card has 4 memory banks (A…D). A bank is referred to as an active bank. Unless otherwise stated, the operations described in the following are always performed on the active bank.

#### 9.9.2.1 Data incompatible

If a card with incompatible data is found, the following error message is output:



#### 9.9.2.2 Data compatible

If a card with an empty active memory bank is found, the safety configuration including code sequences is written to the card and in future all changes are made in the card and in the device at the same time. The following message is displayed on the device:

```
CHIPCARD FOUND.
SAFETY DATA WILL
BE SYNCHRONIZED
```

#### 9.9.2.3 Complete configuration

If when starting with an empty device a card with a released safety configuration including code sequences is found (Complete safety configuration) in the active memory bank, this configuration is written to the device, then the menu for releasing using Release Code is opened:

```
COPY BANK A
TO MONITOR
RELEASE DATE:
2006/06/17 18:43
BY: ROLF BECKER
CONFIG NAME:
L3040 MIT LADEVO
RRICHTUNG LINKU
ND PALETTENWECHS
LER V1.23
RELEASE CODE: 1BDF
  - - - - - - - - -
- - - - - -
TYPE CODE
0000
OK
```

If the active bank contains a Complete Configuration and if the data in the active bank on the memory card and the data in the device are identical (e.g. both empty), in future all changes are made in the card and in the device at the same time.

#### 9.9.2.4 Data on the chip card and in the device are identical

If the card and device are not empty at start and the data are identical, no message is displayed.

#### 9.9.2.5 Data not identical

If the active bank on the memory card and in the device are not empty at start and the data are not identical, the following message is displayed:

```
ERROR.
CHIPCARD AND
SAFETY DATA
DIFFERENT.
DELETE CHIPCARD
OR SAFETY DATA
```

The safety unit will not operate in this case. You must either clear the device or the active bank via menu.

#### 9.9.2.6 Operating the chip card from the menu

The data on the chip card can, as described in section <SAFE CHIPCARD>, be exchanged between the Monitor and the chip card. Note however the following:

In order to store a configuration on the chip card as a master configuration (i.e. without code sequences), proceed as follows:

- Write the released configuration into the Monitor without code sequences.
- Copy the configuration into a memory bank using the menu.

For additional information, see section <CARD –>MONITOR (copy card data to the Monitor)>.

To convert a master configuration on the memory card to a Complete Configuration, this configuration must be overwritten by a Complete Configuration.

This is done as follows:

- Copy the card data to the Monitor.
- Teach the code sequences
- Write the data from the Monitor to the card.

### 9.9.3 Working with multiple memory banks

The chip card has four memory banks, each of which may contain a configuration (Complete or Master configuration). One of the banks is the active bank.

The AS-i 3.0 EtherNet/IP+Modbus TCP Gateway with integr. Safety Monitor always independently utilizes the active bank. Menu commands can however be used to copy the other memory banks to the AS-i Safety Monitor.

The corresponding memory bank thereby becomes the active bank.

If configurations from another memory bank are copied, a few safety rules need to be followed:

***Attention!***

*Safety advisory:*

*Ensure that the configuration intended for and released for the application is used!*

*This can be done by comparing the release codes on the display (See section <MONITOR CONFIG>):*

- The safety representative who generated and validated the configuration stores the release code for the configuration (Complete or Master) stores the release code for the configuration and approves use of the configuration for specific equipment.
- The person performing the startup reads out the release code on the display before starting the equipment or before teaching the code sequences in the case of master configurations and compares it with the release code released for the equipment.

*After the chip card has been used to load the configuration into the device, the safety functions of the device must be checked in the equipment.*

*Checking of the release code and testing the system must be documented in writing and is part of the system documentation.*

# 10. Operation in advanced display mode

***Information!***

*You will find a description of the display menu in the separate document "**Display_Menue**".*

# 11. Advanced Diagnostics for AS-i Masters

The advanced AS-i diagnostics is intended to localize occasionally occurring configuration errors and to determine the quality of data transmission on AS-i without using additional diagnostics tools.

AS-i Control Tools, a MS-Windows software designed to simplify AS-i installation and used to program AS-i Control, enables operation of the advanced diagnostics functions (LCS, error counters, and LOS).

## 11.1 List of corrupted AS-i Slaves (LCS)

The LCS contains the information from the Delta list. In addition to the list of configured slaves (LPS), the list of detected slaves (LDS), and the list of activated slaves (LAS), the AS-i master creates a fourth list, the list of corrupted slaves (LCS) containing advanced diagnostics data used to diagnose the causes for intermittently occurring configuration errors on AS-i. This list contains entries for all AS-i slaves that were responsible for at least one intermittent configuration error since the list was last read or since the AS-i master was turned on. Furthermore, intermittent AS-i power failures are listed in the LCS at the position of AS-i slave with address 0.

***Information!***

*Whenever the LCS is read it is deleted from memory.*

***Information!***

*The last intermittent configuration error can also be displayed on the AS-i master:*

*Pressing the "Set" button on the AS-i master initiates the display of the AS-i slave responsible for the last intermittent configuration error. If a intermittent AS-i power failure occurred, the display shows 39 after pressing the "Set" button.*

*This function is only available if the device is in normal operating mode of the protected mode (display empty) or in the off-line phase (Display: "40").*

## 11.2 Protocol analysis: Counters for corrupted data telegrams

The AS-i master with advanced diagnostics provides a counter for telegram repetitions for each AS-i slave. The counter counts up every time a corrupted data telegram has been found, making it possible to determine the quality of the transmission if only a few telegrams are corrupt and the AS-i slave never caused a configuration error.

***Information!***

*The counter values are read via the host interface and will be deleted after they were read.*

*The highest possible counter value is 254. 255 indicates a counter overflow.*

Displaying the protocol analysis is possible through the AS-i Control Tools software by using the command "Master | AS-i Diagnostics".

## 11.3 Offline Phase for Configuration Errors

The AS-i masters with advanced diagnostics offer the possibility to set themselves into the offline phase when a configuration error occurs and thus are able to transition the AS-i network into a safe operational state. This ensures a quick reaction to a configuration error and the host can be relieved from this task. If any problems occur on the AS-i network, the AS-i masters can independently switch the AS-interface into a safe state.

There are two different ways to parameterize the AS-i master for this feature:

- Any configuration error occurring on AS-i switches the master from regular operation in protected mode into the offline phase.
- o . A list with the addresses of slaves that can potential initiate the off-line phase is defined (list of offline slaves LOS).

The user can decide how the system should react to a configuration error on AS-i. Thus, the AS-i master can be set to the offline phase for critical AS-i slaves, whereas for less critical slaves only the error message is sent to the host, but AS-i is still running.

Like the advanced diagnostics, the parameterization "offline phase on configuration error" is also supported by "AS-i-Control-Tools"
(Command | Characteristics | Offline because of configuration error).

There are two options to reset the error message "OFFLINE BY LOS:

1. Deleting the complete LOS list on the affected AS-i network ("CLEAR ALL").
2. Power reset on the affected AS-i network.

***Attention!***

*If a power reset occurs on the AS-i network 1 the complete double gateway will be shut down.*

## 11.4 Functions of the AS-i Fault Detector

### 11.4.1 Duplicate address detection

If two slaves on an AS-i network have the same address, a duplicate address exists. Since the master cannot communicate individually with these slaves any longer, this is considered an error. Because the two slave replies interfere, it is impossible for the master to recognize the slave responses. This results in extremely unstable network behavior.

The duplicate address detection function is used to safely recognize a duplicate address and to display it on the screen and in AS-i Control Tools.

A duplicate address causes a configuration error and is displayed on the screen.

***Information!***

*Duplicate addresses can be recognized only on an AS-i segment directly connected to the master.*

### 11.4.2 Earth/Ground Fault Detector

An Earth/Ground Fault exists when the voltage $\mathbf{U_{GND}}$ (Nominal value of $U_{GND}$=0,5 $U_{AS-i}$.) is outside of the following range:

$$\mathbf{10\%\ U_{AS-i} \leq U_{GND} \leq 90\%\ U_{AS-i}}$$

This error substantially limits the noise immunity of the AS-i communication.

Ground faults are indicated on the master´s display as well as in AS-i Control Tools.

***Information!***

*To recognize ground faults the master must be grounded with its machine ground connection.*

***Information!***

*A ground fault in one of the two networks of a double master in a version 1 power supply for two AS-i networks causes a ground fault in the other network as well because of the the existing galvanic connection.*

### 11.4.3 Noise Detector

The noise detector detects AC voltages on AS-i, that are not initiated by an AS-i master or AS-i slaves. These interference voltages can cause telegram disturbances.

A frequent cause are insufficiently shielded frequency inverters or improperly routed cables.

Noises is indicated on the master´s display as well as in AS-i Control Tools.

### 11.4.4 Over-voltage Detector

Over-voltages are present if the conductors of an AS-i network that normally are routed electrically symmetrical with respect to machine ground, are strongly electrically raised. A cause can for example be startup procedures of large consumers.

However, over-voltages do generally not interfere with the AS-i communication, but can under certain circumstances cause incorrect sensor signals.

Over-voltages are indicated on the master´s display as well as in the AS-i Control Tools.

## 11.5 Functions of the new generation of AS-i Gateways

The new generation scores with further optimized diagnostics, several additional functions and even greater operating convenience.

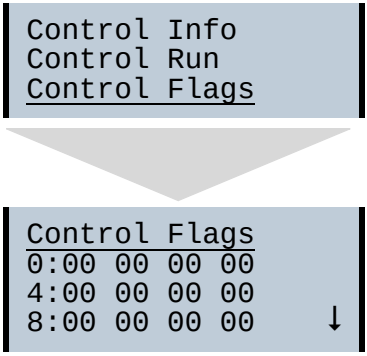
***Information!***

*A listing of the individual devices and their features can be found in section <New Generation of AS-i Gateways with ethernet diagnostics interface>.*

### 11.5.1 C-programmable Gateways

Main menu || SETUP || AS-I CONTROL || **CONTROL FLAGS** ||

The devices programmed in C are able themselves to take over a great number of control tasks. In smaller systems the user will even be able to do without a PLC altogether: if desired the C program can function as a full mini-PLC. In more complex applications the C-programmable Gateways make the work of the PLC easier - for example by pre-processing special functions.




### 11.5.2 Interchangeable memory card

Main menu || SETUP || CHIPCARD || **AS-I CHIPCARD** ||

Interchangeable memory card: redundant memory for C program and device configuration.


### 11.5.3 Earth fault monitor

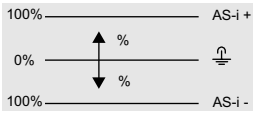
Main menu || DIAGNOSE || **ASI WATCHDOG** ||

The new earth fault monitor allows the service technician to detect whether an earth fault has occurred directly on AS-i

or on a sensor line.

```
1.
 Earth fault sen.
```

The menu **EFLT Ratio** shows the asymmetry of the AS-i network, referenced to ground (see sketch).



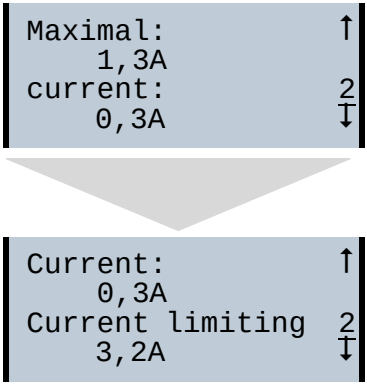

```
EFLT Ratio:          ↑
 AS-i+ 2%
 AS-i DC Voltage: 1
    31,3V
                     $
```

```
EFLT Ratio:          ↑
 AS-i+ 100%
 AS-i DC Voltage: 2
    31,5V
```

### 11.5.4 Current can be read directly on the unit

Now the devices display both the maximum current and the current actually present in the respective AS-i circuit. Heavy consumers or a strong overload in an AS-i circuit are then easy to detect. Plus you can set the maximum current in the AS-i circuit on these devices. This ensures line protection even when using large 24V power supplies.

```
AS-i power
Reset
Maximal:          2
    1,3A          ↓
```

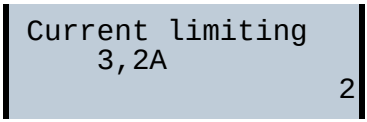



### 11.5.5 Self-resetting fuses

Main menu || SETUP || **CURRENT LIMIT** ||

Thanks to self-resetting fuses in the "1 Gateway, 1 power supply for 2 AS-i circuits" Gateway version, when there is a short circuit in one of the two AS-i circuits the other circuit and the Gateway remain operational - the host controller keeps receiving diagnostic information from AS-i, which also provides meaningful assistance towards rapid troubleshooting.

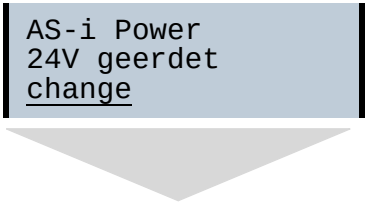
The fuse resets itself periodically to check if the error is solved. The measured current value is available as diagnostic information at the field on the display and at the control level.

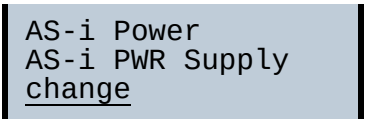



### 11.5.6 AS-i Power24V capable

Main menu || SETUP || **ASI POWER** ||

Gateways for AS-i Power24V have been developed especially for use in small systems. They don‘t need any special AS-i power supply. With a standard 24V power supply a 50 m line lenght and with an AS-i power supply min. 100 m line lenght can be realised.






### 11.5.7 Ethernet diagnostics interface with web server

These devices allow diagnostics for both the Gateway and the AS-i networks (including Safety technology) over Ethernet without additional software. AS-i network can be thus a part of a remote maintenance concept. Morover the configuration file are stored on the web server and so they are always within reach.

### 11.5.8 Transitionless operating mode changes

Main menu || SETUP || **MODE CHANGE** ||

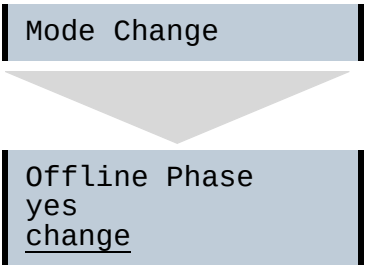
These devices are able to change the operating mode from projecting mode to the protected operating mode without having to first go to the "offline phase".

This means the Slave outputs are not cleared and the safe Slaves not turned off.

Activation and deactivation is set using the Ethernet start parameterization.

This function must be explicitly activated; the default setting is “Deactivated.”

The setting for activated and deactivated is saved, which means that it remains set after a "power cycle".



## 12. EtherNet/IP Interface

***Object modelling***

The attributes of bus participants are mapped into objects in the CIP family (DeviceNet, ControlNet and EtherNet/IP) bus systems.

In addition to for all EtherNet/IP devices common objects, there are other objects in the AS-i gateways to access the data of the AS-i network:

- Identity
- Assembly
- AS-i master
- AS-i slave
- I/O data
- Advanced diagnostics
- Short command interface
- Long command interface
- Safety Control Status (internal)
- Safety Control Status (external)

| Class code | Object name | Number of instances |
|---|---|---|
| 1 (0x01) | Identity | 1 |
| 2 (0x02) | Message router | 1 |
| 4 (0x04) | Assembly | 24 (single master (e.g.: "2447"))<br>86 (double master, (e.g.: "2761")) |
| 6 (0x06) | Connection manager | 1 |
| 71 (0x47) | Device level ring | 1 |
| 72 (0x48) | Quality of service | 1 |
| 100 (0x64) | AS-i master | 1 for each AS-i circuit |
| 101 (0x65) | AS-i slave | 64 for each AS-i circuit |
| 102 (0x66) | E/A data | 1 for each AS-i circuit |
| 103 (0x67) | Advanced diagnosics | 1 for each AS-i circuit |
| 104 (0x68) | Short command interface | 1 |
| 105 (0x69) | Long command interface | 1 |
| 106 (0x6A) | Safety Control Status internal Monitor | 1 |
| 107 (0x6B) | Safety Control Status external Monitor | 1 for each AS-i circuit |

*Tab. 12-9.*

12.9.2013

## 12.1 Identity object

class code: 1 (0x01)
number of instanzes: 1
instance attributes

| Attribute ID | Access Rule | Name | Value |
|---|---|---|---|
| 1 (0x01) | get | vendor | 5 |
| 2 (0x02) | get | device type | 12 |
| 3 (0x03) | get | product code | e. g.: "2448" (double master)<br>e. g.: "2447" (single master) |
| 4 (0x04) | get | revision | 1.1 |
| 5 (0x05) | get | status | see overwiev listed below |
| 6 (0x06) | get | serial number | unique number, 32-bit |
| 7 (0x07) | get | product name | e. g.: "VBG-ENX-K30-DMD-S16" |

*Tab. 12-10.*

**Common services**

| Service Code | Class | Instance | Service name |
|---|---|---|---|
| 5 (0x05) | no | yes | code 1<br>(class + instance) |
| 16 (0x10) | yes | yes | get attributes all |
| 14 (0x0E) | yes | yes | get attributes all |

*Tab. 12-11.*

## 12.2 Device Level Ring Object

Class Code: 71 (0x47)
number of instanzes: 1
instance attributes

| Attribute ID | Access Rule | Name | Value |
|---|---|---|---|
| 1 (0x01) | get | network topology | 0 (linear), 1 (ring) |
| 2 (0x02) | get | network status | 0 (normal), 1 (ring fault) |
| 10 (0x0E) | get | active supervisor address | byte 0-3: ip-adress,<br>byte 4-9: mac-adress |
| 12 (0x0C) | get | capability flags | 1 (announce-based ring node) |

*Tab. 12-12.*

### Common Services

| Service Code | Class | Instance | Service Name |
|---|---|---|---|
| 1 (0x01) | yes | yes | get attributes all |
| 14 (0x0E) | yes | yes | get attribute single |

*Tab. 12-13.*

## 12.3 Quality of Service Object

Class Code: 72 (0x48)
number of instanzes: 1
instance attributes

| Attribute ID | Access Rule | Name | Value |
|---|---|---|---|
| 1 (0x01) | get/set | 802.1q tag enable | 0 (disabled), 1 (enabled) |
| 4 (0x04) | get/set | dscp urgent | dscp after rfc 3168 for cip class 0/1 urgent (default 55) |
| 5 (0x05) | get/set | dscp scheduled | dscp after rfc 3168 for cip class 0/1 scheduled (default 47) |
| 6 (0x06) | get/set | dscp high | dscp after rfc 3168 for cip class 0/1 high (default 43) |
| 7 (0x07) | get/set | dscp low | dscp after rfc 3168 for cip class 0/1 low (default 31) |
| 8 (0x08) | get/set | dscp explicit | dscp after rfc 3168 for cip class 3/ ucmm (default 27) |

*Tab. 12-14.*

### Common Services

| Service Code | Class | Instance | Service Name |
|---|---|---|---|
| 14 (0x0E) | no | yes | get attributes single |
| 16 (0x10) | no | yes | get attribute single |

*Tab. 12-15.*

***Information!***

*The new settings take effect only after a device restart.*

***Information!***

*If “802.1Q Tag Enable“ is turned on, the VLAN ID set in the device menu “Ethernet“ -> “EtherNet/IP“ -> “VLAN ID“ is used.*

***Information!***

*The integrated switch uses four internal priority queues.*

***Information!***

*The VLAN ID is only used if in the EtherNet/IP Quality of Service Object (0x48) Attribute 1 (802.1Q Tag Enable) is set to 1 (= ON), so that Ethernet frames are sent in accordance with IEEE 802.1Q.*

Mapping of the SDCP and 802.1D priorities to the queues is as follows:

| Switch queue | DSCP | 802.1D priority |
|---|---|---|
| 4 (highest priority) | 59 | 7 |
| 3 | 46, DSCP Urgent, DSCP Scheduled, DSCP High | 4, 5, 6 |
| 2 | 24, DSCP Low, DSCP Explicit | 2,3 |
| 1 (lowest priority) | other values | 0,1 |

*Tab. 12-16.*

## 12.4 Assembly Object

class code 4 (0x04)
number of instances: 86

The Assembly Object bandles data from the application objects.

