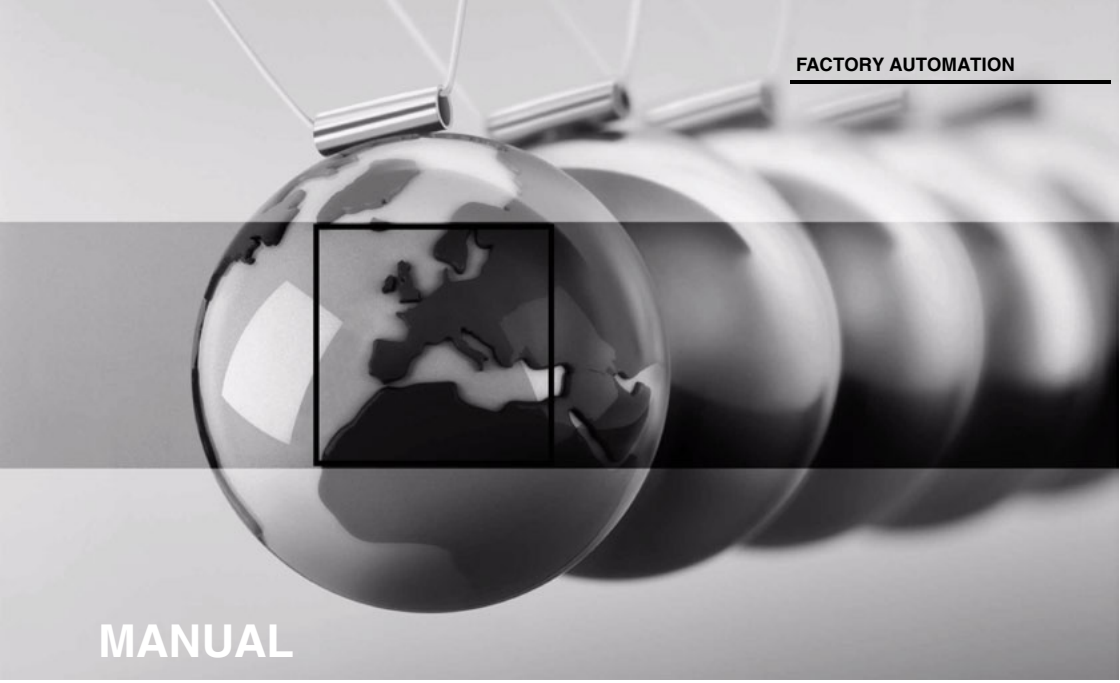

MANUAL

VBG-MOD-K20-D

AS-Interface/MODBUS-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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Conformity Statement

The AS-i 3.0 Modbus Gateway in Stainless Steel has been developed and produced in accordance with the applicable european standards and directives. The conformity statement according to the EC EMC-, low voltage, and -maschinery directive can be sent to by request.

Additional information can be found in the Pepperl+Fuchs GmbH basic catalogue or in the online catalogue in internet.

Subject to technical modifications.

Issue date: 6.12.2010

1. Symbol catalog

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.

1.1 Abbreviations

Information!

Additional information can be found in section <Glossary>.

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2. General

2.1 Product information

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

AS-i 3.0 Modbus Gateway in Stainless Steel, 1 Master, with duplicate address' recognition and AS-i inspector	**VBG-MOD-K20-D**
For all special versions, derived from the basic product AS-i 3.0 Modbus Gateway in Stainless Steel	

Tab. 2-1.

The AS-i 3.0 Modbus Gateway in Stainless Steel serves to connect AS-i systems to a Modbus controller.

All AS-i functions can be called via Modbus. The AS-Interface data can be used in many different ways. All the important data are available in three different forms - binarily, packed or unpacked in registers. The AS-i Masters with the Modbus slave interface can thus be operated without expensive adaptions.

2.2 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".

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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.

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4. Spezifications

4.1 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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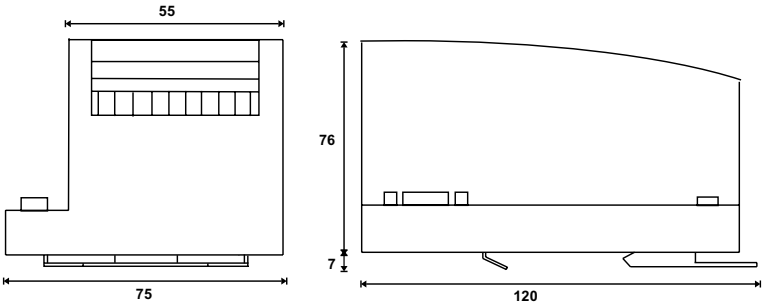
5. Installation

5.1 Dimensions



5.2 Connections

∅ 5 ... 6 mm / PZ2	0,8 Nm 7 LB.IN
10	2 x (0,5 ... 1,5) mm²
10	2 x (0,5 ... 1,5) mm²
AWG	2 x 24 ...12

5.3 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.

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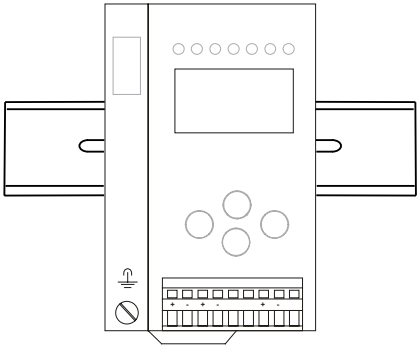
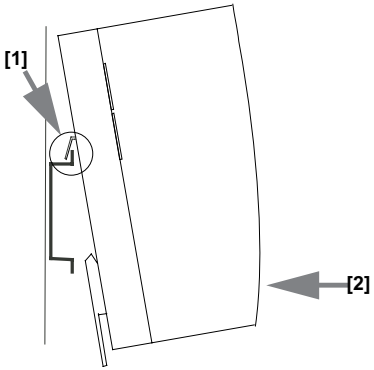
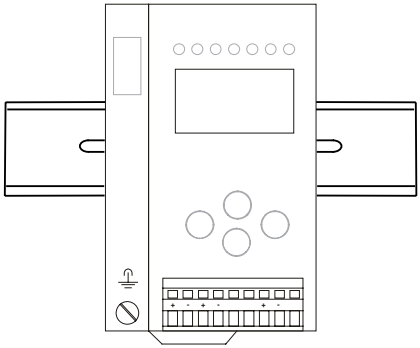
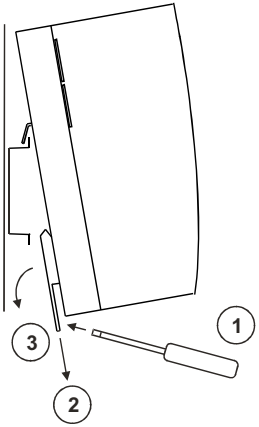
To install, place the unit on the upper edge of the DIN rail and then snap in the lower edge.





5.4 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.

5.5 Electrical Connection

Information!

Electrical connections are described in section <Electrical connection>.

Information!

See also section <Operation in advanced display mode> for further information.

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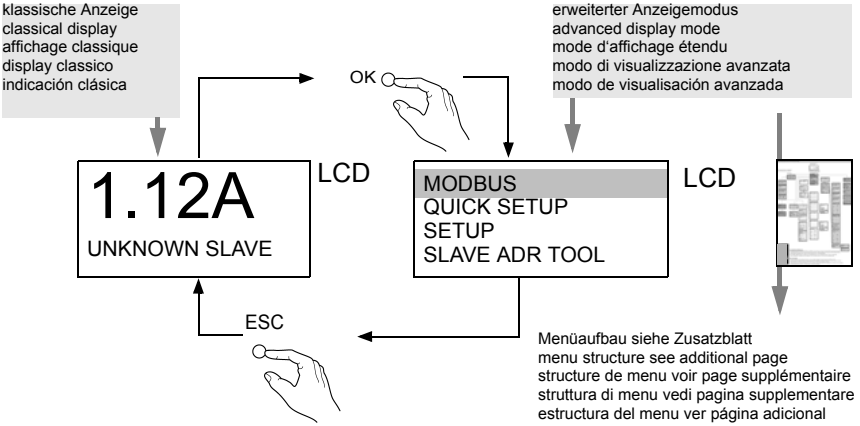
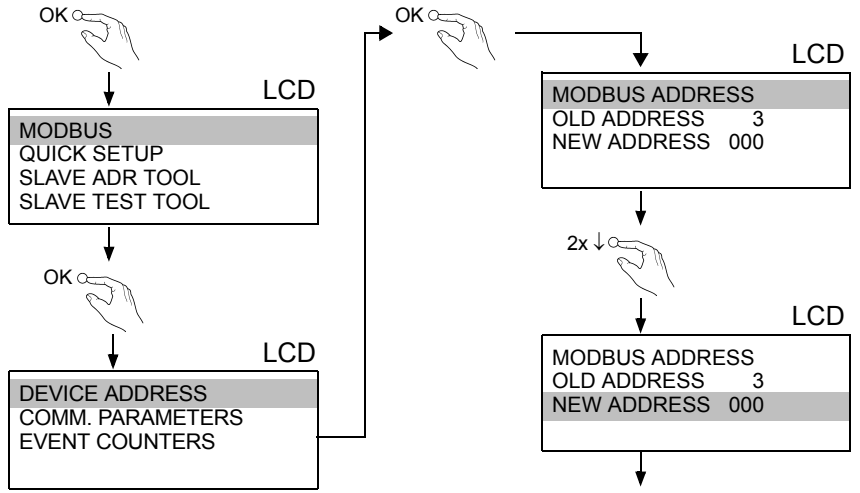
5.6 Startup

5.6.1 Switching to advanced display mode



5.6.2 Setting the MODBUS address



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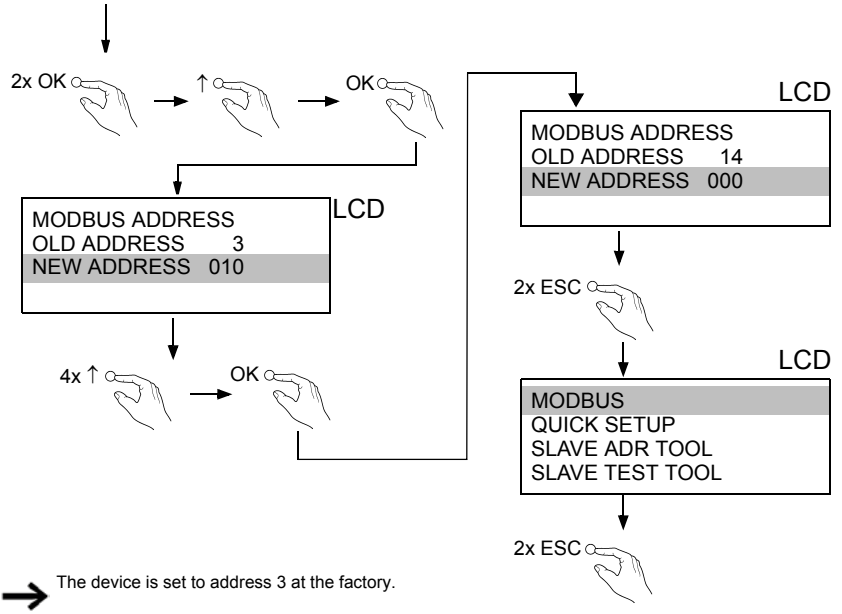
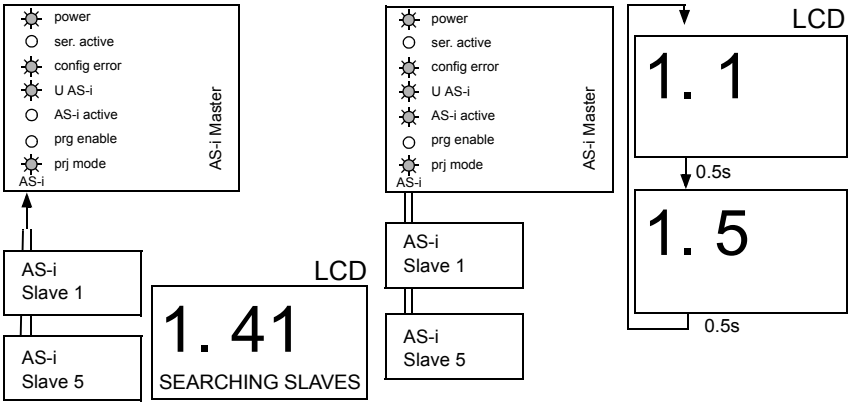


→ The device is set to address 3 at the factory.

