FACTORY AUTOMATION

Manual

VBG-CAN-K5-D

AS-Interface/CANopen Gateway

in acc. to specification 2.1

PEPPERL+FUCHS

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1 Declaration of Conformity

The AS-i/VBG-CAN-K5-D has been developed and produced in accordance with the applicable European standards and directives.

Note

The corresponding of conformity can be requested from the manufacturer.

The manufacturer of the product, Pepperl+Fuchs Group in D-68301 Mannheim, possesses a certified quality assurance system in accordance with ISO 9001.

ISO**9001**

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2 The Symbols Used

Warning

This symbol warns the user of possible danger. Failure to heed this warning can lead to personal injury or death and/or damage to equipment.

Attention

This symbol warns the user of a possible failure. Failure to heed this warning can lead to total failure of the equipment or any other connected equipment.

Note

This symbol gives the user important hints.

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3 Safety

3.1 Intended Use

Warning

The protection of operating personnel and the system against possible danger is not guaranteed if the control interface unit is not operated in accordance with its intended use.
The device may only be operated by appropriately qualified personnel in accordance with this operating manual.

3.2 General Safety Information

Warning

Safety and correct functioning of the device cannot be guaranteed if any operation other than that described in this operation manual is performed.
The connecting of the equipment and any maintenance work to be carried out with voltage applied to the equipment must only be performed by appropriately qualified electrotechnical personnel.
In the case that a failure cannot be repaired, the device must be taken out of operation and kept from inadvertently put back into operation.
Repair work is to be carried out by the manufacturer only. Additions or modifications to the equipment are not allowed and void the warranty.

Note

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

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4 General Information

This operating instruction is for use with the following device of the Pepperl+Fuchs GmbH:

- VBG-CAN-K5-D

The AS-i/CANopen-Gateway serves to connect the AS-Interface to a superordinate CANopen. The Gateway acts as a complete Master for the AS-Interface and as a slave for the CANopen.

New AS-i Specification 2.1

The AS-i/CANopen-Gateways already fulfil the new AS-i Specification 2.1. This means:

- Up to 62 AS-Interface slaves can be connected per 1 AS-i network
- The transfer of analog signals via AS-i is integrated in the Masters
- All further functions of the new specification as e. g. the diagnosis of the AS-i peripheral fault are implemented.

AS-i Scope Function

Diagnostics, which go far beyond the standard diagnostics facilitate the simple detection of the occassionally occuring 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

The AS-i/CANopen Gateways can be commissioned with the help of the software "AS-i Control Tools" in combination with the CANopen Master Simulator. The EDS file is included in the package.

Commissioning, debugging and setting up of the AS-i parameters without the software can only be accomplished with the use of two push-buttons, the display and the LEDs directly on the system.

Gateways with Graphical Display

The AS-i Gateways with Graphical Display are a high-end solution to link AS-Interfaces with a superior CANopen system.

Simple and Fast Commissioning

Using the AS-i Gateway with Graphical Display, the entire AS-i network can be commissioned and the connected periphery can be completely tested without CANopen Master. The new interactive graphic display also enables the user to complete all tasks which previously required the "AS-i Control Tools" software package. This allows for simpler and faster commissioning.

Addressing Unit within the AS-i Master

With the help of the new graphical display, the hand held unit is now obsolete. The slaves can now be easily addressed directly on the gateway. Slaves with extended address mode are detected automatically and are used only when allowed. This

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ensures that no two AS-i slaves with the same address will be on the same network.

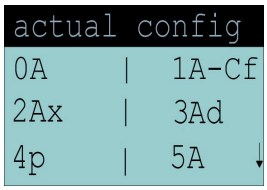
Testing of Connected Periphery without Additional Test Tools

Once the AS-Interface is put into operation, the cabling and the connected sensors and actuators can be tested, inputs can be read and outputs can be set and even analog sensors and actuators can be checked just using the Gateway with Graphical Display.

On-board Diagnostics:

Configuration Fault, Periphery Fault

At a glance, the display shows the configuration faults (missing slave, additional slave detected, wrong slave type) as well as periphery faults, such as a short circuit at a sensor cable. This allows the user to get the proper information to solve the problem in the shortest amount of time.



Detection of Occasional Faults

A list of slaves, which have previously caused an error, is also available through the graphical display. This can be very helpful in solving problems.

Scope Functions shown on the Display

While strange phenomena can occur as the AS-Interface gets to its limits (e. g. cable length >100 m, EMC problems), the AS-i Gateway with Graphical Display has on-board diagnostic tools. With the help of the AS-i error counters the user can ea-

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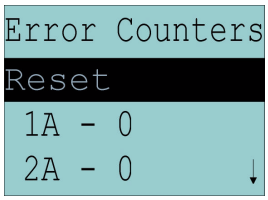
sily check the quality of AS-i communications. The user can then test the impact of any actions taken.



Accessories:

CANopen Master Simulator

Transmission cords for AS-i/CAN Gateways

Software AS-i Control Tools

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5 Description

5.1 LED Displays

Display	Color	Description
power	green	Supply of the gateway
MNS	green/red	Module/Network state
config err	red	Configuration error
U ASI	green	The AS-i circuit is sufficiently powered
ASI aktiv	green	Normal operation active
prg enable	green	Automatic address programming enabled
prj mode	yellow	

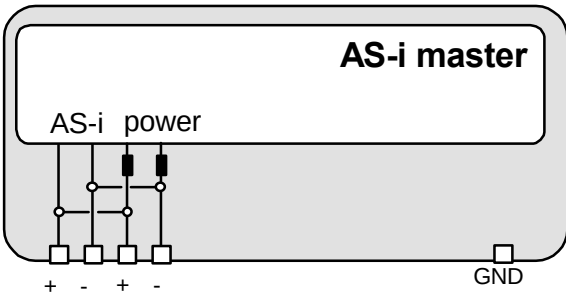
5.2 Power Supply Concepts and AS-i Connection Techniques

Note

The AS-i masters with master power supply A do not need a voltage supply of their own. They can be powered completely out of the AS-i line (the power consumption is about 200 mA from AS-i). An additional 24 V voltage source is not necessary. The AS-i master merely requires the connection to the AS-i line. When the AS-i power supply is switched on, the master starts to operate.

5.2.1 Single Masters with Power Supply A

The terminals have the following functions:



+ "AS-i +", Actuator Sensor Interface, positive terminal

- "AS-i -", Actuator Sensor Interface, negative terminal

GND Ground terminal, used for better EMC.
Should be connected with a short wire to machine GND.

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5.3 The fieldbus interface

According to the CANopen specification the CANopen interface connector is designed as a 5-pin COMBICON connector. It is located on the right hand side of the front panel.

1 V + (not used by the AS-i master)
2 CAN+
3 Shield
4 CAN -
5 V - (not used by the AS-i master)

COMBICON connector

5.4 Display and Operating Elements

On the front panel of the AS-i/CANopen gateway are seven light-emitting diodes, a two-digit display and push buttons.

5.4.1 LEDs of the Single Masters with graphical Display

power	The master's power supply is sufficient.	
MNS	Red LED flashes:	no CAN communication in “Pre Operational Mode”
	Green LED flashes:	CAN communication node in “Pre Operational Mode”
	Green LED:	CAN communication node in “Operational Mode”
config err	Configuration error At least one configured slave is missing, or at least one detected slave is not projected or for at least one projected and detected slave the actual configuration data does not match the nominal configuration data.	
U ASI	The AS-i circuit is sufficiently powered.	
ASI active	Normal operation active.	
prg enable	Automatic address programming enabled. Exactly one slave is missing in protected operating mode. The slave can be replaced by another slave of the same type with address zero. The master addresses the new slave to the faulty address and thus eliminates the configuration error.	
prj mode	The AS-i master is in configuration mode.	

5.4.2 Push-Buttons

The push-buttons cause following:

mode Switching between the configuration mode and the protected operating mode and saving the actual AS-i configuration as the nominal configuration.

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set	Selection and assigning the address to a slave.
OK, ESC	Changing to graphical mode. Have a look at chapter 7 (master with graphical display only).

The detailled description is described in chapter 6.

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6 Operating the AS-i/CANopen Gateway

6.1 Master Start-Up

After powering on, all segments of the figure display and all LEDs light up for approximately one second (self-test). Afterwards, the LEDs display the condition of their respective flags. The figure display shows the condition of the master:

40 Off-line Phase
The AS-i master initializes - there is no data communication on the AS-i.

If the AS-i circuit is insufficiently powered ("U AS-i" does not light up) *or there is no communication relationship between the CANopen master and the AS-i/CANopen gateway****, the master remains in the off-line phase.***

41 Detection Phase
Start of the start-up phase, where the system looks for slaves located on the AS-i. The master remains in the detection phase until it finds at least one slave.

42[1] Activation Phase
Condition at the end of the start-up operation where the parameters are transmitted to all connected and recognized slaves. This enables access to the AS-i slaves' data connections.

43[2] Start of Normal Operation
In normal operation the AS-i master can exchange data with all active slaves. It transmits management messages and looks for and activates newly connected slaves. During normal operation, the system keeps the maximum cycle time of 5 milliseconds.

6.2 Configuration Mode

The configuration mode serves to configure the AS-i circuit.

In the configuration mode, all recognized slaves are activated even when the desired and actual configurations do not match.

Pressing the "mode" button for at least five seconds switches the gateway to configuration mode. While in configuration mode, the yellow "prj mode" LED lights up.

The system then displays one after the other all detected slaves at a speed of two per second. If the display is empty, no slaves were detached on the AS-i circuit.

In configuration mode, all recognized slaves are activated except of slave zero. The AS-i master is in normal operation. There is data exchange between the AS-i

1. Activation phase and the start of normal operation maybe so short that the numbers can not be seen in the display.
2. Activation phase and the start of normal operation maybe so short that the numbers can not be seen in the display.

master and all AS-i slaves detected by the master regardless of whether the detected AS-i slaves were projected before.

When delivered the device is in configuration mode.

6.3 Protected Operating Mode

In contrast with the configuration mode in the protected mode there is only data exchange between the AS-i master and the projected AS-i slaves.

6.3.1 Switching to Protected Operating Mode

The configuration mode can be left by pressing the “mode” button.

Pressing the button shortly:
Exits the configuration mode without projecting the current AS-i configuration.

Pressing the button for more than five seconds:
Exits the configuration mode and projects the actual AS-i configuration. Simultaneously the actual AS-i configuration is stored as nominal configuration in the EEPROM.

If the system detects an AS-i slave with address zero on the AS-i, it can not leave the configuration mode.

In the protected operating mode, only AS-i slaves that are projected and whose actual configurations match the nominal configurations will be activated.

6.3.2 Configuration Errors in Protected Operating Mode

As long as there is no configuration error, the numeric display is turned off while in protected operating mode. Otherwise, the address with a faulty assignment is displayed. A faulty assignment occurs when a slave has been recognized or projected but cannot be activated.

If there are more than one faulty assignments the one that was first detected is displayed. Pressing the “set” button shortly displays the next higher faulty address.

Shortly appearing configuration errors are stored in the device (advanced AS-i diagnosis). The last error that occurred can be displayed by pressing the set button. If a short AS-i power failure is responsible for the configuration error the display shows a “39”.

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6.4 Assigning an AS-i Address in Configuration Mode

To assign a slave with address unequal zero to another address unequal zero, you have to follow the instructions first in chapter 6.4.2 and then chapter 6.4.1 one after the other.

6.4.1 Assigning a Slave Address

(assigning an available address to a slave with address zero)

In configuration mode, the addresses of all detected slaves are displayed one after the other. To display the next higher available operating address, press the “set” button shortly. Each time you press the “set” button, the next available address is displayed.

Choose the displayed address as your target address by pressing the “set” button for more than five seconds. The address display blinks. The master is ready for programming; pressing the “set” button again addresses the connected slave with address zero to the target (blinking address).

Any errors will be displayed by their error codes according to chapter 12. Otherwise, the detected slaves are displayed again as described in chapter 6.2..

Note

Only slaves with address 0 can get a new address by the master.

Attention

There must not be two AS-i slaves with the same adrress on the AS-i circuit.

6.4.2 Erasing the Slave Address

(assigning address zero to a detected slave)

In configuration mode, the addresses of all recognized slaves are displayed one after the other. By pressing and releasing the “set” button, the master displays the next available address. If you press the button for more than five seconds while the address of a detected slave is displayed, this slave will get the address zero and the display shows “00”.

When you release the button, the display continues to display the detected slaves.

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6.5 Programming the Address in Case of Configuration Errors

6.5.1 Automatic Address Assignment


Note

One of AS-i's great advantages is the automatic address assignment. If a slave fails, it can be replaced by one of the same type with address zero. The master will detect the replacement and automatically addresses the new slave with the address of the faulty one.

For automatic programming to work, some requirements must be met:

1. The AS-i master must be in the protected operating mode.
2. The "Auto_Address_Assign"[1] release flag must be set.
3. Only one of the projected slaves may not be detected.

If these requirements are met, the AS-i master's "**prg enable**" LED lights up and a slave with address zero will be automatically assigned to the operating address of the missing slave. The "Automatic Address Assignment" can be activated and deactivated via the software "AS-i Control Tools". .


