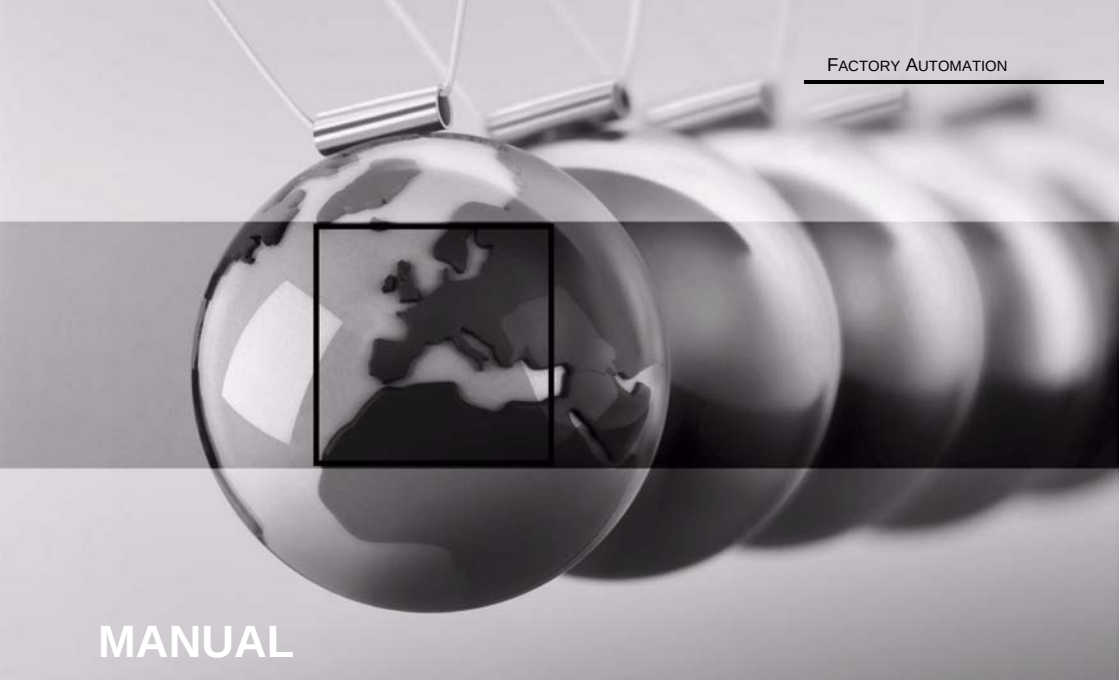

MANUAL

AS-I 3.0 ETHERNET/IP+ MODBUS TCP GATEWAY

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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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

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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 Intended use

Warning!

This symbol warns of a possible danger. The protection of operating personnel and the system against possible danger is not guaranteed if the control interface unit is not operated in accordance to its intended use.

3.2 General safety information

Warning!

Safety and correct functioning of the device cannot be guaranteed if any operation other than described in this operation manual is performed. Connecting the equipment and conducting any maintenance work under power must exclusively be performed by appropriately qualified personnel. In case a failure cannot be eliminated, the device must be taken out of operation and inadvertently operation must be prevented. Repair work must be performed by the manufacturer only. Additions or modifications to the equipment are not permitted and will void the warranty.

Information!

The operator is responsible for the observation of local safety standards.

3.2.1 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:

Artikel Nr.	Art	Schutzart	Schnittstelle, Feldbus	Anzahl AS-i Kreise, Anzahl der AS-i Master	1 Netzteil, 1 Gateway für 2 AS-i Kreise, günstige Netzteile	Diagnose- und Konfigurationsschnittstelle	Doppeladresserkennung	AS-i Wächter	AS-i Power24V[1]	Programmierung in C
VBG-ENX-K20-DMD-EV	Gateway	IP20	EtherNet/IP + ModbusTCP	2 AS-i networks, 2 AS-i Masters	yes, max. 4A/ AS-i network	Ethernet Feldbus + RS 232	yes			optional
VBG-ENX-K20-DMD	Gateway	IP20	EtherNet/IP + ModbusTCP	2 AS-i networks, 2 AS-i Masters	no, max. 8A/ AS-i network, redundant supply	Ethernet Feldbus + RS 232	yes			optional
VBG-ENX-K20-D	Gateway	IP20	EtherNet/IP + ModbusTCP	2 AS-i networks, 2 AS-i Masters	no, max. 8A/ AS-i network	Ethernet Feldbus + RS 232	yes			optional

Tab. 4-1.

1. **AS-i Power24V** capable.
The devices can be operated directly on a 24V (PELV) power supply. The gateway VBG-ENX-K20-DMD-EV is optimized with integrated data coupling coils and adjustable self-resetting fuses for safe use also of powerful 24V power supplies. The gateways VBG-ENX-K20-D and VBG-ENX-K20-DMD need to add in Power24V-operation a power supply decoupling unit.

The AS-i 3.0 EtherNet/IP+Modbus TCP Gateway serves to connect AS-i systems to the superordinate Ethernet controller.

Information!

The device uses one of two protokols: EtherNet/IP or Modbus TCP. The selection takes place in the menu (see chap. <Installation>).

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 AS-i specification 3.0

The AS-i 3.0 devices already fulfil the AS-i specification 3.0.

The previous specifications (2.1 and 2.0) are supported as well.

Advanced Diagnostics

Diagnostics, which go far beyond the standard diagnostics facilitate the simple detection of the occasionally occurring configuration errors and further irritations towards the AS-i communication. So in case of an error the down time of machines can be minimized or you can initiate preventive maintenance.

Commissioning and monitoring

Commissioning, debugging and setting up of the AS-i parameters can also be accomplished with the use of push-buttons on the frontside of the gateway, the display and the LEDs. It is also possible to do the configuration with the software "AS-i Control Tools".

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.de.

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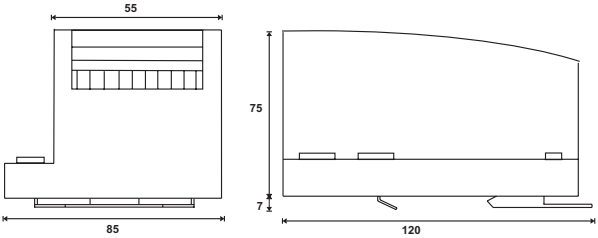
6. Installation

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

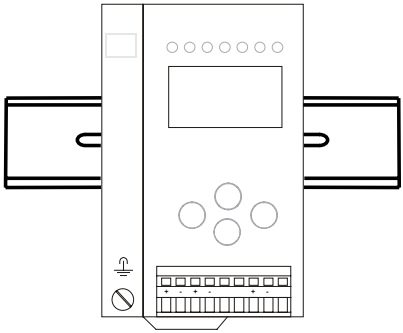
6.3 Installing in the control cabinet

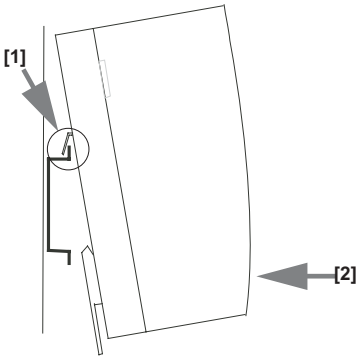
The AS-i/Gateway is installed in the control cabinet on 35mm DIN rails per DIN EN 50 022.

Information!

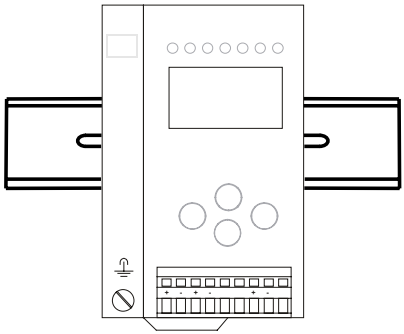
The enclosure of the AS-i/Gateway is made of stainless steel. The unit is also suitable for exposed wall mounting.

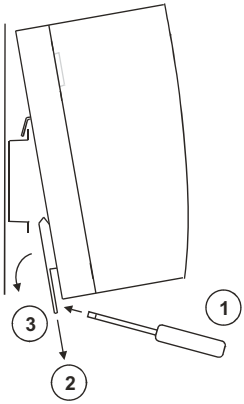
To install, place the unit on the upper edge of the DIN rail and then snap in the lower edge.





6.4 Removing

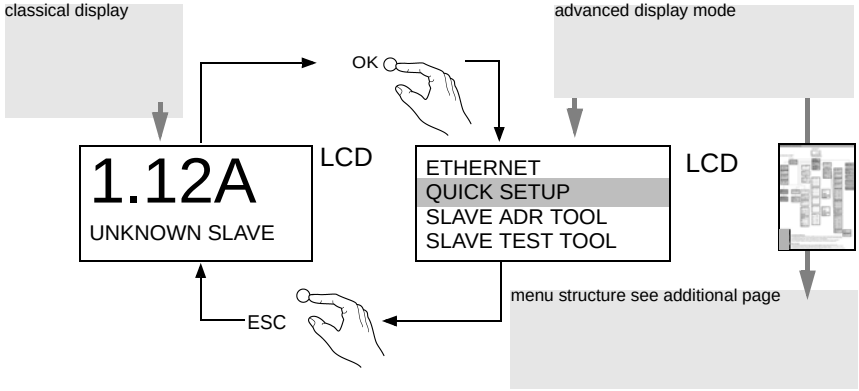




To remove, press the holding clamps [2] down using a screwdriver [1], press the unit firmly against the upper rail guide and lift out.

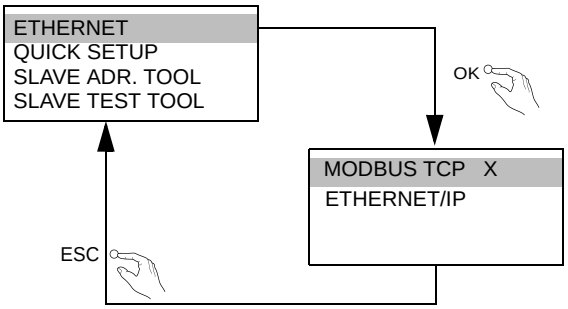
6.5 Commissioning

6.5.1 Switching to advanced display mode

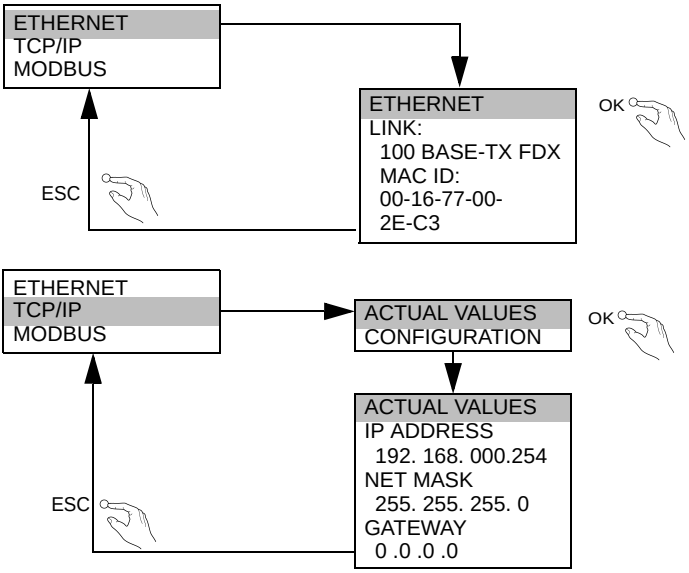


The device handels multiple protocols! Please select one of them during the initial operation.