5.6.3 Connecting AS-i Slaves



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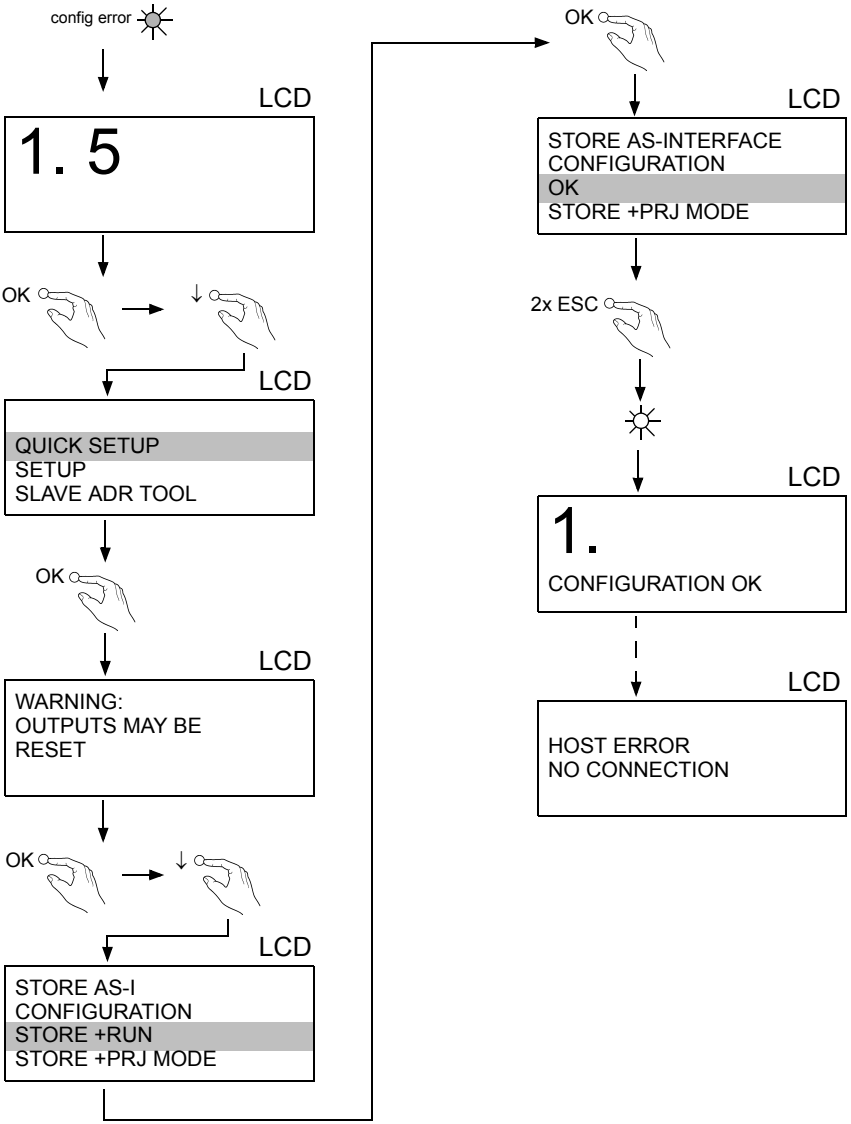
5.7 Quick setup



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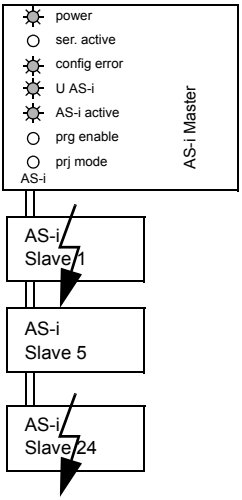
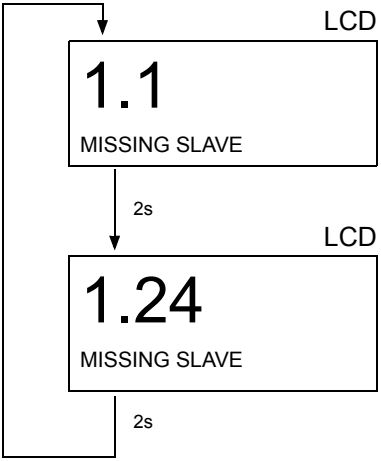
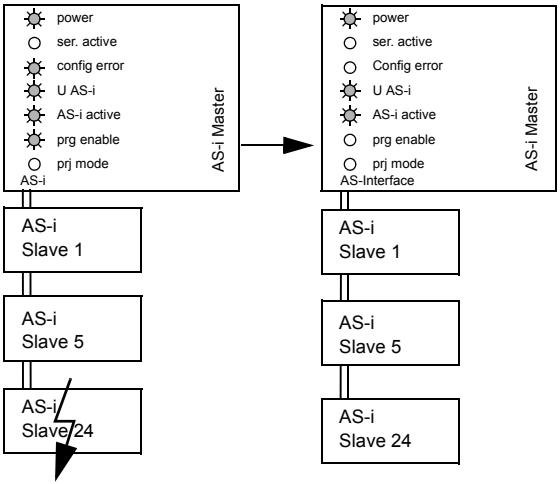
5.8 Error tracing

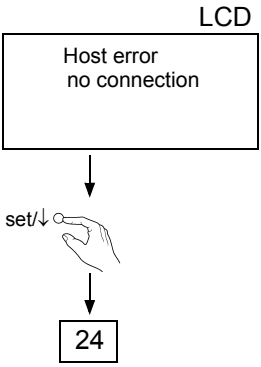
5.8.1 Faulty slaves





5.8.2 Error display (last error)





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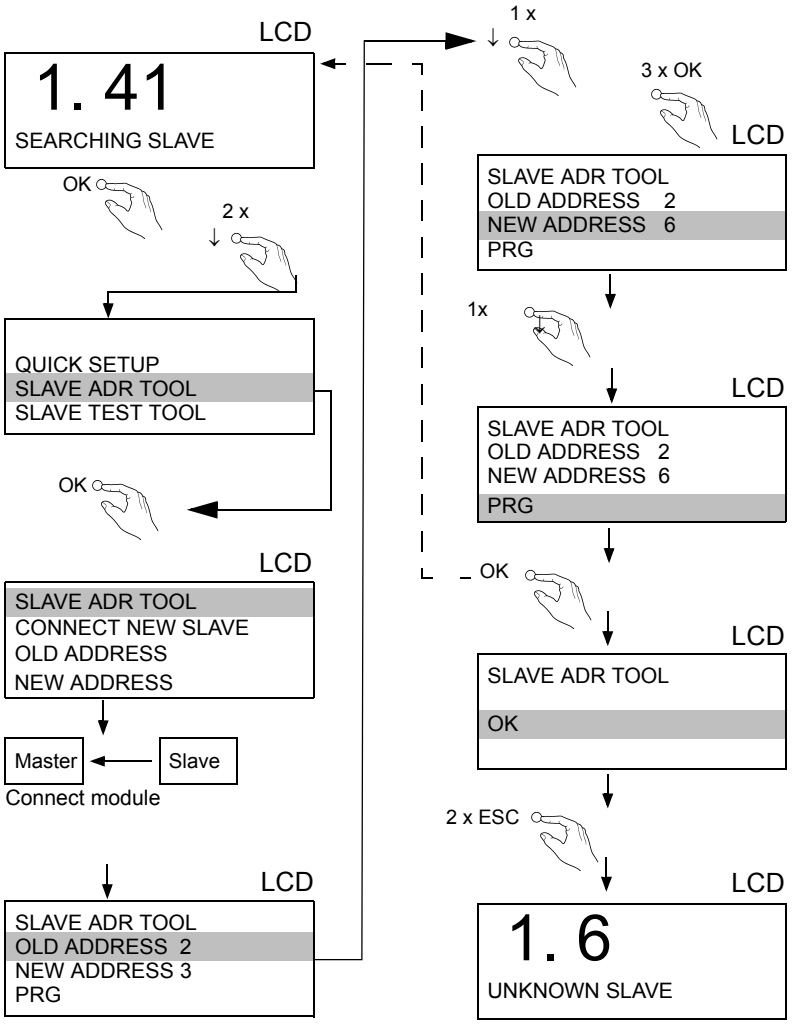
5.8.3 Addressing

5.8.3.1 Assigning address 6 to slave currently at address 2



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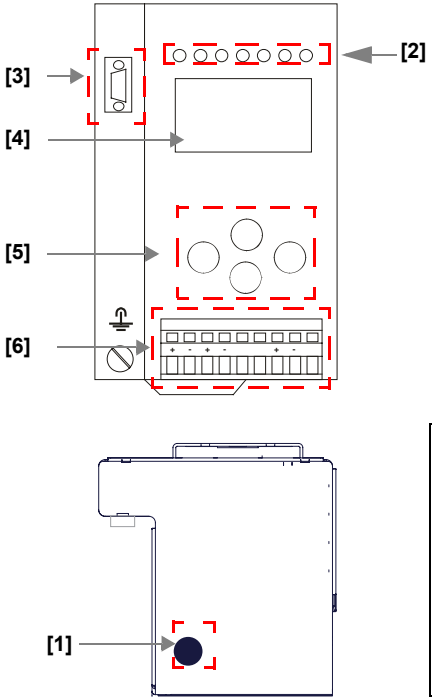
6. Electrical connection

6.1 Overview of terminals, indicators and operating elements

6.1.1 VBG-MOD-K20-D



∅ 5 ... 6 mm / PZ2	0,8 Nm 7 LB.IN
10	2 x (0,5 ... 1,5) mm²
10	2 x (0,5 ... 1,5) mm²
AWG	2 x 24 ...12

Legend:

[1] RS232 diagnostics port[1]
[2] LEDs
[3] D-sub connection (Modbus interface)
[4] LC display
[5] Push-buttons
[6] AS-i and power supply terminal

1. Only in conjunction with AS-i Control Tools

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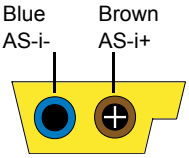
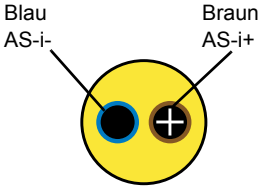
6.2 AS-i bus connection



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.

6.3 Information about the device types

Information!

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

6.4 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.

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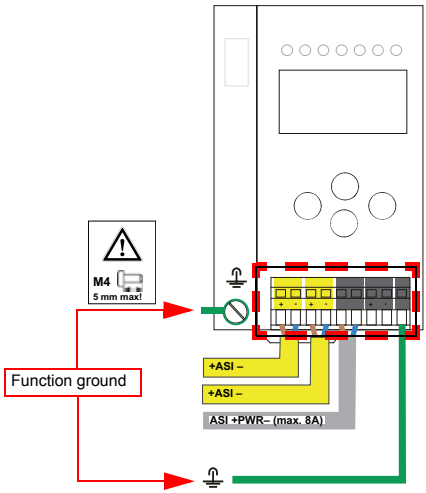
6.4.1 Electrical connection VBG-MOD-K20-D



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!