Attention

If the two slaves have different configuration data, i.e. are not of the same type as far as AS-i is concerned, the automatic address assignment will not be carried out.


Note

Only slaves with address 0 can get a new address by the master.

6.5.2 Manual Address Assignment


Note

If several slaves fail, they cannot be replaced automatically by the AS-i master. Then these addresses have to be set manually. If this should not be done via the host interface or with a hand held addressing device, the slave addresses can also be changed with the help of the push buttons and the figure display of the device.

In protected operating mode, wrong assignments are displayed as errors (see chapter 6.3). By pressing the "set" button, you can display all faulty assignments one after the other. By pressing the "set" button for more than five seconds, you can select the currently displayed address as a potential target address, and the display starts to blink.

If the faulty slave was previously replaced by a slave with address zero, the new slave can now be programmed for the blinking address by pressing the "set" key again. As a requirement, the new slave's configuration data must match the configuration data for the blinking address.

1. By deletion of flag "Auto_prog" the user can close "automatic addressing".

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After the address has been successfully set, the next faulty assignment is displayed and the address assignment can begin from the start. Otherwise, the system displays an error code (chapter 12). When all faulty assignments are eliminated the display is empty.

6.6 Adjusting the CANopen Node Address and Baud Rate

6.6.1 CANopen Node Address

Note

The addressing of the AS-i/CANopen Gateway as a CANopen node can only be done on the gateway. It is not possible to change the address via CANopen.

For the changing of the address, both the “set” and the “mode” button have to be pushed simultaneously for at least five seconds until the current CANopen node address is shown on the LCD screen. With every push of the “set” button, the node address will be incremented.

If the desired CANopen node address is displayed, it can be stored non-volatile in the EEPROM by pushing the “mode” button.

The AS-i/CANopen Gateway's node address can range from 1 to 99. Node address 3 is set on delivery.

6.6.2 Baud Rate

Note

After the node address has been set, the baud rate is displayed coded in accordance with table below. It can be changed by pressing the “set” button and be stored into the EEPROM by pressing the “mode” button. On delivery, the baud rate is set to 125 kbaud.

Table: baud rates

Code	Baudrate
0	10 kBaud
1	20 kBaud
2	50 kBaud
3	100 kBaud
4	125 kBaud
5	250 kBaud
6	500 kBaud
7	800 kBaud
8	1000 kBaud

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6.7 Error Messages

The system displays error codes for error messages that do not point to faulty assignments on the AS-i circuit. The code numbers are larger than 50 and are therefore outside the slave address range. These codes are described in the appendix, chapter 12.

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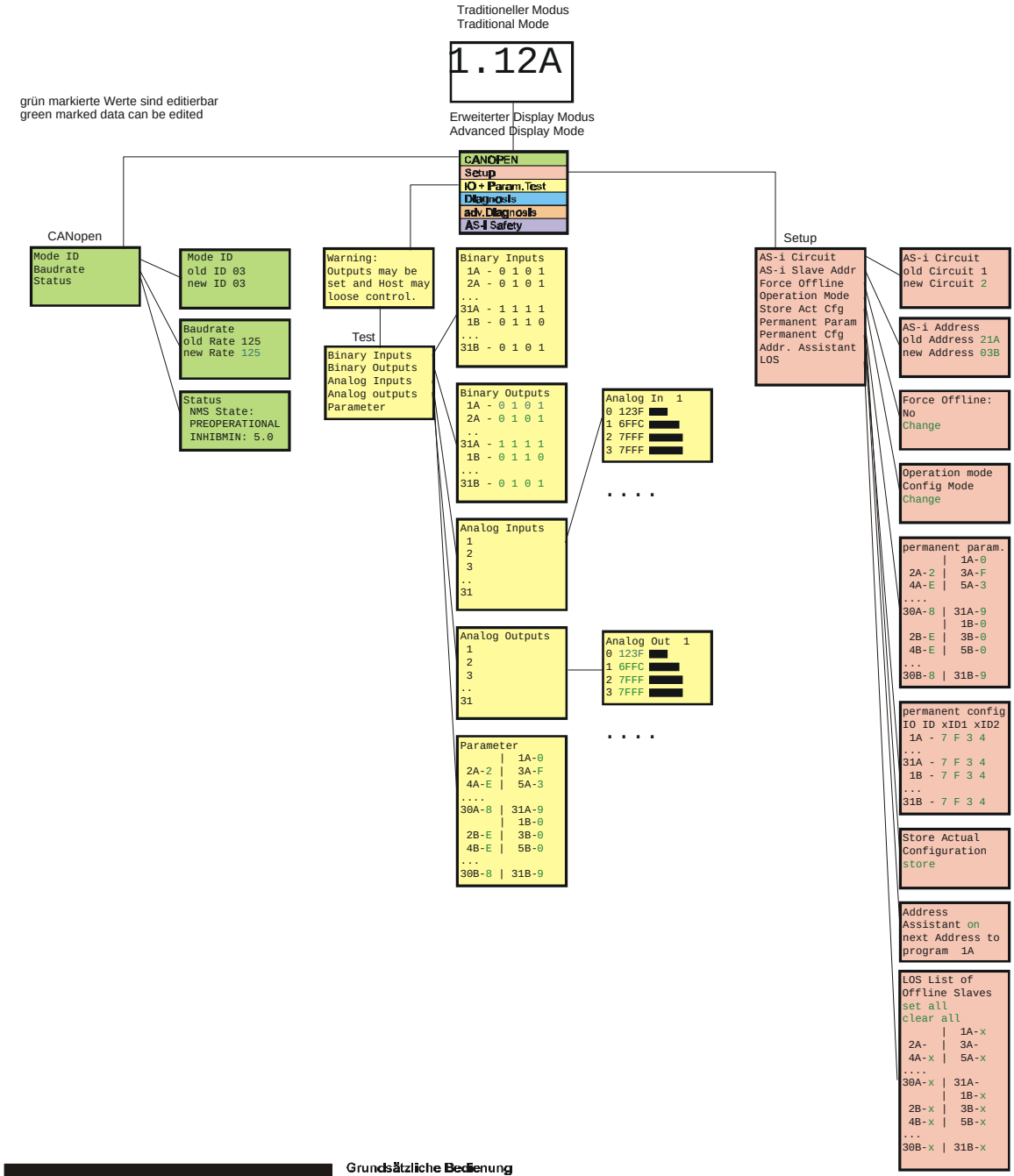
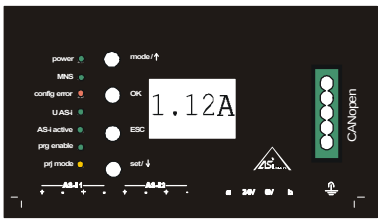
7 Operating by Full-graphic Display

Inbetriebnahme/Commission ing





Grundsätzliche Bedienung
Das Gerät startet im traditionellen Modus. Mit ESC oder OK kann zwischen beiden Modi gewechselt werden. Im Erweiterten Modus wird ein Cursor mit den beiden Pfeil-Tasten bewegt. OK bringt ins nächsthöhere Menü (In der Zeichnung weiter nach rechts). ESC bringt zurück ins vorherige Menü.
Wenn Werte editiert werden, werden sie zunächst mit dem Cursor markiert, dann mit OK ausgewählt, mit den Pfeiltasten verändert und schließlich mit OK übernommen. ESC bricht das Editieren ab.

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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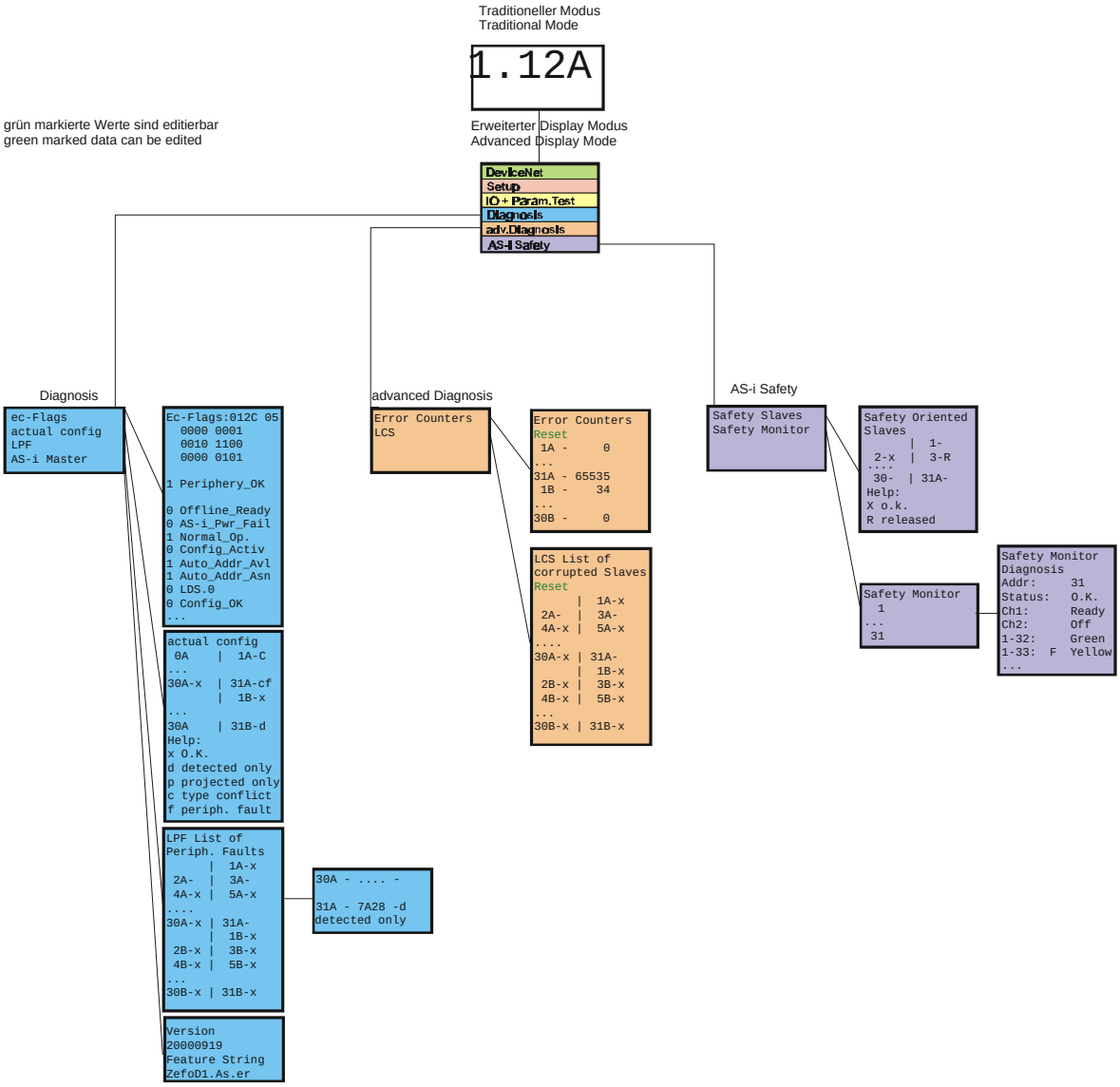
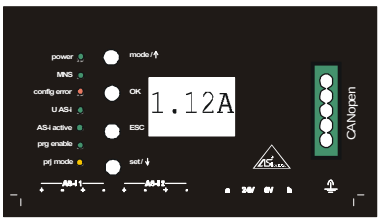
Fehlersuche/Diagnostics





Grundsätzliche Bedienung
Das Gerät startet im traditionellen Modus. Mit ESC oder OK kann zwischen beiden Modi gewechselt werden. Im Erweiterten Modus wird ein Cursor mit den beiden Pfeil-Tasten bewegt. OK bringt ins nächsthöhere Menü (in der Zeichnung weiter nach rechts). ESC bringt zurück ins vorherige Menü.
Wenn Werte editiert werden, werden sie zunächst mit dem Cursor markiert, dann mit OK ausgewählt, mit den Pfeiltasten verändert und schließlich mit OK übernommen. ESC bricht das Editieren ab.

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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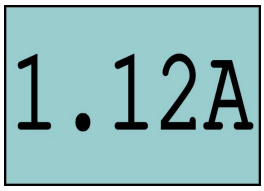
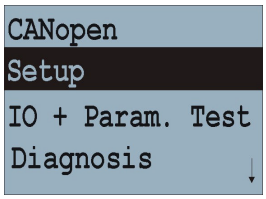
Warning

In the classical mode it is possible to change settings while the device is in operation. That can lead to failure of the plant (e. g. changing the address of an AS-i slave).

In the Full-graphic Mode however the settings are protected, as long as the superior fieldbus (CANopen) runs.





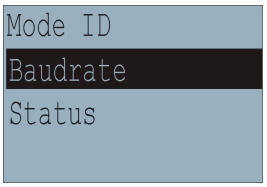
The device starts in the classical mode, i. e. like the former AS-i Masters with two-digit display (see chapter 6). Press the buttons ESC or OK to switch to the fullgraphic mode. To return to the classical mode just press the ESC-button several times.

When in full-graphic mode there is a highlighted bar that can be moved up or down with the arrow-buttons. Press OK to switch to the selected function or menue (in the drawing one step to the right, page 25). Press ESC to go back to previous menue.