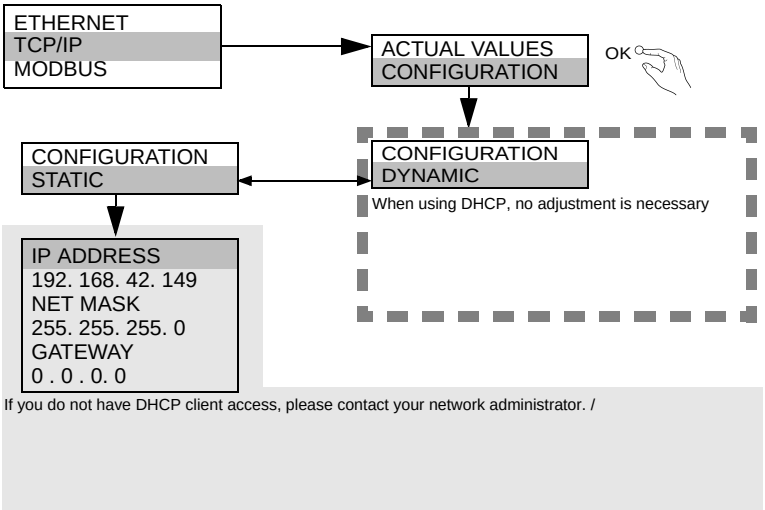
6.5.2 Select Modbus TCP



6.5.2.1 Displaying of Ethernet properties



6.5.2.2 Setting of Ethernet properties



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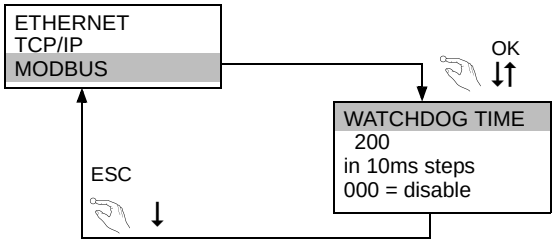
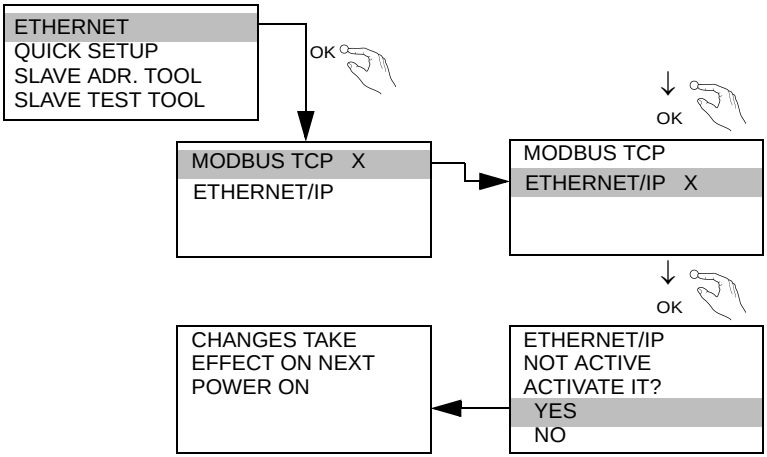
6.5.2.3 Setting of watchdog time

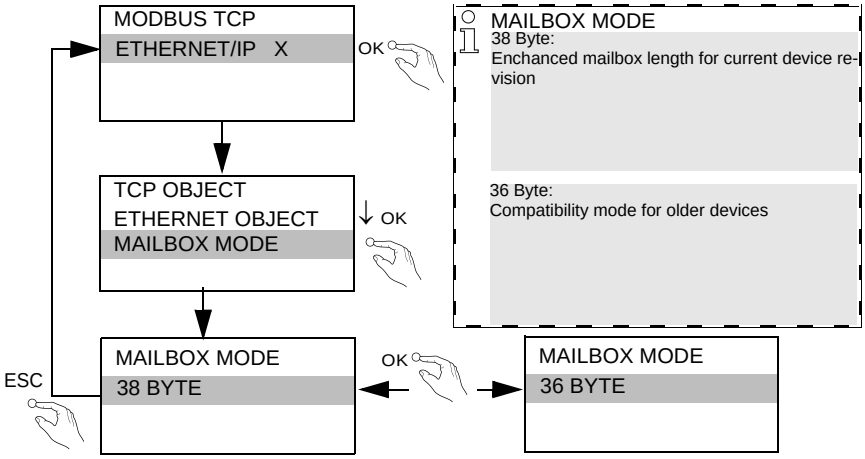


6.5.3 Select EtherNet/IP

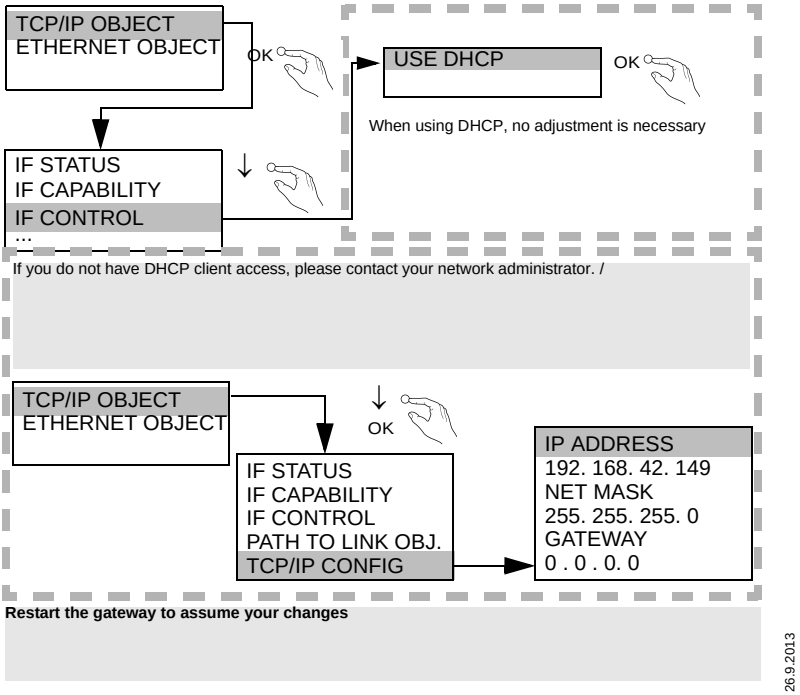


Restart the gateway to assume your changes

6.5.3.1 Select command interface mode



6.5.3.2 Setting of EtherNet/IP properties



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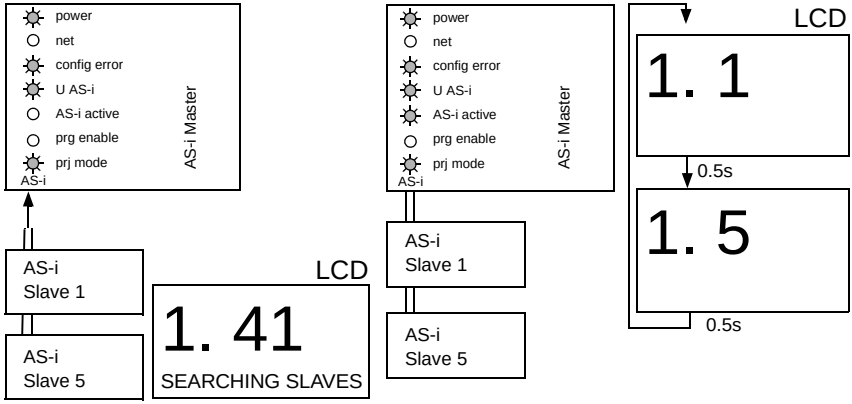
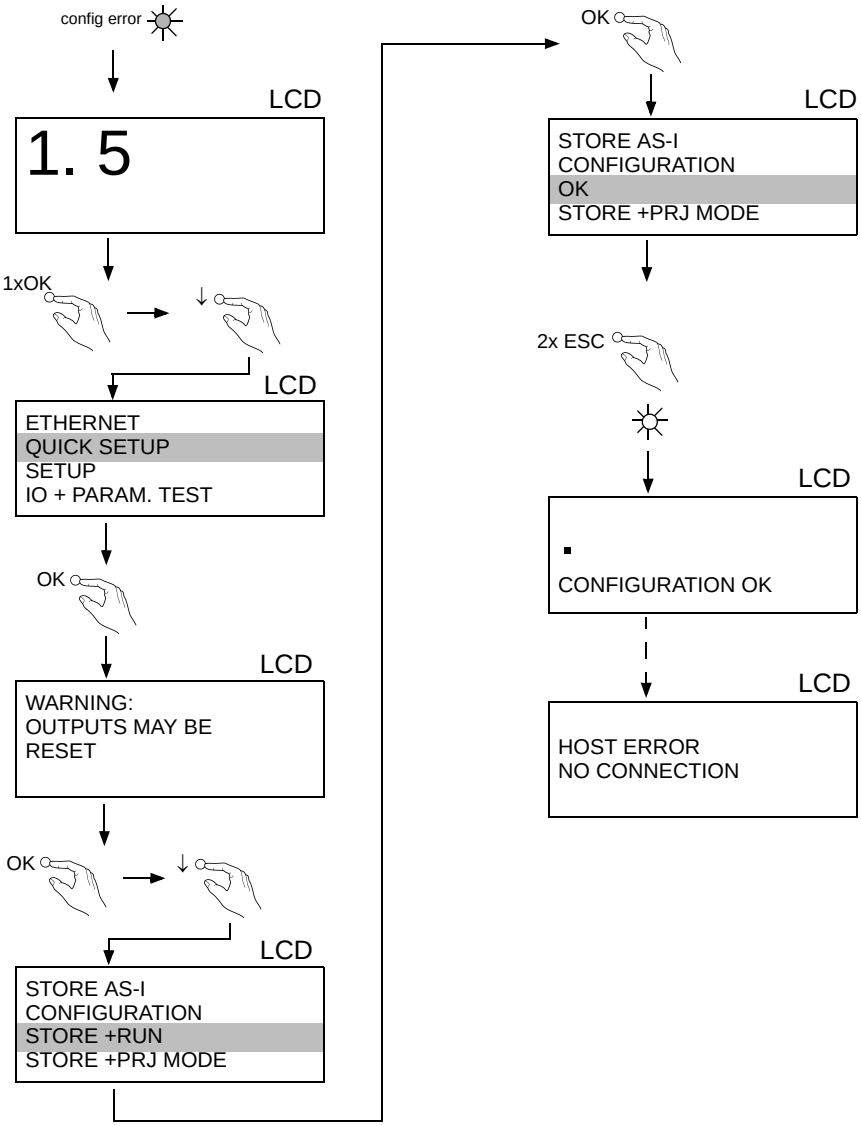
6.5.4 Connecting AS-i Slaves