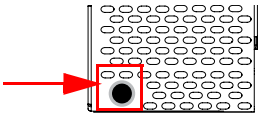
For additional information, please refer to the section <AS-i and power supply terminal assignments>.

6.5 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.

6.5.1 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>).



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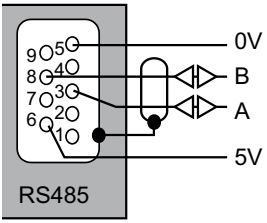
6.6 Serial interface RS485

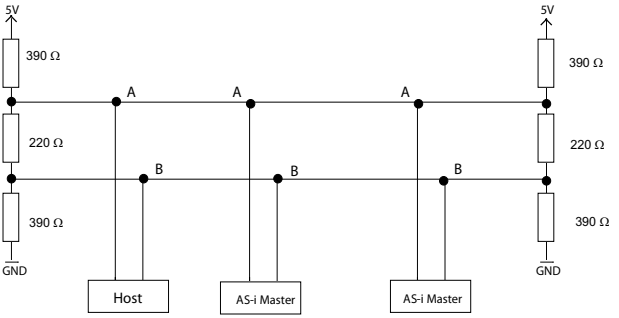
The AS-i/Modbus/RTU gateway with RS 485 interface sends and receives data on pins 3 and 8 of the sub-D socket. The RS 485 signal “A” is assigned to pin 3 and signal “B” to pin 8.



PIN	Description of the D-SUB connector
Pin 3	A („RxD/TxD+“)
Pin 5	0 V
Pin 6	5 V
Pin 8	B („RxD/TxD-")

The shilding of the interface cable is connected to the grounding terminal of the AS-i master via a capacitor to avoid equalizing currents. It should be electrically grounded elsewhere.

6.6.1 Bus termination in a RS 485 network



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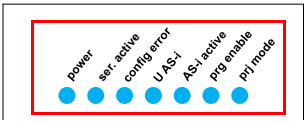
6.7 Indicators and operating elements

6.7.1 LED indicators – master



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

Power

The AS-i master is receiving sufficient power.

Ser. active (status)

The AS-i master in operating status.

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.

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6.7.2 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>.

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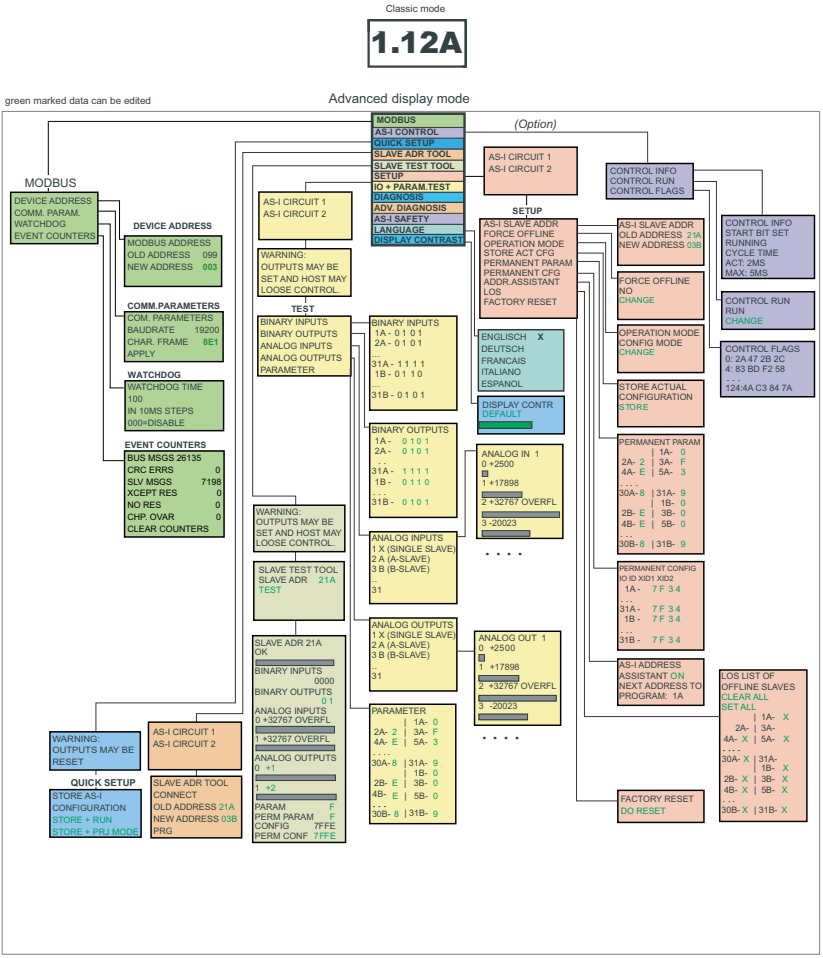
7. Operation in advanced display mode

Information!

From SETUP/LANGUAGE you can set the desired menu language (German, English, French, Italian or Spanish), see <Language (menu language)>.

7.1 Overview

Commissioning



Basic Operation

The device starts in the traditional mode. You can switch between the two modes with ESC or OK. In the advanced mode the cursor is moved by both arrow buttons. Pushing OK puts you to the superior menue (in the drawing one step to the right side). ESC puts you back to the previous menue. To edit data you first mark them with the cursor and then select them with OK, change them with the arrow buttons and finally apply them with OK. Pushing ESC cancels the editing.

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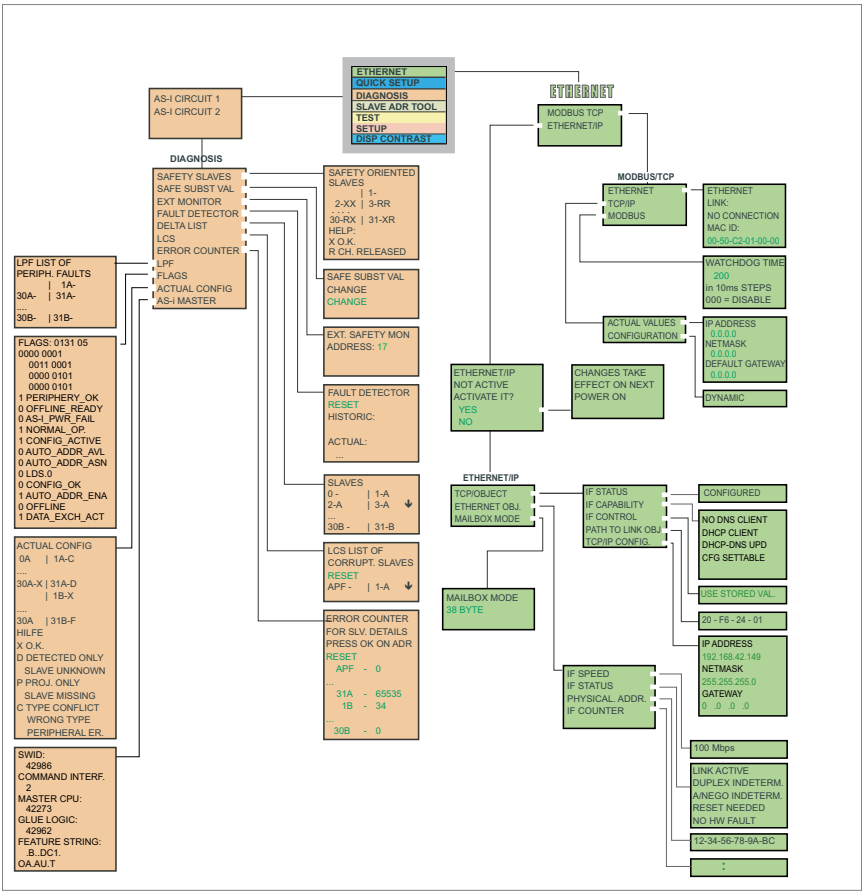
Commissioning

Classic mode

1.12A

green marked data can be edited

Advanced display mode



Basic Operation

The device starts in the traditional mode. You can switch between the two modes with ESC or OK. In the advanced mode the cursor is moved by both arrow buttons. Pushing OK puts you to the superior menue (in the drawing one step to the right side). ESC puts you back to the previous menue. To edit data you first mark them with the cursor and then select them with OK, change them with the arrow buttons and finally apply them with OK. Pushing ESC cancels the editing.

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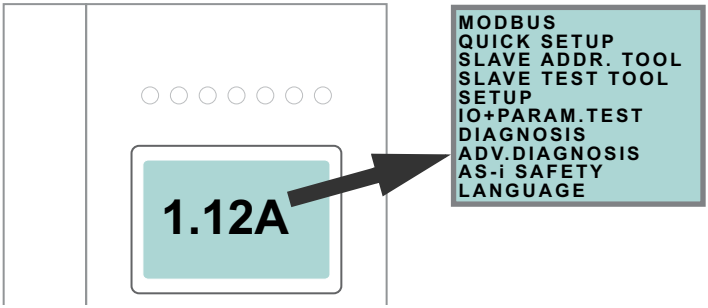
Warning!

Classical (traditional) mode does not guarantee any protection of the settings of the device!

In the classical mode, it is possible to change settings while the device is in operation. This can lead to failures of the installation/process (for example changing the address of an AS-i slave).

7.2 Navigating through the advanced display mode



Information!

Some of the settings in the advanced mode are protected as long as the upstream fieldbus running. That means that some status information can be displayed only.

To protect the installation/process, many options such as "change address", "write parameter", "set outputs", etc. cannot be performed with an active connection to the control system (active fieldbus connection) . In order to execute these commands via the display, the connection to the control system must be deactivated first (no fieldbus connection).

The device starts up in the classical mode. Pressing the OK button switches to the advanced mode. To return to the classical mode, the ESC button must be pressed several times.

In the advanced mode, the selection menu can be moved up and down by using the two arrow buttons. Pressing OK switches to the selected function or to the displayed menu, respectively. Pressing ESC returns to the previous menu.

To edit a value it must be highlighted by using the selection bar and then pressing OK. The data can be changed by using the arrow-buttons. Changes are confirmed with OK. The ESC button cancels the editing process.

All possible slave addresses are displayed in sequence from 1 A to 31 A and from 1 B to 31 B. Data for single slaves are displayed along with the addresses 1 A to 31 A.

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7.3 MODBUS (Main menu)

Main menu || **MODBUS** ||

```
DEVICE ADDRESS
COMM. PARAM.
EVENT COUNTERS
```

Within the menu "Modbus", one of the following submenues can be called up:

- Device Address
- Comm. Parameters
- Event Counters

7.4 DEVICE ADDRESS

Main menu || **DEVICE ADDRESS** ||

```
MODBUS ADDRESS
OLD ADDRESS 099
NEW ADDRESS 003
```

This feature allows you to set or change the Modbus station address.

The number behind "Old Address" shows the current station address. By selecting "New Address" the station address can be changed.

7.5 Communications parameter

Main menu || COM. PARAMETERS ||

```
COM. PARAMETERS
BAUDRATE  19200
CHAR. FRAME 8E1
APPLY
```

This function enables the changing of the interface configuration of the serial interface.

The number behind "Baud Rate" shows the actual transmission speed of the serial interface.

You can select the following baudrates: 1200, 2400, 4800, 9600, 19200, 28800, 38400, 57600 or 115000 baud, whereas 9600 baud is set as default.

In the next line of this menu you can select the bus parameters like stop bit, data bit and parity. The following values are possible:

data bit:	7, 8
parity:	no, even, odd
stop bit:	1, 2

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8N1 is set as default. This means: 8 data bits, no parity and 1 stop bit.

Possible changes can be set as actual by selecting "Apply" and confirming by pressing the "OK" button.

7.6 Event counter

main menu || EVENT COUNTERS ||

```
BUS MSGS   26135
CRC ERRS       0
SLV MSGS    7198
XCEPT RES      0
NO RES         0
CHP. OVAR      0
CLEAR COUNTERS
```

With this function several event counters are displayed for further diagnostics of the AS-i circuit.