To edit data values mark them with the selection bar, press OK, then change them with the arrow-buttons and confirm the data input with OK. The ESC-button cancels the editing process.

All possible addresses are displayed one after the other from 1A to 31A and from 1B to 31B. Data for single slaves are displayed at the addresses 1A - 31A.

7.1 CANopen (Fieldbus Interface)



7.1.1 CANopen Node Address

This function is for setting and changing the CANopen node address.

The number behind "Old ID" shows the actual node address. By selecting "New ID" you can change this address.

7.1.2 CANopen Baud Rate

This function is for setting and changing the CANopen baud rate.

The number behind "old Rate" shows the actual baud rate. By selecting "new Rate" you can change this baud rate.

Following baud rates are possible:

- 10 kBaud
- 20 kBaud

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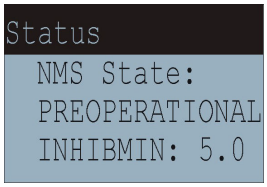
- 50 kBaud
- 100 kBaud
- 125 kBaud
- 250 kBaud
- 500 kBaud
- 800 kBaud
- 1000 kBaud

On delivery, the baud rate is set to 125 kbaud

7.1.3 CANopen Status



With the function CANopen-Status the Network Module Status (NMS) is shown.

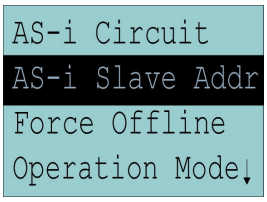
NMS:

- Initializing
- Disconnected
- Connecting
- Preparing
- Prepared
- Operational
- Preoperational

INHIBMIN:

- minimum TxPDO Inhibit time in [ms]

7.2 Setup (Configuration of the AS-i Circuit)



Within the menue "Setup" you can choose one of the following submenues:

- AS-i Circuit
- AS-i Slave Addr (AS-i Slave Address)
- Force Offline (switch AS-i Master offline)
- Operation Mode
- Store Act Cfg (store actual detected configuration)

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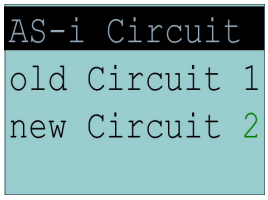
- Permanent Param (projected parameter)
- Permanent Cfg (projected configuration data)
- Addr. Assistant (address assistent)
- LOS (list of offline-slaves)

7.2.1 AS-i Circuit

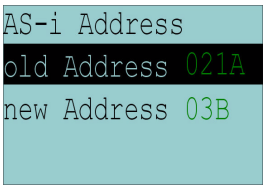


This function is only availbale in devices with 2 AS-i masters.

It makes possible to change the AS-i circuit that is actually active for operating by the user.

The number behind "Old Circuit" shows the active AS-i circuit. By selecting "New Circuit" you can choose the other AS-i circuit to be active.

7.2.2 AS-i Slave Addr (AS-i Slave Address)



This function sets and changes the addresses of the AS-i slaves. This function replaces the handheld AS-i address programming device.

"Old Address" shows the address of the first detected AS-i slave on the AS-i circuit. Please note that you have selected the desired AS-i circuit when you operate a device with two AS-i circuits (see chapter 7.2.1).

If "Old Address" is selected you can choose the next detected AS-i slave with the OK-button. The new address for the AS-i slave has to be set with "New Address".

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 not detected.
Failed: SD0: slave with address zero detected.
Failed: SD2: slave with new address detected.
Failed: DE: error with deletion of old address.
Failed: SE: error with settinng of new address.
Failed: AT: new address could only be stored temporarily.
Failed: RE: error with reading the extended ID-code 1.

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7.2.3 Force Offline (switch AS-i Master offline)

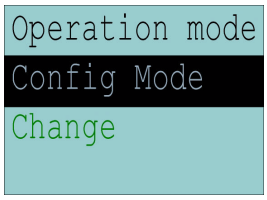
This function shows the actual state of the AS-i Master:

Yes: AS-i Master is offline.
No: AS-i Master is online.

With "Change" you can modify this state.

Switching the AS-i Master offline puts the AS-i circuit into the safe state. The AS-i Master has to be in the offline-phase if an AS-i slave shall be addressed via the IR-interface.

7.2.4 Operation Mode



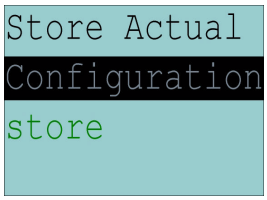
This function shows the actual operation mode of the AS-i Master:

Protected Mode: protected mode
Config Mode: configuration mode

With "Change" you can switch to the other operation mode.

Only in configuration mode parameters and configuration data can be stored.

7.2.5 Store Act Cfg (Store Actual Detected Configuration)



This function can only be executed in configuration mode.

This function enables you to store the configuration of all slaves wich are connected and detected on the selcted AS-i circuit.

If "Store" was successful, the LED "config error" is off. The configuration is stored, there is no configuration error anymore.

If one of the connected slaves has a peripheral fault, the LED "config error" blinks.

If the AS-i Master is in protected mode, the following error message appears: "Failed No Config Mode"

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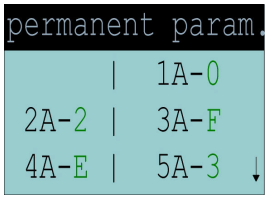
If an AS-i slave with address zero exists storing the configuration is confirmed with "OK". However, the configuration error remains because address zero is not a valid operating address to project a slave on.

7.2.6 Permanent Param (Projected Parameter)



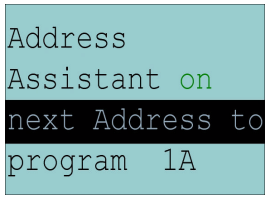
This function enables you to set the permanent parameters. A list of all slaves is displayed. The parameter is shown as hexadecimal value behind the slave address.

7.2.7 Permanent Cfg (Projected Configuration Data)

With this function you can set the projected configuration data. The values for the configuration data are displayed behind the slave address in the following order:

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

7.2.8 Addr. Assistant (Address Assistent)



The AS-i address assistant helps you with the fast setting up of the AS-i circuit. Once you have stored an AS-i configuration to the master, the AS-i address assistant addresses a virgin AS-i slaves with address zero to the desired address.

Selecting "Assistant On" or "Assistant off" switches the AS-i address assistant off or on. The actual 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 an AS-i configuration to the device. You can do this very comfortably with the Windows-software AS-i Control Tools (Master/Write configuration to the AS-i Master ...). Or directly with the fullgraphic display (see chapter 7.2.7).
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 circuit.

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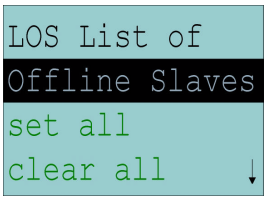
3. Start the AS-i address assistant.
4. Now connect the AS-i slaves one after the other exactly in the order that the AS-i address assistant displays (The last line on the display of the AS-i address assistant shows which AS-i slave has to be connected next).

7.2.9 LOS (List of Offline-Slaves)

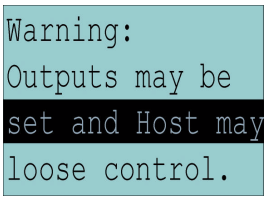


See also "Advanced Diagnostics for AS-i Masters", chapter 8.

With "Clear all" and "Set all" you can delete or set a single bit for each AS-i slave address.

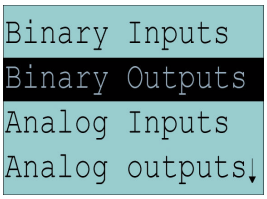
empty field: LOS-bit deleted
X: LOS-bit set

7.3 IO + Param. Test (Testing AS-i In- and Outputs as well as AS-i Parameters)



Before you switch to this menu the following warning occurs:

"Warning: Outputs may be set and Host may loose control."



The menue "IO + Param.Test" enables you to choose one of the following submenues:

- Binary Inputs
- Binary Outputs
- Analog Inputs
- Analog Outputs
- Parameter

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7.3.1 Binary Inputs

This list shows the state of the binary inputs for all AS-i slaves.

0: input deleted
1: input set

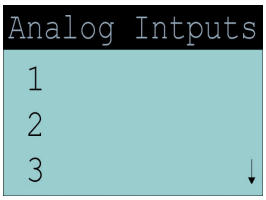
7.3.2 Binary Outputs

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

0: output deleted
1: output set

The binary outputs can be changed after selecting the desired AS-i slave.

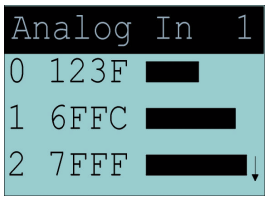
7.3.3 Analog Inputs



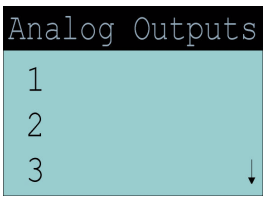
This function shows the state of the analog inputs for all AS-i slaves.

The display is as follows:

AS-i slave address, hexadecimal 16-bit-value, bar display



7.3.4 Analog Outputs



This function shows the state of the analog outputs for all AS-i slaves.

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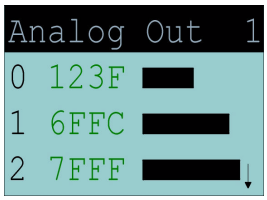
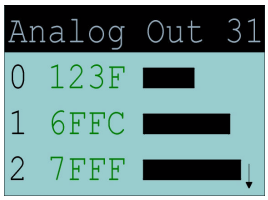
The display is as follows:

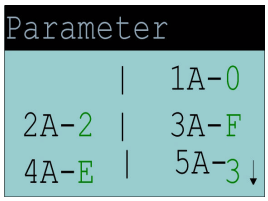
AS-i slave address, hexadecimal 16-bit-value, bar display





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

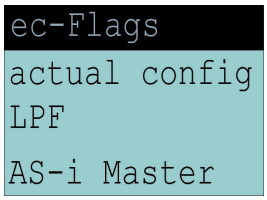
7.3.5 Parameter



This function shows the hexadecimal value of the actual AS-i paramerters for all AS-i slaves.

The actual AS-i parameters can be changed after selecting the desired slave address.

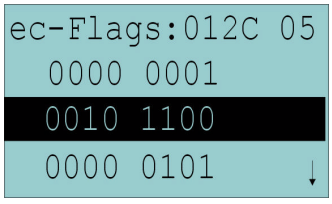
7.4 Diagnosis (Normal AS-i Diagnosis)



The menue "Diagnosis" enables you to choose one of the following submenues:

- EC-Flags (Execution control flags)
- Actual Config (actual configuration)
- LPF (list of periphery faults)
- AS-i Master (Info)

7.4.1 EC-Flags (Execution Control Flags)



This function shows the EC-flags hexadecimal, binary and as single bits beginning with the lowest-order bit.

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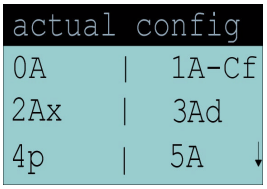
Byte 1:
Bit 0: 1 =Periphery_OK

Byte 2:
Bit 0: 0 = Offline_Ready
Bit 1: 0 = AS-i Pwr Fail
Bit 2: 1 = Normal_Op.
Bit 3: 0 = Config_Active
Bit 4: 1 = Auto_Addr_Avl
Bit 5: 1 = Auto_Addr_Asn
Bit 6: 0 = LDS.0
Bit 7: 0 = Config_OK

Byte 3:
Bit 0: 1 = Auto_Addr_Ena
Bit 1: 1 = Data_Exch_Act
Bit 2: 1 = Data_Exch_Act

7.4.2 Actual Config (Actual Configuration)



This function shows the state of the actual configuration of the individual AS-i slaves.

At the end of the list there is a help text that describes the abbreviations:

X (O.K.): The configuration data of the detected AS-i slave matches the projected configuration data.

D (Detected Only): An AS-i slave is detected at this address, but not projected.

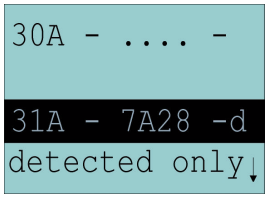
P (Projected Only): An AS-i slave is projected at this address, but not detected.

C (Type Conflict): The configuration data of the detected AS-i slave does not match the projected configuration data. The actual detected configuration of the connected AS-i slave is displayed.

F (Periph. Fault): The AS-i slave has a peripheral fault.

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

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



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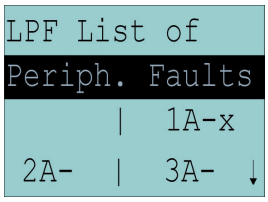
Furthermore the state of the configuration is displayed in plaintext.

If no AS-i slave is detected and no AS-i slave is projected at a certain address, there are four dots instead of the configuration data.

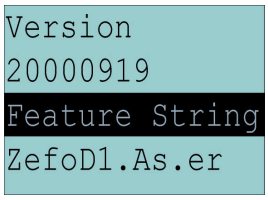
7.4.3 LPF (List of Periphery Faults)



The list shows AS-i slaves, which have released a peripheral fault.

empty field: periphery O.K.
X: peripheral fault

7.4.4 AS-i Master (Info)

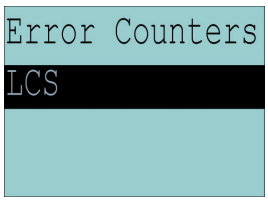


This function shows information about the version and the features of the AS-i master.