The Assembly Object Instances consist of (in case of a double master):

- A-slaves and/or single slaves from circuit 1
- single, A- and B-slaves (all slaves) from circuit 1
- A-slaves and/or single slaves from both circuits
- single, A- and B-slaves (all slaves) from both circuits
- no 16-bit data
- no command interface
- short command interface
- long command interface
- no safety FB bits/status
- safety FB bits/status
- 16-bit data of slaves 10 … 31 from circuit 1 (or from both circuits) sorted in ascending order
- 16-bit data of slaves 29 … 31 from circuit 1 (or from both circuits) in the following format:

**16-bit data of slaves 29 … 31**

| byte | data item (attribute ID=3) |
|---|---|
| n | Slave 31 ch1 high byte |
| n+1 | Slave 31 ch1 low byte |
| n+2 | Slave 31 ch2 high byte |
| n+3 | Slave 31 ch2 low byte |
| n+4 | Slave 31 ch3 high byte |
| n+5 | Slave 31 ch3 low byte |
| n+6 | Slave 31 ch4 high byte |
| n+7 | Slave 31 ch4 low byte |
| n+8 | Slave 30 ch1 high byte |
| n+9 | Slave 30 ch1 low byte |
| n+10 | Slave 30 ch2 high byte |
| n+11 | Slave 30 ch2 low byte |
| n+12 | Slave 30 ch3 high byte |
| n+13 | Slave 30 ch3 low byte |
| n+14 | Slave 30 ch4 high byte |

*Tab. 12-17.*

**16-bit data of slaves 29 … 31**

| | |
|---|---|
| n+15 | Slave 30 ch4 low byte |
| n+16 | Slave 29 ch1 high byte |
| n+17 | Slave 29 ch1 low byte |
| n+18 | Slave 29 ch2 high byte |
| n+19 | Slave 29 ch2 low byte |
| n+20 | Slave 29 ch3 high byte |
| n+21 | Slave 29 ch3 low byte |
| n+22 | Slave 29 ch4 high byte |
| n+23 | Slave 29 ch4 low byte |

*Tab. 12-17.*

Instances 100 (0x64) ... 135 (0x87), 172 (0xAC), 174 (0xAE), 176 (0xB0), 178 (0xB2), 180 (0xB4), 182 (0xB6) and 184 (0xB8) can only be read, while instances 136 (0x88) ... 171 (0xAB), 173 (0xAD), 175 (0xAF), 177 (0xB1), 179 (0xB3), 181 (0xB5), 183 (0xB7) und 185 (0xB9) can be read and written.

***Information!***

*The are only instances 100 (0x64) ... 105 (0x69), 109 (0x6D) ... 114 (0x72), 172 (0xAC) und 173 (0xAD) in case of a single master.*

### 12.4.1 Assembly Objects for VBG-ENX-K30-DMD-S16-C1, VBG-ENX-K30-DMD-S16

| Assembly Instance | | | Data Item | | |
|---|---|---|---|---|---|
| input | output | size (byte) | digital | analog | command interface |
| 100 (0x64) | 136 (0x88) | 16 | AS-i circuit 1, single- and A-slaves | | |
| 101 (0x65) | 137 (0x89) | 28 | | | short |
| 102 (0x66) | 138 (0x8A) | 54 | | | long |
| 103 (0x67) | 139 (0x8B) | 40 | | AS-i circuit 1, analog slaves 29 .. 31 | |
| 104 (0x68) | 140 (0x8C) | 52 | | | short |
| 105 (0x69) | 141 (0x8D) | 78 | | | long |
| 106 (0x6A) | 142 (0x8E) | 64 | | AS-i circuit 1+2, analog slaves 29 .. 31 | |
| 107 (0x6B) | 143 (0x8F) | 76 | | | short |
| 108 (0x6C) | 144 (0x90) | 102 | | | long |
| 109 (0x6D) | 145 (0x91) | 32 | AS-i circuit 1, all slaves | | |
| 110 (0x6E) | 146 (0x92) | 44 | | | short |
| 111 (0x6F) | 147 (0x93) | 70 | | | long |
| 112 (0x70) | 148 (0x94) | 56 | | AS-i circuit 1, analog slaves 29 .. 31 | |
| 113 (0x71) | 149 (0x95) | 68 | | | short |
| 114 (0x72) | 150 (0x96) | 94 | | | long |
| 115 (0x73) | 151 (0x97) | 80 | | AS-i circuit 1+2, analog slaves 29 .. 31 | |
| 116 (0x74) | 152 (0x98) | 92 | | | short |
| 117 (0x75) | 153 (0x99) | 118 | | | long |
| 118 (0x76) | 154 (0x9A) | 32 | AS-i circuit 1+2, single- and A-slaves | | |
| 119 (0x77) | 155 (0x9B) | 44 | | | short |
| 120 (0x78) | 156 (0x9C) | 70 | | | long |
| 121 (0x79) | 157 (0x9D) | 56 | | AS-i circuit 1, analog slaves 29 .. 31 | |
| 122 (0x7A) | 158 (0x9E) | 68 | | | short |
| 123 (0x7B) | 159 (0x9F) | 94 | | | long |
| 124 (0x7C) | 160 (0xA0) | 80 | | AS-i circuit 1+2, analog slaves 29 .. 31 | |
| 125 (0x7D) | 161 (0xA1) | 92 | | | short |
| 126 (0x7E) | 162 (0xA2) | 118 | | | long |
| 127 (0x7F) | 163 (0xA3) | 64 | AS-i circuit 1+2, all slaves | | |
| 128 (0x80) | 164 (0xA4) | 76 | | | short |
| 129 (0x81) | 165 (0xA5) | 102 | | | long |
| 130 (0x82) | 166 (0xA6) | 88 | | AS-i circuit 1, analog slaves 29 .. 31 | |
| 131 (0x83) | 167 (0xA7) | 100 | | | short |
| 132 (0x84) | 168 (0xA8) | 126 | | | long |
| 133 (0x85) | 169 (0xA9) | 112 | | AS-i circuit 1+2, analog slaves 29 .. 31 | |
| 134 (0x86) | 170 (0xAA) | 124 | | | short |
| 135 (0x87) | 171 (0xAB) | 150 | | | long |

*Tab. 12-18.*

## 12.4.2 Assembly Objects for VBG-ENX-K30-DMD-S16-EV

| Assembly Instance | | | | Data Item | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Input | Size (Byte) | Output | Size (Byte) | Digital | Analog | Command interface | Safety FB Bits | Safety Status | min. RPI (ms) | min. RPI (ms) with DLR |
| 100 (0x64) | 16 | 136 (0x88) | 16 | AS-i circuit 1, single- and A-slaves | | | | | 5 | 10 |
| 101 (0x65) | 28 | 137 (0x89) | 28 | | | short | | | 5 | 10 |
| 102 (0x66) | 54 | 138 (0x8A) | 54 | | | long | | | 6 | 14 |
| 103 (0x67) | 40 | 139 (0x8B) | 40 | | AS-i circuit 1, analog slaves 29 .. 31 | | | | 6 | 14 |
| 104 (0x68) | 52 | 140 (0x8C) | 52 | | | short | | | 6 | 14 |
| 105 (0x69) | 78 | 141 (0x8D) | 78 | | | long | | | 8 | 18 |
| 106 (0x6A) | 64 | 142 (0x8E) | 64 | | AS-i circuit 1+2, analog slaves 29 .. 31 | | | | 8 | 16 |
| 107 (0x6B) | 76 | 143 (0x8F) | 76 | | | short | | | 8 | 18 |
| 108 (0x6C) | 102 | 144 (0x90) | 102 | | | long | | | 10 | 22 |
| 109 (0x6D) | 32 | 145 (0x91) | 32 | AS-i circuit 1, all slaves | | | | | 6 | 12 |
| 110 (0x6E) | 44 | 146 (0x92) | 44 | | | short | | | 6 | 14 |
| 111 (0x6F) | 70 | 147 (0x93) | 70 | | | long | | | 8 | 16 |
| 112 (0x70) | 56 | 148 (0x94) | 56 | | AS-i circuit 1, analog slaves 29 .. 31 | | | | 7 | 15 |
| 113 (0x71) | 68 | 149 (0x95) | 68 | | | short | | | 8 | 16 |
| 114 (0x72) | 94 | 150 (0x96) | 94 | | | long | | | 9 | 18 |
| 115 (0x73) | 80 | 151 (0x97) | 80 | | AS-i circuit 1+2, analog slaves 29 .. 31 | | | | 9 | 18 |
| 116 (0x74) | 92 | 152 (0x98) | 92 | | | short | | | 9 | 18 |
| 117 (0x75) | 118 | 153 (0x99) | 118 | | | long | | | 11 | 24 |
| 118 (0x76) | 32 | 154 (0x9A) | 32 | AS-i circuit 1+2, single- and A-slaves | | | | | 6 | 12 |
| 119 (0x77) | 44 | 155 (0x9B) | 44 | | | short | | | 6 | 14 |
| 120 (0x78) | 70 | 156 (0x9C) | 70 | | | long | | | 8 | 16 |
| 121 (0x79) | 56 | 157 (0x9D) | 56 | | AS-i circuit 1, analog slaves 29 .. 31 | | | | 7 | 15 |
| 122 (0x7A) | 68 | 158 (0x9E) | 68 | | | short | | | 8 | 16 |
| 123 (0x7B) | 94 | 159 (0x9F) | 94 | | | long | | | 9 | 18 |
| 124 (0x7C) | 80 | 160 (0xA0) | 80 | | AS-i circuit 1+2, analog slaves 29 .. 31 | | | | 9 | 18 |
| 125 (0x7D) | 92 | 161 (0xA1) | 92 | | | short | | | 9 | 18 |
| 126 (0x7E) | 118 | 162 (0xA2) | 118 | | | long | | | 11 | 24 |
| 127 (0x7F) | 64 | 163 (0xA3) | 64 | AS-i circuit 1+2, all slaves | | | | | 8 | 16 |
| 128 (0x80) | 76 | 164 (0xA4) | 76 | | | short | | | 8 | 18 |
| 129 (0x81) | 102 | 165 (0xA5) | 102 | | | long | | | 10 | 22 |
| 130 (0x82) | 88 | 166 (0xA6) | 88 | | AS-i circuit 1, analog slaves 29 .. 31 | | | | 9 | 18 |
| 131 (0x83) | 100 | 167 (0xA7) | 100 | | | short | | | 10 | 22 |
| 132 (0x84) | 126 | 168 (0xA8) | 126 | | | long | | | 12 | 25 |
| 133 (0x85) | 112 | 169 (0xA9) | 112 | | AS-i circuit 1+2, analog slaves 29 .. 31 | | | | 11 | 24 |
| 134 (0x86) | 124 | 170 (0xAA) | 124 | | | short | | | 12 | 25 |
| 135 (0x87) | 150 | 171 (0xAB) | 150 | | | long | | | 13 | 26 |

*Tab. 12-19.*

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| Assembly Instance | | | | Data Item | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Input | Size (Byte) | Output | Size (Byte) | Digital | Analog | Command interface | Safety FB Bits | Safety Status | min. RPI (ms) | min. RPI (ms) with DLR |
| 172 (0xAC) | 246 | 173(0xAD) | 246 | AS-i circuit 1, all slaves | AS-i circuit 1, analog slaves 10 .. 31 | long | | | 17 | 32 |
| 174 (0xAE) | 454 | 175 (0xAF) | 454 | AS-i circuit 1 + 2, all slaves | AS-i circuit 1 + 2, analog slaves 10 .. 31 | | | | 25 | 50 |
| 176 (0xB0) | 98 | 177(0xB1) | 66 | | | | 2 bytes In / Out | 32 byte In | 10 | 20 |
| 178 (0xB2) | 136 | 179(0xB3) | 104 | | | long | | | 12 | 25 |
| 180 (0xB4) | 146 | 181(0xB5) | 114 | | AS-i circuit 1+2, analog slaves 29 .. 31 | | | | 13 | 26 |
| 182 (0xB6) | 184 | 183(0xB7) | 152 | | AS-i circuit 1+2, analog slaves 29 .. 31 | long | | | 15 | 30 |
| 184 (0xB8) | 488 | 185(0xB9) | 456 | | AS-i circuit 1+2, analog slaves 10 .. 31 | | | | 27 | 52 |

*Tab. 12-19.*

## 12.5 AS-i Master Object

class code: 100 (0x64)
1 instance for each AS-i circuit

| attribute ID | access rule | name | devicenet data type | default data value |
|---|---|---|---|---|
| 100 (0x64) | get | ec-flags | UINT (16-bit) | |
| 101 (0x65) | get/set | hi-flags | USINT | |
| 102 (0x66) | get/set | operational mode | BOOL | |
| 103 (0x67) | get | LDS (list of detected slaves) | ULINT | |
| 104 (0x68) | get/set | LPS (list of projected slaves) | ULINT | |
| 105 (0x69) | get | LAS (list of activated slaves) | ULINT | |
| 106 (0x6A) | get | LPF (list of peripheral faults) | ULINT | |
| 107 (0x6B) | get/set | Store_Actual_Configuration | BOOL | |
| 108 (0x6C) | get/set | Store_Actual_Parameters | BOOL | |
| 109 (0x6D) | get/set | Change_Slave_Adress | UINT | |
| 110 (0x6E) | get/set | Lock push-buttons | BOOL | |

*Tab. 12-20.*

**EC-flags (16-bit)**

| $2^{15}$ | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^{9}$ | $2^{8}$ | $2^{7}$ | $2^{6}$ | $2^{5}$ | $2^{4}$ | $2^{3}$ | $2^{2}$ | $2^{1}$ | $2^{0}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DA | NSE | OV | EF | – | – | – | Pok | OR | APF | NA | CA | AAv | AAs | S0 | Cok |

*Tab. 12-21.*

| | |
|---|---|
| DA (double_address): | AS-i duplicate address detection |
| | *0: no duplicate address* |
| | *1: duplicate address* |
| NSE (noise): | AS-i noise detection |
| | *0: no noise* |
| | *1: noise fault* |
| OV (overvoltage): | AS-i overvoltage detection |
| | *0: no overvoltage* |
| | *1: overvoltage fault* |
| EF (earth_fault): | AS-i earth fault detection |
| | *0: no earth fault* |
| | *1: earth fault* |
| PoK (periphery_ok): | Periphery is OK |
| | *0: Periphery is OK* |
| | *1: Periphery is not OK* |
| OR (offline_ready): | The off-line phase is active |
| APF (ASi-power_fail): | An AS-i power fail is occured |
| NA (normal_operation_active): | The normal operation mode is active |
| | *0: normal operation is active* |
| | *1: normal operation is not active* |
| CA (configuration_active): | The configuration-mode is active |

| | |
|---|---|
| AAv (Auto_Address_Available): | Automatic programming is possible |
| | *0: Auto-address is possible* |
| | *1: Auto-address is not possible* |
| AAs (Auto_Address_Assign): | Automatic programming is allowed |
| S0 (LDS.0): | There is an AS-i slave with address '0' |
| Cok (config_ok): | Configuration error: |
| | *0: no error* |
| | *1: error* |

**Hi-flags (8-bit)**

| $2^2$ | $2^1$ | $2^0$ |
|---|---|---|
| AAe | OL | DX |

*Tab. 12-22.*

| | |
|---|---|
| AAe: | Auto_Address_Enable |
| OL: | Off-line |
| DX: | Data_Exchange_Active |

**Operational mode (8-bit):**

| | |
|---|---|
| 1: | configuration mode |
| 0: | protected mode |

**LDS, LAS, LPS, LPF (64-bit)**

| Byte | $2^7$ | $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |
|---|---|---|---|---|---|---|---|---|
| 0 | 7A | 6A | 5A | 4A | 3A | 2A | 1A | 0A |
| … | … | | | | | | | |
| 7 | 31B | 30B | 29B | 28B | 27B | 26B | 25B | 24B |

*Tab. 12-23.*

| | |
|---|---|
| LDS: | list of detected slaves |
| LAS: | list of activated slaves |
| LPS: | list of activated slaves |
| LPF: | list of peripheral faults |

***Store actual parameter/store actual configuration/lock push-buttons***

True: proceed the action

**Change slave address (16-bit)**

| Byte | $2^7$ | $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |
|---|---|---|---|---|---|---|---|---|
| 0 | – | | B | source address | | | | |
| 1 | – | | B | target address | | | | |

*Tab. 12-24.*

**Meaning of the bit B**

| | |
|---|---|
| B = 0: | Single AS-i Slave or A-slave |
| B = 1: | B-slave |

## 12.6 AS-i slave Object

class code: 101 (0x65)
64 instances for each AS-i circuit, 1 for each AS-i slave

| instance ID | AS-i slave |
|---|---|
| 1 (0x01) | slave 0, circuit 1 |
| 2 (0x02) | slave 1A, circuit 1 |
| … | … |
| 32 (0x20) | slave 31A circuit 1 |
| 33 (0x21) | empty, circuit 1 |
| 34 (0x22) | slave 1B, circuit |
| … | … |
| 64 (0x40) | slave 31B, circuit 1 |
| 65 (0x41) | slave 0, circuit 2 |
| … | … |
| 96 (0x60) | slave 31A, circuit 2 |
| 97 (0x61) | empty, circuit 2 |
| … | … |
| 98 (0x62) | slave 1B, circuit 2 |
| … | … |
| 128 (0x80) | slave 31B, circuit 2 |