The following informations are displayed:

Bus Msgs:	number of bus messages
CRC Errors:	number of checksum errors
Slv Msgs:	number of slave messages
Xcept Res:	number of exception results
Chr Ovrr:	number of character overflow of serial interface

To reset the counters select "Clear Counters" and then press the "OK" button.

7.7 AS-I CONTROL (option)

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

```
CONTROL INFO
CONTROL RUN
CONTROL FLAGS
```

The control menu contains the following sub-menus:

CONTROL INFO:	status of the control programm
CONTROL RUN:	start/stop the control programm
CONTROL FLAGS:	read/change the control programm

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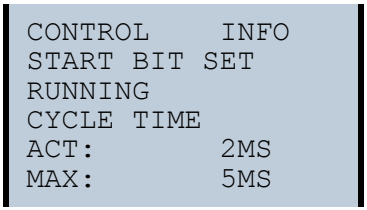
7.7.1 CONTROL INFO

Main menu || AS-I CONTROL || **CONTROL INFO** ||



This function displays the current status of the AS-i control (control program).

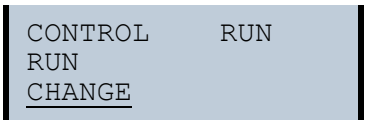
START BIT SET:	the control program has been started
START BIT RESET:	the control program has been stopped
RUNNING:	the control program is running
STOPPED:	the control program has stopped

The control program can be stopped even though the start bit was set. Example: any configuration error occurs, or the master is in the configuration mode.

ACT:	current cycle time of the control program
MAX:	maximum cycle time of the control program since its last start

7.7.2 CONTROL RUN

Main menu || AS-I CONTROL || **CONTROL RUN** ||



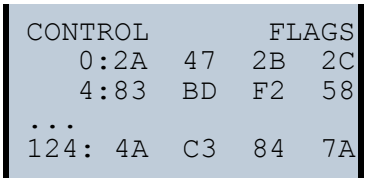
This function is used to start or stop the control program. It modifies the START BIT in the Control Info menu.

RUN:	The control program has been started. The control program can be stopped even if the start bit is set, for example if a configuration error occurred or if the master is in configuration mode.
CHANGE:	Change the state between RUN and and STOP.

Issue date: 6.12.2010

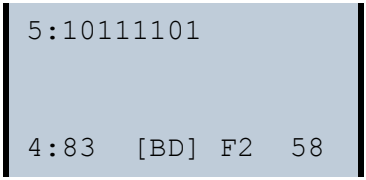
7.7.3 CONTROL FLAGS (control program flag memory)

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



This function is used to read and modify the control program's flag memory.

- First, a row needs to be selected using the soft keys.
- Pressing OK displays the selected row.



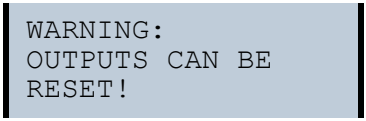
After pressing OK, the display mode changes and it is now possible to select individual flags using the soft keys. The selected flag is then displayed in binary format at the top row.

- Pressing OK again enables editing the selected binary value.

7.8 QUICK SETUP

Main menu || **QUICK SETUP** ||

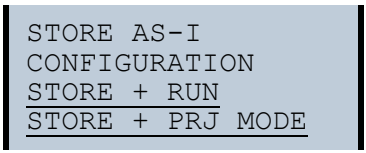
This menu enables a quick configuration of the AS-i network.



Warning!

Outputs can be reset!

Pressing "OK" switches the user to the sub menu "Store AS-i Configuration".



Store+Run

Issue date: 6.12.2010

Pressing "OK" stores the detected configuration and the detected slaves on the AS-i network as the active configuration. The gateway then switches to the protected operating mode.

Store + Prj Mode

Pressing "OK" stores the detected configuration and the detected slaves on the AS-i network as the active configuration. The gateway remains in configuration mode.

Pressing "ESC" leaves this menu and switches back to the main menu.

7.9 SLAVE ADR TOOL

Main menu || **SLAVE ADR TOOL** ||

This function enables setting and changing the addresses of both new and already configured AS-i slaves. This function replaces the handheld AS-i address programming device.

Pressing the OK button continues with the actual test, ESC cancels the process.

```
SLAVE ADR TOOL
CONNECT NEW SLV
OLD ADDRESS
NEW ADDRESS
PRG
```

Now the new slave can be connected to the AS-i network. After connecting, the current address of the slave is displayed as "OLD ADDRESS"and the message "CONNECT NEW SLV" disappears.

To assign a new address to the slave the menu entry "NEW ADDRESS" must be selected. Afterwards the new address can be selected by using the arrow buttons. The selected address is assigned by selecting "PRG" on the menu and pressing the OK button.

```
SLAVE ADR TOOL
CONNECT
OLD ADDRESS  21A
NEW ADDRESS  03B
PRG
```

If an error occurs while addressing a slave, one of the following error messages is displayed for about 2 seconds:

Failed: SND:	slave with old address has not been detected.
Failed: SD0:	slave with address 0 already exists.
Failed: SD2:	chosen slave address already exists.
Failed: DE:	AS-i slave address cannot be deleted.
Failed: SE:	error setting new address for AS-i slave.

Issue date: 6.12.2010

Failed: SND:	slave with old address has not been detected.
Failed: AT:	new address for AS-i slave could be stored temporarily only.
Failed: RE:	error reading extended ID1-code.

Information!

When working with a double master (AS-i master and two AS-i networks) the AS-i network must be selected first by using the arrow and the OK buttons.

```
AS-i CIRCUIT 1
AS-i CIRCUIT 2
```

7.10 SLAVE TEST TOOL

Main menu || **SLAVE TEST TOOL** ||

After selecting the menu SLAVE TEST TOOL a warning message is displayed, pointing out, that it is possible during this test that outputs are set and that the host may loose control over the network.

Pressing the OK button continues with the actual test, ESC cancels the process.

```
WARNING:
OUTPUTS MAY BE
SET AND HOST MAY
LOOSE CONTROL.
```

In the proceeding menu the slave to be tested has to be selected by entering the slave address.

Afterwards, testing the selected slave is started by confirming the menu entry "Test".

```
SLAVE TEST TOOL
SLAVE ADR   21A
TEST
```

After finishing testing the selected slave all relevant information is displayed. A successful test is indicated by "OK" below the address of the tested slave.

The following information is displayed:

- Address of the tested slave
- Display of a configuration error (if present)
- Binary inputs (digital inputs)
- Binary outputs (digital outputs)
- Analog inputs
- Analog outputs

Issue date: 6.12.2010

- Param (actual parameters)
- Perm Param (permanent parameters)
- Config (actual configuration)
- Perm Conf (permanent configuration)

```
SLAVE ADR 21A
OK

BINARY INPUTS
                1
BINARY OUTPUTS

                1
ANALOG INPUTS
           0000

1 +32767 OVERFL

ANALOG OUTPUTS
0 +32767 OVERFL

ANALOG OUTPUTS
0 +1

1 +2
PARAM          F
PERM PARAM     F
CONFIG     0A72
PERM CONF  0A72
```

Information!

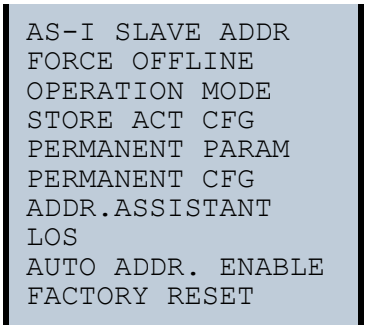
When working with a double master (AS-i master and two AS-i networks) the AS-i network must be selected first by using the arrow and the OK buttons.

```
AS-i CIRCUIT 1
AS-i CIRCUIT 2
```

Issue date: 6.12.2010

7.11 SETUP (configuration of an AS-i network)

Main menu || **SETUP** ||

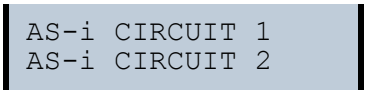


In the "Setup menu", the following sub-menus are available:

AS-I SLAVE ADDR:	set/edit AS-i slave address
FORCE OFFLINE:	switch AS-i master to offline operation
OPERATION MODE:	operation mode
STORE ACT CFG:	store current configuration
PERMANENT PARAM	permanent parameters
PERMANENT CFG:	permanent configuration data
ADDR.ASSISTANT:	address assistant
LOS:	list of offline slaves
AUTO ADDR. ENABLE:	auto addressing enable
FACTORY RESET:	reset to factory settings

7.11.1 AS-I CIRCUIT

Main menu || **SETUP** ||

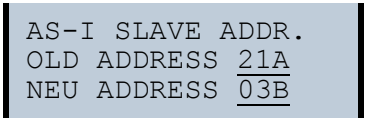


To start this setup menu, an AS-i circuit must first be selected using the arrow and the OK buttons.

The function is only available for AS-i masters with two AS-i circuits.

7.11.2 AS-I SLAVE ADR. (set/change slave address)

Main menu || SETUP || **AS-I SLAVE ADDR** ||



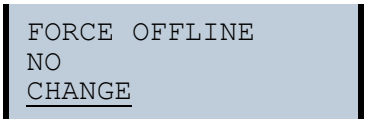
Issue date: 6.12.2010

This function is used to change the address of a slave.

To assign a new address to a slave, the menu entry "OLD ADDRESS" and then the slave to be changed must be selected. The new address of the slave can be set in the menu item "NEW ADDRESS". The address change is performed by pressing the OK button.

7.11.3 FORCE OFFLINE (Switch AS-i Master to offline operation)

Main menu || SETUP || **FORCE OFFLINE** ||



This function is used to change the address of a slave.

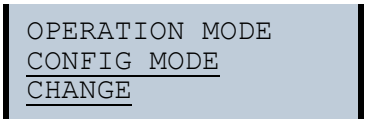
YES: AS-i Master is offline.
NO: AS-i Master is online.

With "Change", this status can be changed.

Switching the AS-i master to offline operation puts the AS-i network into the safe state. The AS-i master must be offline if an AS-i slave needs to be readdressed via the IR-interface.

7.11.4 OPERATION MODE

Main menu || SETUP || OPERATION MODE ||



This function shows the current operation mode of the AS-i master:

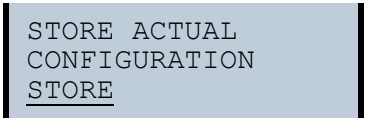
PROTECTED MODE: protected operating mode
CONFIG MODE: configuration mode

The operation mode can be changed with “Change”.

Parameters and configuration data can be modified in configuration mode, only.

7.11.5 STORE ACTUAL (store currently detected configuration)

Main menu || SETUP || STORE ACTUAL||



This function can only be executed in configuration mode.

Issue date: 6.12.2010

This function enables currently detected slaves on the selected AS-i network to be stored in the configuration of the AS-i Master.

If "Store" was successful, the LED "Config error" is turned off. The configuration is stored and the configuration error has been eliminated.

However, if one of the connected slaves exhibits a peripheral fault, the LED "Config error" will flash.

If the AS-i master is in protected mode, the error message "Failed No Config Mode" will appear:

Address 0 is not a permitted operation address for a slave. If an AS-i slave with this address exists, storing the configuration will still be confirmed with "OK". However, the configuration error remains.

7.11.6 PERMANENT PARA (permanent parameters)

Main menu || SETUP || PERMANENT PARA ||

```
PERMANENT PARAM
          |  1A-  0
2A - 2    |  3A-  F
4A - E    |  5A-  F
…
30A- 8    | 31A-  9
          |  1B-  0
2B - E    |  3B-  0
4B - E    |  5B-  0
…
30B- 8    | 31B-  9
```

This function is used to set the permanent parameters. All present slave addresses are displayed in sequence from 1A to 31A and from 1B to 31B. Data for single slaves are displayed with the addresses 1A to 31A. The parameter value is displayed behind the respective slave address.