6.6 Quick setup



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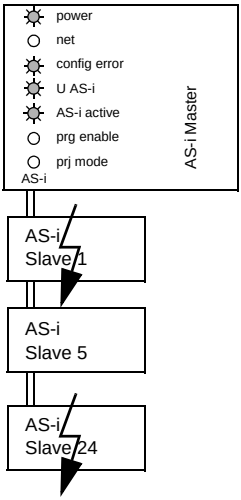
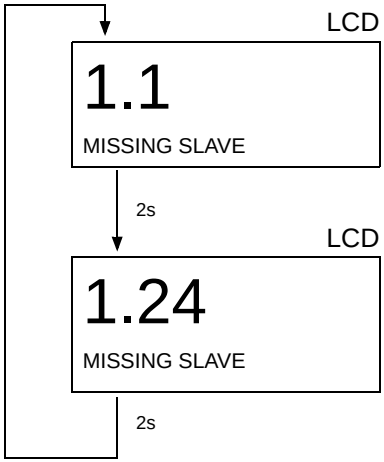
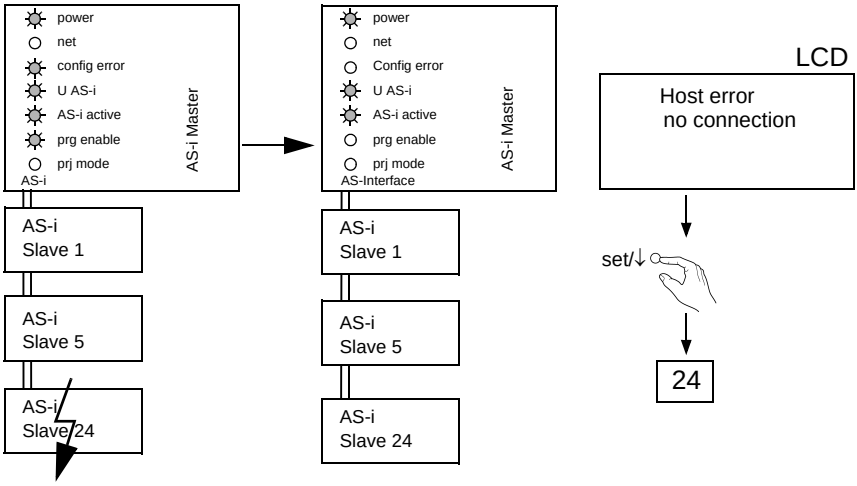
6.7 Error tracing

6.7.1 Faulty slaves



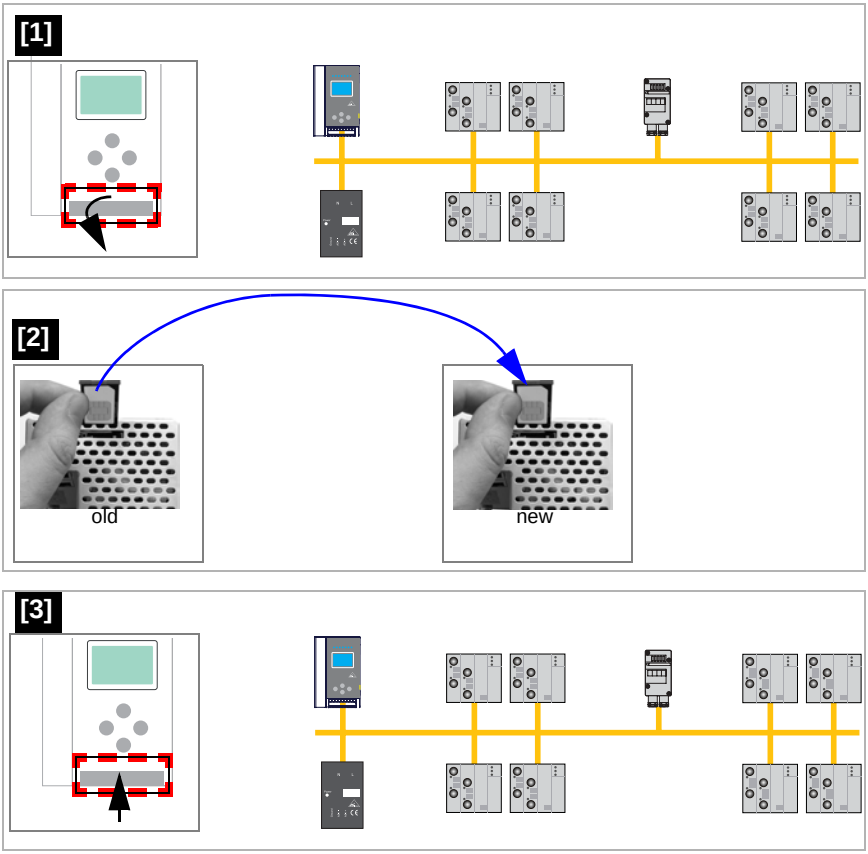


6.7.2 Error display (last error)

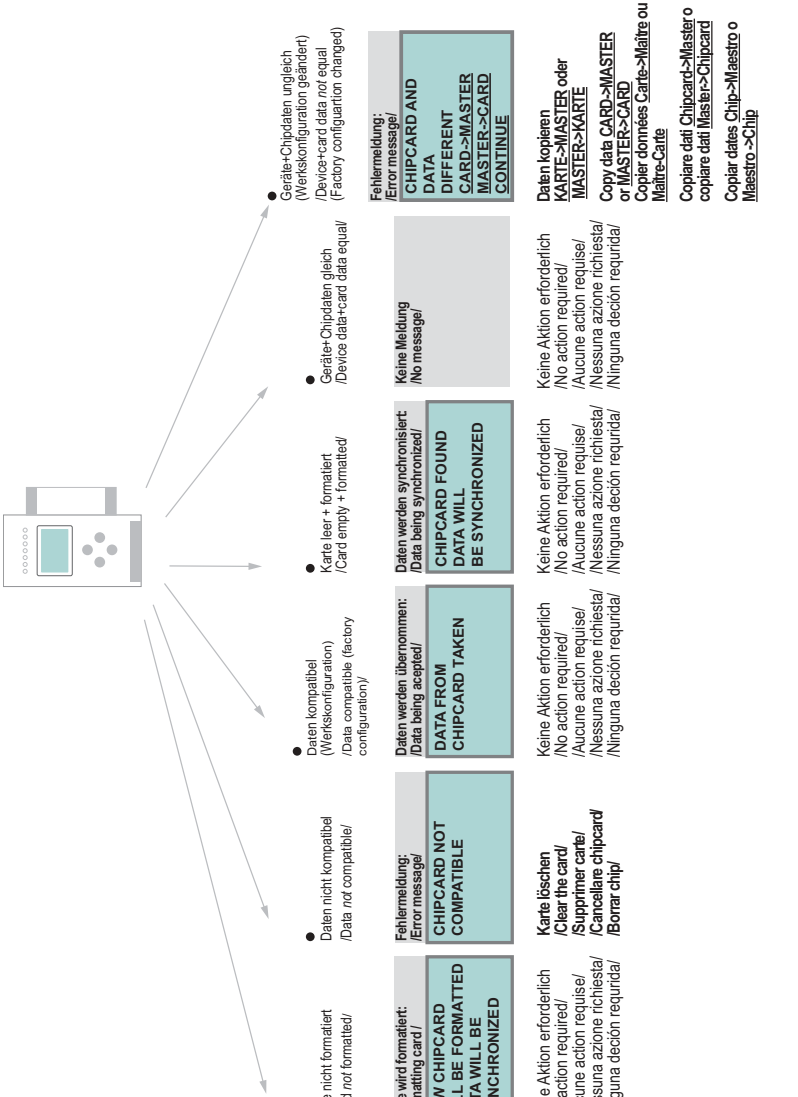


6.7.3 Replacing the chip card

Always turn off power before inserting or removing the card!



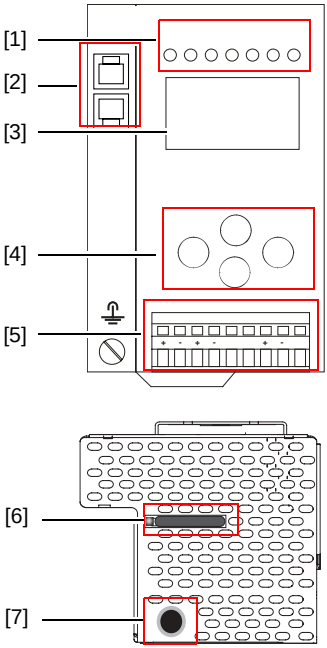
6.7.4 Local parameter setting of AS-i/Gateways



7. Electrical connection

7.1 Overview of terminals, indicators and operating elements

7.1.1 VBG-ENX-K20-D, VBG-ENX-K20-DMD, VBG-ENX-K20-DMD-EV



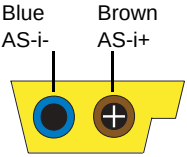
10	0,2 ... 2,5 mm²
10	0,2 ... 2,5 mm²
AWG	24 ... 12

Legend:

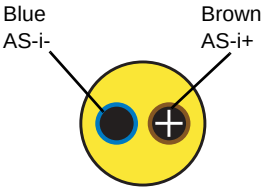
[1] LEDs
[2] Ethernet interface
[3] LC display
[4] Buttons
[5] Terminals: Supply voltage and AS-i circuit
[6] Chip card
[7] RS232 diagnostics port[1]

1. Only together with AS-i Control Tools

7.2 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.

7.3 Information about the device types

Information!

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

7.4 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.

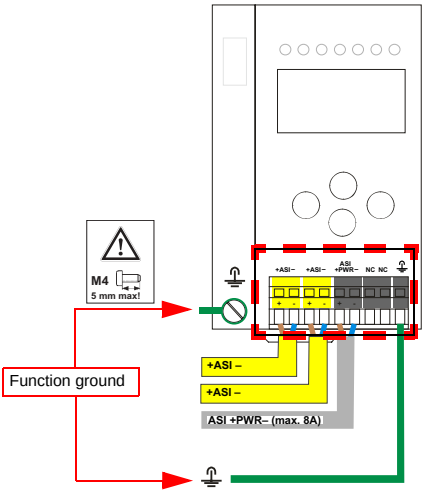
Information!

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.

7.4.1 Electrical connection VBG-ENX-K20-D

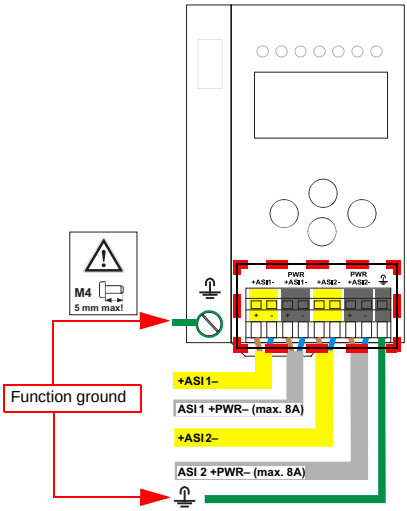


Terminal	Signal / Description
+AS-i–	Connection to AS-i Circuit
ASI +PWR–	Supply voltage for AS-i Circuit (max. 8 A)
FE	Function ground

Information!

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

7.4.2 Electrical connection VBG-ENX-K20-DMD



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)
FE	Function ground

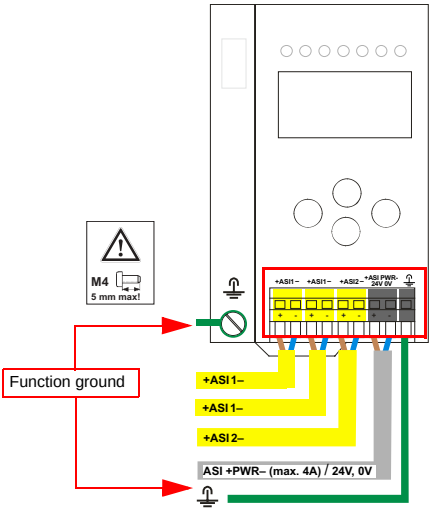
Information!