Version xxxxxxxx (datecode of the firmware)

Feature String xxxxxxxxxxxxxxxx

7.5 Adv. Diagnosis (Advanced AS-i Diagnosis)



See also "Advanced Diagnostics for AS-i Masters", chapter 8.

Under the menue "Adv. Diagnosis" you find following submenues:

- Error Counters
- LCS (list of slaves, that produced a configuration error)

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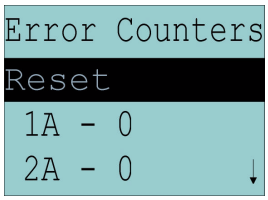
7.5.1 Error Counters



This list shows the error counter for each single AS-i slave.

Furthermore the number of power failures on AS-i (APF) is displayed.

With "Reset" the error counters are reset to 0.

7.5.2 LCS (List of Slaves, that produced a Configuration Error)

This list shows for each single AS-i slave wether at least one configuration error was released through an errorneous telegram transmission. This function is especially important if the configuration error only occurs short-time.

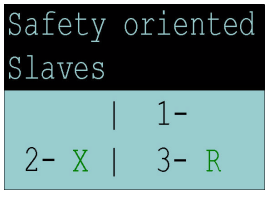
empty field: no error
X: AS-i slave released a configuration error.

7.6 AS-i Safety

This function shows information about the safety slaves and the safety monitor:

- Safety Slaves
- Safety Monitor

7.6.1 Safety Slaves



This list shows the "safety-directed input slaves" ("AS-i Safety at Work"), by which the safety function is released

empty field
X: o.k.
R: released

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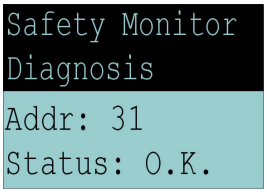
In this list are entered that slaves according to profile S-7.B or S-0.B, by which are deleted all 4 bits in the IDI. Therefore slaves with 2 contacts are entered only then, if both contacts are released.

Because the safety function of a safety-directed input slave can be released, if the slave does exchange no data with the AS-i master, the list may be utilized only in combination with the ec-flags.

For the building of the list CDI and IDI are utilized only. Safety-directed slaves, which are projected but not existing, and slaves, which are existing but sending a wrong code, are entered therfore not here.

This list is not acualizied into the master permanently, but only it is made out of the image of the digital inputus IDI, if required.

7.6.2 Safety Monitor



The AS-i safety monitor is reading the diagnosis data out of the AS-i safety monitor and represent this data in the display. For the meaning of the shown diagnosis data please read the description of the safety monitor.

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8 Advanced Diagnostics for AS-i Masters

The advanced AS-i diagnostics serve to locate occasionally occurring errors and to judge the quality of data transmission on AS-i without additional diagnostics tools.

8.1 List of Corrupted AS-i Slaves (*LCS*)

To locate occasionally occurring short-time configuration errors the AS-i masters with advanced diagnostics manage beside the list of projected slaves (*LPS*), the list of detected slaves (*LDS*) and the list of activated slaves (*LAS*) a forth list, the **list of corrupted slaves (*LCS*)**. This list contains entries of all AS-i slaves which were responsible for at least one configuration error since powering up the AS-i master or reading the list. Short-time AS-i power failures are represented in the *LCS* at the position of AS-i slave with address 0.

Note

With every read access the LCS will be deleted.

Note

The last short-time configuration error can also be displayed on the AS-i master:
Pressing the “set” button of the AS-i master shows the AS-i slave which was responsible for the last short-time configuration error. If there was a short-time AS-i power failure the display shows “39” after pressing the “set” button.
This function is only available if device is in the normal operation mode of the protected mode (display empty) or in the off-line-phase.

8.2 Protocol Analysis: Counters of Corrupted Data Telegrams

The AS-i master with advanced diagnostics has a counter of telegram repetitions for each AS-i slave, which is increased everytime there is a corrupted data telegram. This makes possible to judge the quality of the AS-i network, even if only a few corrupted telegrams occured and the AS-i slave did not cause any configuration errors.

Note

The counter values can be read via the host interface and will be deleted with every read access. The counter value is limited to 254. 255 means counter overflow.

8.3 Off-line Phase on Configuration Errors (LOS)

The AS-i master with advanced diagnostics offer the possibility to put themselves into the off-line Phase when a configuration error on the AS-Interface occurs. In this way the security of the application can be ensured. The reaction to a configuration error is very fast and the host can be relieved from this task. If there are any problems on the AS-i network, the AS-interface can be switched to a secure state.

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

- Every configuration error during normal operation in protected mode releases the off-line phase.
- For each slave address can be chosen whether a configuration error on this address will release the off-line phase or not. This information is stored in the List of Off-line Slaves (*LOS*).
  The user himself can decide how the system reacts to a configuration error on the AS-Interface. The AS-i master can release the off-line phase in critical situations, i. e. only with certain slave addresses, while in less critical situations (if one of the other AS-i slaves have a configuration error) only the error message configuration error is sent to the host, but AS-i is still running.

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9 Operation as CANopen Node

In this chapter you will learn all about operating the AS-i/CANopen Gateway in a CANopen network. The AS-i/CANopen Gateway supports the CANopen protocol for data exchange.

The following functions are available via CANopen communication:

- reading AS-i input data
- writing AS-i output data
- reading all the flags of the execution control,
  plus the flags "slave 0 detected", "automatic programming permitted", "automatic programming available", "offline ready"
- setting off important functions of the host interface:
  "offline phase on/off", "enable/disable automatic addressing" and "configuration mode on/off"

The CANopen communication can be subdivided into process and service data communication. Service data messages are used for read and write access to all entries of the object dictionary of a device. The main usage of this facility is device configuration. By means of process data messages the real-time data transmission is performed.

The objects have following ptoperties:

Process Data Objects (PDO):

- maximum 8 byte long
- cyclic or event driven transmission
- differentation between sending (max. 512) and receiving PDOs (max. 512)
- PDOs reserve its own identifier in the CAN network
- binary AS-i process data of the A and B slaves of circuit 1 are laid on the 8 default PDOs

Service Data Objects (SDOs):

- length as you like
- cyclic transmission
- SDOs of a device are grouped in the object directory
- mailbox is laid on a (server) SDO, 36 byte length

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The main features of "Process Data Objects" (PDOs) and "Service Data Objects" (SDOs) are shown in the table below.

Process data objects (PDOs)	Service data objects (SDOs)
used for real time data exchange	provide access to a device object dictionary; each SDO establishes a peer to peer service communication channel.
typically high priority messages	low priority messages
synchronous and asynchronous message transmission	typically transmitted asynchronously
cyclic and acyclic transmission	typically acyclic transmission
data content configurable via SDOs	usage of data field determines by CMS (CAN Message Specification) multiplexed domain protocol
pre-formatted data field	access to device object directory entry by index and sub-index

9.1 CANopen Parameter Communication

Note

This chapter contains all information about exchanging data via CANopen. The data exchange with the gateway is accomplished via objects. The following directory of SDOs lists these objects and their particular available functions.

9.1.1 Object Directory

object	description
1000	device type
1001	error register
1003	pre-defined error field
1008	manufacturer device name
1009	manufacturer hardware version
100A	manufacturer software version
100C	guard time
100D	life time factor
100E	reserved for compatibility reasons
100F	reserved for compatibility reasons
1014	emergency id
1015	emergency inhibit time
1016	consumer heartbeat time
1017	producer heartbeat time
1018	identity object

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object	description
1200	1st server SDO parameter (default SDO)
1400	receive-PDO 1st parameter
…	…
1403	receive-PDO 4th parameter
1600	receive-PDO 1st mapping
…	…
1603	receive-PDO 4th mapping
1800	send-PDO 1st parameter
…	…
1803	send-PDO 4th parameter
1845	send-PDO 70th parameter
1A00	send-PDO 1st mapping
…	…
1A03	send-PDO 4th mapping
1A45	send-PDO 70th mapping

object	subindex	description
2000	0	mailbox write
2001	0	mailbox read
2010	1	hi-flags, outputs single/A-slaves 1 … 15, circuit 1
2010	2	outputs single/A-slaves 16 … 31, circuit 1
2010	3	outputs B-slaves 1 … 15, circuit 1
2010	4	outputs B-slaves 16 … 31, circuit 1
2020	1	inputs 7.3 16 bit Slave 1, circuit 1
…	…	…
2020	30	inputs 7.3 16 bit slave 31, circuit 1
2040	1	ec-flags, inputs single/A-slaves 1 … 15, circuit 1
2040	2	inputs single/A-slaves 16 … 31, circuit 1
2040	3	inputs B-slaves 1 … 15, circuit 1
2040	4	inputs B-slaves 16 … 31, circuit 1
2050	1	outputs 7.3 16 bit slave 1, circuit 1
…	…	…
2050	30	outputs 7.3 16 bit slave 31, circuit 1

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9.2 Process Data Communication

9.2.1 Mapping AS-i Data in CANopen PDOs

Input and Output Data Image:

PDO	byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	0	flags				slave 1/1A			
		F3	F2	F1	F0	D3	D2	D1	D0
	1	slave 2/2A				slave 3/3A			
	2	slave 4/4A				slave 5/5A			
	3	slave 6/6A				slave 7/7A			
	4	slave 8/8A				slave 9/9A			
	5	slave 10/10A				slave 11/11A			
	6	slave 12/12A				slave 13/13A			
	7	slave 14/14A				slave 15/15A			
2	0	slave 16/16A				slave 17/17A			
	1	slave 18/18A				slave 19/19A			
	2	slave 20/20A				slave 21/21A			
	3	slave 22/22A				slave 23/23A			
	4	slave 24/24A				slave 25/25A			
	5	slave 26/26A				slave 27/27A			
	6	slave 28/28A				slave 29/29A			
	7	slave 30/30A				slave 31/31A			
3	0	reserved				slave 1B			
	1	slave 2B				slave 3B			
	2	slave 4B				slave 5B			
	3	slave 6B				slave 7B			
	4	slave 8B				slave 9B			
	5	slave 10B				slave 11B			
	6	slave 12B				slave 13B			
	7	slave 14B				slave 15B			
4	0	slave 16B				slave 17B			
	1	slave 18B				slave 19B			
	2	slave 20B				slave 21B			
	3	slave 22B				slave 23B			
	4	slave 24B				slave 25B			
	5	slave 26B				slave 27B			
	6	slave 28B				slave 29B			
	7	slave 30B				slave 31B			

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PDO	byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
5	0	7.3 16 bit slave 1st channel 0 high							
	1	7.3 16 bit slave 1st channel 0 low							
		…							
	6	7.3 16 bit slave 1st channel 3 high							
	7	7.3 16 bit slave 1st channel 3 Low							
…	…	…							
35	0	7.3 16 bit slave 31th channel 0 high							
	1	7.3 16 bit slave 31th channel 0 low							
		…							
	6	7.3 16 bit slave 31th channel 3 high							
	7	7.3 16 bit slave 31th channel 3 low							

Flags		
	input data	output data
F0	ConfigError	Off-line
F1	APF	LOS-master-bit
F2	PeripheryFault	→ ConfigurationMode
F3	ConfigurationActive	→ ProtectedMode

ConfigError: 0=ConfigOK, 1=ConfigError
APF: 0=AS-i-Power OK, 1=AS-i-Power Fail
PeripheryFault: 0=PeripheryOK, 1=PeripheryFault
ConfigurationActive: 0=ConfigurationActive, 1=ConfigurationInactive
Off-Line: 0=OnLine, 1=Off-Line
LOS-master-bit 0=Off-Line by ConfigError deactivated
1=Off-Line by ConfigError activated

9.2.1.1 Receive-PDOs

number	**type**	**content**
PDO 1	default	hi-flags, outputs single/A slaves 1 … 15, circuit 1
PDO 2	default	outputs single/A slaves 16 … 31, circuit 1
PDO 3	default	outputs B slaves 1 … 15, circuit 1
PDO 4	default	outputs B slaves 16..31, circuit 1
PDO 5	advanced	outputs 7.3 16 bit slave 1, circuit 1
…	…	…
PDO 35	advanced	outputs 7.3 16 bit slave 31, circuit 1

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9.2.1.2 Send-PDOs

number	type	content
PDO 1	default	ec-flags, inputs single/A slaves 1 … 15, circuit 1
PDO 2	default	inputs single/A slaves 16 … 31, circuit 1
PDO 3	default	inputs B slaves 1 … 15, circuit 1
PDO 4	default	inputs B slaves 16 … 31, circuit 1
PDO 5	advanced	inputs 7.3 16 bit slave 1, circuit 1
…	…	…
PDO 35	advanced	inputs 7.3 16 bit slave 31, circuit 1

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10 CANopen Telegrams

10.1 Representation of a CAN Message

Note

CAN messages are represented in tables as shown below. The classification corresponds to the sbitoftware interfaces of common standard CAN drivers (2 bytes CAN header, 8 user data bytes).