Issue date: 6.12.2010

7.11.7 PERMANENT CONFIG (permanent configuration data)

Main menu || SETUP || PERMANENT CONFIG ||

```
PERMANENT CONFIG.
IO ID XID1 XID2
 1A-  7F34
…
31A-  7F34
 1B-  7F34
…
31B-  7F34
```

This function is used to set the permanent configuration values. The defined values for the configuration data are displayed behind the respective slave address in the following order:

IO (I/O-configuration) ID (ID-configuration) xID1 (extended ID1) xID2 (extended ID2).

7.11.8 AS-I ADDRESS (AS-i address assistant)

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

```
AS-I ADDRESS
ASSISTANT    ON
NEXT ADDRESS
ADDR.: -
```

The AS-i address assistant assists the user to quickly set up an AS-i network. Once the AS-i configuration has been stored, a new AS-i slave with address 0 can be used to assign the correct address.

Selecting "Assistant on" or "Assistant off" switches the AS-i address assistant on or off. The current state of the AS-i address assistant is displayed:

ASSISTANT ON:	AS-i address assistant is switched on.
ASSISTANT OFF:	AS-i address assistant is switched off.

Procedure:

1. Store AS-i configuration in the device. This can easily be done by using the Windows software AS-i Control Tools (Master | Store configuration for the AS-i Master ...), or directly in the advanced display mode.
2. All AS-i slaves have to be addressed to 0 or to the desired address. The slaves must be disconnected from the AS-i network.
3. Start the AS-i address assistant.

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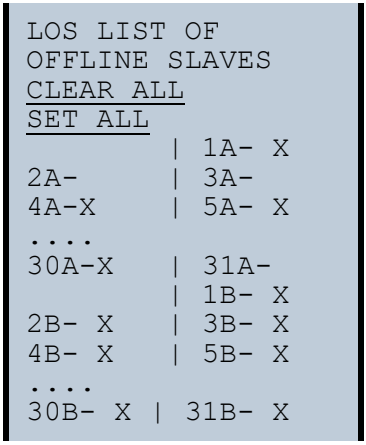
4. Now the AS-i slaves are connected to the AS-i network one at the time in the order specified by the AS-i address assistant. The last line displayed for the AS-i address assistant shows which AS-i slave will be connected next.

7.11.9 LOS (list of offline slaves)

Main menu || SETUP || LOS LIST OF OFFLINE SLAVES ||



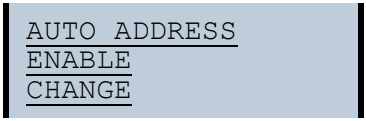
See also <Advanced Diagnostics for AS-i Masters>.

By using "Clear all" and "Set all" all bits in this list can be delete or set, respectively, at the same time. Below this is a list of all slaves that can be selected individually in order to set or delete the LOS bit.

Empty field:	LOS bit deleted
X:	LOS bit set

7.11.10 AUTO ADDR (enable automatic address)

Main menu || SETUP || **AUTO ADDRESS** ||



This function is used to enable or disable automatic address assignment.

This mode can be:

Enable:	automatic address assignment is released.
Disable:	automatic address assignment is locked.

Issue date: 6.12.2010

7.11.11 FACTORY RESET (factory default settings)

Main Menu || SETUP || FACTORY RESET ||

```
FACTORY RESET
DO RESET
```

This function can be used to reset the master to the factory default settings. The “Reset” is done by selecting menu point DO RESET.

Warning!

This function should be used only in emergencies, since all previously set attributes are set back to the factory setting and ,thus, secure communication and operation of the masters with the AS-i network is no longer guaranteed.

Master and AS-i network have to be reconfigured after a successful "Reset".

For double masters the "Reset" acts on both AS-i masters!

7.12 AS-I CIRCUIT

Main menu || **I+O PARAM.TEST** ||

```
AS-I CIRCUIT 1
AS-i CIRCUIT 2
```

To get to the IO and Parameter Test Program, an AS-i network must first be selected by using the arrow and OK buttons.

The function is only available for AS-i masters with two AS-i networks.

7.13 IO + PARAM.TEST

Main menu || **IO + PARAM.TEST** ||

The following warning message will be displayed before entering this menu:

```
WARNING: OUTPUTS
MAY BE SET AND
HOST MAY LOSE
CONTROL OVER
THE AS-I MASTER.
```

Pressing the OK button continues with the actual test, ESC cancels the process.

```
BINARY INPUTS
BINARY OUTPUTS
ANALOG INPUTS
ANALOG OUTPUTS
PARAMETER
```

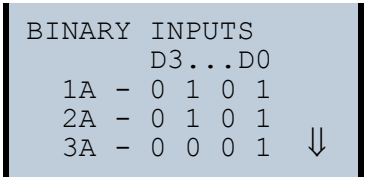
The menu "IO + Param.Test" offers the following sub menus:

Issue date: 6.12.2010

BINARY INPUTS:	State of the binary inputs
BINARY OUTPUTS:	State of the binary outputs
ANALOG INPUTS	State of the analog inputs
ANALOG OUTPUTS:	State of the analog outputs
PARAMETERS:	Value of the current AS-i parameter

7.13.1 BINARY INPUTS

Main menu || IO + PARAM.TEST || **BINARY INPUTS** ||

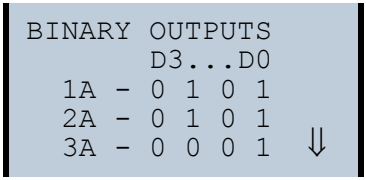


This function displays the state of the binary inputs for all AS-i slaves.

0:	Input cleared
1:	Input set

7.13.2 BINARY OUTPUTS

Main menu || IO + PARAM.TEST || **BINARY OUTPUTS** ||



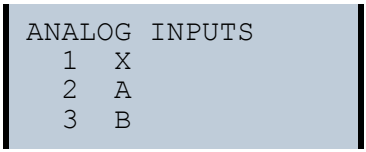
This function displays the state of the binary outputs for all AS-i slaves.

0:	output cleared
1:	output set

The binary outputs can be modified after selecting an AS-i slave.

7.13.3 ANALOG INPUTS

Main menu || IO + PARAM.TEST || **ANALOG INPUTS** ||



Issue date: 6.12.2010

The slave types are characterized as follows:

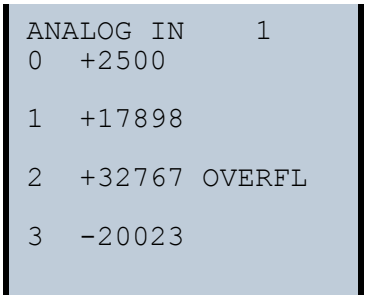
X:	Single Slave
A:	A-Slave
B:	B-Slave
AB:	A+B Slave
...	

The data of the B slaves starts at channel 2!

The order in which information is displayed is as follows:

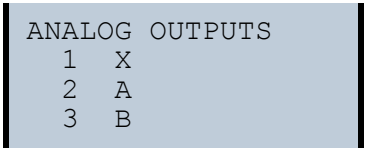
- AS-i slave address
- decimal 16-bit value
- bar graph

If the selected slave is a transparent slave, the value is always displayed without sign. If the selected slave is a transparent slave, the value is always displayed without sign. In this case, when the value is changed only positive values can be entered. Additionally, a value overflow is indicated by "Overfl".



7.13.4 ANALOG OUTPUTS

Main menu || IO + PARAM.TEST || **ANALOG OUTPUTS** ||



This function displays the values of the analog outputs for all AS-i slaves.

The order in which information is displayed is as follows:

- AS-i slave address
- decimal 16-bit value
- bar graph.

If the selected slave is a transparent slave, the value is always displayed without sign. If the selected slave is a transparent slave, the value is always displayed without sign. In this case, when the value is changed only positive values can be entered. Additionally, a value overflow is indicated by "Overfl".

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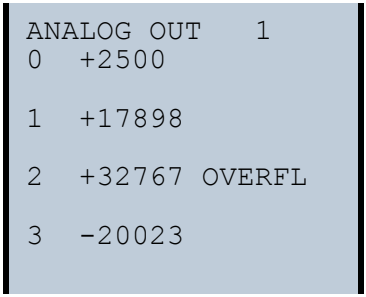
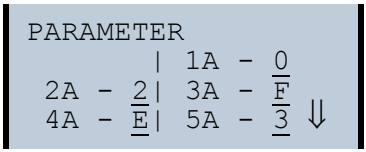


The analog outputs can be changed after selecting an AS-i slave.

7.13.5 PARAMETER

Main menu || IO + PARAM.TEST || **PARAMETER** ||

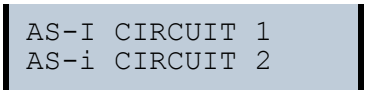


This function displays the hexadecimal value of the current AS-i parameters for all AS-i slaves.

The current AS-i parameters can be changed after selecting a slave address.

7.14 AS-I CIRCUIT

Main menu || **DIAGNOSIS** ||

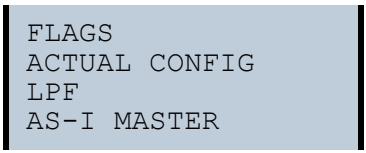


Please select the required AS-i circuit using the arrow buttons and the OK button. Than you get the diagnostic menu.

The function is only available for AS-i masters with two AS-i circuits.

7.15 DIAGNOSIS

Main menu || **DIAGNOSIS** ||



Issue date: 6.12.2010

FLAGS:	Display of the EC-Flags
ACTUAL CONFIG:	Display of the current configuration
LPF:	List of Peripheral Faults
AS-I MASTER:	Display of the software states

For additional information refer to chap. <Advanced Diagnostics for AS-i Masters>.

7.15.1 FLAGS

Main menu || DIAGNOSIS || **FLAGS** ||

```
FLAGS: 0131 05
       0000 0001
       0011 0001
       0000 0101
1   PERIPHERY_OK
0   OFFLINE_READY
0   AS-I_PWR_FAIL
1   NORMAL_OP.
1   CONFIG_ACTIVE
0   AUTO_ADDR_AVL
0   AUTO_ADDR_ASN
0   LDS.0
1   CONFIG_OK

1   AUTO_ADDR_ENA
0   OFFLINE
1   DATA_EXCH_ACT
```

This function displays the EC-flags in hexadecimal or binary format as well as single bits beginning with the least significant bit.

Arrangement of the bits within the byte:

Byte								
Byte value:	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Bit:	7	6	5	4	3	2	1	0

Byte 1

Bit 0: Periphery_OK
This flag is set if none of the AS-i slave signals a peripheral fault.

Byte 2

Bit 7: Offline_Ready
The flag is set if the AS-i master is offline.

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Bit 6: AS-i Pwr Fail
The flag is set if the AS-i circuit is not sufficiently powered.

Bit 5: Normal_Op.
The flag is set if the AS-i master is in normal operation.

Bit 4: Config_Active
The flag is set in configuration mode and is reset in protected mode.

Bit 3: Auto_Addr_Avl
The flag is set if the automatic addressing is possible. This means that exactly one slave has failed.

Bit 2: Auto_Addr_Asn
The flag is set if automatic addressing is possible (AUTO_ADDR_ENABLE = 1; no "incorrect" AS-i slave is connected to AS-i).

Bit 1: LDS.0
The flag is set,if an AS-i slave with address 0 has been detected.

Bit 0: Config_OK
The flag is set if the projected configuration is equal to the actual configuration.

Byte 3

Bit 0: Data_Exch_Act
If the flag "Data Exchange Active" is set, the data exchange with AS-i slaves is possible during the data exchange phase. If the bit is not set, the data exchange with AS-i slaves is inhibited. Instead of data telegrams READ_ID telegrams will be sent.
The bit is set by the AS-i master at the beginning of the offline phase.

Bit 1: Offline
This bit is set if the operating mode is supposed to be changing to offline or is already offline.