*Tab. 12-25.*

| attribute ID | access rule | name | devicenet data type | remark |
|---|---|---|---|---|
| 100 (0x64) | get | actual configuration | UINT | |
| 101 (0x65) | get/set | permanent configuration | UINT | slave 0, 32: not read-/writeable |
| 102 (0x66) | get/set | actual parameters | USINT | |
| 103 (0x67) | get/set | permanent parameters | USINT | |
| 104 (0x68) | get/set | xID1 | USINT | slave 0: writeable only, slave 0 - 32: readable |

*Tab. 12-26.*

**actual configuration/permanent configuration (16-bit)**

| $2^{15}$ | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^{9}$ | $2^{8}$ | $2^{7}$ | $2^{6}$ | $2^{5}$ | $2^{4}$ | $2^{3}$ | $2^{2}$ | $2^{1}$ | $2^{0}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | | | | IO | | | | xID2 | | | | XID1 | | | |

*Tab. 12-27.*

**parameter xID1 (8-bit)**

| $2^{7}$ | $2^{6}$ | $2^{5}$ | $2^{4}$ | $2^{3}$ | $2^{2}$ | $2^{1}$ | $2^{0}$ |
|---|---|---|---|---|---|---|---|
| – | | | | data | | | |

*Tab. 12-28.*

## 12.7 I/O Data Object

class code: 102 (0x66)
Input and output data
1 instance for each AS-i circuit
Instance 1 equates to AS-i circuit 1
Instance 2 equates to AS-i circuit 2

| attribute ID | access rule | name | devicenet data type | default data value |
|---|---|---|---|---|
| 100 (0x64) | get | input data image, single and A-slaves | ARRAY[16] of USINT | |
| 101 (0x65) | get | input data image, B-slaves | ARRAY[16] of USINT | |
| 102 (0x66) | get/set | output data image single and A-slaves | ARRAY[16] of USINT | |
| 103 (0x67) | get/set | output data image, B-slaves | ARRAY[16] of USINT | |
| 104 (0x68) | get | 16-bit input data slave 1 | ARRAY[4] of INT | |
| … | … | … | … | … |
| 134 (0x86) | get | 16-bit input data slave 31 | ARRAY[4] of INT | |
| 135 (0x87) | get/set | 16-bit output data slave 1 | ARRAY[4] of INT | |
| … | … | … | … | … |
| 165 (0xA5) | get/set | 16-bit output data slave 31 | ARRAY[4] of INT | |

*Tab. 12-29.*

**Input and Output Data Image**

| Byte | $2^7$ | $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |
|---|---|---|---|---|---|---|---|---|
| | F3 | F2 | F1 | F0 | | | | |
| 0 | flags | | | | slave 1/1A | | | |
| 1 | slave 2/2A | | | | slave 3/3A | | | |
| 2 | slave 4/4A | | | | slave 5/5A | | | |
| 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 29/29A | | | |
| 15 | slave 30/30A | | | | slave 31/31A | | | |
| 16 | reserved | | | | 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. 12-30.*

**Flags**

| | Input data | Output data |
|---|---|---|
| F0 | ConfigError | Off-line |
| F1 | APF | LOS-master-bit |
| F2 | PeripheryFault | → ConfigurationMode |
| F3 | ConfigurationActive | → ProtectedMode |

*Tab. 12-31.*

| | | |
|---|---|---|
| ConfigError: | 0=ConfigOK | 1=ConfigError |
| APF: | 0=AS-i-Power OK | 1=AS-i-Power Fail |
| PeripheryFault: | 0=PeripheryOK | 1=PeripheryFault |
| ConfigurationActive: | 0=ProtectedOperationMode | 1=ProjectingMode |
| Off-Line: | 0=On-Line | 1=Off-Line |
| LOS-master-bit | 0=Off-Line by ConfigError deactivated | 1=Off-Line by ConfigError activated. |

***16-bit data***

***Information!***

*A-slaves map the data on channels 1 and 2.*

*B-slaves map the data on channels 3 and 4.*

In addition to the access via the command interfaces, the 16-bit data for or by the slaves with 16-bit value can by exchanged cyclically (profile 7.3., S-7.4, S-6.0, S-7.5, S-7.A.8, S-7.A.9, S-7.A.A). Competing writing access attemps on 16-bit output data will not be blocked by every other. If 16-bit output data for a particular slave are being transmitted both cyclically and acyclically with the command interface, the acyclically transmitted values will be overwritten by the cyclically transmitted values.

Data of all channels of a slave can be transmitted in a reserved data area. Therefore accessing 16-bit data is as easy as accessing digital data.

**16-bit value**

| Word | $2^{15}$ | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^{9}$ | $2^{8}$ | $2^{7}$ | $2^{6}$ | $2^{5}$ | $2^{4}$ | $2^{3}$ | $2^{2}$ | $2^{1}$ | $2^{0}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 1 | slave X, channel 1 | | | | | | | | | | | | | | | |
| 2 | slave X, channel 2 | | | | | | | | | | | | | | | |
| 3 | slave X, channel 3 | | | | | | | | | | | | | | | |
| 4 | slave X, channel 4 | | | | | | | | | | | | | | | |

*Tab. 12-32.*

## 12.8 Advanced Diagnostics Object

class code: 103 (0x67)

1 instance for each AS-i circuit
Instance 1 equates to AS-i circuit 1
Instance 2 equates to AS-i circuit 2

| attribute ID | access rule | name | devicenet data type | default data value |
|---|---|---|---|---|
| 100 (0x64) | Get/Set | LOS (List of offline slaves) | ULINT | |
| 101 (0x65) | Get | error counter A | ARRAY[32] of USINT | |
| 102 (0x66) | Get | error counter B | ARRAY[32] of USINT | |

*Tab. 12-33.*

***Slave error counter:***

**single and A slaves**

| Index | error counter |
|---|---|
| 1 | slave 1/1A |
| 2 | slave 2/2A |
| 3 | slave 3/3A |
| … | … |
| 31 | slave 31/31A |

*Tab. 12-34.*

**B slaves**

| index | error counter |
|---|---|
| 1 | slave 1B |
| 2 | slave 2B |
| 3 | slave 3B |
| … | … |
| 31 | slave 31B |

*Tab. 12-35.*

## 12.9 Short Command Interface Object

class code: 104 (0x68)
1 instance

| attribute ID | access rule | name | devicenet data type | default data value |
|---|---|---|---|---|
| **100 (0x64)** | **get/set** | **content** | **ARRAY[12] of USINT** | |
| | | command | [0] | |
| | | toggle-bit and AS-i circuit | [1] | |
| | | data | [2 … 11] | |

*Tab. 12-36.*

## 12.10 Long Command Interface Object

class code: 105 (0x69)
1 instance

| attribute ID | access rule | name | devicenet data type | default data value |
|---|---|---|---|---|
| **100 (0x64)** | **get/set** | **content** | **ARRAY [38] of USINT** | |
| | | command | [0] | |
| | | toggle-bit and AS-i circuit | [1] | |
| | | data | [2 … 37] | |

*Tab. 12-37.*

For special details acc. the command interface commands see the separat manual "AS-i 3.0 Command Interface".

## 12.11 Safety Control/Status

### 12.11.1 Internal monitor

#### 12.11.1.1 Safety Control Status internal monitor for VBG-ENX-K30-DMD-S16-C1, VBG-ENX-K30-DMD-S16

class code: 106 (0x6A)
1 instance

| attribute ID | access rule | name | devicenet data type | default data value |
|---|---|---|---|---|
| **100 (0x64)** | **get** | | **ARRAY [16] of USINT** | |
| | | safety status release circuit 1 | [0] | |
| | | safety status release circuit 2 | [1] | |
| | | … | [2 … 14] | |
| | | safety status relais circuit 16 | [15] | |
| **101 (0x65)** | **get/set** | **safety control** | **USINT** | |

*Tab. 12-38.*

Coding of states and colors see tab. <Coding of status bytes per OSSD>.

**Safety control**

| byte | description |
|---|---|
| 1 | byte from the EtherNet/IP |
| | bit 0: 1.Y1 |
| | bit 1: 1.Y2 |
| | bit 2: 2.Y1 |
| | bit 3: 2.Y2 |
| | bit 4 ... 7: reserved |

***Set (data write access)***

*The bits of the output bytes which have been set via the host interface are ORed with the real and the homonymous hardware inputs of the device.*

***GET (data read access)***

*The information-bits of the outputs 1.Y1, 1.Y2, 1.Y2 and 2.Y2 which have been read back only reflect the data bits set via the host interface.*

**Coding of status bytes per OSSD**

| Bit [0 ... 3] | State or. color |
|---|---|
| $00_{16}$ | green permanent lighting |
| $01_{16}$ | green flashing |
| $02_{16}$ | yellow permanent lighting |
| $03_{16}$ | yellow flashing |
| $04_{16}$ | red permanent lighting |
| $05_{16}$ | red flashing |
| $06_{16}$ | grey or off |
| $07_{16}$ | reserved |
| Bit [6] | status or color |
| 0 | no device flashing yellow |
| 1 | at least one device flashing yellow |
| Bit [7] | status or color |
| 0 | no device flashing red |
| 1 | at least one device flashing red |

*Tab. 12-39.*

### 12.11.1.2 Feldbus bits internal monitor for VBG-ENX-K30-DMD-S16-EV

Class Code: 106 (0x6A)
1 Instance

| Attribute ID | Access Rule | Name | DeviceNet Data Type | Default Data Value |
|---|---|---|---|---|
| **100 (0x64)** | **get** | | **ARRAY [32] of USINT** | |
| | | safety status OSSD 1 | [0] | |
| | | safety status OSSD 2 | [1] | |
| | | … | [2 … 30] | |
| | | safety status OSSD 32 | [31] | |
| **101 (0x65)** | **get/set** | **fieldbus bits** | **ARRAY [2] of USINT** | |

*Tab. 12-40.*

**Fieldbus bits**

| **Bit** | **15** | **…** | **3** | **2** | **1** | **0** |
|---|---|---|---|---|---|---|
| **meaning** | Bits from EtherNet/IP | | | | | |

### 12.11.2 External Monitor

#### 12.11.2.1 Safety Control Status external Monitor

class code: 107 (0x6B)
1 instance per AS-i circuit

| attribute ID | access rule | name | devicenet data type | default data value |
|---|---|---|---|---|
| **100 (0x64)** | **get** | **slave 1:** | **ARRAY [8] of USINT** | |
| | | safety status release circuit 1 | [0] | |
| | | safety status release circuit 2 | [1] | |
| | | … | [2 … 6] | |
| | | safety status, release circuit 8 | [7] | |
| … | … | … | … | … |
| **130 (0x82)** | **get** | **slave 31:** | **ARRAY [8] of USINT** | |
| | | safety status release circuit 1 | [0] | |
| | | safety status release circuit 2 | [1] | |
| | | … | [2 … 6] | |
| | | safety status release circuit 8 | [7] | |
| **131 (0x83)** | **get/set** | **safety control slave 1** | **USINT** | |
| … | … | … | … | … |
| **161 (0xA1)** | **get/set** | **safety control slave 31** | **USINT** | |

*Tab. 12-41.*

Coding of states and colors see tab. <Coding of status bytes per OSSD>.

**Safety control**

| Byte | description |
|---|---|
| 1 | byte from the EtherNet/IP |
| | bit 0: 1.Y1 |
| | bit 1: 1.Y2 |
| | bit 2: 2.Y1 |
| | bit 3: 2.Y2 |
| | bit 4 ... 7: reserved |

***Set (data write access)***

*The bits of the output bytes which have been set via the host interface are ORed with the real and the homonymous hardware inputs of the device.*

***GET (data read access)***

*The information-bits of the outputs 1.Y1, 1.Y2, 1.Y2 and 2.Y2 which have been read back only reflect the data bits set via the host interface.*

**Coding of status bytes per OSSD**

| | |
|---|---|
| Bit [0 ... 3] | State or. color |
| $00_{16}$ | green permanent lighting |
| $01_{16}$ | green flashing |
| $02_{16}$ | yellow permanent lighting |
| $03_{16}$ | yellow flashing |
| $04_{16}$ | red permanent lighting |
| $05_{16}$ | red flashing |
| $06_{16}$ | grey or off |
| $07_{16}$ | reserved |
| Bit [6] | status or color |
| 0 | no device flashing yellow |
| 1 | at least one device flashing yellow |
| Bit [7] | status or color |
| 0 | no device flashing red |
| 1 | at least one device flashing red |

*Tab. 12-42.*

***Information!***

*For further codes indicated by the display, see section <Status indication, faults and fault elimination>.*

# 13. The Modbus Address Table

Cyclic data exchange similar to the Momentum Ethernet Adapter
**AS-i circuit 1: Input Data Imagge IDI**

| 4x 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 |
| 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. 13-43.*

F1 - F16: flags, see tab. <Reference 1>.

12.9.2013



PEPPERL+FUCHS

Cyclic data exchange similar to the Momentum Ethernet Adapter
**AS-i circuit 2: Input Data Imagge IDI**

| 4x 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 |
| 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. 13-44.*

F1 - F16: flags, see tab. <Reference 1>.

Cyclic data exchange similar to the Momentum Ethernet Adapter

**AS-i circuit 1: Output Data Imagge ODI**

| 4x 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 |
| 2 | 17 - 32 | slave 0/0A | | | | slave 1/1A | | | | slave 2/2A | | | | slave 3/3A | | | |
| | | D0 | D1 | D2 | D3 | D0 | D1 | D2 | D 3 | 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. 13-45.*

F1 - F16: flags, see tab. <Reference 1>.

12.9.2013

Cyclic data exchange similar to the Momentum Ethernet Adapter

**AS-i circuit 2: Output Data Imagge ODI**

| 4x 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 |
| 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. 13-46.*

F1 - F16: flags, see tab. <Reference 1>.

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:

**Reference 1**

| Flag | bit | bit value | write | read |
|---|---|---|---|---|
| F1 | 1 | $8000_h$ | Data_Exchange_Active | Config_OK |
| F2 | 2 | $4000_h$ | Off-Line | LDS.0 |
| F3 | 3 | $2000_h$ | Auto_Address_Enable | Auto_Address_Assign |
| F4 | 4 | $1000_h$ | Configuration Mode on | Auto_Address_Available |
| F5 | 5 | $800_h$ | Configuration Mode off | Conguration_Active |
| F6 | 6 | $400_h$ | | Normal_Operation_Active |
| F7 | 7 | $200_h$ | | APF/not APO |
| F8 | 8 | $100_h$ | | Offline_Ready |
| F9 | 9 | $80_h$ | | Periphery_OK |
| F10 | 10 | $40_h$ | | |
| F11 | 11 | $20_h$ | | |
| F12 | 12 | $10_h$ | | |
| F13 | 13 | $8_h$ | | Earth Fault |
| F14 | 14 | $4_h$ | | Overvoltage |
| F15 | 15 | $2_h$ | | Noise |
| F16 | 16 | $1_h$ | | Duplicate Address |

*Tab. 13-47. Reference 1*

| | |
|---|---|
| Data_Exchange_Active: | If this output is set, no data transmisson between the AS-i/Gateway and the AS-i slaves is possible.<br>*0: Data exchange is active*<br>*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 programming.<br>*0: Auto-address is enabled*<br>*1: Auto-address is disabled* |
| Configuration_Mode_on: | Configuration mode is on |
| Configuration_Mode_off: | Configuration mode is off |
| Config_OK: | Configuration error:<br>*0: no error*<br>*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<br>*0: Auto-address is possible*<br>*1: Auto-address is not possible* |
| Configuration_Active: | The configuration-mode is active |
| Normal_Operation_Active: | The normal operation mode is active<br>*0: normal operation is active*<br>*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<br>*0: Periphery is OK*<br>*1: Periphery is not OK* |
| Earth Fault: | AS-i earth fault detection<br>*0: no earth fault*<br>*1: earth fault* |
| Overvoltage: | AS-i overvoltage detection<br>*0: no overvoltage*<br>*1: overvoltage fault* |
| Noise: | AS-i noise detection<br>*0: no noise*<br>*1: noise fault* |
| Duplicate Address: | AS-i duplicate address detection<br>*0: no duplicate address*<br>*1: duplicate address* |

**Reference 2**

| Bit | bit value | write | read |
|---|---|---|---|
| 1 | $8000_h$ | ODI slave 0, D0 | IDI slave 0, D0 |
| 2 | $4000_h$ | ODI slave 0, D1 | IDI slave 0, D1 |
| 3 | $2000_h$ | ODI slave 0, D2 | IDI slave 0, D2 |
| 4 | $1000_h$ | ODI slave 0, D3 | IDI slave 0, D3 |
| 5 | $800_h$ | ODI slave 1, D0 | IDI slave 1, D0 |
| 6 | $400_h$ | ODI slave 1, D1 | IDI slave 1, D1 |
| 7 | $200_h$ | ODI slave 1, D2 | IDI slave 1, D2 |
| 8 | $100_h$ | ODI slave 1, D3 | IDI slave 1, D3 |
| 9 | $80_h$ | ODI slave 2, D0 | IDI slave 2, D0 |
| 10 | $40_h$ | ODI slave 2, D1 | IDI slave 2, D1 |
| ... | ... | ... | ... |

*Tab. 13-48. Reference 2*

Some of the flags are inverted in order to have zero values in protected mode during normal operation without any conguration errors.

The bits within the words of all other blocks contain input or output data.

They have the following arrangement:

| Bit | bit value | slave | input or output port |
|---|---|---|---|
| 1 | $8000_h$ | 1 | D3 |
| 2 | $4000_h$ | 1 | D2 |
| 3 | $2000_h$ | 1 | D1 |
| 4 | $1000_h$ | 1 | D0 |
| 5 | $800_h$ | 0 | D3 |
| 6 | $400_h$ | 0 | D2 |
| 7 | $200_h$ | 0 | D1 |
| 8 | $100_h$ | 0 | D0 |
| 9 | $80_h$ | 3 | D3 |
| 10 | $40_h$ | 3 | D2 |
| 11 | $20_h$ | 3 | D1 |
| 12 | $10_h$ | 3 | D0 |
| 13 | $8_h$ | 2 | D3 |
| 14 | $4_h$ | 2 | D2 |
| 15 | $2_h$ | 2 | D1 |
| 16 | $1_h$ | 2 | D0 |

*Tab. 13-49.*

The configuration mode can be switched on or off with an rising edge in reference 0, bit 4 or 5, respectively.