CAN header

byte	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	hex
byte 0	ID 10	ID 9	ID 8	ID 7	ID 6	ID 5	ID 4	ID 3	
byte 1	ID 2	ID 1	ID 0	RTR	DLC 3	DLC 2	DLC 1	DLC 0	

CAN data

byte	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	hex
byte 2	data	data	data	data	data	data	data	data	
byte 3	data	data	data	data	data	data	data	data	
byte 4	data	data	data	data	data	data	data	data	
byte 5	data	data	data	data	data	data	data	data	
byte 6	data	data	data	data	data	data	data	data	
byte 7	data	data	data	data	data	data	data	data	
byte 8	data	data	data	data	data	data	data	data	
byte 9	data	data	data	data	data	data	data	data	

ID 10 ... ID 0: CAN identifier
The CAN identifier consists of the object code (ID 10 ... ID 7) and of the node address (ID 6 ... ID 0).

ID 10	ID 9	ID 8	ID 7	ID 6	ID 5	ID 4	ID 3	ID 2	ID 1	ID 0
objektcode				node address						

RTR: Remote Transmission Request bit

DLC 3... DLC0: Data Length Code, length of the user data

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10.2 Default Identifier Distribution

Note

Once it has been switched on, the AS-i/CANopen Gateway has a default identifier distribution according to the CANopen standard CiA DS 401.

The following table gives a survey of this distribution from the **AS-i/CANopen Gateway's point of view**.

object	identifier (binary)	identifier (decimal)	function	object for communication. Parameter/mapping	remark
NMT	00000000000	0	bootup	(cancelled)	
Emergency	0001XXXXXXX	129-255	status	0x1014 0x1015	send status message
Tx_PDO1	0011XXXXXXX	385-511	digital inputs A slaves	0x1800/ 0x1A00	event driven
Rx_PDO1	0100XXXXXXX	513-639	digital inputs A slaves	0x1400/ 0x1600	asynchronous
Tx_PDO2	0101XXXXXXX	641-767	digital inputs A slaves	0x1801/ 0x1A01	event driven
Rx_PDO2	0110XXXXXXX	769-895	digital outputs A slaves	0x1401/ 0x1601	asynchronous
Tx_PDO3	0111XXXXXXX	897-1023	digital intputs B slaves	0x1802/ 0x1A02	event driven
Rx_PDO3	1000XXXXXXX	1025-1151	digital outputs B slaves	0x1402/ 0x1602	asynchronous
Tx_PDO4	1001XXXXXXX	1153-1279	digital inputs B slaves	0x1803/ 0x1A03	event driven
Rx_PDO4	1010XXXXXXX	1281-1407	digital outputs B slaves	0x1403 0x1603	asynchronous
Tx_SDO	1011XXXXXXX	1409-1535	parameter	0x1200	SDO identifier for transmitting from AS-i gateway´s point of view
Rx_SDO	1100XXXXXXX	1537-1663	parameter	0x1200	SDO identifier for receiving from AS-i gateway´s point of view
NMT Error Control	1110XXXXXXX	1793-1919	life guarding	0x100C 0x100D 0x1016 0x1017	nodeguarding (remote frame), heartbeat produce/consume

XXXXXXX = node address

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10.2.1 Simplified Boot-up According to CANopen (NMT=0, DBT=0)

Note

CANopen allows a very simple boot up of a distributed network. After initialization, the modules enter the "Pre Operational" state autonomously. In this state it is already possible to access the object directory via SDOs, using the default identifiers, so that the modules can be configured. As there is a default setting for every object in the object directory, there is, in most cases, no need for a configuration. Only a single CANopen message is necessary for the starting up of the modules: "Start_Remote_Node".

The network managing messages for minimal bootup have a simple structure: CAN identifier "0" with two bytes data.

The first data byte contains the so-called command specifier (cs), the second data byte the node address. Node address 0 appeals to all nodes (broadcast).

NMT master telegram: CAN identifier = 0		
byte	daten byte 0	daten byte 1
description	command specifier	node-ID
data type	(unsigned8)	(unsigned8)

The different states of the simplified boot up and the transitions are shown in the state diagram.

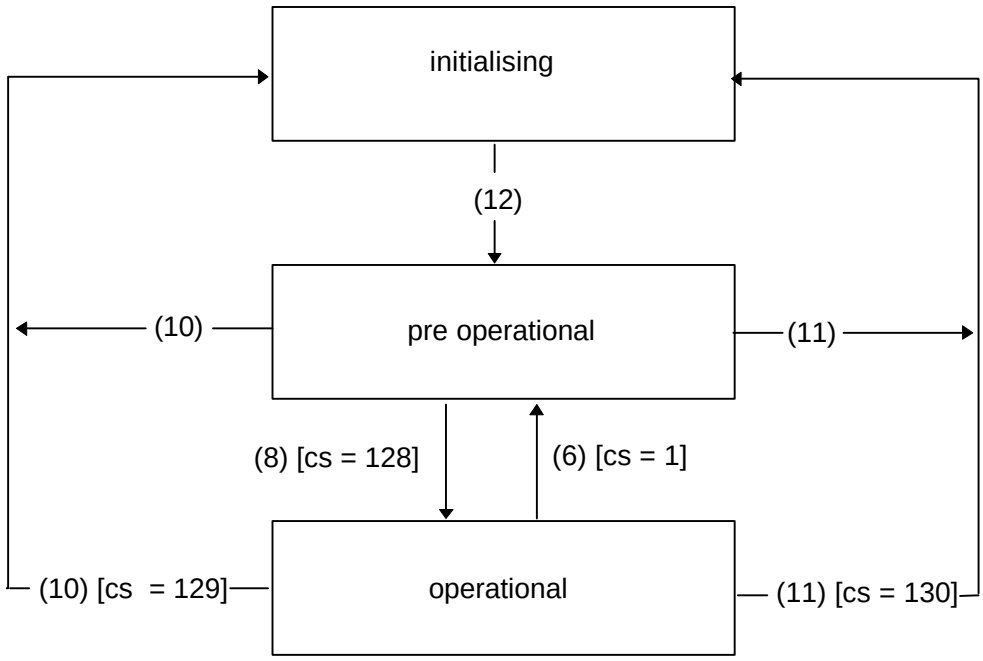

Figure: State diagram node module NMT class 0 and DBT class 0

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Description of the state transitions:

transition (see above)	term	command specifier (cs)	function
(6)	Start_Remote_Node indication	$1_{dez} = 01_h$	starts module, open outputs, starts transmission of PDOs
(8)	Enter_Pre-Operational_ State indication	$128_{dez} = 80_h$	stops PDO transmission, SDO transmission stays active
(10)	Reset_Node indication	$129_{dez} = 81_h$	leads to a reset (including the application)
(11)	Reset_Communication indication	$130_{dez} = 82_h$	leads to a reset of the communication functions
(12)	initialisation finished - enter "Pre Operational"	-	automatic transition to the "Pre Operational" state

All nodes of the network can be started simultaneously with following telegram:

CAN header

byte	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	hex
byte 0	0	0	0	0	0	0	0	0	00
byte 1	0	0	0	0	0	0	1	0	02

CAN data

byte	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	hex
byte 2	0	0	0	0	0	0	0	1	01
byte 3	0	0	0	0	0	0	0	0	00
byte 4									
byte 5									
byte 6									
byte 7									
byte 8									
byte 9									

The following telegram takes the module with node-ID 12 back to the "Pre Operational" mode:

CAN header

byte	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	hex
byte 0	0	0	0	0	0	0	0	0	00
byte 1	0	0	0	0	0	0	1	0	02

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CAN data

byte	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	hex
byte 2	1	0	0	0	0	0	0	0	01
byte 3	0	0	0	0	1	1	0	0	0
byte 4									
byte 5									
byte 6									
byte 7									
byte 8									
byte 9									

10.2.2 Examples for data exchange

1.) Telegram for the outputs, Rx_PDO1, node address 2

CAN header

byte	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	hex
byte 0	0	1	0	0	0	0	0	0	40
byte 1	0	1	0	0	1	0	0	0	48

CAN data

byte	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	hex
byte 2	F3	F2	F1	F0	slave 1 output 0	slave 1 output 1	slave 1 output 2	slave 1 output 3	
byte 3	slave 2 output 0	slave 2 output 1	slave 2 output 2	slave 2 output 3	slave 3 output 0	slave 3 output 1	slave 3 output 2	slave 3 output 3	
byte 4	slave 4 output 0	slave 4 output 1	...						
byte 5									
byte 6									
byte 7									
byte 8						...	slave 13 output 2	slave 13 output 3	
byte 9	slave 14 output 0	slave 14 output 1	slave 14 output 2	slave 14 output 3	slave 15 output 0	slave 15 output 1	slave 15 output 2	slave 15 output 3	

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Flags	
F0	Off-line
F1	LOS-master-bit
F2	→ ConfigurationMode
F3	→ ProtectedMode

Off-Line: 0=OnLine, 1=Off-Line
LOS-master-bit 0=Off-Line by ConfigError deactivated
1=Off-Line by ConfigError activated

2.) Telegram or inputs, Tx_PDO1, note address 2

CAN header

byte	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	hex
byte 0	0	0	1	1	0	0	0	0	30
byte 1	0	1	0	0	1	0	0	0	48

CAN data

byte	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	hex
byte 2	F3	F2	F1	F0	slave 1 input 0	slave 1 input 1	slave 1 input 2	slave 1 input 3	
byte 3	slave 2 input 0	slave 2 input 1	slave 2 input 2	slave 2 input 3	slave 3 input 0	slave 3 input 1	slave 3 input 2	slave 3 input 3	
byte 4	slave 4 input 0	slave 4 input 1	...						
byte 5									
byte 6									
byte 7									
byte 8						...	slave 13 input 2	slave 13 input 3	
byte 9	slave 14 input 0	slave 14 input 1	slave 14 input 2	slave 14 input 3	slave 15 input 0	slave 15 input 1	slave 15 input 2	slave 15 input 3	

Flags	
F0	ConfigError
F1	APF
F2	PeripheryFault
F3	ConfigurationActive

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

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11 CANopen

This chapter contains all the necessary information to operate the AS-i/CANopen gateway in a CANopen network.

11.1 Mailbox

11.1.1 Construction

If an AS-i slave is addressed in a command or in a response, the address is structured as shown below:

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	command							
2	T	–	circuit					
3	request parameter byte 1							
…	…							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	command							
2	T	result						
3	response parameter byte 1							
…	…							

Command byte and T-bit are always part of the response. The T-bit is necessary to operate the mailbox. In that way the same mailbox command can be used two times directly one command after the other with different parameters.

Circuit = 0 If AS-i gateway with one AS-i master or the master 1 of an AS-i gateway with 2 masters is choosen.

Circuit = 1 If AS-i gateway with 2 masters and the master 2 is choosen.

The commands for reading and writinig exist in 2 variants. By the first variant the bits in the slave lists are arranged, so that the data for slave with lower address appear in the lower bits. The second variant is compatible to Siemens masters, by which the sequence of the bits in the slave lists bytes are inverse.

Between the 2 variants can be changed with bit 2^6 in byte 2 of the request. For Siemens compatibility bit 2^6 should not be deleted.

The coding of requests for commands to reading and writing is following therefore:

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	command							
2	T	0	circuit					
3	Request parameter byte 1							
…	…							

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11.1.1.1 Values for command

Values for command				
command	**value**	**meaning**	**Req Len**	**Res Len**
IDLE	00_{16}	No order	2	2
READ_IDI	41_{16}	Read IDI	2	4
WRITE_ODI	42_{16}	Write_ODI	4	2
SET_PP	43_{16}	Set_Permanent_Parameter	4	2
GET_PP	01_{16}	Get_Permanent_Parameter	3	3
WRITE_P	02_{16}	Write_Parameter	4	3
READ_PI	03_{16}	Read_Parameter	3	3
STORE_PI	04_{16}	Store_Actual_Parameter	2	2
SET_PCD	25_{16}	Set_Permanent_Config	5	2
GET_PCD	26_{16}	Get_Permanent_Config	3	4
STORE_CDI	07_{16}	Store_Actual_Configuration	2	2
READ_CDI	28_{16}	Read_Actual_Configuration	3	4
SET_LPS	29_{16}	SET_LPS	11	2
GET_LPS	44_{16}	Get_LPS	2	10
GET_LAS	45_{16}	Get_LAS	2	10
GET_LDS	46_{16}	Get_LDS	2	10
GET_FLAGS	47_{16}	Get_Flags	2	5
SET_OP_MODE	$0C_{16}$	Set_Operation_Mode	3	2
SET_OFFLINE	$0A_{16}$	Set_Offline_Mode	3	2
SET_DATA_EX	48_{16}	Set_Data_Exchange_Active	3	2
SLAVE_ADDR	$0D_{16}$	Change_Slave_Address	4	2
SET_AAE	$0B_{16}$	Set_Auto_Adress_Enable	3	2
GET_LPF	$3E_{16}$	Get_LPF	2	10
WRITE_XID1	$3F_{16}$	Write_Extended_ID-Code_1	3	2
RD_7X_IN	50_{16}	Read 1 7.3-slave in.data	3	10
WR_7X_OUT	51_{16}	Write 1 7.3-slave out.data	11	2
RD_7X_OUT	52_{16}	Read 1 7.3-slave out.data	3	10
RD_7X_IN_X	53_{16}	Read 4 7.3-slaves in.data	3	
WR_7X_OUT_X	54_{16}	Write 4 7.3-slaves out.data		2
RD_7X_OUT_X	55_{16}	Read 4 7.3-slaves out.data	3	
READ_ODI	56_{16}	Read ODI	2	
GET_DELTA	57_{16}	Get list of config. diff.	2	10