Bit 2: Auto_Addr_Ena
This flag indicates if automatic addressing has been disabled (bit = 0) or enabled (bit = 1) by the user.

Issue date: 6.12.2010

7.15.2 ACTUAL CONFIG (actual slave configuration)

Main menu || DIAGNOSIS || **ACTUAL CONFIG** ||

```
ACTUAL CONFIG
 0A      |  1A-C
....
30A-X    | 31A-D
         |  1B-X
....
30A      | 31B-F
HELP:
X O.K.
D DETECTED ONLY
  UNKNOWN SLAVE
P PROJ. ONLY
  MISSING SLAVE
C TYPE CONFLICT
F PERIPH. FAULT
A DUPLICATE ADDR
```

This function displays the status of the actual configuration of the individual AS-i slaves.

A help appears at the end of the list explaining the abbreviations:

X (O.K.):	The configuration data for the detected AS-i slave agree with the designed in configuration data.
D (Detected Only):	An AS-i slave is detected at this address, but it was not designed in.
P (Projected Only):	An AS-i slave was designed in at this address, but it was not detected.
C (Type Conflict):	The configuration data for the detected AS-i slave do not agree with the designed in configuration data. The actual existing configuration of the connected AS-i slave is displayed.
F (Periph. Fault):	The AS-i slave has a peripheral error.
A (Duplicate Adr.):	Two AS-i slaves at the indicated address.

After selecting the desired AS-i slave address, the values for the current configuration data are displayed after the respective address in the following order:

- IO (I/O-Configuration)
- ID (ID-Configuration)
- xID1 (extended ID1)
- xID2 (extended ID2).

Issue date: 6.12.2010

```
0A - .... -

1A - 7A28 -C
WRONG TYPE
```

In addition, the status of the configuration is shown in plain text.

If no AS-i slave is present at an address and none is designed in, four decimal points are displayed instead of the configuration data.

7.15.3 LPF (List of Peripheral Faults)

Main menu|| DIAGNOSIS || **LPF LIST OF PERIPH. FAULTS** ||

```
LPF LIST OF
PERIPH. FAULTS
      |  1A-X
2A-   |  3A-
4A-X  |  5A-X
....
30A-X | 31A-
      |  1B-X
```

This list shows the list of slaves which have triggered peripheral faults (LPF).

Empty field:	Peripheral O.K.
X:	Peripheral fault

7.15.4 AS-I MASTER (info)

Main menu || DIAGNOSIS || **AS-I MASTER** ||

```
VERSION
20000919
FEATURE STRING
ZEFOD1.AS.ER
```

This function shows information about the version and features of the AS-i master:

VERSION:	date of the firmware
FEATURE STRING:	feature string of the AS-i masters

Issue date: 6.12.2010

7.16 AS-I CIRCUIT (selecting the AS-i circuit)

Main Menu || **ADV. DIAGNOSIS** ||

```
AS-I CIRCUIT 1
AS-i CIRCUIT 2
```

Please select the required AS-i circuit using the arrow buttons and the OK button. Than you get the diagnostic menu.

7.17 ADV. DIAGNOSIS (advanced diagnostics)

Main menu || **ADV. DIAGNOSIS** ||

```
ERROR COUNTER
LCS
FAULT DETECTOR
```

The menu "Adv. Diagnosis" has the following sub menu:

ERROR COUNTER:	error counter
LCS:	list of slaves, that caused a configuration error
FAULT DETECTOR:	history of the AS-i fault detector

For additional information refer to section <Advanced Diagnostics for AS-i Masters>.

7.17.1 ERROR COUNTERS

Main Menu|| ADV. DIAGNOSIS || **ERROR COUNTERS** ||

```
ERROR COUNTERS
RESET
1A - 0
...
31A - 65535
 1B - 34
...
30B - 0
```

This list displays the fault counter for each single AS-i slave.

In addition, the number of voltage dropouts/undervoltage on AS-i (APF) is displayed.

Selecting RESET resets the fault counter to 0.

Issue date: 6.12.2010

7.17.2 LCS (History of the slaves which have triggered a configuration error)

Main menu || ADV. DIAGNOSIS || **LCS** ||

```
LCS LIST OF
CORRUPTED SLAVES
RESET
        |  1A-X
2A-     |  3A-
4A-X    |  5A-X
....
30A-X   | 31A-
        |  1B-X
2B-X    |  3B-X
4B-X    |  5B-X
....
30B-X   | 31B-X
```

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.

empty field:	no error
X:	AS-i Slave triggered a configuration error.

7.17.3 FAULT DETECTOR

Main menu || ADV. DIAGNOSIS || FAULT DETECTOR ||

```
FAULT DETECTOR
RESET
HISTORIC:
EFLT OVRV NOIS
ACTUAL:
EFLT OVRV NOIS
DUP ASI ADR:
  0       | 31B
HELP:
EFLT EARTH FAULT
OVRV OVERVOLTAGE
NOIS NOISE
DUP ASI ADDR
   DUPLICATE ASI
   SLAVE ADDRESS
```

Issue date: 6.12.2010

The menu "Fault Detector" displays information about the AS-i fault detector and permits deleting the AS-i fault detector´s history. Furthermore, a list of abbreviations in clear text is displayed in the "Help" section.

By selecting "Reset" the history of the AS-i fault detector can be deleted.

The section "Historic" lists the error messages generated by the AS-i fault detector since the last "Reset".

The section "Actual" lists the currently present error messages of the AS-i fault detector.

The following error messages are displayed:

- Duplicate address (displaying of 2 lowest slave addresses with duplicate addresses)
- Earth faults
- Noise
- Over-voltage

Optionally, the absence of the redundant 24V for some single masters may be displayed.

7.18 AS-I CIRCUIT

Main menu || **SAFETY** ||

```
AS-I CIRCUIT 1
AS-i CIRCUIT 2
```

Please select the required AS-i circuit using the arrow buttons and the OK button. Than you get the AS-I SAFETY menu.

The function is only available for AS-i masters with two AS-i circuits.

7.19 AS-I SAFETY

Main menu || **AS-I SAFETY** ||

```
SAFETY SLAVES
SAFETY MONITOR
SAFE SUBST. VAL.
```

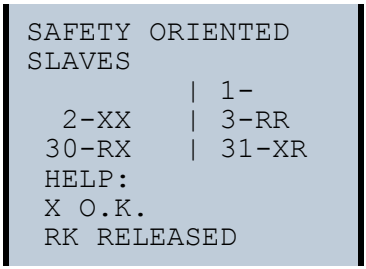
This menu enables the following functions:

SAFETY SLAVES:	safety oriented slaves
SAFETY MONITOR:	safety monitor
SAFE SUBST. VAL:	safe substitude values for safety slaves

Issue date: 6.12.2010

7.19.1 SAFETY SLAVES (safety oriented slaves)

Main Menu|| AS-I SAFETY || **SAFETY ORIENTED SLAVES** ||



The list of “Safety Input Slaves” (“AS-i Safety at Work”) shows the slaves for which the safety function has been released:

X: The channel is OK
R: The channel has released

The first place corresponds to Channel 2, the second place to Channel 1. Thus RX means that Channel 2 released and Channel 1 is OK.

The channels can not be evaluated individually, if the substitution of safety slaves input data was disabled in menu:

• command interface/ function profile

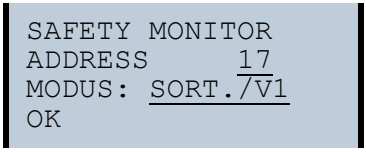
or

• slave value substitute (SAFETY SUBST VALUE).

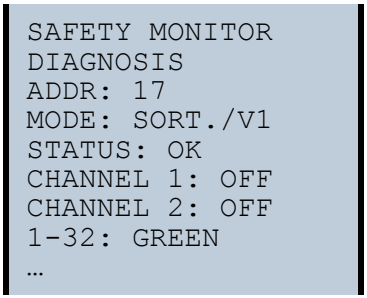
In this case both channels must have the same state, otherwise the indication will not be proper.

7.19.2 SAFETY MONITOR

Main menu || AS-I SAFETY || **SAFETY MONITOR** ||



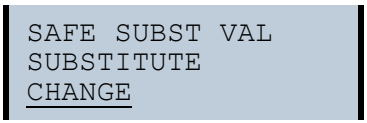
Issue date: 6.12.2010



The AS-i safety monitor diagnostics function reads the diagnostics data from the AS-i safety monitor and displays these data. The significance of the displayed diagnostics and of the setting SORTED/V1, UNSORTED is described in the operating manual of the safety monitor.

7.19.3 SAFETY SUBST VAL (Substitute values for input data from safe slaves)

Main menu || AS-I SAFETY || SAFETY SUBST VAL ||



This function enables activation/deactivation of the code substitute function for safe slaves.

SUBSTITUTE (values)

The safety code sequences are replaced by the following values:

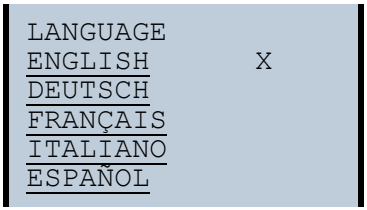
Both channels are in the safe state:	0000bin
Channel 1 is in the safe state:	0011bin
Channel 2 is in the safe state:	1100bin
No channel is in the safe state:	1111bin

NO SUBSTITUTE

The safety code sequences are transmitted via the input data.

7.20 Language (menu language)

Main Menu || **LANGUAGE** ||

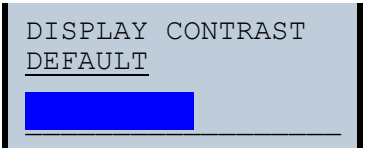


Issue date: 6.12.2010

From this menu you can select the menu language. „X“ marks the currently selected language.

7.21 DISPLAY CONTRAST (set display contrast)

Main Menu || **DISPLAY CONTRAST** ||



This function allows you to set the display contrast.

- Use the arrow keys to select the line with the bar
- Confirm your selection with OK (bar flashes)
- Use the arrow keys to set the display contrast
- Use OK to apply the setting

The factory settings are invoked from the DEFAULT field.

If the contrast is set so that the display can no longer be read, it can be reset to the factory default setting as follows:

- Shut the unit off
- Press the MODE and SET keys and hold them down.
- Shut the unit on.

Issue date: 6.12.2010

8. 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).

8.1 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").

8.2 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".

Issue date: 6.12.2010

8.3 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.

8.4 Functions of the AS-i Fault Detector

8.4.1 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.

Issue date: 6.12.2010

8.4.2 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.

8.4.3 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.

8.4.4 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.

Issue date: 6.12.2010

9. The Modbus Address Table

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

4x reference	contakt	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	nicht benutzt				slave 1/1B				slave 2/2A				slave 3/3B			
11	161 - 176	slave 4/4B				slave 5/5B				slave 6/6B				slave 7/7B			
12	177 - 192	slave 8/8B				slave 9/9B				slave 10/10B				slave 11/11B			
13	193 - 208	slave 12/12B				slave 13/13B				slave 14/14B				slave 15/15B			
14	209 - 224	slave 16/16B				slave 17/17B				slave 18/18B				slave 19/19B			
15	225 - 240	slave 20/20B				slave 21/21B				slave 22/22B				slave 23/23B			
16	241 - 256	slave 24/24B				slave 25/25B				slave 26/26B				slave 27/27B			
17	257 - 272	slave 28/28B				slave 29/29B				slave 30/30B				slave 31/31B			

Tab. 9-2.