**Device-relevant references**

| 4x referece | access | data |
|---|---|---|
| 2049 ... 2064 | r/- | AS-i/ENIP Gateway |
| 2065 ... 2072 | r/- | device version |
| 2073 ... 2080 | r/- | firmware feature (without hi-flags) |
| 2081 ... 2084 | r/- | firmware data code |
| 2085 | r/w | Front_Panel_Operation<br>(0 enabled, else disabled) |
| 2086 | r/- | return value of most recently called *Execution Control* function:<br>0: success<br>1: failure<br>2: slave with 1st address not detected<br>3: slave with zero address detected<br>4: slave with 2nd address detected<br>5: delete error<br>6: set error<br>7: address stored temporarily<br>8: *extended ID1* stored temporarily<br>9: error reading *extended ID1* |
| 2304 | r/w | AS-i control status bits |
| 2305 ... 2368 | r/w | AS-i control flag memory |
| 3073 ... 3091 | r/w | command interface |

*Tab. 13-50.*

The device-relevant references 2305 … 2368 have the following arrangement:

| 4x reference | high byte | low byte |
|---|---|---|
| 2305 | flag byte 0 | flag byte 1 |
| 2306 | flag byte 2 | flag byte 3 |
| ... | ... | ... |
| 2368 | flag byte 126 | flag byte 127 |

*Tab. 13-51.*

**Device-relevant references (similar to the Momentum Ethernet Adapter)**

| 4x reference | access | data |
|---|---|---|
| 2087 | r/w | default value for watchdog timeout in 10 ms units<br>range 1 to 999<br>(this value overwrites the value written in the reference 61441) |
| 61441 | r/w | timeout in 10 msec units<br>default 100 (≡ 1 sec)<br>range 3 to 65536 |
| 62465 ... 62476 | r/w | list of "allowed master" (not used) |
| 62481 | -/w | authorize IP address record<br>Set to 1 allow IP address assignment to be retained in FLASH.<br>Default of 0 to require BOOTP. |
| 63489 | r/- | size of status block (63488 ... 63500) |
| 63490 | r/- | number of word of input<br>(in cyclic data block, 34) |
| 63491 | r/- | number of word of output<br>(in cyclic data block, 34) |
| 63492 | r/- | module ID code |
| 63493 | r/- | module revision number |
| 63494 | r/- | ASCII header size in words.<br>ASCII header is (largely!) printable and starts at 64512 |
| 63495 | r/- | internal diagnostic (not used) |
| 63496 | r/- | reservation time remaining (not used) |
| 63497 | r/- | watchdog holdup time remaining<br>(resets to value in reference 61441 at each output operation) |
| 63498 | r/- | *module health* (32768 is *good health*) |
| 63499 ... 63501 | r/- | internal diagnostic (not used) |
| 64513 ... 64522 | r/- | ASCII text description of device<br>`e.g.: "VBG-ENX-K30-DMD-S16"` |

*Tab. 13-52.*

**AS-i circuit 1**
**process data and actual configuration data**

| 4x reference | access | data |
|---|---|---|
| 4097 ... 4112 | r/- | input data image IDI |
| 4113 ... 4128 | r/w | output data image ODI |
| 4129 ... 4144 | r/w | parameter image PI[1] |
| 4145 ... 4208 | r/- | configuration data image CDI |
| 4209 ... 4212 | r/- | list of activated slaves LAS |
| 4213 ... 4216 | r/- | list of detected slaves LDS |
| 4217 ... 4220 | r/- | list of periphery faults LPF |
| 4225 | r/- | EC-flags |
| 4226 | r/w | hi-flags |

*Tab. 13-53.*

1. Writing to the references 4129 to 4144 invokes the Execution Control function. Write_Parameter () rather than writing the PI.

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**4x reference 4225**

| Bit value | execution control flags |
|---|---|
| $1_h$ | Config_OK! |
| $2_h$ | LDS.0 |
| 4 | Auto_Address_Assign |
| $8_h$ | Auto_Address_Available! |
| $10_h$ | Configuration_Active |
| $20_h$ | Normal_Operation_Active! |
| $40_h$ | APF/not APO |
| $80_h$ | Offline_Ready |
| $100_h$ | Periphery_OK! |
| $1000_h$ | Earth Fault |
| $2000_h$ | Overvoltage |
| $4000_h$ | Noise |
| $8000_h$ | Duplicate Address |

*Tab. 13-54.*

| | |
|---|---|
| Config_OK!: | Configuration error<br>*0: error*<br>*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<br>*0: Auto-address is not possible*<br>*1: Auto-address is possible* |
| Configuration_Active: | The configuration-mode is active |
| Normal_Operation_Active!: | The normal operation mode is active<br>*0: normal operation is not active*<br>*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<br>*0: Periphery is not OK*<br>*1: Periphery is OK* |
| Earth Fault: | AS-i earth fault detection<br>*0: no earth fault*<br>*1: earth fault* |
| Overvoltage: | AS-i overvoltage detection<br>*0: no overvoltage*<br>*1: overvoltage fault* |
| Noise: | AS-i noise detection<br>*0: no noise*<br>*1: noise fault* |
| Duplicate Address: | AS-i duplicate address detection<br>*0: no duplicate address*<br>*1: duplicate address* |

**4x reference 4226**

| Bit value | Host Interface-Flags |
|---|---|
| 1 | Data_Exchange_Active! |
| 2 | Off_Line |
| 4 | Auto_Address_Enable! |

*Tab. 13-55.*

| | |
|---|---|
| Data_Exchange_Active!: | If this output is set, no data transmisson between the AS-i/Gateway and the AS-i slaves is possible.<br>0: Data exchange is not active<br>1: Data exchange is active |

| | |
|---|---|
| Off-line: | This output sets the master into the off-line phase. |
| Auto_Address_Enable!: | This output blocks automatic slave-address programming.<br>0: Auto-address is disabled<br>1: Auto-address is enabled |

**4x reference 4145 ... 4208**

| Bit mask | data |
|---|---|
| $000F_h$ | I/O configuration |
| $00F0_h$ | ID-code |
| $0F00_h$ | extended ID 1-code |
| $F000_h$ | extended ID 2-code |

*Tab. 13-56.*

### *Arrangement of lists LAS, LOS, LPS, LCS, DELTA and LPF*

The lists LAS, LOS, LPS, LCS, DELTA und LPF are arrangement bit by bit, see the table below:

**LAS, LOS, LPS, LCS, DELTA, LPF (16-bit)**

| $2^{15}$ | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^9$ | $2^8$ | $2^7$ | $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |

*Tab. 13-57.*

| | |
|---|---|
| LAS: | list of activated slaves |
| LOS: | list of offline slaves |
| LPS: | list of projekted slaves |
| LCS: | list of corrupted slaves |
| DELTA: | list of slaves with configuration error |
| LPF: | list of periphery faults |

## 13.1 Safety Control/Status

### 13.1.1 Internal Monitor for VBG-ENX-K30-DMD-S16-C1, VBG-ENX-K30-DMD-S16

**Safety Control Status internal monitor (data for read access)**

| 4x 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 | | | | | | | |

*Tab. 13-58.*

**Coding of status bytes per OSSD**

| Bit [0 ... 3] | State or. color |
|---|---|
| $00_{16}$ | green permanent lighting |
| $01_{16}$ | green flashing |
| $02_{16}$ | yellow permanent lighting |
| $03_{16}$ | yellow flashing |
| $04_{16}$ | red permanent lighting |
| $05_{16}$ | red flashing |
| $06_{16}$ | grey or off |
| $07_{16}$ | reserved |
| Bit [6] | status or color |
| 0 | no device flashing yellow |
| 1 | at least one device flashing yellow |
| Bit [7] | status or color |
| 0 | no device flashing red |
| 1 | at least one device flashing red |

*Tab. 13-59.*

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 internal monitor (data for write access)

**Safety Control internal monitor (data for write access)**

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

*Tab. 13-60.*

### 13.1.2 Internal Monitor for VBG-ENX-K30-DMD-S16-EV

**Safety status internal monitor (data for read access)**

| 4x 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 | | | | | | | |

*Tab. 13-61.*

### 13.1.3 Safety fieldbus bits for VBG-ENX-K30-DMD-S16-EV

**Safety fieldbus bits (data for read/write access)**

| 4x 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 | feldbus bits | | | | | | | | | | | | | | | |

*Tab. 13-62.*

### 13.1.4 External monitor, AS-i circuit 1/2

**Safety status external monitor (data for read access)**

| 4x reference | access | data 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 |
| 5641 | r / – | slave 1: OSSD 1 | | | | | | | | slave 1: OSSD 2 | | | | | | | |
| … | … | … | | | | | | | | … | | | | | | | |
| 5648 | r / – | slave 1: OSSD 15 | | | | | | | | slave 1: OSSD 16 | | | | | | | |
| 5649 | r / – | slave 2: OSSD 1 | | | | | | | | slave 2: OSSD 2 | | | | | | | |
| … | … | … | | | | | | | | … | | | | | | | |
| 5887 | r / – | slave 31: OSSD 15 | | | | | | | | slave 31: OSSD 16 | | | | | | | |

*Tab. 13-63.*

**Coding of status bytes per OSSD**

| Bit [0 ... 3] | State or. color |
|---|---|
| $00_{16}$ | green permanent lighting |
| $01_{16}$ | green flashing |
| $02_{16}$ | yellow permanent lighting |
| $03_{16}$ | yellow flashing |
| $04_{16}$ | red permanent lighting |
| $05_{16}$ | red flashing |
| $06_{16}$ | grey or off |
| $07_{16}$ | reserved |
| Bit [6] | status or color |
| 0 | no device flashing yellow |
| 1 | at least one device flashing yellow |
| Bit [7] | status or color |
| 0 | no device flashing red |
| 1 | at least one device flashing red |

*Tab. 13-64.*

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 status external monitor (data for write access)**

| 4x reference | access | data 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 |
| 5889 | r / w | reserved | | | | | | | | | | | | Slave 1 2.Y2 | Slave 1 2.Y1 | Slave 1 1.Y2 | Slave 1 1.Y1 |
| 5890 | r / w | reserved | | | | | | | | | | | | Slave 2 2.Y2 | Slave 2 2.Y1 | Slave 2 1.Y2 | Slave 2 1.Y1 |
| … | … | … | | | | | | | | | | | | … | … | … | … |
| 5919 | r / w | reserved | | | | | | | | | | | | Slave 31 2.Y2 | Slave 31 2.Y1 | Slave 31 1.Y2 | Slave 31 1.Y1 |

*Tab. 13-65.*

## 13.2 AS-i circuit 1 data

### 13.2.1 Permanent configuration data

**AS-i circuit 1**
**permanent configuration data**

| 4x reference | access | data |
|---|---|---|
| 4385 ... 4400 | r/w | permanent parameter (*PP*) |
| 4401 ... 4464 | r/w | permanent configuration data (*PCD*) |
| 4465 ... 4468 | r/w | list of projected slaves (*LPS*) |

*Tab. 13-66.*

### 13.2.2 Enhanced diagnostic

**AS-i circuit 1**
**enhanced diagnostic**

| 4x reference | access | data |
|---|---|---|
| 4609 ... 4672 | r/- | transmisson error counters[1] |
| 4673 ... 4676 | r/- | list of corrupted slaves LCS[1] |
| 4677 ... 4680 | r/w | list of offline slaves LOS |
| 4681 ... 4684 | r/- | delta list |

*Tab. 13-67.*

1. The transmission error counters and the LCS are reset each time they are read.

### 13.2.3 Function invocation

**AS-i circuit 1**
**function invocation**

| 4x reference | access | data |
|---|---|---|
| 4865 | -/w | function: opcode<br>1: Set_Operation_Mode<br>2: Change_Slave_Address<br>3: Store_Actual_Parameters<br>4: Store_Actual_Configuration<br>5: Execute_Command<br>6: Send_Parameter |
| 4865 | r/- | function: result<br>0: success<br>32769: failure<br>32770: slave with 1st addr not detected<br>32771: slave with zero addr detected<br>32772: slave with 2nd addr detected<br>32773: delete error<br>32774: set error<br>32775: address stored temporarily<br>32776: extended ID1 stored temporarily<br>32777: error reading extended ID1<br>32778: parameter out of range<br>32779: invalid opcode |
| 4866 | r/w | function: parameter 1 (old slave address) |
| 4867 | r/w | function: parameter 2 (new slave address) |

*Tab. 13-68.*

| | |
|---|---|
| Set_Operation_Mode: | A zero in the 4x reference 4865 activates the protected mode. All other values switch on the configuration mode. |
| Change_Slave_Address: | This function will be executed, if the value 2 is written to the 4x reference 4865. The value written in the 4x reference 4867 will be the new address of the slave. The old address has to be written to the 4x reference 4866 before. |
| Store_Actual_Parameters: | If the value 3 is written to the 4x reference 4865, the actual parameters (PI) will be stored as parameters projected (PP). |
| Store_Actual_Configuration: | If the value 4 is written to the 4x reference 4865, the actual AS-i configuration will be stored as projected parameters (PCD, LPS). |
| Execute_command: | If the value 5 is written to the 4x reference 4865, this function will be executed. The value written in the 4x reference 4867 will be sent as the information-part to a slave, which the 4x reference has been written before to the 4x reference 4866. |

***Information!***

***B** addresses are located behind **A** addresses.*

*Addresses **0** … **31** correspond to **0A** … **31A**, addresses **32** … **64** correspond to **0B** … **31B**.*

## 13.3 AS-i circuit 1 analog data

### 13.3.1 16 bit output data of AS-i slaves according to slave profile 7.3 or 7.4

**AS-i circuit 1**
**16 bit output data of AS-i slaves according to slave profile 7.3 or 7.4**

| | | data | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4x reference | word | $2^{15}$ | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^{9}$ | $2^{8}$ | $2^{7}$ | $2^{6}$ | $2^{5}$ | $2^{4}$ | $2^{3}$ | $2^{2}$ | $2^{1}$ | $2^{0}$ |
| 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. 13-69.*

### 13.3.2 16 bit input data of AS-i slaves according to slave profile 7.3 or 7.4

**AS-i circuit 1**
**16 bit input data of AS-i slaves according to slave profile 7.3 or 7.4**

| | | data | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4x reference | word | $2^{15}$ | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^{9}$ | $2^{8}$ | $2^{7}$ | $2^{6}$ | $2^{5}$ | $2^{4}$ | $2^{3}$ | $2^{2}$ | $2^{1}$ | $2^{0}$ |
| 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. 13-70.*

## 13.4 AS-i circuit 2 data

### 13.4.1 Process data and actual configuration data

**AS-i circuit 2**
**process data and actual configuration data**

| 4x reference | access | data |
|---|---|---|
| 8193 ... 8208 | r/- | input data image IDI |
| 8209 ... 8224 | r/w | output data image ODI |
| 8225 ... 8234 | r/w | parameter image PI[1] |
| 8241 ... 8304 | r/- | conguration data image CDI |
| 8305 ... 8308 | r/- | list of activated slaves LAS |
| 8309 ... 8312 | r/- | list of detected slaves LDS |
| 8313 ... 8316 | r/- | list of periphery faults LPF |
| 8321 | r/- | ec-flags |
| 8322 | r/w | hi-flags |

*Tab. 13-71.*

1. Writing to the refercences 8225 to 8234 invokes the Execution Control function. Write_Parameter() rather than writing the PI.

### 13.4.2 Permanent configuration data

**AS-i circuit 2**
**permanent configuration data**

| 4x reference | access | data |
|---|---|---|
| 8481 ... 8496 | r/w | permanent parameter (PP) |
| 8497 ... 8560 | r/w | permanent configuration data (PCD) |
| 8561 ... 8564 | r/w | list of projected slaves (LPS) |

*Tab. 13-72.*

### 13.4.3 Enhanced diagnostic

**AS-i circuit 2**
**enhanced diagnostic**

| 4x reference | access | data |
|---|---|---|
| 8705 ... 8768 | r/- | transmisson error counters[1] |
| 8769 ... 8772 | r/- | list of corrupted slaves (LCS)[1] |
| 8773 ... 8776 | r/w | list of offline slaves (LOS) |
| 8777 ... 8780 | r/- | delta list |

*Tab. 13-73.*

1. The transmission error counters and the LCS are reset each time they are read.

### 13.4.4 Function invocation

**AS-i circuit 2**
**Function invocation**

| 4x reference | access | data |
|---|---|---|
| 8961 | -/w | function: opcode<br>1: Set_Operation_Mode<br>2: Change_Slave_Address<br>3: Store_Actual_Parameters<br>4: Store_Actual_Configuration<br>5: Execute_Command<br>6: Send_Parameter |
| 8961 | r/- | function: result<br>0: success<br>32769: failure<br>32770: slave with 1st addr not detected<br>32771: slave with zero addr detected<br>32772: slave with 2nd addr detected<br>32773: delete error<br>32774: set error<br>32775: address stored temporarily<br>32776: extended ID1 stored temporarily<br>32777: error reading extended ID1<br>32778: parameter out of range<br>32779: invalid opcode |
| 8962 | r/w | function: parameter 1 |
| 8963 | r/w | function: parameter 2 |

*Tab. 13-74.*

## 13.5 AS-i circuit 2 analog data

### 13.5.1 16 bit output data of AS-i slaves according to slave profile 7.3 or 7.4

**AS-i circuit 2**
**16 bit output data of as-i slaves according to slave profile 7.3 or 7.4**

| | | data | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4x reference | word | $2^{15}$ | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^{9}$ | $2^{8}$ | $2^{7}$ | $2^{6}$ | $2^{5}$ | $2^{4}$ | $2^{3}$ | $2^{2}$ | $2^{1}$ | $2^{0}$ |
| 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. 13-75.*

### 13.5.2 16 bit input data of as-i slaves according to slave profile 7.3 or 7.4

**AS-i circuit 2**
**16-bit input data of AS-i slaves according to slave profile 7.3 or 7.4**

| | | data | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4x reference | word | $2^{15}$ | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^{9}$ | $2^{8}$ | $2^{7}$ | $2^{6}$ | $2^{5}$ | $2^{4}$ | $2^{3}$ | $2^{2}$ | $2^{1}$ | $2^{0}$ |
| 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. 13-76.*

## 13.6 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 automaticly 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 to 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 to 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).

# 14. Operation via Ethernet IP (Modbus/TCP)

The AS-i/Gateway acts as a 1 or 2 complete Master for the AS-i and as a 256 bit digital I/O module for Ethernet. All possibilities offered by AS-i can be used via Ethernet TCP/IP.

The used Modbus/TCP protocol is similar to the Modbus protocol. Specifically, it covers the use of Modbus messaging in an Intranet or Internet environment using TCP/IP protocols. The only differences to the Modbus protocol are the form of any "framing" sequence, error check pattern and address interpretation.

All requests are sent via TCP on registered port 502.