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>.

7.4.3 Electrical connection VBG-ENX-K20-DMD-EV



Terminal	Signal / Description
+ASI 1–	Connection to AS-i circuit 1
+ASI 2–	Connection to AS-i circuit 2
ASI +PWR– / 24 V, 0 V	Supply voltage for AS-i circuits (max. 4 A) / **AS-i Power24**[1] supply optional
FE	Function ground

1. The gateway is AS-i Power24V capable and can be operated directly on a 24V (PELV) power supply.

Information!

AS-i Circuit 1 and 2 are both powered from a Bihl+Wiedemann GmbH power supply!

No other power supplies are approved!

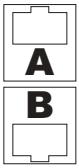
Attention!

*Earth fault detector sensor without function when using **AS-i Power24**!*

Information!

For additional information, please refer to the sections: <AS-i and power supply terminal assignments> and <AS-i Power24V capable>.

7.5 Ethernet interface



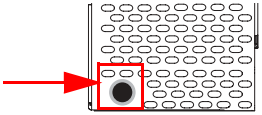
The ethernet interface consists of two RJ-45 sockets. It is placed on the left housing side (see section <Overview of terminals, indicators and operating elements>). The ethernet interface is driven according to the IEEE 802.3

7.6 Diagnostics interface

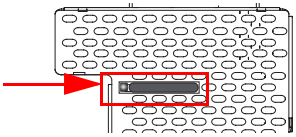
The service and diagnostics interface (in conjunction with **AS-i Control Tools** software) is used for communication between the PC and the unit.

7.6.1 Diagnostics port RS 232

The service and diagnostics interface is configured as a mini DIN-6 female and it is placed at the top of the housing (see section <Overview of terminals, indicators and operating elements>).



7.7 Chip card



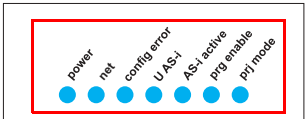
The configuration is stored in a fixed installed EEPROM and can be overwritten by the chip card. The chip card does not have to be inserted in operation.

Warning!

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

7.8 Indicators and operating elements

7.8.1 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.

7.8.2 Buttons

The buttons are used for the following:

Mode/⇑ Switching between configuration mode and protected operating mode, and saving the current AS-i configuration as the nominal configuration.
Set/⇓ Selecting the address of and assigning an address to a slave.
OK, ESC Changing to the advanced display mode.

For additional information see section <Operation in advanced display mode>.

8. Operation in advanced display mode

Information!

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

9. 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).

9.1 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").

9.2 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".

9.3 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.

9.4 Functions of the AS-i Fault Detector

9.4.1 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.

9.4.2 Earth/Ground Fault Detector

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

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

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.

9.4.3 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.

9.4.4 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.

9.5 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.

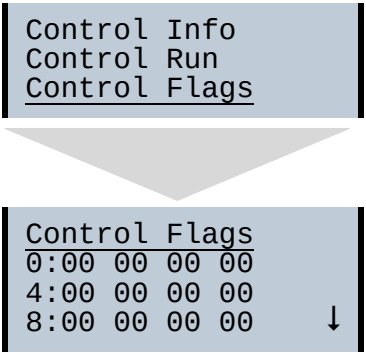
Information!

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

9.5.1 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.



9.5.2 Interchangeable memory card

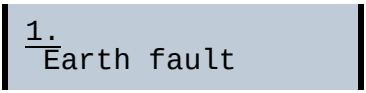
Main menu || SETUP || CHIPCARD || **AS-I CHIPCARD** ||

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

9.5.3 Earth fault monitor

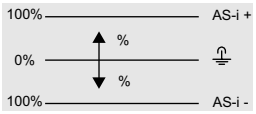
Main menu || DIAGNOSE || **ASI WATCHDOG** ||

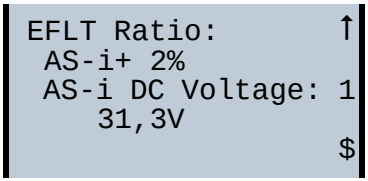
The new earth fault monitor allows the service technician to detect whether an earth fault has occurred directly on AS-i

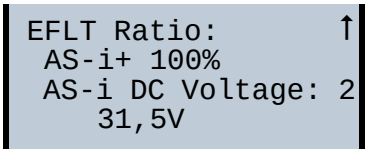


or on a sensor line.

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

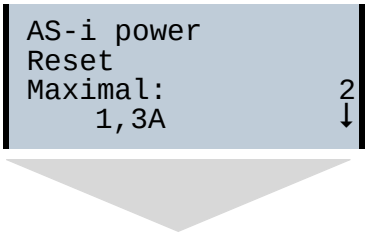


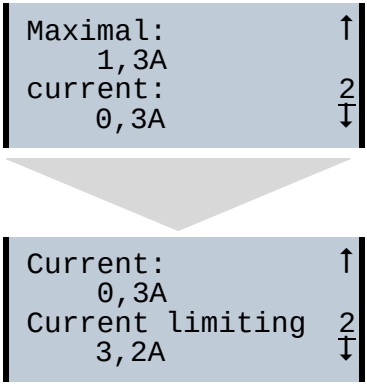




9.5.4 Current can be read directly on the unit

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.



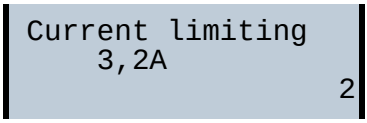


9.5.5 Self-resetting fuses

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.

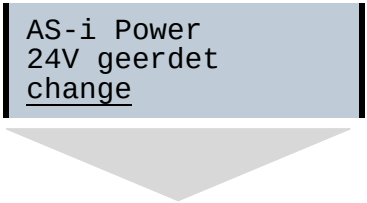
The fuse resets itself periodically to check if the error is solved. The measured current value is available as diagnostic information at the field on the display and at the control level.

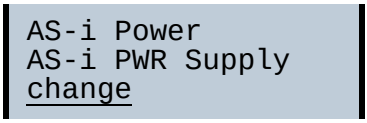


9.5.6 AS-i Power24V capable

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.





9.5.7 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.

9.5.8 Transitionless operating mode changes

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

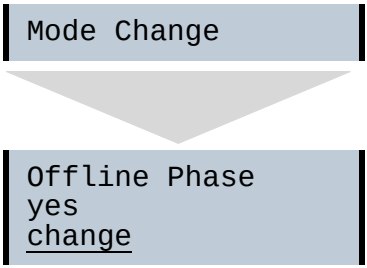
These devices are able to change the operating mode from projecting mode to the protected operating mode without having to first go to the "offline phase".

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".



10. EtherNet/IP interface

Objekt 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 (external)

Class code	Object name	Number of instances
0x01	Identity	1
0x02	Message router	1
0x04	Assembly	24 (single master) 86 (double master)
0x06	Connection manager	1
0x47	Device level ring	1
0x48	Quality of service	1
0x64	AS-i master	1 for each AS-i circuit
0x65	AS-i slave	64 for each AS-i circuit
0x66	E/A data	1 for each AS-i circuit
0x67	Advanced diagnosics	1 for each AS-i circuit
0x68	Short command interface	1
0x69	Long command interface	1
0x6B	Safety Control Status external Monitor	1 for each AS-i circuit

Tab. 10-2.

10.1 Identity object

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

Attribute ID	Access Rule	Name	Value
1	get	vendor	5
2	get	device type	12
3	get	product code	e. g.: "2386" (double master) e. g.: "2385" (single master)
4	get	revision	1.1
5	get	status	see overwiev listed below
6	get	serial number	unique number, 32-bit
7	get	product name	e. g.: "VBG-ENX-K20-D"

Tab. 10-3.

Common services

Service Code	Class	Instance	Service name
0x05	no	yes	code 1 (class + instance)
0x10	yes	yes	get attributes all
0x0E	yes	yes	get attributes all

Tab. 10-4.

10.2 Device Level Ring Object

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

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

Tab. 10-5.

Common Services

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

Tab. 10-6.

10.3 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. 10-7.

Common Services

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

Tab. 10-8.

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. 10-9.

10.4 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
- 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
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

Tab. 10-10.

16-bit data of slaves 29 … 31

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. 10-10.

Instances 100 (0x64)…135 (0x87) can only be read, while instances 136 (0x88) …171 (0xAB) can be read and written.

Information!

The are only instances 100 (0x64) … 105 (0x69) and 109 (0x6D) … 114 (0x72) in case of a single master.

Assembly Instance			Data Item		
input	**output**	**size (byte)**	**digital**	**analog**	**command inter-face**
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. 10-11.

10.5 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. 10-12.

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. 10-13.

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. 10-14.

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. 10-15.

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. 10-16.

Meaning of the bit B

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

10.6 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. 10-17.

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. 10-18.

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. 10-19.

parameter xID1 (8-bit)

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

Tab. 10-20.

10.7 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	get	input data image, single and A-slaves	ARRAY[16] of USINT	
101	get	input data image, B-slaves	ARRAY[16] of USINT	
102	get/set	output data image single and A-slaves	ARRAY[16] of USINT	
103	get/set	output data image, B-slaves	ARRAY[16] of USINT	
104	get	16-bit input data slave 1	ARRAY[4] of INT	
…	…	…	…	…
134	get	16-bit input data slave 31	ARRAY[4] of INT	
135	get/set	16-bit output data slave 1	ARRAY[4] of INT	
…	…	…	…	…
165	get/set	16-bit output data slave 31	ARRAY[4] of INT	

Tab. 10-21.

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. 10-22.

Flags

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

Tab. 10-23.

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. 10-24.

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10.8 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. 10-25.

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. 10-26.

B slaves

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

Tab. 10-27.

10.9 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. 10-28.

10.10 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. 10-29.

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

10.11 Safety Control/Status

10.11.1 External Monitor

10.11.1.1 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. 10-30.

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. 10-31.

11. The Modbus Address Table

Cyclic data exchange similar to the Momentum Ethernet Adapter
AS-i circuit 1: Input Data Image 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. 11-32.

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

Cyclic data exchange similar to the Momentum Ethernet Adapter

AS-i circuit 2: Input Data Image 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. 11-33.

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

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Cyclic data exchange similar to the Momentum Ethernet Adapter

AS-i circuit 1: Output Data Image 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. 11-34.

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

Cyclic data exchange similar to the Momentum Ethernet Adapter

AS-i circuit 2: Output Data Image 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. 11-35.

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

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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. 11-36. 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. *0: Data exchange is active* *1: Data exchange is not active*
Off-line:	This output sets the master into the off-line phase
Auto_Address_Enable:	This output blocks the automatic slave-address programming. *0: Auto-address is enabled* *1: Auto-address is disabled*
Configuration_Mode_on:	Configuration mode is on
Configuration_Mode_off:	Configuration mode is off
Config_OK:	Configuration error: *0: no error* *1: error*
LDS.0:	An AS-i slave with address zero exists
Auto_Address_Assign:	Automatic programming is allowed
Auto_Address_Available:	Automatic programming is possible *0: Auto-address is possible* *1: Auto-address is not possible*
Configuration_Active:	The configuration-mode is active
Normal_Operation_Active:	The normal operation mode is active *0: normal operation is active* *1: normal operation is not active*
APF/not APO:	An AS-i power fail occured
Offline_Ready:	The off-line phase is active
Periphery_OK:	Periphery is OK *0: Periphery is OK* *1: Periphery is not OK*
Earth Fault:	AS-i earth fault detection *0: no earth fault* *1: earth fault*
Overvoltage:	AS-i overvoltage detection *0: no overvoltage* *1: overvoltage fault*
Noise:	AS-i noise detection *0: no noise* *1: noise fault*
Duplicate Address:	AS-i duplicate address detection *0: no duplicate address* *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. 11-37. 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. 11-38.