F1 - F15: flags, see "reference 0"

Issue date: 6.12.2010

Cyclic data exchange similar to the Momentum Ethernet Adapter

AS-i circuit 2: Input Data Imagge IDI

4x reference	contakt	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 1/1B				slave 2/2A				slave 3/3B			
28	433 - 448	slave 4/4B				slave 5/5B				slave 6/6B				slave 7/7B			
29	449 - 464	slave 8/8B				slave 9/9B				slave 10/10B				slave 11/11B			
30	465 - 480	slave 12/12B				slave 13/13B				slave 14/14B				slave 15/15B			
31	481 - 496	slave 16/16B				slave 17/17B				slave 18/18B				slave 19/19B			
32	497 - 512	slave 20/20B				slave 21/21B				slave 22/22B				slave 23/23B			
33	513 - 528	slave 24/24B				slave 25/25B				slave 26/26B				slave 27/27B			
34	529 - 544	slave 28/28B				slave 29/29B				slave 30/30B				slave 31/31B			

Tab. 9-3.

F1 - F15: flags, see "reference 0"

Issue date: 6.12.2010

Cyclic data exchange similar to the Momentum Ethernet Adapter

AS-i circuit 1: Output Data Imagge ODI

4x reference	contakt	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	F 8	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 1/1B				slave 2/2A				slave 3/3B			
11	161 - 176	slave 4/4B				slave 5/5B				slave 6/6B				slave 7/7B			
12	177 - 192	slave 8/8B				slave 9/9B				slave 10/10B				slave 11/11B			
13	193 - 208	slave 12/12B				slave 13/13B				slave 14/14B				slave 15/15B			
14	209 - 224	slave 16/16B				slave 17/17B				slave 18/18B				slave 19/19B			
15	225 - 240	slave 20/20B				slave 21/21B				slave 22/22B				slave 23/23B			
16	241 - 256	slave 24/24B				slave 25/25B				slave 26/26B				slave 27/27B			
17	257 - 272	slave 28/28B				slave 29/29B				slave 30/30B				slave 31/31B			

Tab. 9-4.

F1 - F15: flags, see "reference 0"

Issue date: 6.12.2010

Cyclic data exchange similar to the Momentum Ethernet Adapter

AS-i circuit 2: Output Data Imagge ODI

4x reference	contakt	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 1/1B				slave 2/2A				slave 3/3B			
28	433 - 448	slave 4/4B				slave 5/5B				slave 6/6B				slave 7/7B			
29	449 - 464	slave 8/8B				slave 9/9B				slave 10/10B				slave 11/11B			
30	465 - 480	slave 12/12B				slave 13/13B				slave 14/14B				slave 15/15B			
31	481 - 496	slave 16/16B				slave 17/17B				slave 18/18B				slave 19/19B			
32	497 - 512	slave 20/20B				slave 21/21B				slave 22/22B				slave 23/23B			
33	513 - 528	slave 24/24B				slave 25/25B				slave 26/26B				slave 27/27B			
34	529 - 544	slave 28/28B				slave 29/29B				slave 30/30B				slave 31/31B			

Tab. 9-5.

F1 - F15: flags, see "reference 0"

Issue date: 6.12.2010

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. 9-6.

Issue date: 6.12.2010

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*

Issue date: 6.12.2010

Referenz 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. 9-7.

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. 9-8.

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

Issue date: 6.12.2010

Device-relevant references

4x referece	access	data
2049 ... 2064	r/-	device
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/w	Modbus watchdog[1]
2304	r/w	AS-i control status bits
2305 ... 2368	r/w	AS-i control flag memory
3073 ... 3091	r/w	command interface

Tab. 9-9.

1. The watchdog is set by default to 1000 msec (=100 in register 2086). This value will be automaticly set after POWER ON of the gateway. Every write access on any Modbus registers reload the Watchdog timer with the value in register 2086.

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. 9-10.

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

Tab. 9-11.

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

4x reference	access	data
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-MOD-K20-D"

Tab. 9-11.

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. 9-12.

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

4x reference 4225

Bitwert	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

Tab. 9-13.

Issue date: 6.12.2010

4x reference 4225

Bitwert	Execution Control-Flags
4000_h	Noise
8000_h	Duplicate Address

Tab. 9-13.

Issue date: 6.12.2010

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

Bitwert	Host Interface-Flags
1	Data_Exchange_Active!
2	Off_Line
4	Auto_Address_Enable!

Tab. 9-14.

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

Issue date: 6.12.2010

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

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

Tab. 9-15.

Issue date: 6.12.2010

9.1 AS-i circuit 1 data

9.1.1 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. 9-16.

9.1.2 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. 9-17.

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

Issue date: 6.12.2010

9.1.3 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. 9-18.

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.

Issue date: 6.12.2010

Information!

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

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

9.2 AS-i circuit 1 analog data

9.2.1 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. 9-19.

9.2.2 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. 9-20.

Issue date: 6.12.2010

9.3 AS-i circuit 2 data

9.3.1 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. 9-21.

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

9.3.2 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. 9-22.

9.3.3 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. 9-23.

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

Issue date: 6.12.2010

9.3.4 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. 9-24.

Issue date: 6.12.2010

9.4 AS-i circuit 2 analog data

9.4.1 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. 9-25.

9.4.2 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. 9-26.

9.5 Modbus watchdog

The watchdog is set by default to 1000 msec (=100 in register 2086). 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 *configuration mode* in a safe state by clearing the outputs.

The timeout period can be adjusted if necessary at the address 2086 (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 2086, the watchdog is disabled.

Reading the Address 2086 sets the remaining watchdog hold time back to the time period set in this address (resetting the holding time at each output operation).

Issue date: 6.12.2010

10. Operation via Modbus

The AS-i/Modbus gateway consists of an AS-i master and Modbus slave.

From the AS-Interface, the AS-i/Modbus gateway is the master. The master initiates the AS-i communication and the AS-i slaves only respond.

From the Modbus site the AS-i/Modbus gateway is a slave. It reacts after a query from an Modbus-master.

Attention!

Data Addresses in Modbus Messages

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

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).

10.1 Configuring the Interface

When transferring data via the AS-i master's serial interface, RTU-coding (remote terminal unit) is used. Bus-parameters must be set as follows:

Start bits:	1
data bits:	8 (LSB 2^0 is send first)
parity:	adjustable
stop bits:	1 or 2
baud rate:	adjustable from 1200 bps to 115000 bps

Preselected is 9600 baud, no parity and one stop-bit (see chap. <Communications parameter>).

10.2 Message Structure

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

A	F	N_1	N_2			N_n	C_{lo}	C_{hi}

Slaveaddress *A*	Busaddress of the Modbus-slave. With certain Modbus-Function, it is possible to address all connected slaves in addressing slave zero (A = 0). These broadcast-messages cause slave operation but no slave answer.
Functioncode *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.

Issue date: 6.12.2010

Databytes N_1 ... N_n	Field to hold user-data. The number of bytes is variable. In the case of AS-i/Modbus gateway this field can exceed to the maximum of 30 bytes.
Checksum C_{lo}, C_{hi}	Low- and high-byte of the checksum over all preceding telegram-bytes (CRC-16). After connecting all telegrams bytes to one large binary-number B the CRC-16 is calculated al follows: CRC - 16 = (B * 100000_{hex}) mod 18005_{hex}

For synchronization of the transmitter and the receiver an delay of three and a half bytes-times must precede to each telegram.

10.3 Modbus Functions

Modbus functions supported by the AS-i/Modbus Gateway and their telegrams are described in the following.

10.3.1 Function 1: "*Read Coil Status*"

With this function, discrete outputs can be read.

In the case of AS-i/Modbus gateway it is possible to access the output-data (actuator-data) of the AS-i circuit, the LPS (List of projected-slaves) and the host interface flags.

Additionally this data can be read as "*Holding Register*" (see chap. <Function 3: "Read Holding Registers">).

Query message:	A	1	S_{hi}	S_{lo}	N_{hi}	N_{lo}	$C_{q,lo}$	$C_{q,hi}$
Response message:	A	1	B	D_1			D_B	$C_{r,lo}$	$C_{r,hi}$

S:	Lowest address within the transmit data area.
N:	Number of discrete outputs, that should be transmitted.
B:	Number of following data-bytes D1 to DB
D_1 ... D_B:	State of the discrete outputs. Every output is represented through one bit, with the lowest address transmitted first. This means, bit 1 (2^0) of D1 represents the state of output S and bit 8 (2^7) of D2 represents output S+15.

Information!

In order to achieve short response times and therefore a fast data exchange , "S" and "N" should be integer multiple of "8". Is this not the case, the master must sort the data bits singly in the bytes to to be transferred. This is very time-consuming.

10.3.2 Function 2: "*Read Input Status*"

With this function, discrete inputs can be read.

In the case of AS-i/Modbus gateway it is possible to access the input-data (sensor-data) of the AS-i circuit, the *LAS* (List of activated slaves), the *LDS* (List of detected slaves) and the *execution control flags*.

Additionally this data could be read as "*Input Register*" (see chap. <Function 4: "Read Input Registers">).

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Leaving out the function-code, the telegram-structure is equal to the one of function 1.

Information!

In order to achieve short response times and therefore a fast data exchange , "S" and "N" should be integer multiple of "8". Is this not the case, the master must sort the data bits singly in the bytes to to be transferred. This is very time-consuming.

10.3.3 Function 3: "*Read Holding Registers*"

In addition to discrete inputs and outputs accessed bit-by-bit, there are also Modbus registers, which are accessed word-by-word.

With this function the value of read/write-register can be read.

In the case of AS-i/Modbus gateway it is possible to access the projected data of the AS-i circuit (*PP*, *PCD* and *LPS*), the actual configuration, the user-memory of AS-i Control and the registers to initiate functions of the AS-i master.

Additionally all read-/writeable "*Coils*", can be accessed with this function.

Query message:	A	3	S_{hi}	S_{lo}	N_{hi}	N_{lo}	$C_{q,lo}$	$C_{q,hi}$
Response message:	A	3	B	$D_{1,hi}$		$D_{N,hi}$	$D_{N,lo}$	$C_{r,lo}$	$C_{r,hi}$

S:	Lowest address within the transmit data area.
N:	Number of read/write-registers, that should be transmitted.
B:	Number of following data-bytes $D_{1,hi}$ to $D_{N,lo}$
D_1 ... D_B:	Values of the read/write-registers.
	For every register 2 bytes are transmitted, with the low-byte first.

The AS-i/Modbus gateway can transmit up to 15 register in one telegram.

10.3.4 Function 4: "*Read Input Registers*"

With this function you can read the content of the read-only-register.

The read-only register of the AS-i/Modbus gateway contain the actual-configuration of the AS-i slave *CDI*.

Additionally, all data readable as "Inputs" are also accessible as "Input-register".

Except to the funcion code, the structure of the telegrams for the function 4 corresponds to the function 3.

The AS-i/Modbus gateway can transmit up to 15 register in one telegram.

Issue date: 6.12.2010

10.3.5 Function 5: "*Force Single Coil*"

Function to set or delete a discrete output.

Query message:	A	5	S_{hi}	S_{lo}	D	0	$C_{q,lo}$	$C_{q,hi}$
Response message:	A	5	S_{hi}	S_{lo}	D	0	$C_{r,lo}$	$C_{r,hi}$

S: Address to write.

D: State of the output:
Only two values are valid:
00_{hex}: The output will be set to 0.
FF_{hex}: The output will be set to 1.

10.3.6 Function 6: "*Preset Single Register*"

Function to write a read/write-register.

Query message:	A	6	S_{hi}	S_{lo}	D_{hi}	D_{lo}	$C_{q,lo}$	$C_{q,hi}$
Response message:	A	6	S_{hi}	S_{lo}	D_{hi}	D_{lo}	$C_{r,lo}$	$C_{r,hi}$

S: address of the register to be described

D: new contents of the read / write register

10.3.7 Function 15: "*Force Multiple Coils*"

Function to set or clear several discrete outputs.

Response message:	A	15	S_{hi}	S_{lo}	N_{hi}	N_{lo}	$C_{r,lo}$	$C_{r,hi}$	
Query message:	A	15	S_{hi}	S_{lo}	N_{hi}	N_{lo}	B	D_1	
							D_B	$C_{q,lo}$	$C_{q,hi}$

S: lowest address in the data field to be transferred.