**Data addresses in Modbus messages**

*All data addresses in Modbus messages are referenced to zero. The first occurrence of a data item is addressed as item number zero.*

*For example:*

*The coil known as "coil 1" in a programmable controller is addressed as coil 0000 in the data address field of a Modbus message.*

*Coil 127 decimal is addressed as coil 007E hex (126 decimal).*

*Holding register 40001 is addressed as register 0000 in the data address field of the message. The function code field already specifies a "holding register" operation. Therefore the "4XXXX reference is implicit.*

*Holding register 40108 is addressed as register 006B hex (107 decimal).*

## 14.1 Message Structure

Telegrams from the Modbus-Master (query-messages) and answers of the Modbus slaves have the same structure:

The request and response are prefixed by 6 bytes as follows:

| T1 high | T2 low | P1 high | P2 low | B1 high | B2 low | UI | F | D1 high | D2 low | ... | Dn low |
|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| Transaction identifier $T_1$,$T_2$: | usually 0 - copied by server. |
| protocol identifier $P_1$,$P_2$: | 0 |
| length field $B_1$: | upper byte of the length field = 0 (since all messages are smaller then 256) |
| length field $B_2$: | lower byte of the length field = number of bytes following |
| unit identifier UI: | value to indentifying the client |
| funktion code F: | Code of Modbus-function to be executed by the slave. Under certain circumstances the slave could answer with an error-telegram. In this case the function-code in the response-message is increased by 128. |
| data bytes $D_1$ ... $D_n$: | Field to hold user-data. The number of bytes is variable |

***Information!***

*Checksum fields are not needed, because the TCP/IP and link layer (eg. Ethernet) instad are used to verfiy accurate delivery of the packet.*

**Example transaction:**

Read 1 register at offset 4 from UI 9. Return value is 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| request | 00 | 00 | 00 | 00 | 00 | 06 | 09 | 03 | 00 | 04 | 00 | 01 |
| response | 00 | 00 | 00 | 00 | 00 | 05 | 09 | 03 | 02 | 00 | 05 | |

## 14.2 Ethernet TCP/IP functions

In the following chapter are shown the support functions. Please note, that only the related bytes are shown (bytes 0 - 3 are let away, because the values are 0).

### 14.2.1 Function 3 (3hex): "*Read multiple registers*"

This function allows to read the value of read/write-registers.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| request: | 3 | R1 high | R2 low | N1 high | N2 low | | |
| response: | 3 | B | D1 high | D1 low | … | Dn high | Dn low |

| | |
|---|---|
| R1/R2: | reference number (high byte / low byte) |
| N1/N2: | word count (range 1 - 125) (high byte / low byte) |
| response: | |
| B: | byte count of response (b = 2 x word count) |
| D: | register values |

### 14.2.2 Function 16 (10hex): "*Write multiple registers*"

This function allows the setting of several read/write-registers:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| request: | 10 | R1 high | R2 low | N1 high | N2 low | B | D1 high | D1 low | ... | Dn high | Dn low |
| response: | 10 | R1 high | R2 low | N1 high | N2 low | | | | | | |

| | |
|---|---|
| R1/R2: | reference number (2 byte hex-value of register e.g. 8192 = 0x2000) |
| N1/N2: | Word count (1 - 100) (2 byte) |
| B: | byte count of response (B = 2 x word count / 1 byte) (redundant information to word count but necessary). |
| D1 … Dn: | register values |

### 14.2.3 Function 23 (17hex): "Read/Write multiple registers"

This function allows to read the value of read/write-registers and the setting of several read/write-registers:

| request: | 17 | RR high | RR low | NR high | NR low | RW high | RW low |
|---|---|---|---|---|---|---|---|

| | NW high | NW low | B | D1 high | D1 low | … | Dn low |
|---|---|---|---|---|---|---|---|

| response: | 17 | B | D1 high | D1 low | … | Dn high | Dn low |
|---|---|---|---|---|---|---|---|

| | |
|---|---|
| RR: | reference number for read (2 byte hex-value of register) |
| NR: | word count for *read* (1 - 125) (2 byte) |
| RW: | reference number for *write* (2 byte hex-value of register) |
| NW: | word count for *write* (1 - 100) (2 Byte) |
| B: | byte count (B = 2 x word count for write / 1 byte)<br>(redundant information to Word count but necessary) |
| D1 ... Dn: | register value |

**Example:**

*Read* 2 registers at reference 0 and write 1 register at reference 3 of value 4660 returning values 4 and 4951.

| request: | 17 | RR high | RR low | NR high | NR low | RW high | RW low | NW high | NW low | B | D1 high | D1 low |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| request: | 17 | 00 | 00 | 00 | 02 | 00 | 03 | 00 | 01 | 02 | 46 | 60 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| response: | 17 | B | D1 high | D1 low | D2 high | D2 low |
|---|---|---|---|---|---|---|

| response: | 17 | 04 | 00 | 04 | 49 | 51 |
|---|---|---|---|---|---|---|

### 14.2.4 Exception codes

There is a defined set of exception codes to be returned by slaves in the event of problems. Note that masters may send out commands "speculatively", and use the success or exception codes received to determine which MODBUS commands the device is willing to respond to and to determine the size of the various data regions available on the slave.

All exceptions are signaled by adding 128 to the function code of the request, and following this byte by a single reason byte for example as follows:

**For instance:**

03 46 60 00 01 ⇒ 128 02

| | |
|---|---|
| request: | read 1 Register at index 4660 |
| response: | exception type 2 - „illegal data address“ |

**List of exceptions:**

- 01 ILLEGAL FUNCTION
  The function code received in the query is not an allowable action for the slave. This may be because the function code is only applicable to newer controllers, and was not implemented in the unit selected. It could also indicate that the slave is in the wrong state to process a request of this type, for example because it is unconfigured and is being asked to return register values.
- 02 ILLEGAL DATA ADDRESS
  The data address received in the query is not an allowable address for the slave. More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, a request with offset 96 and length 4 would succeed, a request with offset 96 and length 5 will generate exception 02.
- 03 ILLEGAL DATA VALUE
  A value contained in the query data field is not an allowable value for the slave. This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the MODBUS protocol is unaware of the significance of any particular value of any particular register.
- 04 ILLEGAL RESPONSE LENGTH
  Indicates that the request as framed would generate a response whose size exceeds the available MODBUS data size. Used only by functions generating a multi-part response, such as functions 20 and 21.
- 05 ACKNOWLEDGE
  Specialized use in conjunction with programming commands
- 06 SLAVE DEVICE BUSY
  Specialized use in conjunction with programming commands
- 07 NEGATIVE ACKNOWLEDGE
  Specialized use in conjunction with programming commands
- 08 MEMORY PARITY ERROR
  Specialized use in conjunction with function codes 20 and 21, to indicate that the extended file area failed to pass a consistency check.
- 0A GATEWAY PATH UNAVAILABLE
  Specialized use in conjunction with Modbus Plus gateways, indicates that the gateway was unable to allocate a Modbus Plus PATH to use to process the request. Usually means that the gateway is misconfigured.

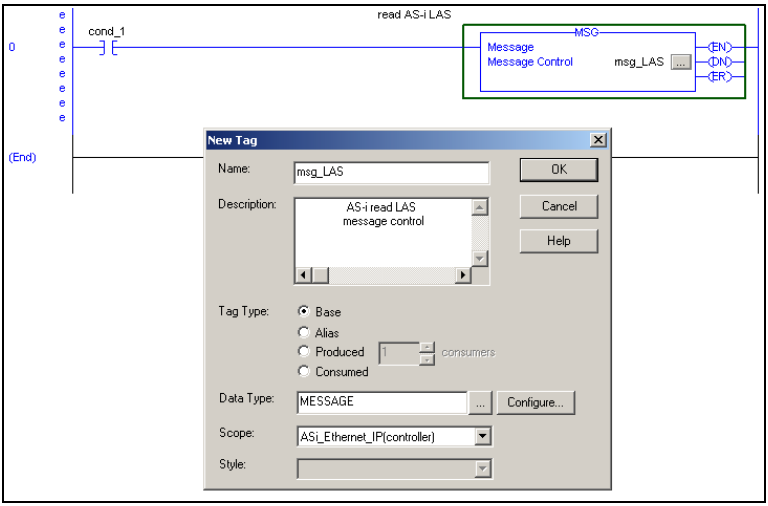
- 0B GATEWAY TARGET DEVICE FAILED TO RESPOND
  Specialized use in conjunction with Modbus Plus gateways, indicates that no response was obtained from the target device. Usually means that the device is not present on the network.

# 15. Data Transfer using CIP Messages in RSLogix5000

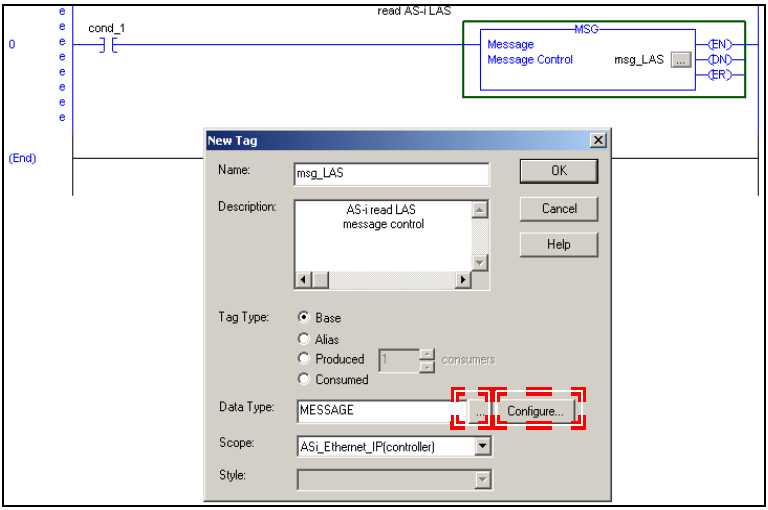
This chapter explains the data transfer of AS-i 3.0 EtherNet/IP Gateways using CIP Messages in RSLogix5000.

## 15.1 MSG instruction and Message Type Tag

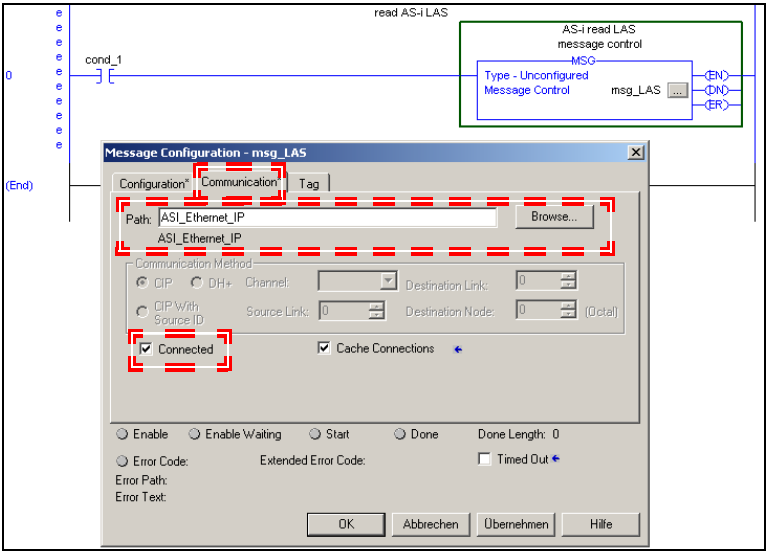
- ☐ Include a MSG instruction.
- ☐ Create a new MESSAGE-type tag as control tag for the instruction.




- ☐ Select "Configure" on the "New Tag" window or "..." next to the tag name to open the "Message Configuration" window.

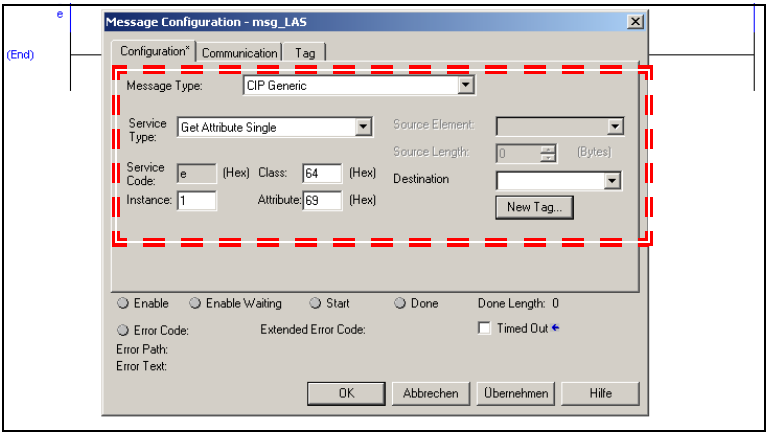


- Select the "Communication" tab.
- Browse to the "AS-i Ethernet IP" module
- Check the "Connected" check box.



## 15.2 Example 1: read LAS

- Select the "Configuration" tab in the "Message Configuration" window
- Select:
  - Message Type: CIP generic
  - Service Type: Get attribute single
- Map:
  - For "Class": "64"
  - For "Instance": "1" (for AS-i circuit 1)
  - For "Attribute": "69"
- As "Destination", create a new tag or select an existing tag to hold the incoming data.



## 15.3 Example 2: read/write 16-bit (analog) data

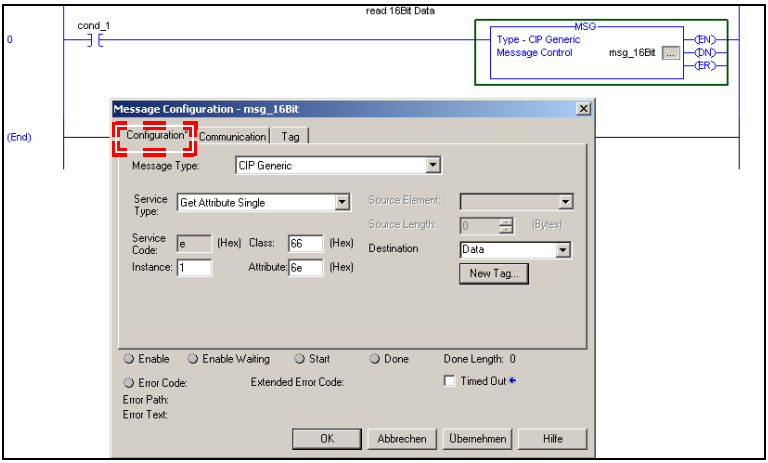
- Select the "Configuration" tab in the "Message Configuration" window
- Select:
  - Message type: CIP generic

**Read 16-bit data from slave address 7**

- Select:
  - Service type: Get attribute single
- Map:
  - For "Class": "66"
  - For "Instance": "1" (for AS-i circuit 1)
  - For "Attribute": "6E" (16-bit input data slave 7)
- As "Destination", create a new tag or select an existing tag to hold the incoming data.

**Write 16-bit data to slave address 7**

- Select:
  - Service type: Set attribute single
- Map:
  - For "Class": "66"
  - For "Instance": "1" (for AS-i circuit 1)
  - For "Attribute": "8D" (16-bit output data slave 7)
- As "Source element", create a new tag or select an existing tag to hold the outgoing data
- As "Source length": "4" (16-bit data = 8 bytes)



## 16. System startup using AS-i Control Tools

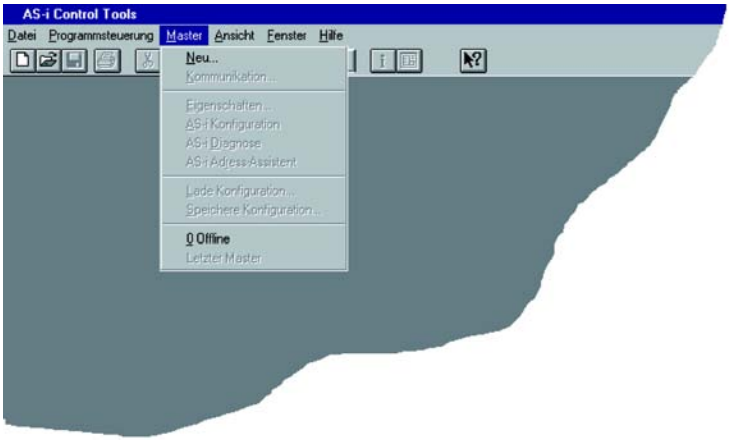
The Windows based software AS-i Control Tools enables an easy and clear configuration of the AS-i network.

***Information!***

*AS-i Control Tools must be installed first!*

*This way, the device driver is copied into the previous designed folder in AS-i Control Tools and should be recognized automatically.*

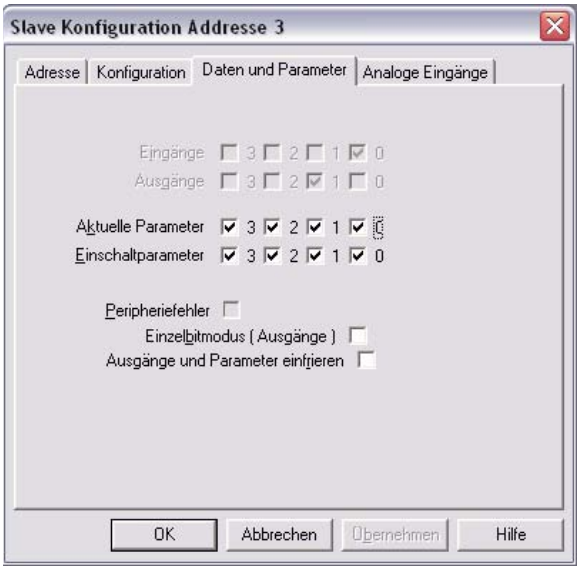
1. Connect the device to the PC via its serial interface and the diagnostic interface.
2. Start AS-i Control Tools.
3. Select Master | New.




4. Choose RS232 diagnostic interface as the protocol.

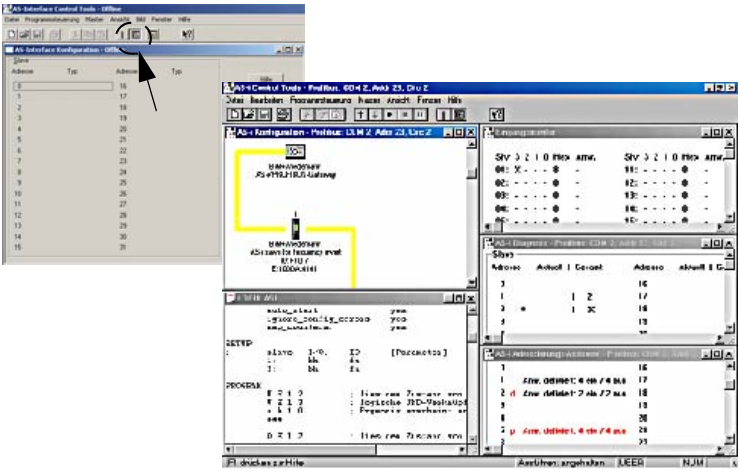

5. Select the appropriate settings (for example serial interface COM 2, station address <auto>).
6. Select Master | AS-i configuration.
7. The AS-i configuration editor will be started. All detected and configured AS-i slaves are displayed in this window.

8. Click on a slave to open the dialog window 'slave configuration'.




This window enables the user to edit a slave address and to set AS-i parameters or AS-i configuration data. Additionally, inputs and outputs can be tested.

9. Click the second button on the right side of the tool bar to get a graphical display of "AS-i Control Tools".



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Configuring the AS-i network is easily accomplished by first connecting each AS-i slave separately to the AS-i line and setting its address, followed by pressing the button “Store configuration” to store the existing AS-i network in the AS-i master as configuration data.