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 (0 enabled, else disabled)
2086	r/-	return value of most recently called *Execution Control* function: 0: success 1: failure 2: slave with 1st address not detected 3: slave with zero address detected 4: slave with 2nd address detected 5: delete error 6: set error 7: address stored temporarily 8: *extended ID1* stored temporarily 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. 11-39.

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. 11-40.

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 range 1 to 999 (this value overwrites the value written in the reference 61441)
61441	r/w	timeout in 10 msec units default 100 (≡ 1 sec) range 3 to 65536
62465 ... 62476	r/w	list of "allowed master" (not used)
62481	-/w	authorize IP address record Set to 1 allow IP address assignment to be retained in FLASH. Default of 0 to require BOOTP.
63489	r/-	size of status block (63488 ... 63500)
63490	r/-	number of word of input (in cyclic data block, 34)
63491	r/-	number of word of output (in cyclic data block, 34)
63492	r/-	module ID code
63493	r/-	module revision number
63494	r/-	ASCII header size in words. 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 (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/-	"VBG-ENX-K20-D" or "VBG-ENX-K20-DMD"

Tab. 11-41.

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. 11-42.

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

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. 11-43.

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

4x reference 4226

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

Tab. 11-44.

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

Off-line:	This output sets the master into the off-line phase.
Auto_Address_Enable!:	This output blocks automatic slave-address programming. 0: Auto-address is disabled 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. 11-45.

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. 11-46.

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

11.1 Safety Control/Status

11.1.1 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. 11-47.

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. 11-48.

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. 11-49.

11.2 AS-i circuit 1 data

11.2.1 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. 11-50.

11.2.2 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. 11-51.

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

11.2.3 Function invocation

AS-i circuit 1
function invocation

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

Tab. 11-52.

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**.*

11.3 AS-i circuit 1 analog data

11.3.1 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. 11-53.

11.3.2 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. 11-54.

11.4 AS-i circuit 2 data

11.4.1 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. 11-55.

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

11.4.2 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. 11-56.

11.4.3 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. 11-57.

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

11.4.4 Function invocation

AS-i circuit 2
Function invocation

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

Tab. 11-58.

11.5 AS-i circuit 2 analog data

11.5.1 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. 11-59.

11.5.2 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. 11-60.

11.6 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).

12. 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).

12.1 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	

12.2 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).

12.2.1 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

12.2.2 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

12.2.3 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) (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

12.2.4 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.

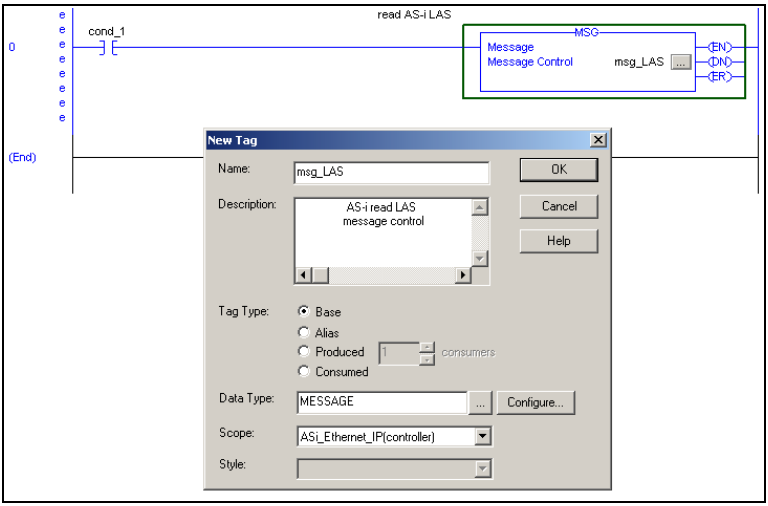
- 0B GATEWAY TARGET DEVICE FAILED TO RESPOND
  Specialized use in conjunction with Modbus Plus gateways, indicates that no response was obtained from the target device. Usually means that the device is not present on the network.

13. Data Transfer using CIP Messages in RSLogix5000

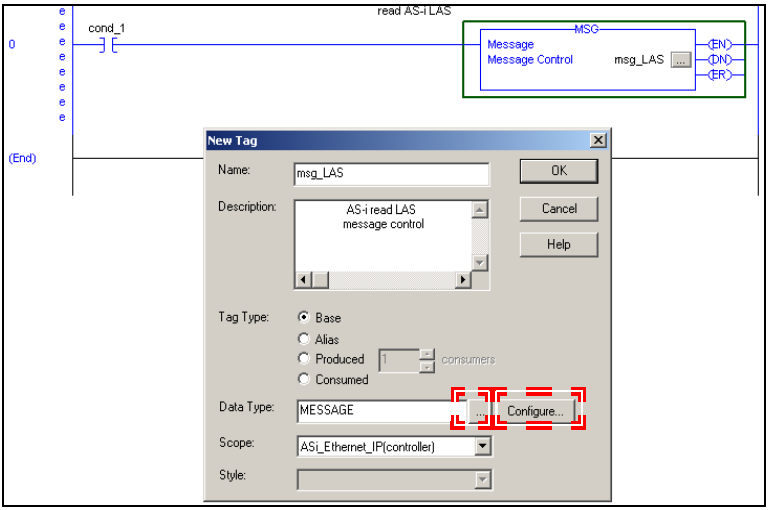
This chapter explains the data transfer of AS-i 3.0 EtherNet/IP Gateways using CIP Messages in RSLogix5000.

13.1 MSG instruction and Message Type Tag

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

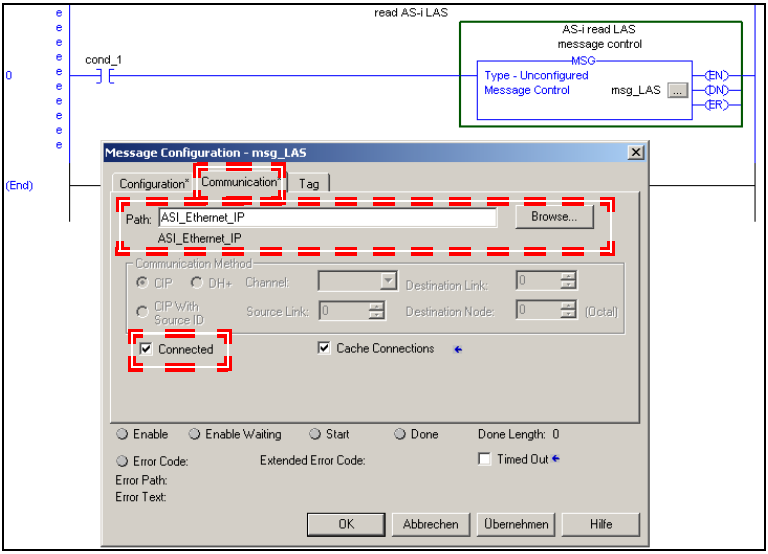


- ☐ Select "Configure" on the "New Tag" window or "..." next to the tag name to open the "Message Configuration" window.



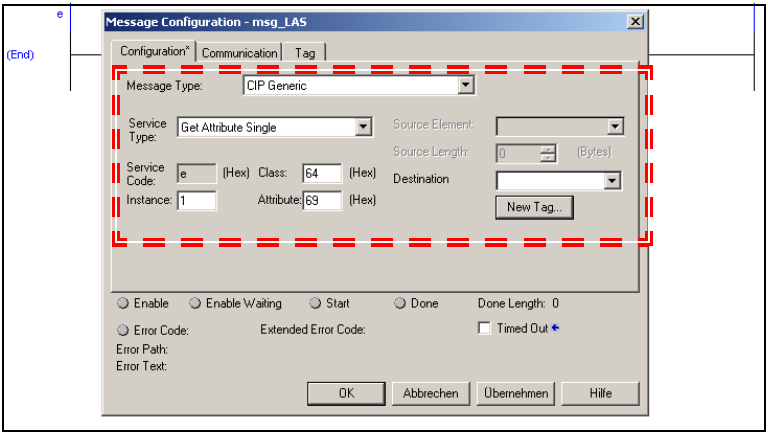
26.9.2013

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



13.2 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.



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

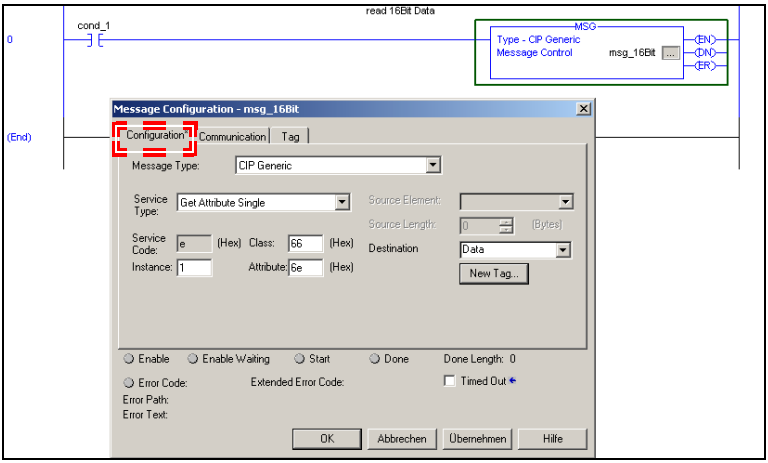
- Select the "Configuration" tab in the "Message Configuration" window
- Select:
  - Message type: CIP generic

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)



14. System startup using AS-i Control Tools

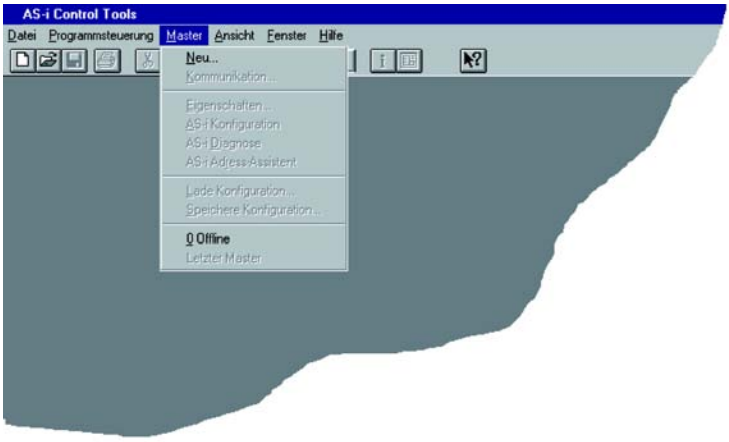
The Windows based software AS-i Control Tools enables an easy and clear configuration of the AS-i network.

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.

