FACTORY AUTOMATION

Manual

VAG-MOD-KF-R4

AS-Interface/Modbus Gateway

Ip20

PEPPERL+FUCHS

Table of Contents

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1 Declaration of Conformity

The AS-iModbus Gateway VAG-MOD-KF-R4 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- 68307 Mannheim, possesses a certified quality assurance system in accordance with ISO 9001.

CE

ISO**9001**

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2 The Used Symbols

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 devices of the Pepperl+Fuchs GmbH:

- VAG-MOD-KF-R4

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5 Advanced Diagnostics for AS-i Masters

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

The AS-i Control Tools, Pepperl+Fuchs software for the comfortable commissioning of the AS-Interface and the programming of AS-i Control, will include the operation of the Advanced Diagnostics from version 3.0 on.

5.1 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 l**ist 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. Was there a short-time AS-i power failure the display shows “39“ after pressing the “set“ button.

5.2 Error Counter: Counter of corrupted data telegrams

The AS-i Master with advanced diagnostics has an error counter for each AS-i slave, which is increased every time there is a corrupted AS-i telegram. This makes it possible to judge the quality of the AS-i network, even if only a few corrupted telegrams occurred 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.

The error counter is included in the command Master | AS-i Diagnostics of AS-i Control Tools version 3.0.

5.3 Off-line Phase on Configuration Errors

The AS-i Masters 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

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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.

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.

The parameterization of Off-line Phase on Configuration Error is also supported by the AS-i Control Tools version 3.0.

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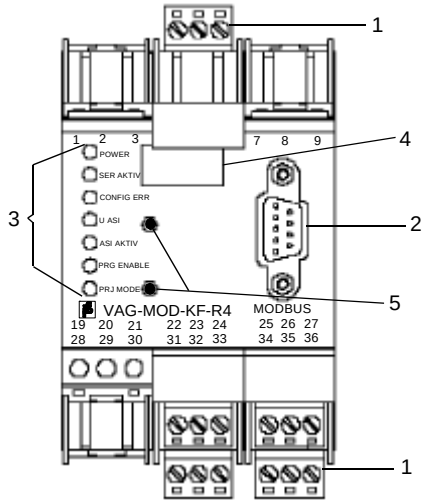
6 Connections, Displays and Controls

6.1 Device Schematics

The following are found on the front of the AS-i/Modbus gateway (see diagram below):

1. Connection terminals for the AS-i circuit, also used for the power supply
2. A nine pin SUB-D connector as a Modbus-interface (see chapter 6.4),
3. 7 LEDs
4. A four position, seven section display for indicating the gateway's operating status
5. 2 buttons for projecting the gateway..



The following diagram provides the dimensions of the AS-i/Modbus-gateway.

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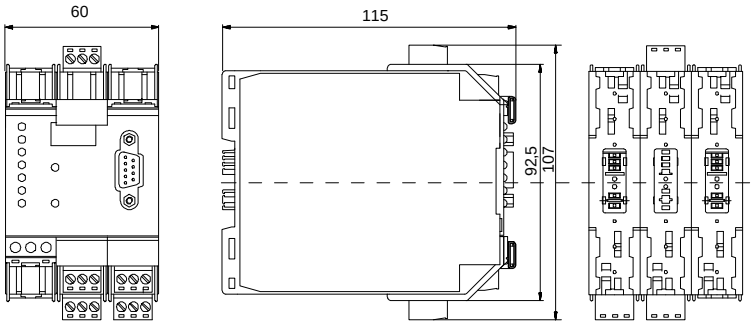

6.2 Displays and Controls

The seven LEDs on the front of the gateway signal the following:

power	The gateway is sufficiently supplied with power.
ser active	LED on: The Modbus communications are active. LED off: Modbus communications are inactive.
config err	A configuration error is imminent or no Modbus communications are taking place (when the "se active" LED is not illuminated). This means that with configuration errors, at least one projected slave is missing or the actual configuration data does not correspond with the reference configuration data for a projected and recognized slave.
U AS-i	The AS-i line is sufficiently supplied with power. (AS-i Flag "APO").
AS-i active	Standard operation is active (AS-i Flag "Normalbetrieb").
prg enable	Automatic address programming is possible (AS-i Flag "Auto_prog_available"). Precisely one slave is missing in the protected operating mode. This slave can be replaced with a slave of similar design and an address of 0. The gateway automatically programs the new slave to the faulty address and thereby resolves the configuration error.
prj mode	The gateway is in the projection mode (AS-i Flag "projecting_active").