Furthermore, an **AS-i Address Assistant** is available, allowing to perform an address change of a new AS-i slave to the desired address as soon as it is connected to the AS-i network. The desired AS-i configuration can be created offline ahead of time and can be stored to a file. When setting up the system the AS-i slaves are then simply connected, one at a time, to the AS-i network. Further descriptions to all additional features of this software can be obtained from the integrated help file.

# 17. Configuration with Windows Software ASIMON 3 G2

***Information!***

*Please note further information in the configuration software **ASIMON 3 G2** for Windows.*

# 18. Safe Link

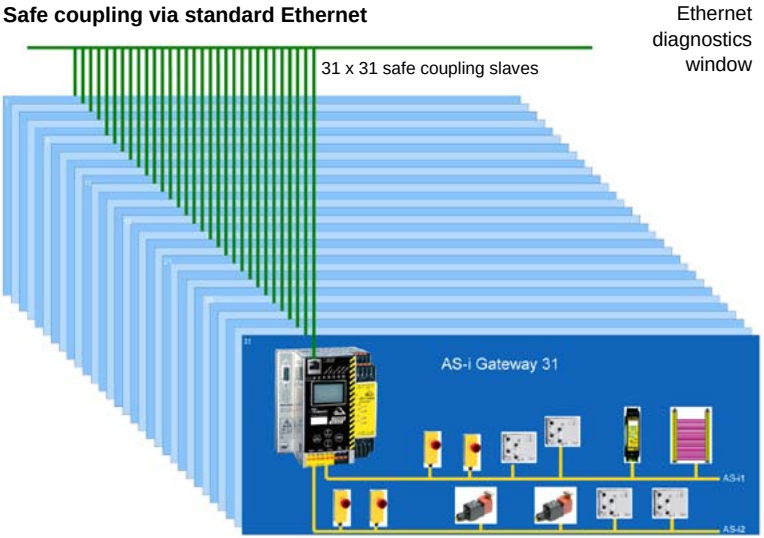
## 18.1 General introduction

Safe Link represents the most efficient and cost-effective way to link safe signals from multiple AS-i networks.

As for an AS-i linking network, safe linking using potential-free contacts or safe electronic in- and outputs eliminates expensive and cumbersome wiring. Safe Link also offers the same system range as a PROFINET controller based on the PROFIsafe standard without being restricted to a particular system controller.

Safe Link allows up to 1922 safe inputs to be processed in a full configuration of 31 gateways with 62 safe slaves. 31 safe bits per Gateway are provided for coupling, resulting in a total of 961 signals that can be safely coupled.

**Safe coupling via standard Ethernet**




For Safe Link the Gateways are connected over the Ethernet diagnostics interface (10 Mbit/s, half-duplex) and a switch. In the case of PROFINET and EtherNET/IP+Modbus TCP, instead the fieldbus interface can be used for Safe Link.

If the Ethernet interface is used for coupling, devices having different controller systems (such as PROFIBUS, PROFINET, EtherNet/IP, Modbus, sercos, etc.) can exchange signals with each other without any additional effort using the switch.

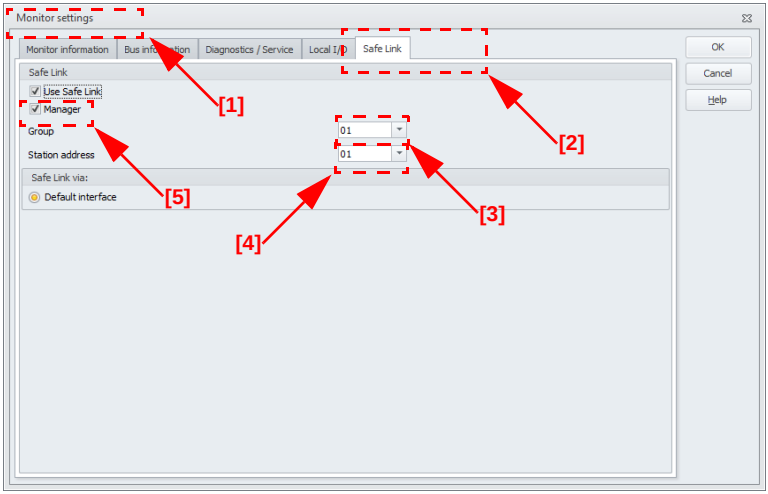
Since data transmission is based on the sending of multicasts, it must be ensured that the switch used can process and pass along the corresponding broadcasts.

## 18.2 Configuration

| | |
|---|---|
| **Safe Link** | |
| Ethernet diagnostics interface | 10Mbits, half-duplex |
| Ports | Depends on the Multicast group<br>Port 1024 to 1038 |
| Protocol | UDP |
| Data packets | 72 bytes per packet<br>Average 286 packets per second |
| **Group organization** | |
| Number | max. 15 groups<br>(Group addresses 1 to 15) |
| No. of devices | max. 31 devices per group |
| **System size** | |
| max. system size | 31 Gateways x 62 safe input slaves<br>= 1922 safe inputs in full configuration |
| **Kopplung** | |
| max. no. of coupled signals | 31 GW x 31 signal bits<br>= 961 safe coupled signals in full configuration |
| **Switch** | |
| Requirements | • Multicast-capable<br>• If not all connected devices receive all signals, an IGMP-capable lean managed switch is required |

### 18.2.1 Configuration using ASIMON

Complete configuration of Safe Link is done using the ASIMON software, in the "Monitor/Bus information" section **[1]** on the "Safe Link" tab **[2]**.




Here the group and device addresses are assigned and the safe programs for the individual Gateways managed. Information about the IP addresses of the participating devices are also stored in the project structure.

In organizational terms all Gateways that need to communicate with each other are combined in one group (Group addresses 1 to 15) **[3]**.

Each device in a group is given a unique device address (Device addresses 1 to 31) **[4]**.

One of the devices is assigned as the manager of the group [5], which means it monitors whether all the participating devices are present in the network.

31 bits are available in each Gateway which can be used by the other group members as safe signals.

In a full configuration with 31 Gateways this means a total of 961 safe coupled signals are available.

***Information!***

*Before setting up Safe Link, be sure you have read the information on configuring Safe Link in the ASIMON documentation in the section <Safe Link Tab>*

## 18.3 Diagnostics

***Directly on the device***

If a group member does not receive the expected messages from another member, it displays the device address of the missing Gateway together with the message "not active".

e.g. missing data telegrams from Devicer 4:

```
X.4 not active
```

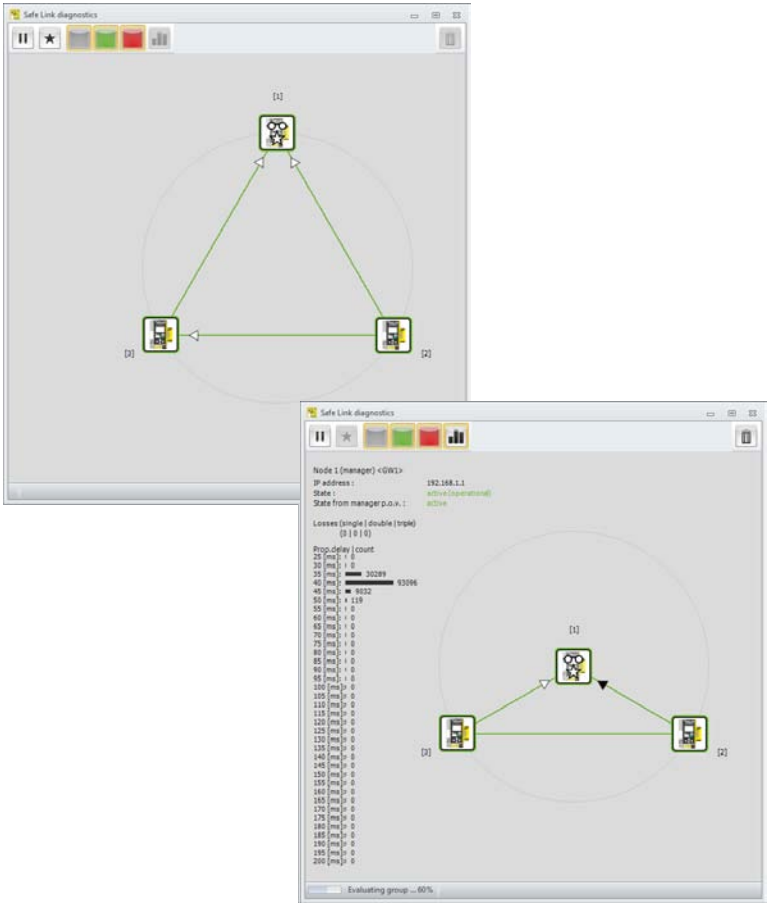
***About ASIMON***

The ASIMON software can be used at any time to perform diagnostics for the Safe Link by invoking "Safe Link diagnostics" from the "Start diagnostics" menu in the "Applications" section. This opens a window with a graphical detailed view of the state of communication for all group members.

If an error occurs in Safe Link, the corresponding signals are shown in gray in the ASIMON configuration, and at the same time a popup window opens automatically with a reference to missing devices.


Clicking on the "Safe Link diagnostics" button **[1]** on the bottom edge of the pop-up window also opens the diagnostics window for Safe Link.

Here you are shown the status and direction of communication between the individual group members in graphical format. Based on the arrow colors you can see which sections of communication may be associated with telegram errors.




***Information!***

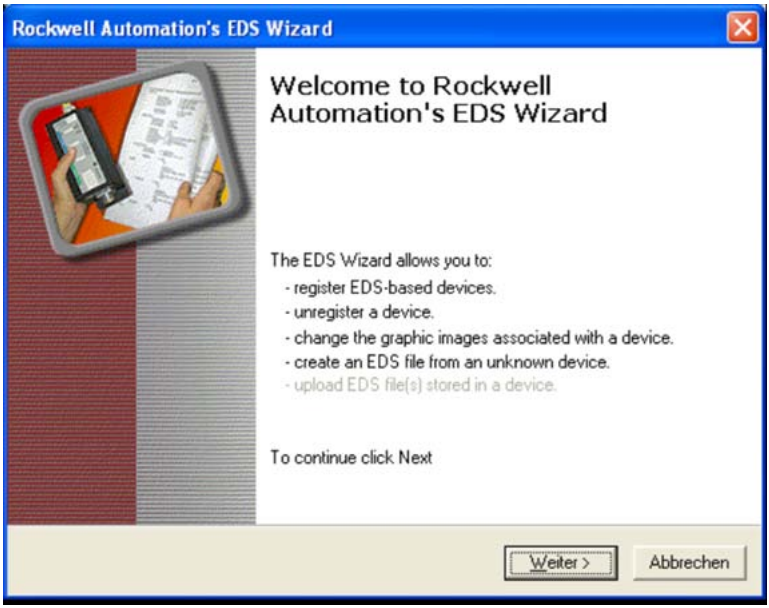
*Please refer here to the information in the ASIMON documentation in the <Safe Link diagnostics> section.*

# 19. Appendix, examples

## 19.1 Commissioning with RSLogix5000 V20 or higher

This document describes how to install and use an EDS file and an Add On Instruction for AS-i Ethernet IP Gateways in RSLogix5000 V20 or higher.

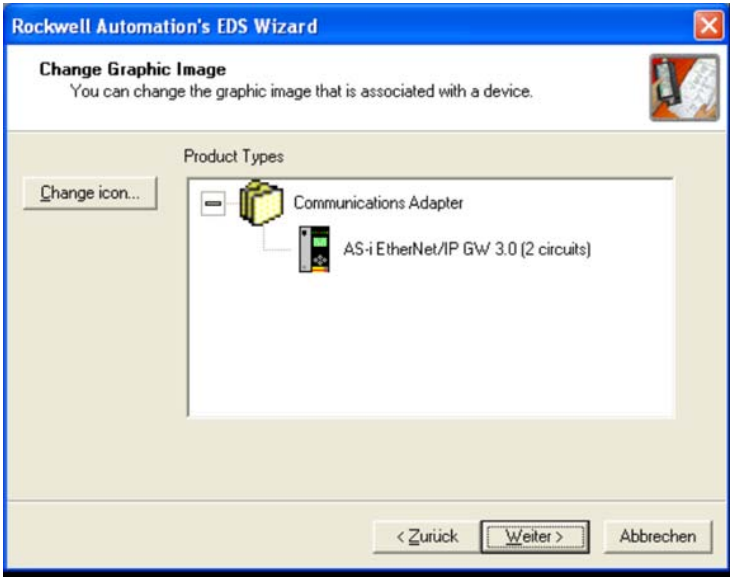
1. 1. Start the EDS Wizard: “**Tools**” –> “**EDS Hardware Installation Tool**”.



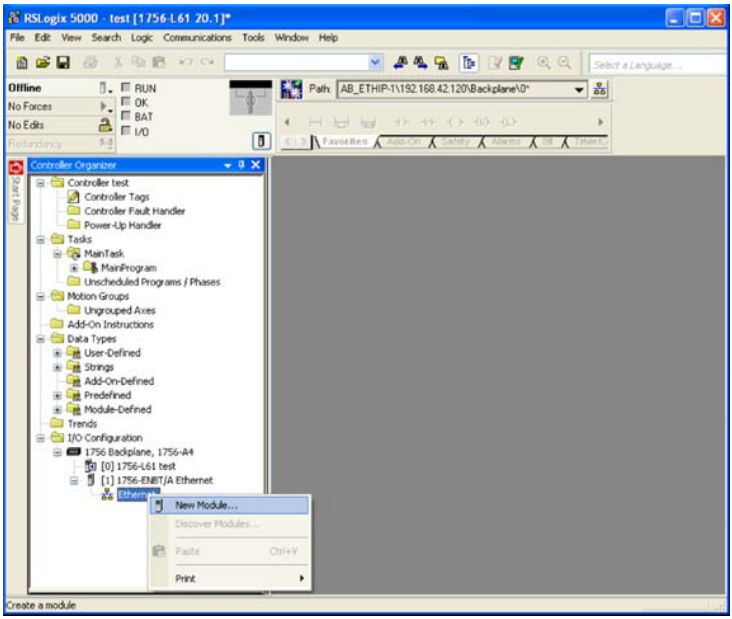
2. Select "**Register an EDS file(s)**".


3. Select your EDS file.

4. Select “**Next**” until the installation is completed.

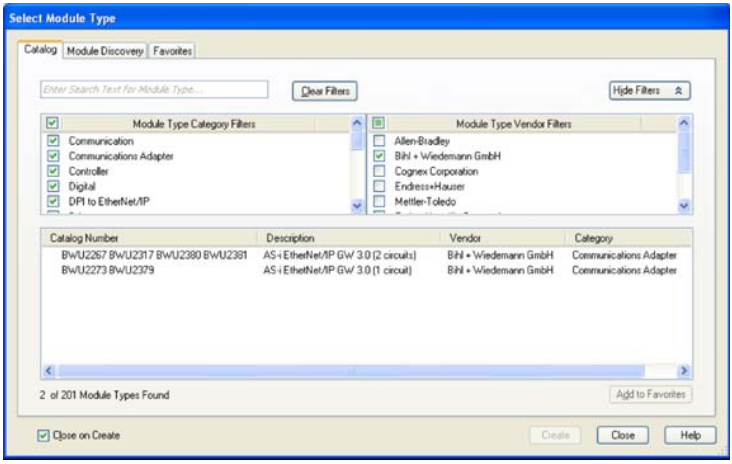



5. Create a new Module in the RSLogix I/O Configuration.

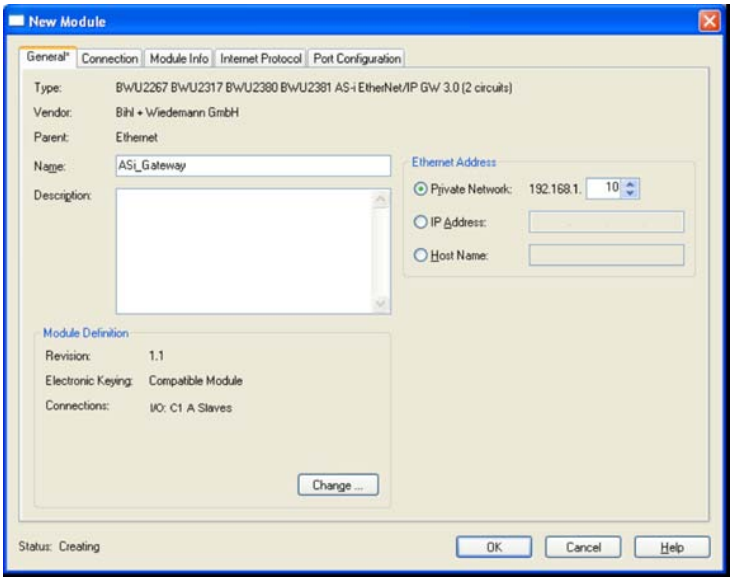



12.9.2013

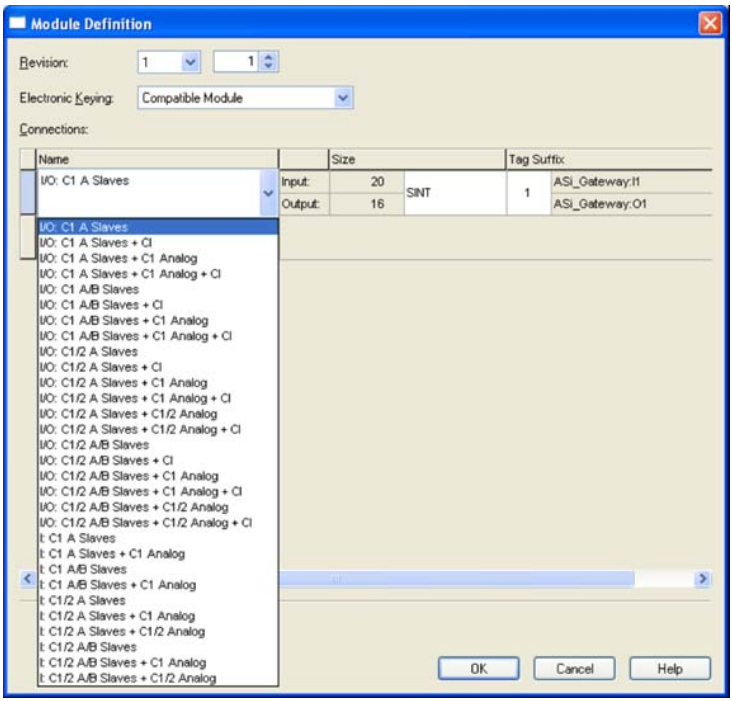
6. Select the Pepperl+Fuchs AS-i Gateway.