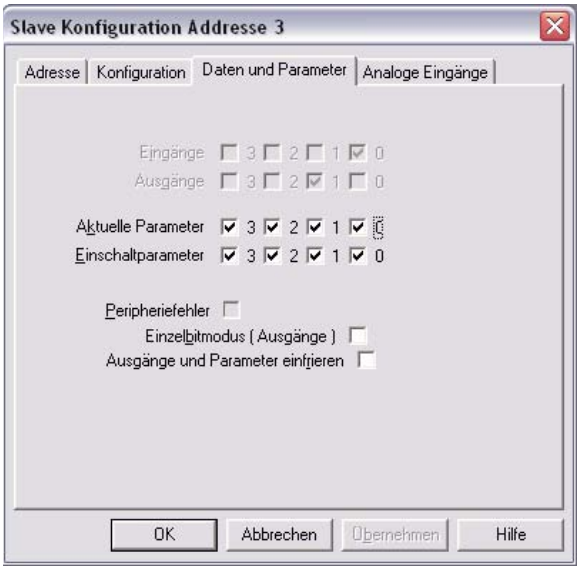
1. Connect the device to the PC via its serial interface and the diagnostic interface.
2. Start AS-i Control Tools.
3. Select Master | New.



4. Choose RS232 diagnostic interface as the protocol.

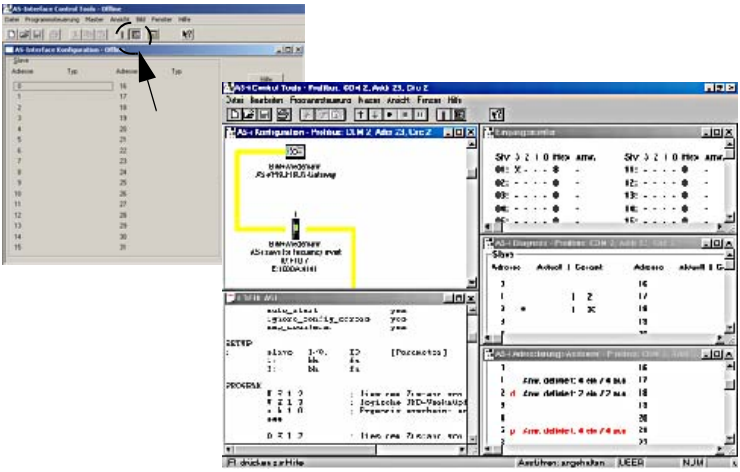
5. Select the appropriate settings (for example serial interface COM 2, station address <auto>).
6. Select Master | AS-i configuration.
7. The AS-i configuration editor will be started. All detected and configured AS-i slaves are displayed in this window.

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".



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.

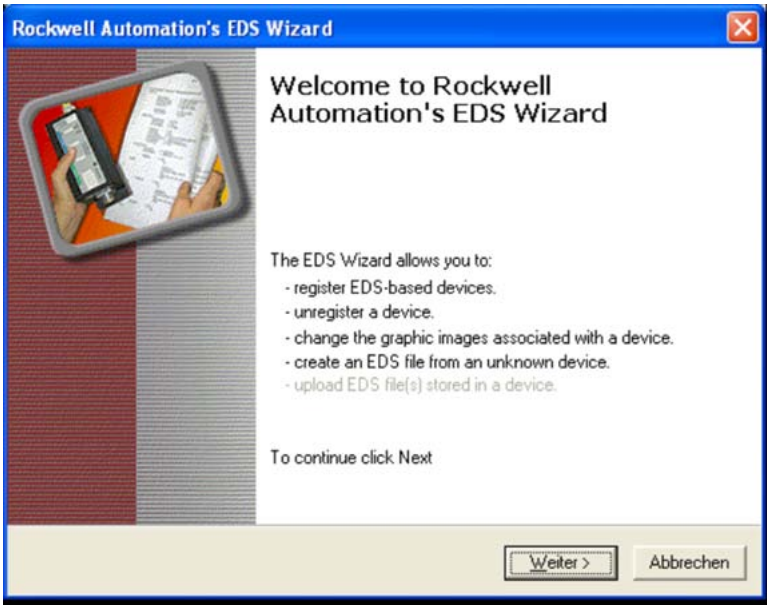
Furthermore, an **AS-i Address Assistant** is available, allowing to perform an address change of a new AS-i slave to the desired address as soon as it is connected to the AS-i network. The desired AS-i configuration can be created offline ahead of time and can be stored to a file. When setting up the 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.

15. Appendix, Examples

15.1 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.

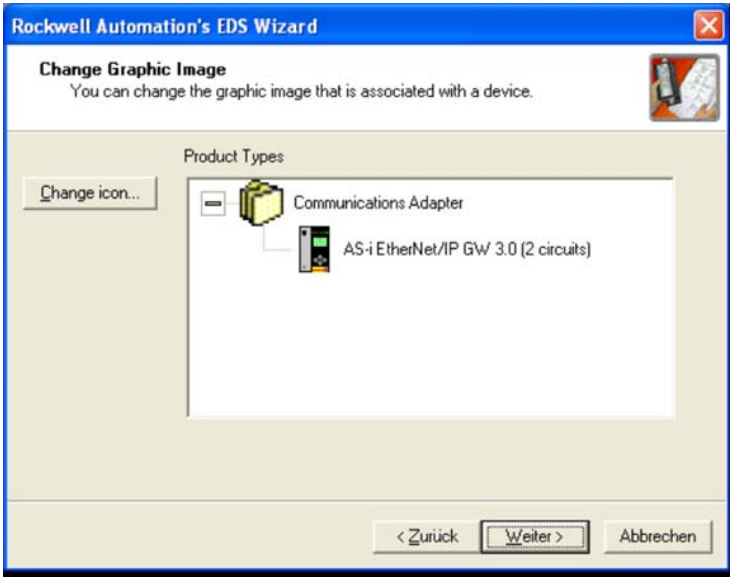
1. 1. Start the EDS Wizard: “**Tools**” –> “**EDS Hardware Installation Tool**”.



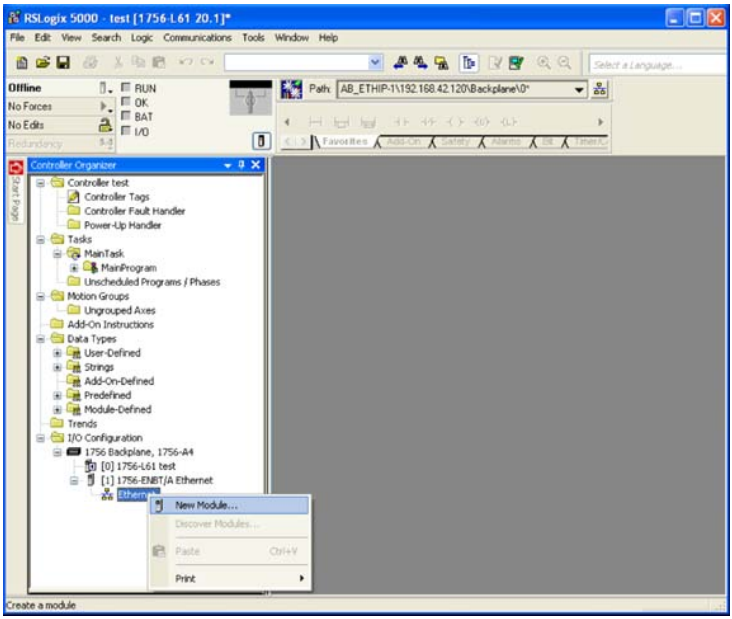
2. Select "**Register an EDS file(s)**".

3. Select your EDS file.

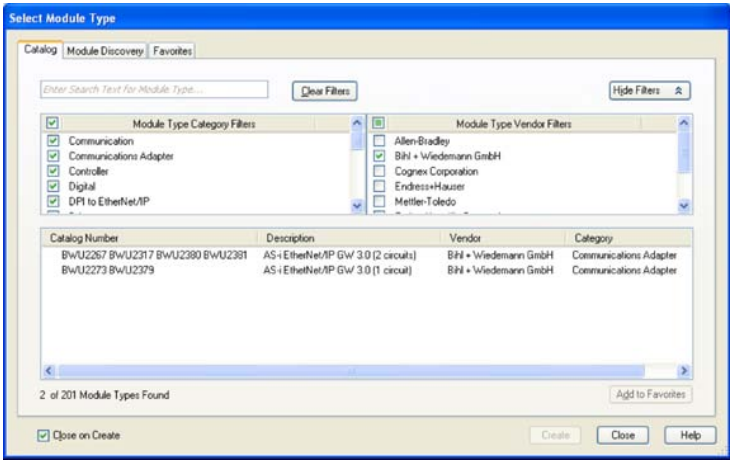
4. Select “**Next**” until the installation is completed.



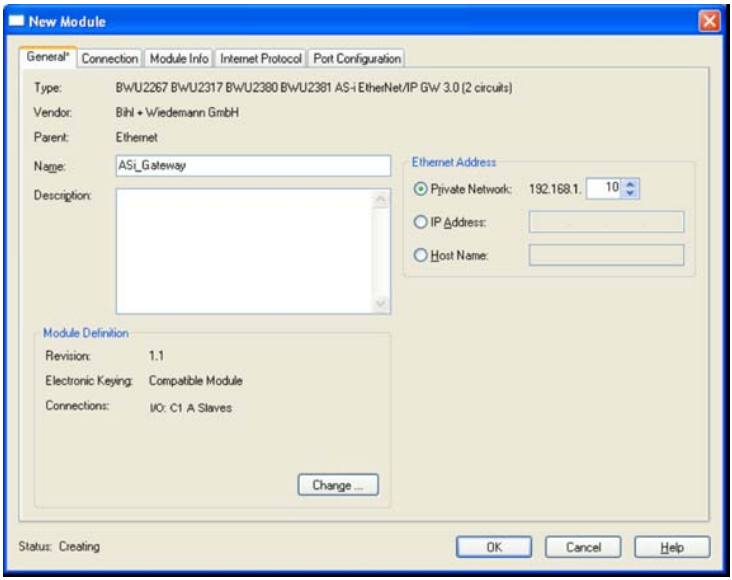
5. Create a new Module in the RSLogix I/O Configuration.



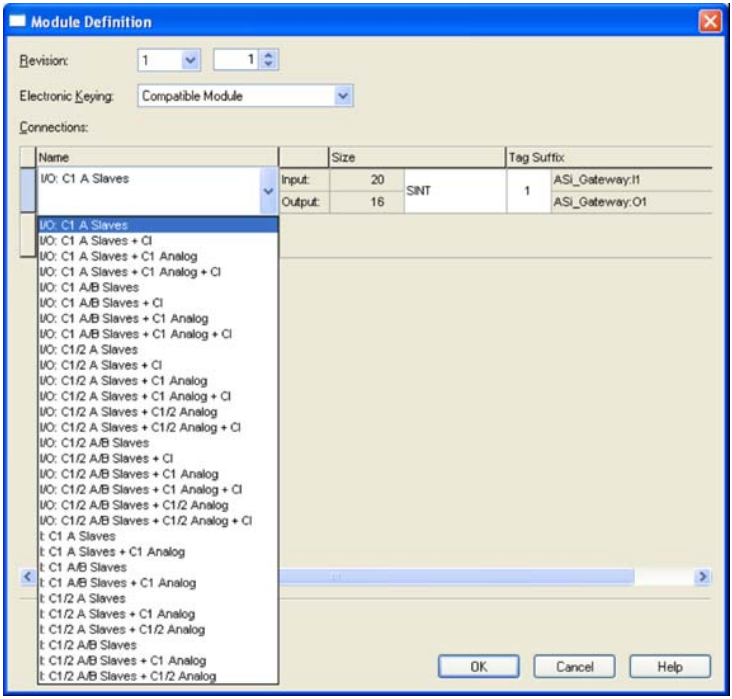
6. Select the Bihl+Wiedemann GmbH AS-i Gateway.