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Values for command				
command	**value**	**meaning**	**Req Len**	**Res Len**
WR_74_PARAM	$5A_{16}$	Write S-7.4-slave parameter	≥6	2
RD_74_PARAM	$5B_{16}$	Read S-7.4-slave parameter	4	≥3
RD_74_ID	$5C_{16}$	Read S-7.4-slave ID string	4	≥3
RD_74_DIAG	$5D_{16}$	Read S-7.4-slave diagnosis string	4	≥3
GET_LISTS	30_{16}	Get LDS, LAS, LPS, Flags	2	
GET_LCS	60_{16}	Get LCS	2	10
GET_LOS	61_{16}	GET_LOS	2	10
SET_LOS	62_{16}	SET_LOS	10	2
GET_TECA	63_{16}	Get transm.err.counters	2	
GET_TECB	64_{16}	Get transm.err.counters	2	
GET_TEC_X	66_{16}	Get transm.err.counters	4	≥3
BUTTONS	75_{16}	Disable pushbuttons	3	2
INVERTER	$7C_{16}$	Configure Inverter Slaves	12	4
FP_PARAM	$7D_{16}$	„Functional Profile“ Param.	≥3	≥2
FP_DATA	$7E_{16}$	„Functional Profile“ Data	≥3	≥2

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11.1.1.2 Values for results

Values for result			
	value	place	meaning
OK	00_{16}	–	execution without fault
HI_NG	11_{16}	HI	general fault
HI_OPCODE	12_{16}	HI	illegal value in command
HI_LENGTH	13_{16}	HI	length of the mailbox is too short
HI_ACCESS	14_{16}	HI	no access right
EC_NG	21_{16}	EC	general fault
EC_SND	22_{16}	EC	„slave (source addr) not detected“
EC_SD0	23_{16}	EC	„slave 0 detected“
EC_SD2	24_{16}	EC	„slave (target addr) not decteced“
EC_DE	25_{16}	EC	„delete error“
EC_SE	26_{16}	EC	„set error“
EC_AT	27_{16}	EC	„address temporary“
EC_ET	28_{16}	EC	„extended ID1 temporary“
EC_RE	29_{16}	EC	„read (extended ID1) error“

11.1.2 Mailbox commands

11.1.2.1 IDLE

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	00_{16}							
2	T	–	circuit					

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	00_{16}							
2	T	result						

11.1.2.2 READ_IDI

With this call the input data values of all AS-i slaves are read out of the AS-i/CANopen Gateway in addition to the cyclic data exchange. Though the mail-box command READ_IDI transmits all Execution-Control-Flags (byte 3 and byte 4).

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Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	41_{16}							
2	T	–	circuit					

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	41_{16}							
2	T	result						
3	–							Pok
4	OR	APF	NA	CA	AAv	AAs	s0	Cok
5	–				slave 1A			
6	slave 2A				slave 3A			
…	…							
36	slave 30B				slave 31B			

Pok Periphery_Ok
S0 LDS.0
AAs Auto_Address_Assign
AAv Auto_Address_Available
CA Configuration_Active
NA Normal_Operation_Active
APF APF
OR Offline_Ready
Cok Config_Ok

11.1.2.3 WRITE_ODI

With this call the output data values of all AS-i slaves are written in additon to the cyclic data exchange.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	42_{16}							
2	T	–	circuit					
3	–				slave 1A			
4	slave 2A				slave 3A			
…	…							
34	slave 30B				slave 31B			

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	42_{16}							
2	T	result						

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11.1.2.4 Set_Permanent_Parameter (SET_PP)

With this call, a parameter value for the specified AS-i slave is configured on the AS-i/CANopen Gateway. The value is stored permanently in the EEPROM of the Gateway.

The configured parameter is not transferred immediately by the AS-i/CANopen Gateway to the AS-i slave. The configured parameter value is only transferred when the AS-i slave is activated after turning on the power supply on the AS-i/CA-Nopen Gateway.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	43_{16}							
2	T	–	circuit					
3	–		B	slave address				
4	–				PP			

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	43_{16}							
2	T	result						

11.1.2.5 Get_Permanent_Parameter (GET_PP)

With this call, a slave-specific parameter value stored on the EEPROM of the AS-i/CANopen Gateway is read.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	01_{16}							
2	T	–	circuit					
3	–		B	slave address				

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	01_{16}							
2	T	result						
3	–				PP			

11.1.2.6 Write Parameter (WRITE_P)

The AS-i slave parameter value transferred with the command is passed on to the addressed AS-i slave.

The parameter is stored on the AS-i/CANopen Gateway only temporarily and is not entered as a configured parameter in the EEPROM!

The AS-i slave transfers its current parameter value in the response (parameter echo). This can deviate from the value that has just been written according to the

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AS-i master specification. The AS-i slave response is returned as a parameter echo in the response data.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	02_{16}							
2	T	–	circuit					
3	–		B	slave address				
4	–				parameter			

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	02_{16}							
2	T	result						
3	–				slave response			

Meaning of bit B:

B = 0 Single AS-i slave or A-slave

B = 1 B-slave

11.1.2.7 Read Parameter (READ_PI)

This call returns the current parameter value (actual parameter) of an AS-i slave sent by the AS-i/CANopen Gateway.

This value must not be confused with the parameter echo that is supplied by the AS-i slave as a response to the write_parameter job.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	03_{16}							
2	T	–	circuit					
3	–		B	slave address				

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	03_{16}							
2	T	result						
3	–				PI			

Meaning of bit B:

B = 0 Single AS-i slave or A-slave

B = 1 B-slave

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11.1.2.8 Store Actual Parameters (STORE_PI)

With this call, the configured parameters stored on the EEPROM are overwritten with the current, permanently stored (actual) parameters; in other words, the parameters of all the AS-i slaves are configured.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	04_{16}							
2	T	–	circuit					

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	04_{16}							
2	T	result						

11.1.2.9 Set Permanent Configuration (SET_PCD)

This call sets the following configuration data for the addressed AS-i slave:

- I/O configuration
- ID code
- Extended ID1 code
- Extended ID2 code

The configuration data are stored permanently on the EEPROM of the AS-i/ CANopen Gateway and are used as the expected configuration by the AS-i master in the protected mode. The configuration data are specified by the manufacturer of the AS-i slave.

If the addressed AS-i slave does not support an extended ID code 1/2, the value F_{hex} must be specified.

When this command is executed, the AS-i master changes to the offline phase and then changes back to the normal mode (warm restart on the AS-i master).

This command can only be executed in the configuration mode.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	25_{16}							
2	T	–	circuit					
3	–		B	slave address				
4	xID2				xID1			
5	ID				I0			

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Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	25_{16}							
2	T	result						

Meaning of bit B:

B = 0 Single AS-i slave or A-slave

B = 1 B-slave

11.1.2.10 Get Extended Permanent Configuration (GET_PCD)

This call reads the following configuration data (configured data) of an addressed AS-i slave stored on the EEPROM of the AS-i master:

- I/O configuration
- ID code
- Extended ID1 code
- Extended ID2 code

The configuration data are specified by the manufacturer of the AS-i slave.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	26_{16}							
2	T	–	circuit					
3	–		B	slave address				

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	26_{16}							
2	T	result						
3	xID2				xID1			
4	ID				I0			

Meaning of bit B:

B = 0 Single AS-i slave or A-slave

B = 1 B-slave

11.1.2.11 Store Actual Configuration (STORE_CDI)

With this call, the (actual) configuration data (I/O configuration, ID code, extended ID1 code and extended ID2 code) of all AS-i slaves are stored permanently in the EEPROM as the (expected) configuration data. The list of activated AS-i slaves (LAS) is adopted in the list of permanent AS-i slaves (LPS).

When this command is executed, the AS-i master changes to the offline phase and then changes back to the normal mode (warm restart on the AS-i master).

This command can only be executed in the configuration mode.

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Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	07_{16}							
2	T	–	circuit					

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	07_{16}							
2	T	result						

11.1.2.12 Read Actual Configuration (READ_CDI)

With this call, the following configuration data of an addressed AS-i slave obtained by the AS-i master on the AS-Interface are read.

- I/O configuration
- ID code
- Extended ID1 code
- Extended ID2 code

The configuration data are specified by the manufacturer of the AS-i slave.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	28_{16}							
2	T	–	circuit					
3	–		B	slave address				

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	28_{16}							
2	T	result						
3	xID2				xID1			
4	ID				I0			

Meaning of bit B:

B = 0 Single AS-i slave or A-slave

B = 1 B-slave

11.1.2.13 SET_LPS

With this call, the list of configured AS-i slaves is transferred for permanent storage in the EEPROM of the master.

When this command is executed, the AS-i master changes to the offline phase and then changes back to the normal mode (warm restart on the AS-i master).

This command can only be executed in the configuration mode.

issue date 27.1.2003

Request (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	29_{16}							
2	T	0	circuit					
3	00_{16}							
4	7A	6A	5A	4A	3A	2A	1A	–
…	…							
11	31B	30B	29B	28B	27B	26B	25B	24B

Request (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	29_{16}							
2	T	1	circuit					
3	00_{16}							
4	–	1A	2A	3A	4A	5A	6A	7A
…	…							
11	24B	25B	26B	27B	28B	29B	30B	31B

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	29_{16}							
2	T	result						

11.1.2.14 GET_LPS

With this call, the following entry is read out of the AS-i/CANopen Gateway: The list of projected AS-i slaves (LPS).

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	44_{16}							
2	T	O	circuit					

Response (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	44_{16}							
2	T	result						
3	7A	6A	5A	4A	3A	2A	1A	0A
…	…							
10	31B	30B	29B	28B	27B	26B	25B	24B

issue date 27.1.2003

Response (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	44_{16}							
2	T	result						
3	0A	1A	2A	3A	4A	5A	6A	7A
…	…							
10	24B	25B	26B	27B	28B	29B	30B	31B

11.1.2.15 GET_LAS

With this call, the following entry is read out of the AS-i/CANopen Gateway: The list of activated slaves (LAS).

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	45_{16}							
2	T	O	circuit					

Response (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	45_{16}							
2	T	result						
3	7A	6A	5A	4A	3A	2A	1A	0A
…	…							
10	31B	30B	29B	28B	27B	26B	25B	24B

Response (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	45_{16}							
2	T	result						
3	0A	1A	2A	3A	4A	5A	6A	7A
…	…							
10	24B	25B	26B	27B	28B	29B	30B	31B

issue date 27.1.2003

11.1.2.16 GET_LDS

With this call, the following entry is read out of the AS-i/CANopen Gateway: The list of detected AS-i slaves (LDS).

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	46_{16}							
2	T	O	circuit					

Response (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	46_{16}							
2	T	result						
3	7A	6A	5A	4A	3A	2A	1A	0A
…	…							
10	31B	30B	29B	28B	27B	26B	25B	24B

Response (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	46_{16}							
2	T	result						
3	0A	1A	2A	3A	4A	5A	6A	7A
…	…							
10	24B	25B	26B	27B	28B	29B	30B	31B

11.1.2.17 GET_FLAGS

With this call, the following entry is read out of the AS-i/CANopen Gateway: The flags according to the AS-i slave specification.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	47_{16}							
2	T	–	circuit					

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	47_{16}							
2	T	response						
3	–							Pok
4	OR	APF	NA	CA	AAv	AAs	S0	Cok
5	–					AAe	OL	DX

issue date 27.1.2003

Pok Periphery_Ok
This flag is set when no AS-i slave is signaling a peripheral fault.

S0 LDS.0
This flag is set when an AS-i slave exists with address 0.

AAs Auto_Address_Assign
This flag is set when the automatic address programming is possible (in other words, AUTO_ADDR_ENABLE = 1 and there is no “incorrect” slave connected to the AS-i Interface).

AAv Auto_Address_Available
This flag is set when the automatic address programming can be executed (in other words, exactly one AS-i slave is currently out of operation).

CA Configuration_Active
The flag is set in the configuration mode and reset in the protected mode.

NA Normal_Operation_Active
This flag is set when the AS-i master is in normal operation.

APF APF
This flag is set when the voltage on the AS-i cable is too low.

OR Offline_Ready
The flag is set when the offline phase is active.

Cok Config_Ok
This flag is set when the desired (configured) and actual configuration match.

AAe Auto_Address_Enable
This flag indicates whether the automatic address programming is enabled (bit = 1) or disabled (bit = 0) by the user.

OL Off-line
This flag is set when the mode is to changed to OFFLINE or this mode has already been adopted.

DX Data_Exchange_Active
If the "Data_Exchnge_Active" flag is set, the the data exchage between AS-i master and slaves is available in the dataexchange phase. If this bit is not set the data exchange is not available. The read ID telgegrams are transmitted to the slave.
The bit is set if the AS-i master entries the offline phase.

11.1.2.18 SET_OP_MODE

This call changes the module between the configuration mode and the protected mode.