N: number of discrete outputs, whose status is to be transferred

B: number of following data bytes (D_1 to D_B).

D_1 ... D_B: required states of the discrete outputs

Each output is represented by a bit, in which the information for low Modbus addresses is transmitted first. This means, in bit 1(2^0) of D_1 is transmitted the value of the output at address S and in bit 8 (2^7) of D_2 the one of address S+15.

Information!

In order to achieve short response times and therefore a fast data exchange , "S" and "N" should be integer multiple of "8". Is this not the case, the master must sort the data bits singly in the bytes to to be transferred. This is very time-consuming.

Issue date: 6.12.2010

10.3.8 Function 16: "*Preset Multiple Registers*"

Function to set several read/write-register.

Response message:	A	16	S_{hi}	S_{lo}	N_{hi}	N_{lo}	$C_{r,lo}$	$C_{r,hi}$		
Query message:	A	16	S_{hi}	S_{lo}	N_{hi}	N_{lo}	B	$D_{1,hi}$	$D_{1,lo}$	
							$D_{N,hi}$	$D_{N,lo}$	$C_{q,lo}$	$C_{q,hi}$

S:	lowest address in the data field to be transferred.
N:	number of read / write registers, which will be described
B:	Number of following data-bytes ($D_{1,hi}$ to $D_{N,lo}$).
$D_{1,hi}$ ... $D_{N,lo}$:	Values for the registers to set. 2 bytes for each register are transmitted, with the value of the lowest register first.

The AS-i/Modbus gateway can transmit up to 15 register in one telegram.

10.3.9 Function 17: "*Report Slave ID*"

This function is not supported.

10.3.10 Function 7: "*Read Exception Status*"

The functions of the *execution control* of the AS-i Master are triggered via Modbus by writing of determined outputs or register. Because the Modbus protocol when writing outputs or register no feedback is possible, the return values of these functions are buffered in the AS-i/Modbus gateway and can be read as an exception status.

Query message:	A	7	$C_{q,lo}$	$C_{q,hi}$	
Response message:	A	7	D	$C_{r,lo}$	$C_{r,hi}$

D:	Value of last function in *execution control*.
	The MSB (2^7) indicates whether the execution of the function errors is occurred or not 2^7 = 0: no error 2^7 = 1: error The slave response in the lower four bits is stored in the functions "Write parameter () and "Execute parameter".

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10.3.11 Function 8: “Diagnostics”

This function is a Modbus service function.

Query message:	A	8	D_{hi}	D_{lo}	$I_{q,hi}$	$I_{q,lo}$	$C_{q,lo}$	$C_{q,hi}$
Response message:	A	8	D_{hi}	D_{lo}	$I_{r,hi}$	$I_{r,lo}$	$C_{r,lo}$	$C_{r,hi}$

D: “*Diagnostic Code*”, defines the type of service function.

I_q: “*Information Field*”, in the query-message gives extra parameters to the service function.

I_r: “*Information Field*”, in the respond-message holds reaction values of the Modbus slave.

The AS-i/Modbus gateway accepts the following diagnostic codes:

D = 0: **return query data**

As only reaction to this telegram the Modbus slave replies the received message to the Modbus master.

D = 1: **restart comm option**

The Modbus slave will be restarted. I_q must either hold 0000_{hex} or $FF00_{hex}$.

In the AS-i/Modbus gateway the following actions are initiated:

The "listen only" mode is deactivated.
The Modbus "error counters" are reset.
The Modbus-watchdog is reset.
Going trough the offline-phase, the AS-i master restarts the AS-i circuit.

D = 2: **return diagnostic register**

The Modbus slave returns a status-byte in I_r. For proper function I_q must hold the value 0000_{hex}.

The status-bits are defined as follows:

2^0	execution control flag “*Config_OK*”
2^1	execution control flag “*LDS.0*”
2^2	execution control flag “*Auto_Address_Assign*”
2^3	execution control flag “*Auto_Address_Available*”
2^4	execution control flag “*Configuration_Active*”
2^5	execution control flag “*Normal_Operation_Active*”
2^6	execution control flag “*APF/not APO*”
2^7	execution control flag “*Offline_Ready*”
2^8	host interface flag “*Data_Exchange_Active*”
2^9	host interface flag “*Off-line*”
2^{10}	host interface flag “*Auto_Address_Enable*”

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D = 4:	**force listen only mode**
	The Modbus slave is set to *Listen Only Mode*. All following telegrams except *restart comm option* are ignored. For correct function I_q must have the value 0000_{hex}.
	After power-on-reset the *Listen Only Mode* is switched off.
D = 10:	**clear counters and diagnostic registers**
	The Modbus error counters will be reset.
D = 11:	**return bus message count**
	The response data field returns the quantity of messages that the slave has detected on the communication system since its last restart, clear counters operation or power-up.
D = 12:	**return bus CRC error count**
	The response data field returns the quantity of CRC errors encountered by the slave since its last restart, clear counters operation, or power-up.
D = 13:	**return bus exception error count**
	The response data field returns the quantity of Modbus exceptions responses returned by the slave since its last restart, clear counters operation, or power-up.
D = 14:	**return slave message count**
	The response data field returns the quantity of messages addressed to the slave, or broadcast, that the slave has processed since its last restart, clear counters operation, or power-up.
D = 15:	**return slave no response count**
	The response data field returns the quantity of messages addressed to the slave for which it returns no response (neither a normal response nor an exception response), since its last restart, clear counters operation, or power-up.

For formal reasons also the diagnostic codes 16, 17 and 18 ("*return slave NAK count*", "*return slave busy count*" and "*return bus character overrun count*") were returned, but with the value zero.

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10.3.12 Function 65: user defined function #1

This function is used to read the name and version of the AS-i/Modbus gateway:

Query message:	A	65	1	P	$C_{q,lo}$	$C_{q,hi}$				
Response message:	A	65	B	D_1			D_B	$C_{r,lo}$	$C_{r,hi}$	

P:	Defines the part of version-information.
B:	Number of data-bytes D1 to DB
D_1 … D_B:	Version-information as null-terminated string.
P = 1:	Name of the master (32 characters, B = 33).
P = 2:	Version of the master (16 characters, B = 17).
P = 3:	Installed software (32 characters, B = 33).
else:	Version number (8 characters, B = 9).

"*Installed software*" is a string holding the capability of Host-Interface and AS-i master as upper- and lower-chase characters.

The single characters have the following significance:

D/d	"*data_exchange_active*" is set (D) or cleared (d).
O/o	"*offline*" is set (O) or cleared (o).
A/a	"*auto_address_enable*" is set (A) or cleared (a).
W/w	The Modbus-watchdog is active (W) or inactive (w).
T/t	The AS-i master front panel buttons are enabled (T) or disabled (t).
C/c	The answering master is an AS-i Control. An uppercase (C) indicates an active control-program, while a lowercase (c) a cleared start-flag or an unfitting AS-i Master state for control-program execution.
B/b	The AS-i master is bus-capable (B). The Modbus-master ever signs (B).
F/f	The answering master is supplied witch the optional AS-i error counter.
E/e	The answering master is capable of the optional EMC-testmode.

The position of the characters within the string is defined as follows:
„CBFE....DOA...WT"

10.3.13 Function 66: user defined function #2

This function is used to write the control programs for AS-i control (download).

Query message:	A	66	18	S_{hi}	S_{lo}	D_1			D_{16}	$C_{q,lo}$	$C_{q,hi}$
Response message:	A	66	2	S_{hi}	S_{lo}	$C_{r,lo}$	$C_{r,hi}$				

S:	first address of program-bytes to write.
D:	16 program-bytes.

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10.3.14 Function 67: user defined function #3

This function is used to read back the control programs for AS-i control (upload).

Query message:	A	67	2	S_{hi}	S_{lo}	$C_{q,lo}$	$C_{q,hi}$					
Response message:	A	67	18	S_{hi}	S_{lo}	D_1			D_{16}	$C_{r,lo}$	$C_{r,h}i$	

S: first address of program-bytes to read.

D: 16 program-bytes.

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11. System startup using AS-i Control Tools

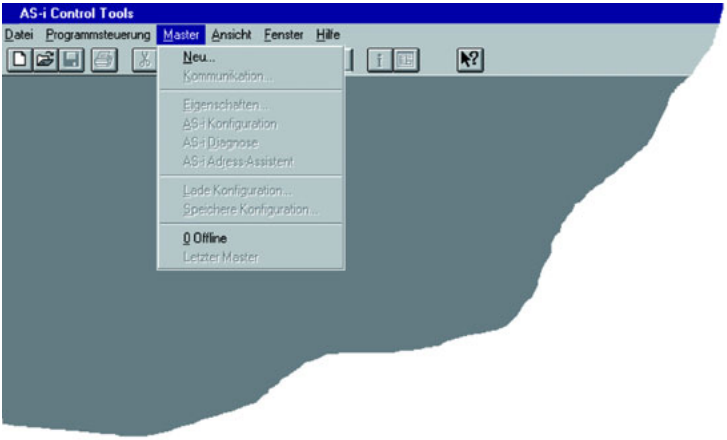
The Windows based software AS-i Control Tools enables an easy and clear configuration of the AS-i network.

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.

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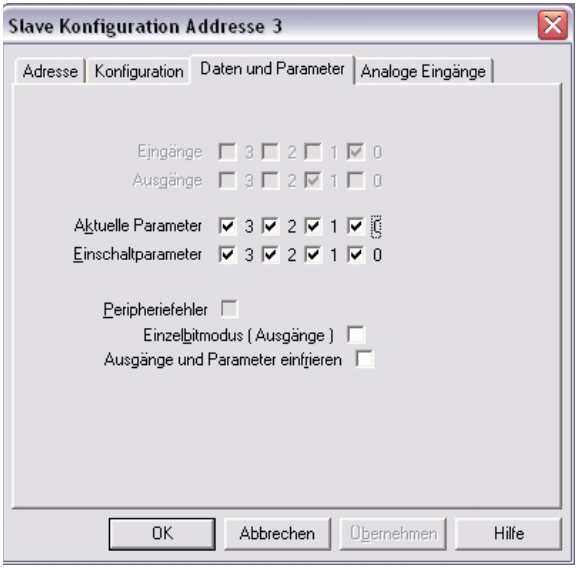
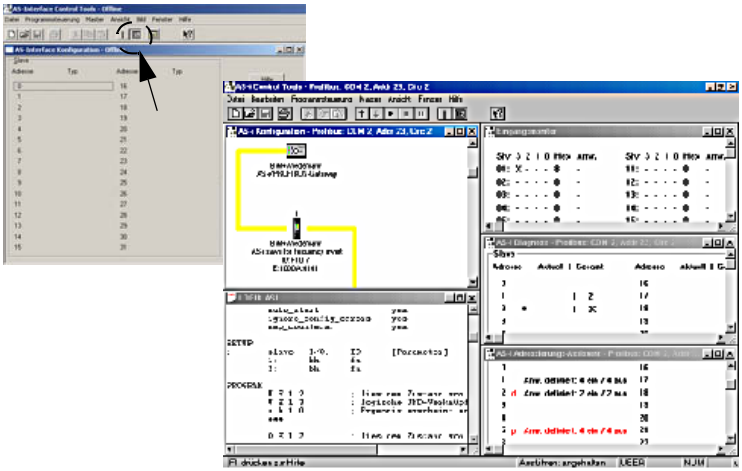
8. Click on a slave to open the dialog window 'slave configuration'.



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

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



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

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

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12. 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.
79	Checksum error in the data menu.
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

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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.)

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13. 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.

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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.

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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-16 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.

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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.

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14. Reference List

14.1 Manual: “AS-i 3.0 Command Interface“

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

Issue date: 6.12.2010

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