7. Assign Name and IP Address and select “**Change**” to change the kind of data being transferred.

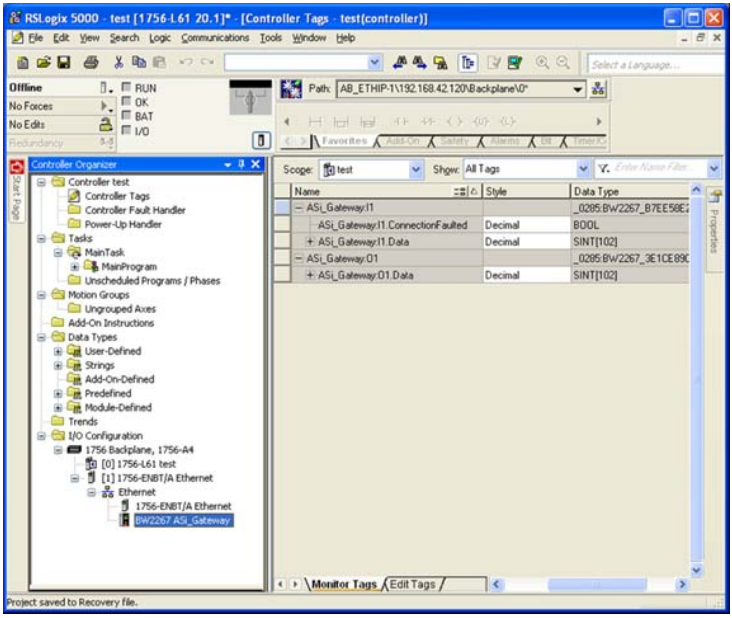


8. Use the Drop Down Menu to select the kind of data.




| abbreviation | meaning |
|---|---|
| I/O | input and output data |
| I | only input data |
| C1[/2] A[/B] slaves | circuit 1 [and 2] A [and B] AS-i slaves |
| C1[/2] analog | circuit 1 [and 2] analog slaves 29 … 31 |
| C1[/2] slaves 10 … 31 analog | circuit 1 [und 2] analog slaves 10 … 31 |
| CI | command interface |
| Safety (from SV 4.3) | Safety Control/Status (from Safety Version 4.3) |

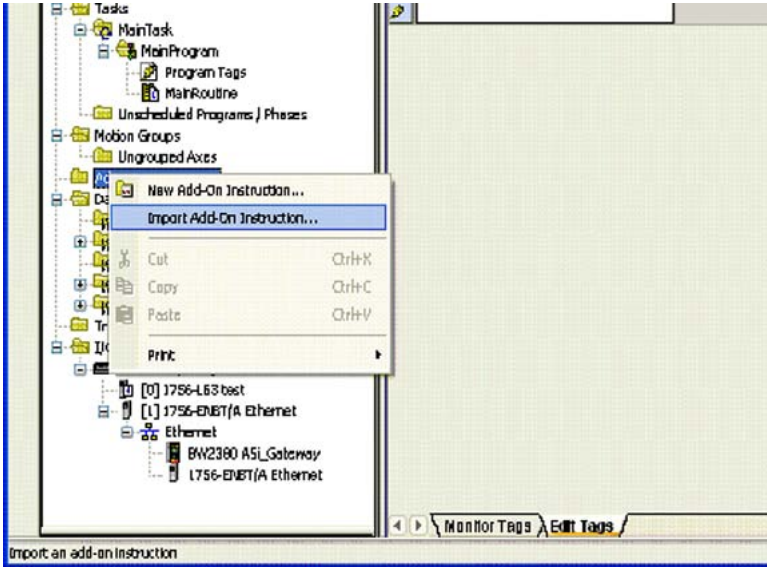
9. The AS-i Gateway data can now be found in the Controller Tags.



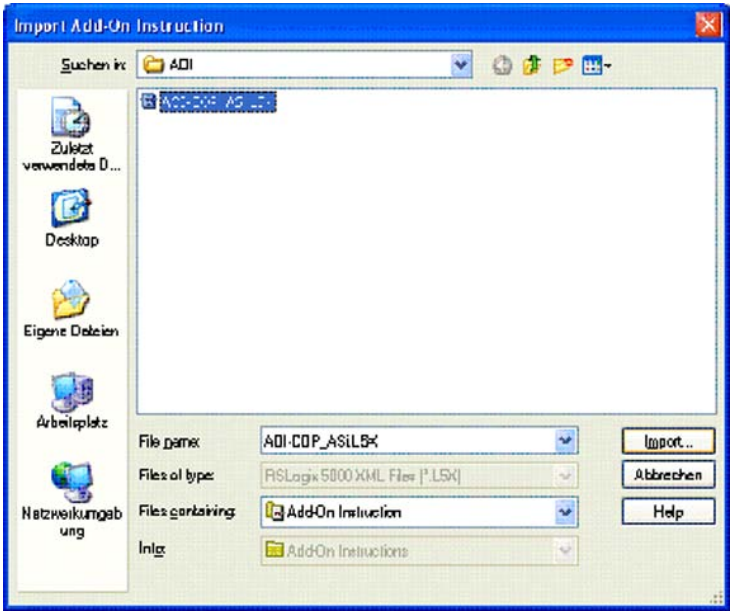
10. Optionally the example AOI (**Add-On Instructions**) can be used to copy the raw data into structured data. Free AOI examples are available:

- **AOI-COP_ASi.L5X** copies digital data (A/B slaves, circuit 1 und 2, three analog slaves and the command interface.
- **AOI-COP_ASi_Safety.L5X** copies additionally Safety Control/Status.
- **AOI-COP_ASi_Safety_Long_Analog.L5X** copies additionally up to 22 analog slaves

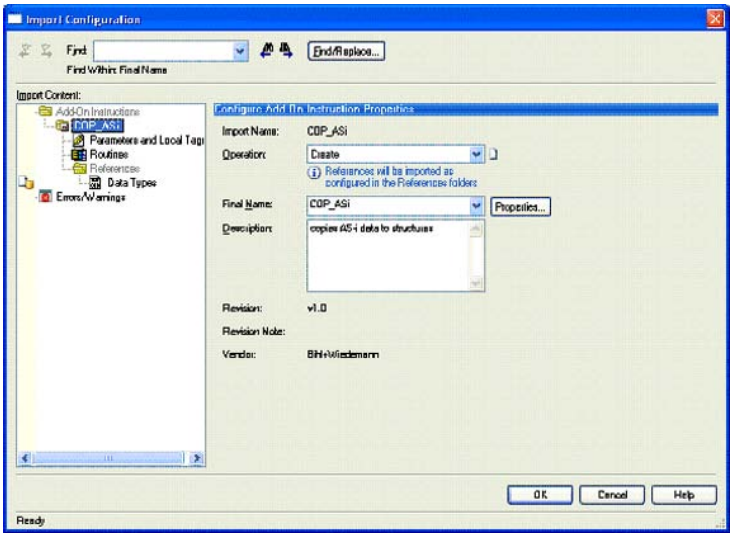
☐ Right click on "**Add-On Instructions**" and select "**Import Add-On Instruction**".



11. Select the file "**AOI-COP_ASi.L5X**" (as an example).

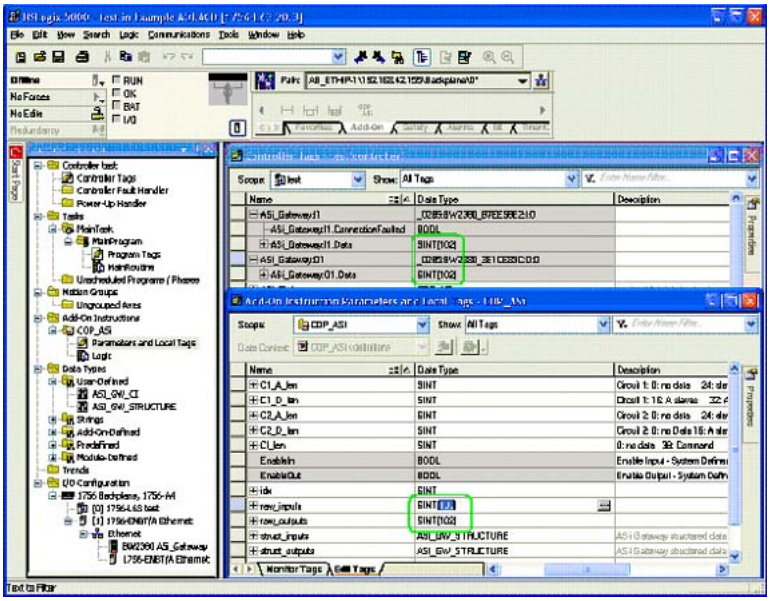



12. Confirm the Import Configuration.

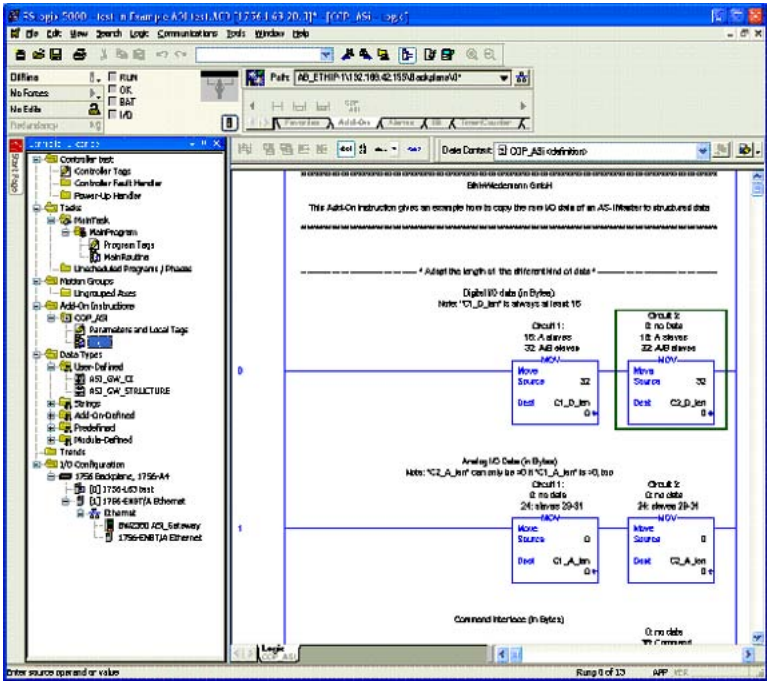


13. The Add-On Instruction “**COP_ASi**” and the User-Defined Data Types “**ASI_GW_CI**” and “**ASI_GW_STRUCTURE**” will be created.

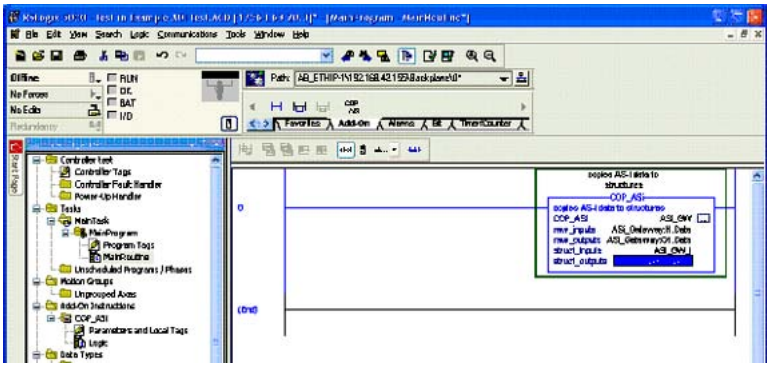
- Open the AOIs “**Parameters and Local Tags**” and adapt the size of the parameters “**raw_inputs**” and “**raw_outputs**” to the actual size of the AS-i Gateways data.



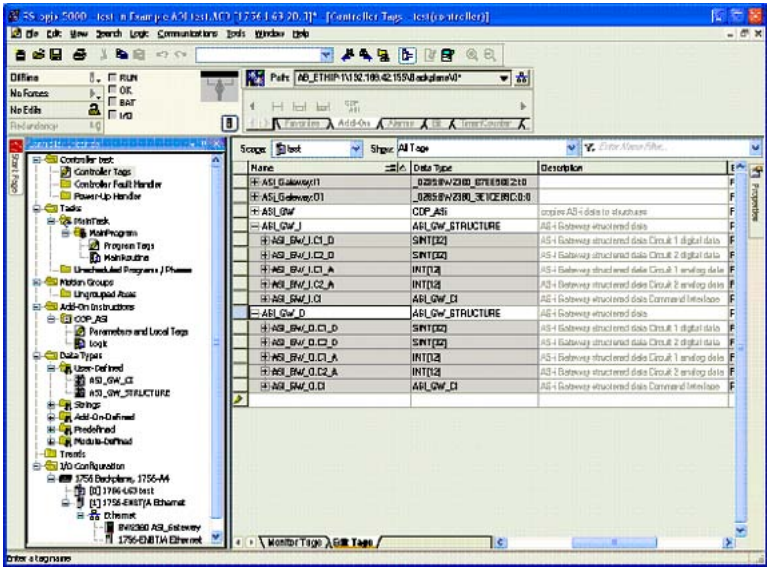
14. Open the AOIs “**Logic**” and adapt the length of the actually configured data. See comments in the routine



15. Call the **AOI** in your program.



16. The AS-i Gateway data can now be found in data structures.

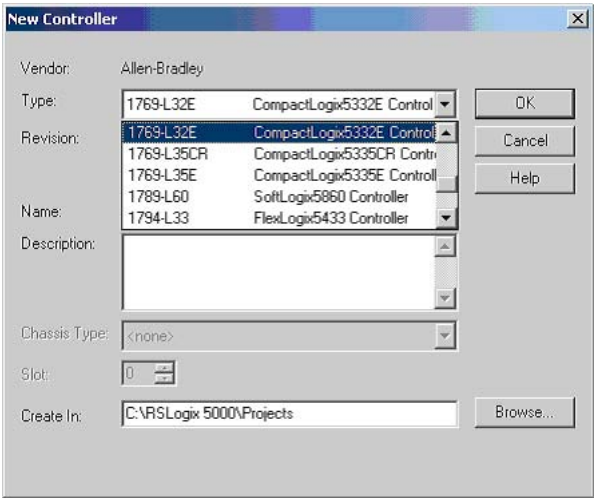


## 19.2 The first commissioning with CompactLogix

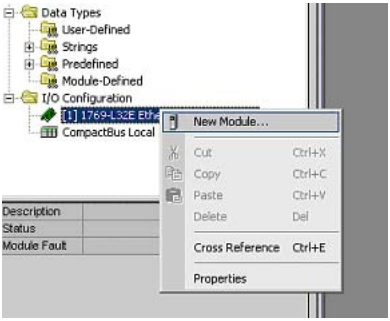
This chapter shows exemplarily the start-up of the AS i 3.0 EtherNet/IP Gateways with the software RSLogix 5000 CompactLogix, version 13.00.

- ☐ Start the software RSLogix 5000.
- ☐ Select *New* from the menu *File*.

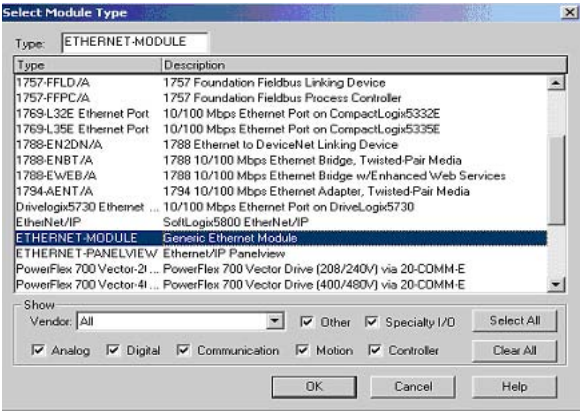
- Now select your controller, register its name and confirm with *OK*.




- Click in the tree view control window with the right mouse button on your controller
- Click in the PopUp window with the left mouse button on *New Module*.



☐ Select the entry *Generic Ethernet Module* and confirm with *OK*.




☐ Now register all necessary characteristics of the module:

- Controller name
- Comm. format
- IP-Address
- Connection parameters
- Assembly Instance - Input/Output
- Assembly Instance - Configuration
  (Register here a number between 1…255)
- Assembly Instance - Size

***Assembly Instances***

*A so-called Assembly Object specifies the structure of objects for the data communication. The data (e.g.: I/O data) can be combined into blocks with the Assembly Object Data and sent over only one communication link.*

*Thus less access to the network are necessary.*

*It is differentiated between Input Assemblies and Output Assemblies:*

*-Input Assembly reads application data over the net and/or produces data on the network.*

*-Output Assembly writes data on the application and/or prozesses data of the network.*

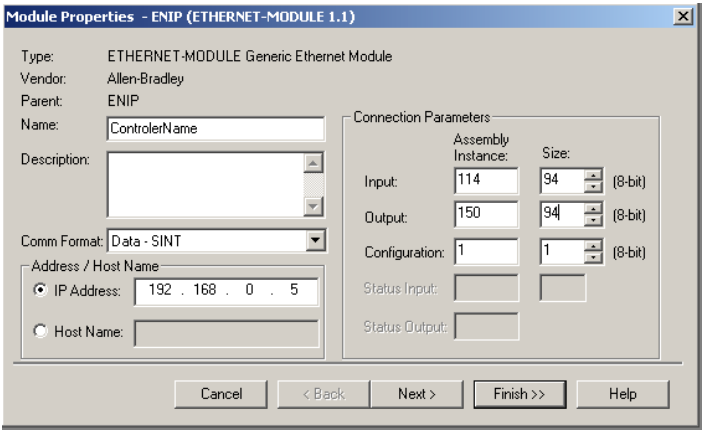
In this example the *Input Instance* **114** and the *Output Instance* **150** is used (94 bytes for in and output data).

**Allocation of the data**

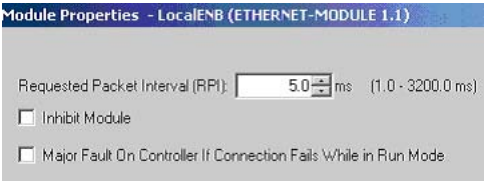
32 bytes for digital data (A/B slaves)

24 bytes for analog data (slave address 29 .. 31)

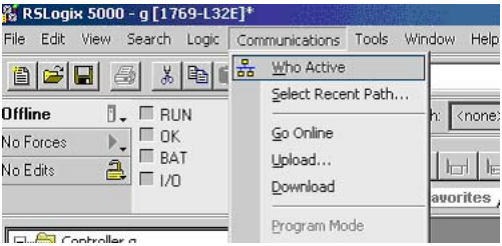
38 bytes für command interface




- Click the button *Next*
- Please enter in the data field *Request Packet Interval* (RPI) a time (see chap. <Assembly Object>) .
- Please click on the *Finish* button.