In the protected mode, only AS-i slaves are activated that are entered in the LPS and whose expected and actual configurations match, in other words, when the I/O configuration and ID codes of the detected AS-i slaves are identical to the configured values.

issue date 27.1.2003

In the configuration mode, all detected AS-i slaves (except for AS-i slave "0") are activated. This also applies to AS-i slaves in which there are differences between the expected and actual configuration.

The “OPERATION MODE” bit is stored permanently; in other words, it is retained following a cold/warm restart.

When you change from the configuration mode to the protected mode, there is a warm restart on the AS-i master (change to the offline phase followed by a change to the online mode).

Note

If an AS-i slave with address "0" is entered in the LDS, the AS-i/CANopen Gateway cannot change from the configuration mode to the protected mode.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$0C_{16}$							
2	T	–	circuit					
3	operation mode							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$0C_{16}$							
2	T	result						

Meaning of bit operation mode:

0 = protected mode
1 = configuration mode

11.1.2.19 SET_OFFLINE

This call switches between the online and offline mode.

The online mode is the normal operating situation for the AS-i master. Here, the following jobs are processed cyclically:

- During the data exchange phase, the fields of the output data are transferred to the slave outputs for all AS-i slaves in the LAS. The addressed AS-i slaves transfer the values of the slave inputs to the master when the transfer was free of errors.
- This is followed by the inclusion phase in which there is a search for the existing AS-i slaves and newly added AS-i slaves are entered in the LDS or LAS.
- In the management phase, jobs from the user such as writing parameters are executed.

In the offline mode, the AS-i/CANopen Gateway only processes jobs from the user. (Jobs that involve the immediate addressing of an AS-i slave are rejected with an error.) There is no cyclic data exchange with the AS-i slaves.

issue date 27.1.2003

The OFFLINE = TRUE bit is not permanently stored; in other words, following a cold/warm restart, the AS-i/CANopen Gateway is once again in the online mode.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$0A_{16}$							
2	T	–	circuit					
3	Off-Line							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$0A_{16}$							
2	T	result						

The master changes to the Offline phase, if there is a 1 written in byte 3.

The master will change to online mode if there is a 0 written in byte 3.

11.1.2.20 SET_DATA_EX

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	48_{16}							
2	T	–	circuit					
3	Data_Exchange_Active							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	48_{16}							
2	T	result						

11.1.2.21 Change Slave Address (SLAVE_ADDR)

With this call, the AS-i address of an AS-i slave can be modified.

This call is mainly used to add a new AS-i slave with the default address "0" to the AS-Interface. In this case, the address is changed from "AS-i slave address old" = 0 to "AS-i slave address new”.

This change can only be made when the following conditions are fulfilled:

1. An AS-i slave with “AS-i slave address old” exists.
2. If the old AS-i slave address is not equal to 0, then an AS-i slave with address "0" cannot be connected at the same time.
3. The "AS-i slave address new" must have a valid value.
4. An AS-i slave with "AS-i slave address new" must not exist.

issue date 27.1.2003

Note

When the AS-i slave address is changed, the AS-i slave is not reset, in other words, the output data of the AS-i slave are retained until new data are received at the new address.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$0D_{16}$							
2	T	–	circuit					
3	–		B	source address				
4	–		B	target address				

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$0D_{16}$							
2	T	result						

Meaning of bit B:

B = 0 Single AS-i slave or A-slave

B = 1 B-slave

11.1.2.22 Set Auto Address Enable (SET_AAE)

This call can enable or disable the "automatic address programming" function.

The AUTO_ADDR_ENABLE bit is stored permanently; in other words, it is retained after a warm/hot restart on the AS-i master.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$0B_{16}$							
2	T	–	circuit					
3	Auto_Address_Enable							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$0B_{16}$							
2	T	result						

issue date 27.1.2003

11.1.2.23 GET_LPF

With this call, the list of peripheral faults (LPF) signaled by the AS-i slaves is read out from the AS-i master. The LPF is updated cyclically by the AS-i master. Whether an when an AS-i slave signals faults of the attached peripherals (for example wire break) can be found in the description of the AS-i slave.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$3E_{16}$							
2	T	O	circuit					

Response (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$3E_{16}$							
2	T	result						
3	7A	6A	5A	4A	3A	2A	1A	0A
…	…							
10	31B	30B	29B	28B	27B	26B	25B	24B

Response (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$3E_{16}$							
2	T	result						
3	0A	1A	2A	3A	4A	5A	6A	7A
…	…							
10	24B	25B	26B	27B	28B	29B	30B	31B

11.1.2.24 Write AS-i Slave Extended ID1 (WRITE_XID1)

With this call, the extended ID1 code of an AS-i slave with address "0" can be written directly over the AS-i cable. The call is intended for diagnostic purposes and is not required in the normal master mode.

The AS-i master passes on the extended ID1 code to the AS-i slave without any plausibility check.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$3F_{16}$							
2	T	–	circuit					
3	–				xID1			

issue date 27.1.2003

Response								
Byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$3F_{16}$							
2	T	result						

11.1.2.25 RD_7X_IN

With this command the four 16 bit channels of an AS-i input slave according to the slave profile 7.3 can be read.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	50_{16}							
2	T	–	circuit					
3	–		0	slave address				

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	50_{16}							
2	T	result						
3	channel 1, high byte							
…	…							
10	channel 4, low byte							

11.1.2.26 WR_7X_OUT

With this command the four 16 bit channels of an AS-i output slave according to the slave profile 7.3 can be written.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	51_{16}							
2	T	–	circuit					
3	–		0	slave address				
4	channel 1, high byte							
…	…							
11	channel 4, low byte							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	51_{16}							
2	T	result						

issue date 27.1.2003

11.1.2.27 RD_7X_OUT

With this command the four 16 bit channels of an AS-i output slave according to the slave profile 7.3 can be read out of the AS-i/CANopen Gateway.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	52_{16}							
2	T	–	circuit					
3	–		0	slave address				

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	52_{16}							
2	T	result						
3	channel 1, high byte							
…	…							
10	channel 4, low byte							

11.1.2.28 RD_7X_IN_X

With this command the four 16 bit channels of 4 AS-i input slaves with succesive addresses according to the slave profile 7.3 can be read.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	53_{16}							
2	T	–	circuit					
3	–		0	1st slave address				

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	53_{16}							
2	T	result						
3	1st slave, channell 1, high byte							
…	…							
34	4th slave, channel 4, low byte							

issue date 27.1.2003

11.1.2.29 WR_7X_OUT_X

With this command the four 16 bit channels of 4 AS-i output slaves with succesive addresses according to the slave profile 7.3 can be written.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	54_{16}							
2	T	–	circuit					
3	–		0	1st slave address				
4	1st slave, channel 1, high byte							
…	…							
35	4th slave, channel 4, low byte							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	54_{16}							
2	T	result						

11.1.2.30 RD_7X_OUT_X

With this command the four 16 bit channels of 4 AS-i output slaves with succesive addresses according to the slave profile 7.3 can be read.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	55_{16}							
2	T	–	circuit					
3	–		0	1st slave address				

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	55_{16}							
2	T	result						
3	1st slave, channel 1, high byte							
…	…							
34	4th slave, channel 4, low byte							

issue date 27.1.2003

11.1.2.31 READ_ODI

With this call the output data values of all AS-i slaves is read out of the AS-i/CA-Nopen Gateway.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	56_{16}							
2	T	–	circuit					

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	56_{16}							
2	T	result						
3	–				slave 1A			
	slave 2A				slave 3A			
…	…							
34	slave 30B				slave 31B			

11.1.2.32 GET_DELTA

The Delta list contents the list of slave addresse with configuration errors.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	57_{16}							
2	T	0	circuit					

Response (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	57_{16}							
2	T	result						
3	7A	6A	5A	4A	3A	2A	1A	–
…	…							
10	31B	30B	29B	28B	27B	26B	25B	24B

Response (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	57_{16}							
2	T	result						
3	0	1A	2A	3A	4A	5A	6A	7A
…	…							
10	24B	25B	26B	27B	28B	29B	30B	31B

issue date 27.1.2003

11.1.2.33 WR_74_PARAM

With this function the parameter string of a slave according to profile S-7.4 is written. Because it is possible, that the string is longer than the maibox, first it will be written into the buffer in parts and then it will be transfered to the slave.

n is the length of the part of the string, that should be written into the buffer from index i.

If i ≡ 0, then the string is transfered to the slave.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$5A_{16}$							
2	T	–	circuit					
3	slave address							
4	i							
5	n							
6	buffer btye i							
…	…							
n+5	buffer byte i+n-1							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$5A_{16}$							
2	T	results						

11.1.2.34 RD_74_PARAM

With this function the parameter string according to profile S-7.4 is read. Because the string can be longer as the mailbox, it is written into the buffer. The content of the buffer can read in parts from index i.

The first byte of the bufferis the length of the read string.

If i ≡ 0, then the string is read from the slave, otherwise the function responses out of the memory, trough which the data can be read consistently.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$5B_{16}$							
2	T	–	circuit					
3	slave address							
4	i							

issue date 27.1.2003

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$5B_{16}$							
2	T	result						
	buffer byte i							
…	…							
n+2	buffer byte i+n-1							

11.1.2.35 RD_74_ID

With this function the ID string of a slave according to profile S-7.4 is read. Because the string can be longer as the mailbox, it is written into the buffer. The content of the buffer can read in parts from index i.

The first byte of the bufferis the length of the read string.

If i ≡ 0, then the string is read from the slave, otherwise the function responses out of the memory, trough which the data can be read consistently.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$5C_{16}$							
2	T	–	circuit					
3	slave address							
4	i							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$5C_{16}$							
2	T	result						
	buffer byte i							
…	…							
n+2	buffer byte i+n-1							

11.1.2.36 RD_74_DIAG

With this function the diagnosis string of a slave according to profile S-7.4 is read. Because the string can be longer as the mailbox, it is written into the buffer. The content of the buffer can read in parts from index i.

The first byte of the buffer is the length of the read string.

issue date 27.1.2003

If i ≡ 0, then the string is read from the slave, otherwise the function responses out of the memory, trough which the data can be read consistently.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$5D_{16}$							
2	T	–	circuit					
3	slave address							
4	i							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$5D_{16}$							
2	T	result						
	buffer byte i							
…	…							
n+2	buffer byte i+n-1							

11.1.2.37 Get_LPS, Get_LAS, Get_LDS, Get_Flags (GET_LISTS)

With this call, the following entries are read out of the AS-i/CANopen Gateway:

- The list of active AS-i slaves (LAS)
- The list of detected AS-i slaves (LDS)
- The list of projected AS-i slaves (LPS)
- The flags according to the AS-i slave specification

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	30_{16}							
2	T	O	circuit					

issue date 27.1.2003

Response (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	30_{16}							
2	T	result						
3	7A	6A	5A	4A	3A	2A	1A	0A
…	LAS							
10	31B	30B	29B	28B	27B	26B	25B	24B
11	7A	6As	5A	4A	3A	2A	1A	0A
…	LDS							
19	31B	30B	29B	28B	27B	26B	25B	24B
20	7A	6As	5A	4A	3A	2A	1A	0A
…	LPS							
26	31B	30B	29B	28B	27B	26B	25B	24B
27	–							Pok
28	OR	APF	NA	CA	AAv	AAs	S0	Cok
29	–					AAe	OL	DX

Response (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	30_{16}							
2	T	result						
3	0A	1A	2A	3A	4A	5A	6A	7A
…	LAS							
10	24B	25B	26B	27B	28B	29B	30B	31B
11	0A	1A	2A	3A	4A	5A	6A	7A
…	LDS							
19	24B	25B	26B	27B	28B	29B	30B	31B
20	0A	1A	2A	3A	4A	5A	6A	7A
…	LPS							
26	24B	25B	26B	27B	28B	29B	30B	31B
27	–							Pok
28	OR	APF	NA	CA	AAv	AAs	S0	Cok
29	–					AAe	OL	DX

Pok Periphery_Ok
S0 LDS.0
AAs Auto_Address_Assign
AAv Auto_Address_Available
CA Configuration_Active
NA Normal_Operation_Active
APF APF
OR Offline_Ready

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Cok Config_Ok
AAe Auto_Address_Enable
OL Off-line
DX Data_Exchange_Active

11.1.2.38 GET_LCS

With this call, the List of Corrupted Slaves (*LCS*) is read out of the AS-i/CANopen Gateway.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	60_{16}							
2	T	O	circuit					

Response (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	60_{16}							
2	T	result						
3	7A	6A	5A	4A	3A	2A	1A	0A
…	…							
10	31B	30B	29B	28B	27B	26B	25B	24B

Response (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	60_{16}							
2	T	result						
3	0A	1A	2A	3A	4A	5A	6A	7A
…	…							
10	24B	25B	26B	27B	28B	29B	30B	31B

11.1.2.39 GET_LOS

With this call, the List of Offline Slaves (*LOS*) is read out of the AS-i/CANopen Gateway (see chapter 8).