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

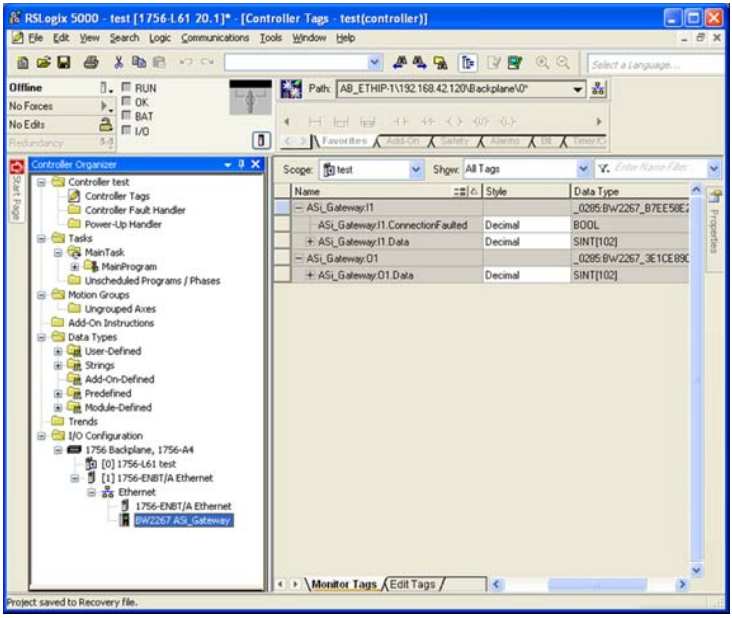


8. Use the Drop Down Menu to select the kind of data.



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)

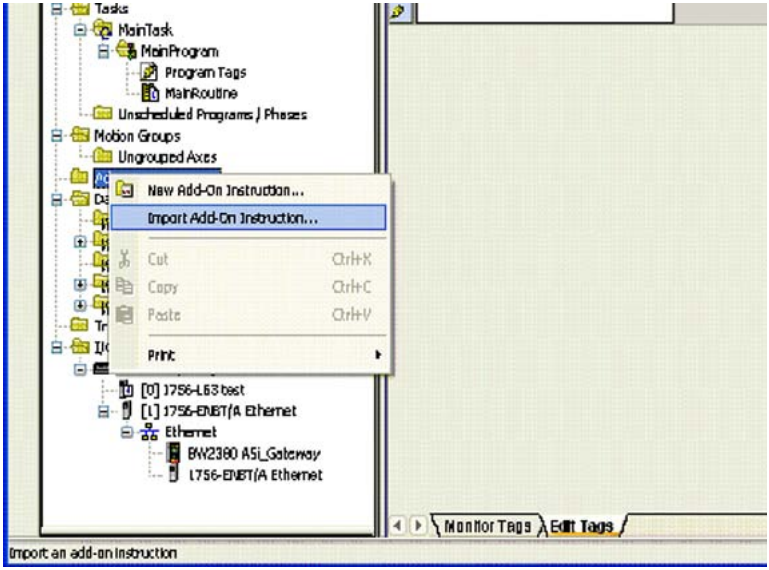
9. The AS-i Gateway data can now be found in the Controller Tags.



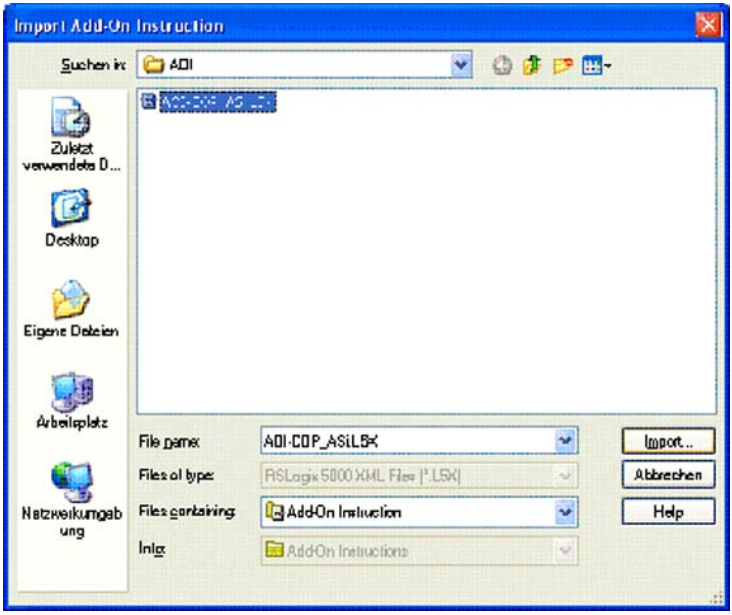
10. Optionally the example AOI (**Add-On Instructions**) can be used to copy the raw data into structured data. Free AOI examples are available:

- **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

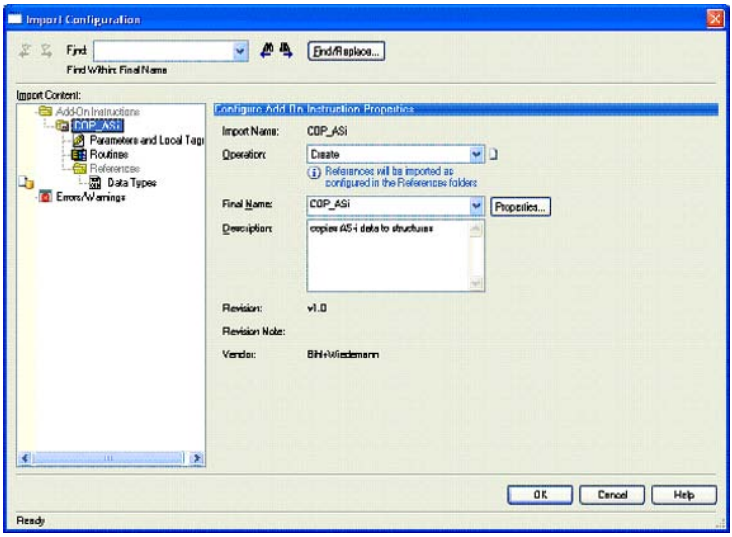
☐ Right click on "**Add-On Instructions**" and select "**Import Add-On Instruction**".



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

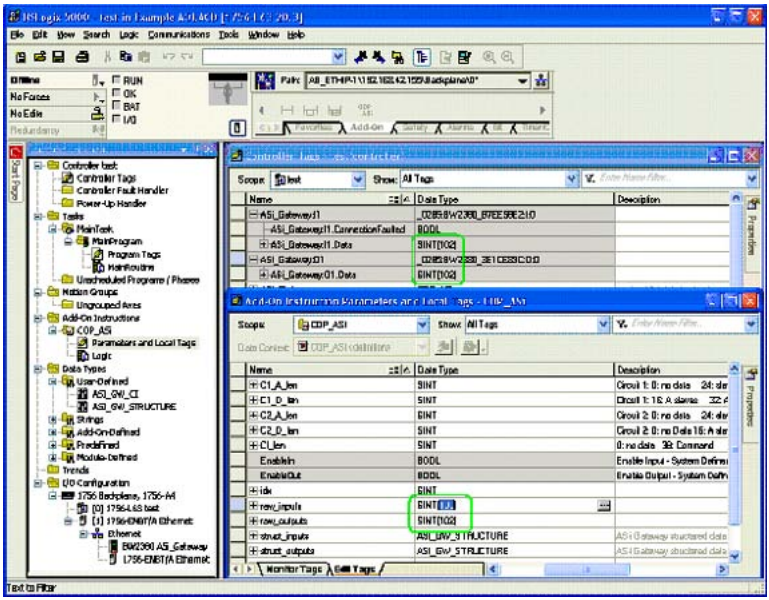


12. Confirm the Import Configuration.

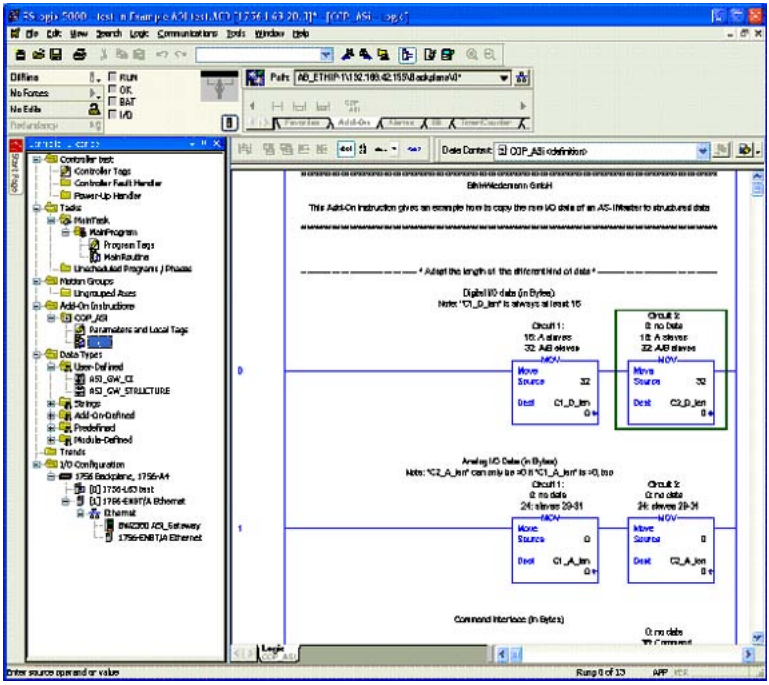


13. The Add-On Instruction “**COP_ASi**” and the User-Defined Data Types “**ASI_GW_CI**” and “**ASI_GW_STRUCTURE**” will be created.

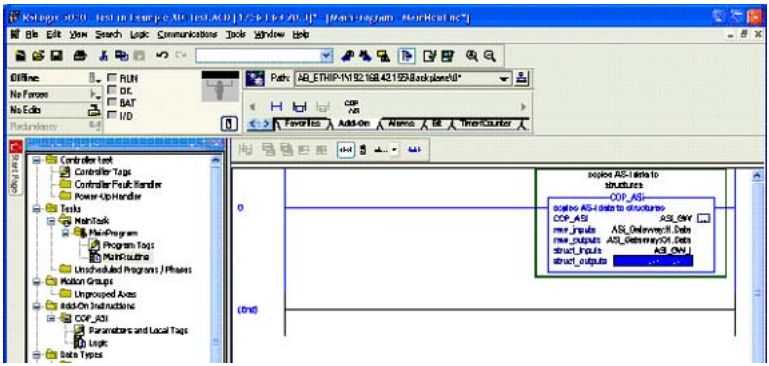
- ☐ Open the AOIs “**Parameters and Local Tags**” and adapt the size of the parameters “**raw_inputs**” and “**raw_outputs**” to the actual size of the AS-i Gateways data.