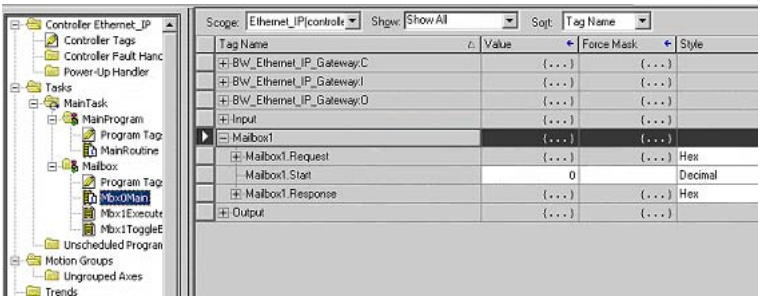

- Now you can begin programming.
- For the first downloading of the software the transmission path must be indicated. Select for this purpose from the menu *Communications* the entry: *Who Active*.




- With a double click on the pictogram *Processor* you can begin with the download.

### 19.2.1 Working with sample files

- Please unzip your "AS-i/Ethernet IP gateway with AS-i Scanner for Allen-Bradley CompactLogix" sample file.
- Please start the software RSLogix 5000.
- Please open the file "F01_Module.ACD". This sample file contains a program that shows you, how to use the command interface (mailbox).
- If it is needed, please adjust your controller and the ip of your gateway.
- Please look at the description of the controller tags, where you can find the tag *Mailbox1*.




Here you can edit the command interface instructions. You can find an appropriate description in the *Mbx0Main* routine in the *Mailbox*.

**Further sample files:**

F02_RD_RW.ACD, F03_Get_LAS.ACD, F04_READ_IDI.ACD,
F05_GET_DELTA.ACD, F06_GET_TECA.ACD,
F07_SET_LOS.ACD, F08_GET_LOS.ACD,
F09_GET_LCS.ACD, F10_GET_LPF.ACD,
F11_SafeDiagSort.ACD, F12_ACYCLIC_TRANS.

The task *MainProgram* of these examples shows, how to use some instructions of the *Command Interface* with help of the task *Mbx0Main*.

DataExchange.ACD
This sample file contains a very simple program that shows you how to read and write digital AS-interface inputs and outputs.

## 19.3 Safety diagnostics in the input data image (IDI)

***Information!***

*This functionality is available only in certain models. For additional information see section <Diagnostic values in the IDI>.*

### 19.3.1 Representation of the diagnostic information

Diagnostics in the IDI is a way to get the most important diagnostics information into the controller without using a command interface (mailbox) and without additional effort. The diagnostics information is sent in the input data image, encoded to the input bits of the safety input slave address.

Bits 0 and 1 represent the switching state of Channels 1 and 2 of the safety input, thereby making the state directly accessible very quickly.

| Bit 3 | Bit 2 | Bit 1 | Bit 0 | 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 channels closed |

*Tab. 19-77.*

Bits 2 and 3 contain the state of the safety input (the device color of the ASIMON):

| Bit 3 | Bit 2 | Bit 1 | Bit 0 | Description |
|---|---|---|---|---|
| 0 | 0 | X | X | Device color: red, green or gray |
| 0 | 1 | X | X | Device color: yellow ("wait") |
| 1 | 0 | X | X | Device color: yellow flashing ("test") |
| 1 | 1 | X | X | Device color: red flashing ("error") |

*Tab. 19-78.*

***Attention!***

Note the following points when performing an evaluation:

- The information for switching state and error status are not processed synchronously
- When there is a configuration error all bits having a value of 0 are sent; this must be noted when evaluating the data.
- When the monitor is stopped the device color is "gray".
- The state "yellow flashing" can be recognized as a transition state with regular switching. This depends on the set module type. This state should be understood as a test request only if it is stably reported.

### 19.3.2 Other representation variants

In addition to the above, there are also the following variants for representing the diagnostics:

- Safety code sequence:
  Sending of the code sequence, with no evaluation of the data; the current state is sent for each bit. Sending of a code sequence for safety input slaves results in a continuous changing between states "1" and "0".
- Substitution values:
  Substitution of the code sequences by the state of the input (Safe Subst Val), where the following values are sent:

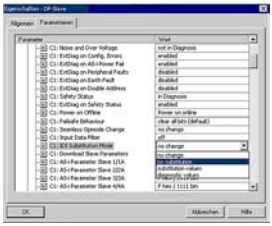
| Bit 3 | Bit 2 | Bit 1 | Bit 0 | Description |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | Both channels off |
| 0 | 0 | 1 | 1 | 2nd channel off, 1st channel on |
| 1 | 1 | 0 | 0 | 2nd channel on, 1st channel off |
| 1 | 1 | 1 | 1 | Both channels on |

*Tab. 19-79.*

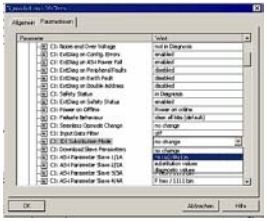
### 19.3.3 Changing the default setting

The diagnostics type is set or changed using the device display (Safety -> AS-i Safety -> Safe subst Val)

Another method for setting the diagnostics type is by using the GSD/GSDML parameters:



Old GSD files do not affect the setting; new GSDs do not change the mode by default (default setting: "no change"):

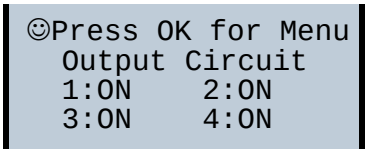


# 20. Status indication, faults and fault elimination

## 20.1 Spontaneous display of faults from the safety unit

Spontaneous messages are displayed on Pepperl+Fuchs GmbH AS-i monitors as follows:

- When both networks are operating without error, a smiley is displayed.
- When field bus communication fails, this is indicated by a text message.
- When there is a fault on an AS-i slave, this is displayed until the fault is no longer present.
- When there are no faults present, the states of the safety unit are displayed in text beneath the smiley.
- When four local release circuits are present, a line is displayed with their status.




**Coding:**

Display in protecting mode:

**1**, **2**, **3** and **4** for the release circuits

| display | status of the safety unit | meaning |
|---|---|---|
| ON | green | relais circuit turned on |
| OFF | red | relais circuit turned off |
| WAIT | flashing green | wait time Stop 1 running |
| START | yellow | waiting for Start signal |

Display in error status:

SAFETY FAULT: flashing red
TEST: flashing yellow

*Red* and *flashing yellow* are fault messages and are treated separately.

If the safety unit is in configuration mode, this is indicated by the CONFIG-OPERATION display.

*Yellow flashing* and *red flashing* means the AS-i slave address of the faulted device is displayed. If there are other faults present at the same time, all faults are displayed alternatingly.

If the safety unit is in the *red flashing* state and no menu is open, the safety unit can be unlocked by pressing the ESC/Service key (Section <Function of the ESC/ Service key>).

- If the message “Fatal Error” is reported from the safety unit, only this error message will be displayed in normal mode (not the menu). The non-safe unit continues to operate normally in this case and the menus can also be opened.

```
FATAL ERROR
000 255 222 111
```

- All other messages are not shown spontaneously.

If the safety unit is in the *yellow flashing* state, depending on the status of the configuration an external test may be required, an acknowledgement of the status may need to be made, or the turn-on delay active.

## 20.2 Replacing a defective safety-configured AS-i slave

If a safety-configured AS-i slave is defective, it can be replaced even without a PC or reconfiguration of the AS-i Safety Monitor by pressing the ESC/Service key on the AS-i Safety Monitor.

***Information!***

*Pressing the ESC/Service key changes the safety monitor from protecting mode to configuration mode. The output circuits are therefore not turned off.*

*Code tables for replaced AS-i slaves can be taught without the PIN.*

Proceed as follows:

1. Disconnect the AS-i slave from the AS-i cable.
2. Press the ESC/Service key on the AS-i Safety Monitor and on all other safety monitors for approx. 3 seconds.

```
CONNECT NEW
SLAVE 17
THEN PRESS
SERVICE
```

3. Connect the new safety-configured AS-i slave, which has already been programmed to the corresponding address, to the AS-i cable.
4. Press the ESC/Service key again on the AS-i Safety Monitor and on all other Safety Monitors which use the replacement safe AS-i slave for approx. 3 seconds. The code table for the new slave is taught and checked for correctness.
   If this is OK, the AS-i Safety Monitor changes to protecting mode. Otherwise you are prompted again to teach.

***Information!***

*Inputs on the new slave must be turned on.*

***Attention!***

*After replacing a defective safe AS-i slave, always check the correct function of the new slave.*

## 20.3 Replacing a defective AS-i Safety Monitor

If an AS-i Safety Monitor is defective and needs to be replaced, the replacement unit does not necessarily have to be newly configured using the **ASIMON 3 G2** software, rather it is possible to copy the configuration of the defective device using a chip card.

Requirement:

The replacement unit has an empty configuration in its configuration memory.

***Information!***

*After replacing a defective safe AS-i Safety Monitor, always check the correct function of the new AS-i Safety Monitor.*

## 20.4 Forget the password? What do I do now?

***Attention!***

*Only the responsible safety representative is permitted to retrieve a lost password as follows!*

If the password is lost for your configuration, proceed as follows:

1. Find the valid configuration protocol for the AS-i Safety Monitor whose password you have lost (printout or file). In the configuration protocol in line 10 (Monitor Section, Validated) you will find a 4-digit code.

- If you do not have the configuration protocol and do not want to place the AS-i safety monitor in configuration mode, connect the AS-i safety monitor whose password you have lost to the PC and start the **ASIMON 3 G2** software.
- Select a neutral configuration and start the diagnostics function in **ASIMON 3 G2** using MONITOR -> DIAGNOSTICS. Wait until the current configuration appears on the screen. This may take up to 1 minute.
- Open the window MONITOR/BUS INFORMATION (EDIT MENU -> MONITOR/BUS INFORMATION…). On the Title tab you will also find the 4-digit code in the Download time window area.

2. Contact technical support at your supplier and enter the 4-digit code.
3. From this code a master password can be generated which can be used to access the stored configuration.
4. Use this master password to stop the AS-i Safety Monitor and enter a new user password. In the Monitor menu of the **ASIMON 3 G2** configuration software select the menu item Password changing.

***Attention!***

*Please note that accessing the configuration stored in the AS-i Safety Monitor can affect the safe function of the system. Changes to released configurations are to be made only by authorized personnel. Any change must be made according to the instructions in the User's Manual for the **ASIMON 3 G2** configuration software.*

***Information!***

*The default password (factory setting) of the AS-i safety monitor is "SIMON". If you would like to reconfigure the AS-i safety monitor, you must first change this default password to a new one known only to you as safety officer.*

## 21. Codes indicated by the display

In the basic state of the configuration mode, the addresses of all detected slaves are displayed in two-second intervals. A blank display indicates that the LDS (List of Detected Slaves) is empty, no slaves were detected.

In the basic state of the protected operating mode, the display is either blank or displays the address of a faulty assignment.

During manual address programming, the slave address display has a different meaning (see also chapter "Operating in advanced display mode").

All displayed numbers bigger than 31 which can not be interpreted as a slave address are status or error messages of the master. They have the following meanings:

| | |
|---|---|
| 39 | Advanced AS-i diagnostics: After pressing the 'set'-button a short-time AS-i power failure occurred. |
| 40 | The AS-i master is in offline phase. |
| 41 | The AS-i master is in detection phase. |
| 42 | The AS-i master is in activation phase. |
| 43 | The AS-i master starts the normal operating mode. |
| 68 | Hardware error: disturbed internal communication. |
| 69 | Hardware error: disturbed internal communication. |
| 70 | Hardware error: The AS-i master's EEPROM cannot be written. |
| 71 | Wrong PIC-type. |
| 72 | Hardware error: wrong PIC-processor. |
| 73 | Hardware error: wrong PIC-processor. |
| 74 | Checksum error in the EEPROM. |
| 75 | Error in the internal RAM. |
| 76 | Error in the external RAM. |
| 77 | AS-i control software error: Stack overflow (AS-i control II) |
| 78 | AS-i control software error: checksum error in the control program.<br>"control checksum":<br>checksumm in Control III C program (bin.file) not correct. The file is possibly damaged.<br>"control exec err":<br>error in Control III C program.<br>"control watchdog":<br>watchdog predetermined in Control III C program has expired .<br>"control incomp":<br>Control III C program from another gateway type loaded (e.g. Ethernet IP in Profibus gateway). |

| | |
|---|---|
| 79 | Checksum error in the data menu.<br>"breakpoint":<br>Control III C program in break point. |
| 80 | Error while attempting to exit the configuration mode: A slave with address zero exists. |
| 81 | General error while changing a slave address |
| 82 | The front panel operation is blocked. Until repowering-up the device can only be accessed from the host via the interface. |
| 83 | Program reset of the AS-i Control program: The AS-i Control program is being read from the EEPROM and copied into the RAM. |
| 88 | Display test while starting up the AS-i master |
| 90 | Error while changing a slave address in protected operating mode: No slave with address 0 existing. |
| 91 | Error while changing slave address: Target address is already used. |
| 92 | Error while changing slave address: New address could not be set. |
| 93 | Error while changing slave address: New address could only be stored volatile in the slave. |
| 94 | Error while changing the slave address in protected operating mode: Slave has wrong configuration data. |
| 95 | The error 95 is caused by a superfluous slave and not by a missing slave. That is why the slave address is occupied by this superfluous slave.<br>(In the protected mode the slave addresses which caused any configuration error can be displayed by pressing the SET button. AS-i master without graphical display are not able to differentiate between a missing slave, an incorrect slave or a redundant slave. All incorrect addresses are displayed.<br>By pressing the SET button 5 sec. the displayed address starts to flash. Pressing the SET button again the master attempts to program the slave at the address 0 to the incorrect address.) |

# 22. Reference List

## 22.1 Manual: “ASIMON 3 G2 Configuration Software“

This Manual contains a detailed description of the configuration software for the AS-i Safety Monitor. The manual is an important component of the documentation for the AS-i Safety Monitor. It is not possible to configure and start up the AS-i Safety Monitor without the **ASIMON 3 G2** software.

## 22.2 Sources

1. Kriesel, Werner R.; Madelung, Otto W. (editors): AS-interface. Das Aktuator-Sensor-Interface für die Automation. Auflage, Carl Hanser Verlag; München, Wien, 1999, ISBN 3-446-21064-4
2. Spezifikation des AS-interface, ComSpec V3.0 AS-international Association (available from AS-international Association, http://www.as-interface.net).
3. Vorschlag eines Grundsatzes für die Prüfung und Zertifizierung von „Bussystemen für die Übertragung sicherheitsrelevanter Nachrichten“, Stand 29.2.2000.
4. AS-interface - Die Lösung in der Automation, Ein Kompendium über Technik, Funktion, Applikation (erhältlich, auch in englischer Sprache, bei AS-international Association, http://www.as-interface.net).

# 23. Glossary

**A/B slave**

An AS-i slave with extended addressing. The address range of an A/B slave extends from 1A to 31A and 1B to 31B.

**AS-i Power Fail**

Voltage below the threshold on the AS-i cable.

**I/O code**

The first digit of the slave profile, which indicates how many in- and outputs the slave has. A 4I/4O slave has for example a “7”, and a slave with 4 digital inputs a "0".

**EDM (External Device Monitoring, feedback circuit)**

Used for monitoring the switching function of the contactors connected to the Safety Monitor, whereby the normally closed contacts (forced-opening when possible) are fed back to the start circuit of the Safety Monitor. A restart is then only possible if the normally closed contacts are closed (in the quiescent state).

**ID code**

The ID code is set by the slave manufacturer and cannot be changed. The AS-i Association determines the ID codes which are assigned for a particular class of slaves. For example, all ⇒ *A/B slaves* have ID code “A“.

**ID1 Code, extended ID1 code**

The ID1 code is set by the slave manufacturer. In contrast to the other codes, which determine the profile, it can be changed from the master or using an addressing device. The user should however only use this feature in exceptional circumstances, since otherwise *configuration errors* may occur.

In the case of A/B slaves, the MSB of the ID1 code is used for distinguishing between the A and the B address. Therefore, only the lowest 3 bits are relevant for these slaves.

Since this code was not introduced until AS-i Specification 2.1, it is also referred to as extended ID1 code.

**ID2 Code, extended ID2 code**

The ID2 code is set by the slave manufacturer and cannot be changed. The AS-i Association determines the ID2 codes, which are assigned for a particular class of slaves. For example, all 2-channel 16 bit input slaves having an S-7-3 bit code use ID2 code “D”. Since this code was not introduced until AS-i Specification 2.1, it is also referred to as extended ID2 code.

**Inclusion phase**

The AS-i master sends a command to an available slave address to detect new slaves. If no reply is received, it immediately begins with the next data exchange phase.

**LPF - List of Peripheral Faults**

The list of peripheral faults was introduced with specification 2.1. This list includes an entry for each slave that signals a ⇒ peripheral fault.

**Offline phase**

In offline phase there is no communication on AS-i.

**OSSD (release circuit)**

The safe AS-i components and functional devices assigned to an output circuit of the AS-i safety monitor. They are responsible for releasing the machine element which generates the hazardous movement.

**Password**

Security code for a (security) configuration, is required for releasing a configuration or activating a changed configuration. The password is a string of 4 ... 8 alphanumeric characters. It is stored in the configuration.

**Peripheral fault**

Depending on the slave, an overflow, an overload on the sensor supply, or some other fault affecting the slave peripheral can be displayed.

**PIN**

A security code is required for teaching code sequences. The PIN is a 4-digit decimal number.

The PIN does not authorize for activating a safety configuration.

The PIN is stored in the EEPROM of the unprotected device section as well as in the unprotected area of the chip card, and is therefore sent to a new device when the chip card is replaced. When resetting to factory defaults, the PIN is set to 0000.

**Release Code**

Security code for a safety configuration on the chip card. A 4-character hexadecimal number generated by the **ASIMON 3 G 2** software. The release code is displayed before copying a configuration from the memory card to the Monitor and must be repeated by the operator.

This provides a technical safeguard against errors in the unprotected display and keyboard software.

**Single Slave**

A single slave can in contrast to a ⇒ *A/B slave* only be addressed from range 1 to 31; the fourth output data bit can be used. All slaves as defined by the older AS-i Specification 2.0 are single slaves.

There are however also single slaves as defined by Specification 2.1, for example the new 16 bit slaves.

**Slave profile**

Configuration data for a slave, consisting of:

⇒ *I/O configuration* and ⇒ *ID-Code*, as well as ⇒ *extended ID1-Code* and ⇒ *extended ID2-Code*.

The slave profile is used to distinguish between various slave classes. It is specified by the AS-i Association and set by the slave manufacturer.

AS-i 2.0 slaves do not have extended ID1 and ID2 codes. A 2.1 or 3.0 AS-interface master enters in this case an “F” for each of the extended ID1 and ID2 codes.

**Master configuration**

Released configuration, without code sequences. The safety unit cannot turn on the outputs, but as soon as the code sequences are learned, the device is usable.

Such a master configuration can for example be used in serial production machine building for loading the safety program, whereby the configuration is created in the design and the code sequences taught on the physical machine.

**Complete configuration**

Counterpart to ⇒ *master configuration*. Release configuration including code sequences. The device is always usable.

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