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	61_{16}							
2	T	O	circuit					

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Response (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	61_{16}							
2	T	result						
3	7A	6A	5A	4A	3A	2A	1A	0A
…	…							
10	31B	30B	29B	28B	27B	26B	25B	24B

Response (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	61_{16}							
2	T	result						
3	0A	1A	2A	3A	4A	5A	6A	7A
…	…							
10	24B	25B	26B	27B	28B	29B	30B	31B

11.1.2.40 SET_LOS

With this call, the List of Offline Slaves is written to the AS-i/CANopen Gateway (see chapter 8).

Request (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	62_{16}							
2	T	O	circuit					
3	7A	6A	5A	4A	3A	2A	1A	0A
…	…							
10	31B	30B	29B	28B	27B	26B	25B	24B

Request (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	62_{16}							
2	T	1	circuit					
3	0A	1A	2A	3A	4A	5A	6A	7A
…	…							
10	24B	25B	26B	27B	28B	29B	30B	31B

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	62_{16}							
2	T	result						

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11.1.2.41 GET_TECA

With this call the error counters of all single slaves/A-slaves can be read (see chapter 8).

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	63_{16}							
2	T	–	circuit					

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	63_{16}							
2	T	result						
3	APF							
4	slave 1A							
…	…							
34	slave 31A							

11.1.2.42 GET_TECB

With this call the counts of the error counters for B-slaves are read out (see chapter 8).

With every read out of the counts the error counters are restarted.

The counts are read out via the correspondending host interface and will be deleted with every read access. The counter value is limited to 254. 255 means counter overflow.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	64_{16}							
2	T	–	circuit					

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	64_{16}							
2	T	result						
3	APF							
4	slave 1B							
…	…							
34	slave 31B							

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11.1.2.43 GET_TEC_X

With this call beginning by a definite slave address the counts of the n error counters are read out (see chapter 8).

With every read out of the counts the error counters are restarted.

The counts are read out via the correspondending host interface and will be deleted with every read access. The counter value is limited to 254. 255 means counter overflow.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	66_{16}							
2	T	–	circuit					
3	1. slave address							
4	number of counters							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	66_{16}							
2	T	result						
3	counter 1							
…	…							
n	counter n - 2							

11.1.2.44 BUTTONS

With this call, the use of the buttons can be enabled/disabled.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	75_{16}							
2	T	–	circuit					
3	ButtonsDisabled							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	75_{16}							
2	T	result						

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11.1.2.45 INVERTER

With that call an AS-i slave for frequency inverters is switched to the mode to get four 16 bit values via the AS-i analog profile 7.3 and afterwards switched to the selcted destination parameter.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7C_{16}$							
2	T	–	circuit					
3	slave address							
4	destination parameter							
5	value 1, high byte							
6	value 1, low byte							
7	value 2, high byte							
8	value 2, low byte							
9	value 3, high byte							
10	value 3, low byte							
11	value 4, high byte							
12	value 4, low byte							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7C_{16}$							
2	T	result						

11.1.2.46 FP_PARAM

This command is used for parametrization of "functional profiles".

The content of the request and response bytes is depending of the called function (see chapter 11.1.3).

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7D_{16}$							
2	T	–	circuit					
3	function							
4	request byte 1							
…	…							
n	request byte n-3							

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Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7D_{16}$							
2	T	result						
3	response byte 1							
…	…							
n	response byte n-2							

11.1.2.47 FP_DATA

This command is used for data exchange with "functional profiles".

The content of the request and response bytes is depending of the called function (see chapter 11.1.3).

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	–	circuit					
3	function							
4	request byte 1							
…	…							
n	request byte n-3							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	result						
3	reponse byte 1							
…	…							
n	response byte n-2							

11.1.3 Functional profiles

11.1.3.1 „Safety at Work“ List 1

Function: 00_{16}

List of "safety-directed input slaves" ("AS-i Safety at Work"), by which the dafety function is released.

In this list are entered that slaves according to profile S-7.B or S-0.B, by which are deleted all 4 bits in the IDI. Therefore slaves with 2 contacts are entered only then, if both contacts are released.

Because the safety function of a safety-directed input slave can be released, if the slave does exchange no data with the AS-i master, the list may be utilized only in combination with the ec-flags.

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For the building of this list CDI and IDI are utilized only. Safety-directed slaves, which are projected but not existing, and slaves, which are existing but sending a wrong code, are entered therfore not here.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	O	circuit					
3	00_{16}							

Response (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	result						
3	–							Pok
4	OR	APF	NA	CA	AAv	AAs	S0	Cok
5	7	6	5	4	3	2	1	-
…	…							
8	31	30	29	28	27	26	25	25

Response (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	result						
3	–							Pok
4	OR	APF	NA	CA	AAv	AAs	S0	Cok
5	-	1	2	3	4	5	6	7
…	…							
8	24	25	26	27	28	29	30	31

Cok Config_Ok
S0 LDS.0
AAs Auto_Address_Assign
AAv Auto_Address_Available
CA Configuration_Active
NA Normal_Operation_Active
APF APF
OR Offline_Ready
Pok Periphery_Ok

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11.1.3.2 „Safety at Work“ Monitor Diagnosis

Function: 02_{16}

Because the „Safety at Work“ monitor can make more than 32 Byte diagnosis data, these must be read with several mailbox calls. The second request byte declares the start index in the field of the daignosis data.

If the start index ist 0, new data is fetched from the monitor, otherwise the function responses out of the memory, through which the data can be read consistently.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	–	circuit					
3	02_{16}							
4	slave address							
5	index							

Response								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	result						
3	diagnosis byte #index+0							
4	diagnosis byte #index+1							
…	…							
n	diagnosis byte #index+n-3							

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The diagnosis data field of the safety monitor has following structure:

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	00_{16}							
1	monitor state							
2	state circuit 1							
3	state circuit 2							
4	number circuit 1							
5	number circuit 2							
6	device index 32, circuit 1							
7	device color, circuit 1							
8	device index 33, circuit 1							
9	device color, circuit 1							
…	…							
68	device index 63, circuit 1							
69	device color, circuit 1							
70	device index 32, circuit 2							
71	device color, circuit 2							
…	…							
132	device index 63, circuit 2							
133	device color, circuit 2							

11.1.3.3 Integrated AS-i Sensors: Warnings

Function: 03_{16}

List of integrated AS-i sensors according to profile S-1.1 (without advanced addressing) or profile S-3.A.1(with advanced addressing), by which the input data bit D1 ("Warning") is deleted.

For building of this list CDI and IDI are utilized only. Integrated AS-i slaves, which are projected but not existing, are entered therfore not here.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	O	circuit					
3	03_{16}							

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Response (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	result						
3	7A	6A	5A	4A	3A	2A	1A	0
…	…							
10	31B	30B	29B	28B	27B	26B	25B	24B

Response if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	result						
3	0	1A	2A	3A	4A	5A	6A	7A
…	…							
10	24A	25A	26A	27A	28A	29A	30A	31A

11.1.3.4 Integrated AS-i Sensors: Availability

Function: 04_{16}

List of the integrated slaves according to profile S-1.1, by which the input data bit D2 ("Availability") is deleted.

For building of this list CDI and IDI are utilized only. Integrated AS-i slaves, which are projected but not existing, are entered therfore not here.

Request								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	O	circuit					
3	04_{16}							

Response (if O ≡ 0)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	result						
3	7	6	5	4	3	2	1	0
…	…							
6	31	30	29	28	27	26	25	24

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Resonse (if O ≡ 1)								
byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	$7E_{16}$							
2	T	result						
3	0	1	2	3	4	5	6	7
…	…							
6	24	25	26	27	28	29	30	31

11.1.4 Mailbox example

Command RD_7X_IN: Reading of analog input values

Used ID/module in the GSD file: 12 bytes management

Meaning of the bytes:

Request: RD_7X_IN	
Byte 1	50_{hex} (RD_7X_IN)
Byte 2	00_{hex} (master 1, single master)
Byte 3	$1D_{hex}$ (slave address 29)
Byte 4	00_{hex}
…	…
Byte 12	00_{hex}

Response	
Byte 1	00_{hex}
Byte 2	00_{hex}
Byte 3	00_{hex}
Byte 4	00_{hex}
…	…
Byte 12	00_{hex}

The mailbox call has not been anwsered with the valid values, beause the toggle bit has not been set.

Set of Toggle bit:

Request	
Byte 1	50_{hex}
Byte 2	80_{hex} (Toggle bit, master 1, single master)
Byte 3	$1D_{hex}$ (slave address 29)
Byte 4	00_{hex}
…	…
Byte 12	00_{hex}

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Response	
Byte 1	50_{hex}
Byte 2	80_{hex} (Toggle bit, master1)
Byte 3	analog channel 1 high $byte_{hex}$
Byte 4	analog channel 1 low $byte_{hex}$
Byte 5	analog channel 2 high $byte_{hex}$
Byte 6	analog channel 2 low $byte_{hex}$
Byte 7	analog channel 3 high $byte_{hex}$
Byte 8	analog channel 3 low $byte_{hex}$
Byte 9	analog channel 4 high $byte_{hex}$
Byte 10	analog channel 4 low $byte_{hex}$
Byte 11	00_{hex} not usedt
Byte 12	00_{hex} not usedt

To get the input data again, the T-bit has to be reset aso.

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12 Appendix: Displaying the Figure Display

In the basic state of the configuration mode, the display shows one after the other the addresses of all detected slaves at a rate of two per second. A blank display means that the *LDS* is empty, i.e. 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 (see chapter 6.3.2).

During manual address programming, the slave address display has a different meaning (see chapter 6.4 and 6.5).

All displayed numbers that are bigger than 31 and therefore 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: If a 39 appears on the display after pressing the 'set'-button a short-time AS-i power failure occured.
40	The AS-i master is in off-line 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.
70	Hardware error: The AS-i master's EEPROM cannot be written to.
72	Hardware error: The PIC processor does not respond.
73	Hardware error: The PIC processor does not respond.
74	Checksum error in the EEPROM.
75	Error in the external RAM.
76	Error in the external RAM.
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 the next power-up of the AS-i master the accessing to the device only from the host via the interface.
83	Program reset of the AS-i Control programm: The AS-i Control programm is just read out of EEPROM and copied into the RAM.
88	Display test while starting up the AS-i master
90	Error while changing a slave address in protected operating mode: No slave with address 0 existing.
91	Error while changing slave address: Target address is already occupied.
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 slave address in protected operating mode: Slave has wrong configuration data.

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95	Error while changing slave address in protected operating mode: The configuration error was caused by one slave too many (instead of one missing slave).

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13 Appendix: The First Commissioning of AS-i

Note

In this chapter an example is given of how to put an AS-i network into operation quickly and easily and without the need for external devices. The addressing of the components connected to the AS-i network can be performed directly on the AS-i master. It is of course more comfortable to do the addressing with a hand-held programming device or with the Windows software AS-i Control Tools. However, it is possible to configure even complex networks using only the AS-i master.

What to do ?	**How to go about it?**
See to it that the AS-i master is properly supplied with power.	Connect the AS-i power supply unit to the terminals AS-i + and AS-i - of the master, connect the ground terminal. Turn on the power supply.
After the self-test: the LEDs “power”, “config err”, ”U ASI” and “prj mode” are on. The figure display shows “40”: the AS-i master is in the off-line phase. Shortly after that a “41” will be displayed: the AS-i master stays in the detection phase.	
Switch the device to the projecting mode, if the yellow LED does not light up.	Press the “modeMODE”-button for approx. five seconds.
The yellow LED “prj mode” lights up. The device is now in projecting mode.	
Add a slave with the address 0 to the AS-i line.	Connect the slave's terminals with the terminals AS-i +/- of the master.
The green LED “ASI active” lights up. The figure display shows “0”. This means the AS-i master has detected the slave.	
Change the slave address to address 1.	Select address 1 by pressing the “set” button shortly, if necessary repeatedly, whereby after each operation the next in each case free address is indicated. When a “1” appears on the display press the “set” button for approx. five seconds until the display blinks. Press again shortly the “set” button to assign the new address to the slave.
The AS-i master detects the slave with address 1 and displays “1”.	
Connect another slave with address 0 to the AS-i line and allocate the address 2 to it.	Connect the slave to the AS-i line. The addressing is the same as for the previous slave.
The addresses of all slaves detected are now displayed sequentially.	
Change to the protected operating mode and store the AS-i configuration.	Leave the configuration mode by pressing the “mode” button for at least five seconds until the “prj mode” LED goes out.

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What to do ?	How to go about it?
The configuration of the AS-i master is now finished. Now the hierarchically higher fieldbus system can be put into operation.	

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One Company, Two Divisions.

Factory Automation Division

Product Range

- Binary and analog sensors
- in different technologies
  - Inductive and capacitive sensors
  - Magnetic sensors
  - Ultrasonic sensors
  - Photoelectric sensors
- Incremental and absolute rotary encoders
- Counters and control equipment
- ID systems
- AS-Interface

Areas of Application

- Machine engineering
- Conveyor or transport
- Packaging and bottling
- Automobile industry

Process Automation Division

Product Range

- Signal conditioners
- Intrinsically safe interface modules
- Remote process interface
- Intrinsically safe field bus solutions
- Level control sensors
- Process measuring and control systems engineering at the interface level
- Intrinsic safety training

Areas of Application

- Chemical industry
- Industrial and community sewage
- Oil, gas and petrochemical industry
- PLC and process control systems
- Engineering companies for process systems

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