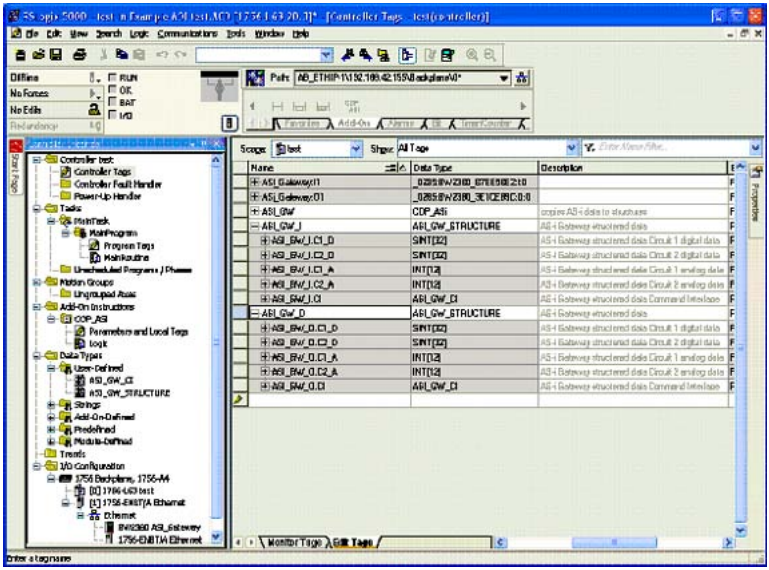
14. Open the AOIs “**Logic**” and adapt the length of the actually configured data. See comments in the routine



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



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

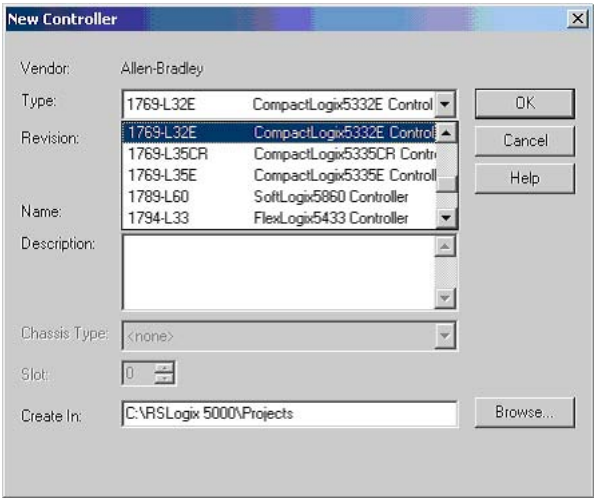


15.2 The first commissioning with CompactLogix

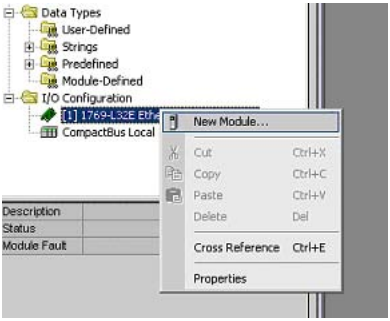
This chapter shows exemplarily the start-up of the AS i 3.0 EtherNet/IP Gateways with the software RSLogix 5000 CompactLogix, version 13.00.

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

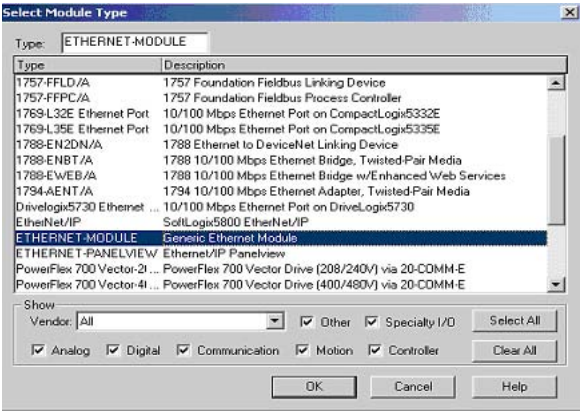
- Now select your controller, register its name and confirm with *OK*.



- 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 (94/92[1] bytes for in and output data).

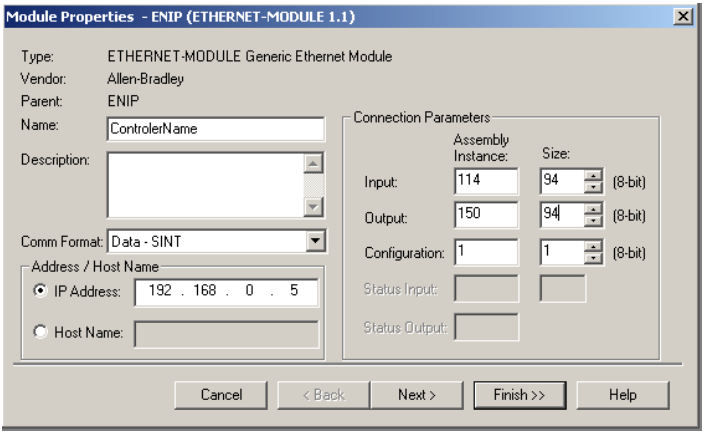
Allocation of the data

32 bytes for digital data (A/B slaves)

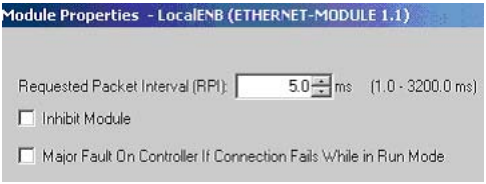
24 bytes for analog data (slave address 29 .. 31)

1. Byte length depending on the selected "Mailbox Mode" (see chap. <Mailbox mode (command interface length)>.

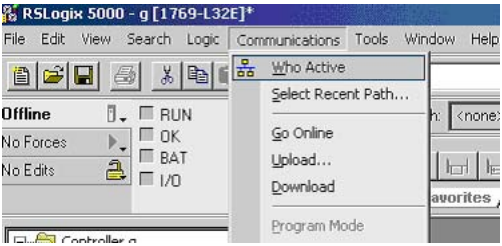
38/36[1] bytes für command interface



- Click the button *Next*
- Please enter in the data field *Request Packet Interval* (RPI) a time (≥ 5 ms).
- 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*.

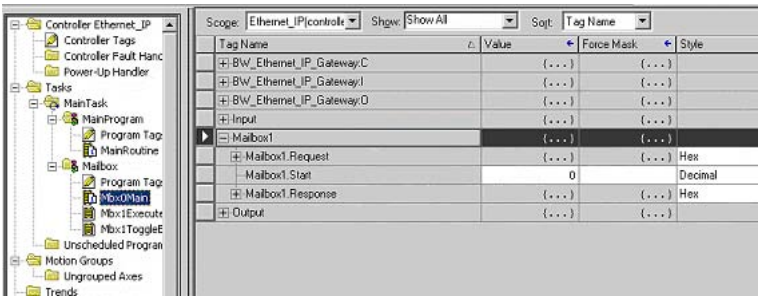


- With a double click on the pictogram *Processor* you can begin with the download.

1. Byte length depending on the selected "Mailbox Mode" (see chap. <Mailbox mode (command interface length)>

15.2.1 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.

16. 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. "control checksum": checksumm in Control III C program (bin.file) not correct. The file is possibly damaged. "control exec err": error in Control III C program. "control watchdog": watchdog predetermined in Control III C program has expired . "control incomp": Control III C program from another gateway type loaded (e.g. Ethernet IP in Profibus gateway).

79	Checksum error in the data menu. "breakpoint": 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. (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. 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.)

17. 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 the master needs the fourth output data bit for switching between A and B address, A/B slaves only have three output data bits maximum.

Activation phase

In the activation phase the detected slaves are activated by sending the parameter. This is indicated by a "42" on the Master's Display. This phase takes only 10 ms, tops, to short to be displayed.

AS-i Power Fail

Voltage drop on the AS-i line; If the voltage drops below a specific value, the master changes to the ⇒ Offline phase.

Initiation phase

After the initial data exchange with all AS-i slaves the master is looking for new slaves. For this purpose an inquiring call is sent to one AS-i address. If a reply is received, the master tries to read the ⇒ current configuration of the slave. Depending on the mode (⇒ protected mode or ⇒ configuration mode) and on the current configuration, the detected slave will be activated.

After each data exchange with all AS-i slaves exactly one inquiring call is sent to one slave address. Hence, the AS-i cycle always includes one more telegram than the number of activated slaves (⇒ LAS).

Autoprog flags

Auto Address Enable; flag from the operating system to the AS-i Master.
With this flag, automatic addressing can be enabled or disabled. This flag is saved in non-volatile memory in the Master.

Auto Address Assign, Auto Address Possible; flag from the AS-i Master to the operating system.
Automatic programming is not disabled and no configuration error was found.
If a slave fails, it could be addressed automatically.

Auto Address Available, flag from the AS-i Master to the operating system. Exactly one AS-i slave is missing and the automatic single node replacement is not disabled.
If at this point a slave with the address 0 and the profile of the missing slave is connected, it automatically receives the address of the missing slave.

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".

Detection phase

In the detection phase, after the startup the master is scanning for AS-i slaves. The master remains in this phase until at least one slave was detected. If the master remains in the detection phase no slave was found. Most of the time, the reason for this is a wrong power supply or a wiring error.

The detection phase is indicated by code "41".

Protected mode

In protected operating mode only those slaves that are registered in the ⇒ LPS and whose current configuration matches the target configuration are activated.

Also see ⇒ configuration mode. This mode is intended for normal operation, since all AS-i protective measures are activated.

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.

Current configuration

The configuration data of all slaves detected by the master. The configuration data of a slave, the ⇒ slave profile, consists of:

⇒ IO code, ⇒ ID code, ⇒ extended ID1code , ⇒ extended ID2 code.

Current parameter

The AS-i parameter that have most recently been sent to the AS-i slave, as opposed to ⇒ permanent parameters.

Configuration Error/Config Error

An configuration error is displayed if the target and the current configuration of the connected slaves do not match. A configuration error could be due to the following:

Missing slave:A slave entered in the ⇒ LPS is not available

Wrong type of slave:The ⇒ slave profile of the connected slave does not comply with the configuration.

Unknown slave: A connected slave is not entered in the ⇒ LPS.

LAS - List of Activated Slaves

The master exchanges I/O data with the slaves entered in the LAS. In protected mode only the detected slaves (⇒ LDS) that are expected by the master and are entered in the ⇒ LPS are activated. In configuration mode all slaves entered in the ⇒ LDS are activated.

LDS - List of Detected Slaves

If the master was able to read the ⇒ slave profile, the slave is entered in the LDS.

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.

LPS - List of Projected Slaves

The list of projected slaves includes all slaves expected by the master. When saving the current configuration all entries in the ⇒ LDS are stored in the LPS (except for a slave with address 0).

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Offline phase

In the offline phase all input and output data is reset. This phase is entered after the startup of the master, after a ⇒ AS-i power fail, and during the transition from the ⇒ configuration mode to the ⇒ protected mode.

Furthermore, the master can actively be transfered into the offline phase by setting the offline flag.

During the offline phase, masters with a LED display show code "40".

Peripheral fault

A peripheral fault is indicated by a red flashing LED on the master and on the slave.

Depending on the slave type this indicates an overflow, an overload of the sensor's power supply, or another fault regarding the periphery of the slave.

Permanent configuration

The configuration data of all expected slaves stored in the master (⇒ slave profile). If the ⇒ permanent configuration differs from the ⇒ actual configuration, a configuration error exists.

Permanent parameter

The parameters saved in the master and sent to the slave after startup of the master during the ⇒ activation phase.

Configuration mode

During the configuration mode the master exchanges data with all connected slaves, no matter which of the slaves were configured. Thus, in this mode it is possible to operate a system without the necessity to configure it before.

See also ⇒ protected mode.

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.

18. Reference List

18.1 Manual: “AS-i 3.0 Command Interface“

This Manual contains a detailed description of the AS-i 3.0 Command Interface.

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