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The two buttons have the following functions:

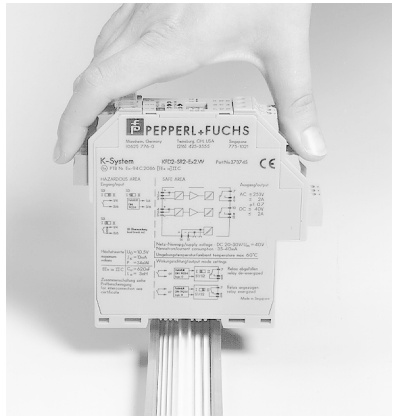
mode	Used to switch between the projection mode and the protected operating mode and to store the actual AS-i configuration as the reference configuration.
set	Selection and storage of an AS-i slave address.

6.3 Mounting and Connections

6.3.1 Mounting

The KF… design of the gateway can be mounted on a 35 mm DIN rail in accordance with EN 50022 and facilitates electrical connection through the "Power Rail". It is also possible to use the more conventional and expensive method of cable connections to terminals with this design.

The gateway is snapped directly onto the DIN rail. When using the power rail, an electrical connection is automatically made (to the AS-i Bus) by snapping the gateway onto the rail leads..



6.3.2 Connection via the Power Rail

The PR05 power rail is an insert for the DIN rail in accordance with EN 50 022. The UPR 05 is delivered with the appropriate DIN rail.

The 5 pin version of the power rail must be used during the establishment of AS-interface circuits. Two of the five power rails make up the AS-i bus.

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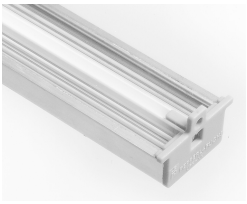
Lead breakage as well as a short circuit caused by the power rail is prevented due to the power rail's solid construction..



UPR 05

PR 05

6.3.3 Device Terminal Connections

In addition to or in combination with power rail connections, the KF… designs can be conventionally connected by means of removable device terminals. The terminal arrangement is shown below.

The device terminals consist of screw type cable piercing terminals which allow for the connection of 14 AWG cables (2.5 mm²). The connectors are 3 pin connectors; they can be keyed to prevent connection errors.

Removable terminals simplify the assembly of the switch encloser and allow for the replacement of components without taking the system off line.

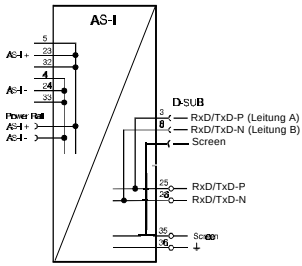
6.3.4 Gateway Power Supply

The gateway is supplied through the AS-i circuit. A connection to the AS-i cable is established by means of the power rail and/or with the device terminals. The terminal layout is displayed in the diagram above.

It is important to note when using the power unit that these AS-Interfaces are compatible and have the necessary decoupling coils.

6.4 The Modbus Interface

The serial interface is a 9 pin SUB-D connector. It is located on the right side of the device front. The other possibility is to use the device terminals. The wiring is shown in the picture below:



MODBUS interface

The AS-iModbus-Gateway with an RS485 interface transmitts and receives through pins 3 and 8 of the SUB-D connector or terminals 25 and 26 of the device terminals.

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The RxD/TxD-P signal is assigned to pin 3 and to terminal 25. The RxD/TxD-N signal is assigned to pin 8 and to terminal 26.

In order to prevent equalizing currents, the interface cable's shielding is connected with the gateways grounding clamp through a capacitor. Otherwise, it should be galvanically grounded.

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7 Operating the AS-i/Modbus Gateway

7.1 Peculiarities with Double Masters

Note

*In **protected mode** the displays of the double Masters are switched over from AS-i circuit 1 to AS-i circuit 2 in a measure of 2 seconds.*

In **configuration mode** all detected AS-i slaves are displayed at first before the display switches to the other AS-i circuit.

The operation of the push buttons is always related to the currently displayed AS-i circuit (LED AS-i 1/AS-i 2). After a push button was pressed the display stays with the respective AS-i circuit until the operation is finished or the operator has not interfered for 10 seconds.

7.2 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 LCD displays the condition of the master:

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

Attention

If the AS-i circuit is insufficiently powered ("U ASI" does not light up) or there is no communication relationship between the Modbus master and the AS-i/Modbus 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 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[1] 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.

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

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

When delivered the AS-i/Modbus Gateway is in configuration mode.

7.4 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.

7.4.1 Switching to Protected Operating Mode

You leave the configuration mode 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.

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

7.4.2 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 that address 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“.

7.5 Assigning an AS-i Address in Configuration Mode

AS-i can be put into operation in a very comfortable manner by using the Windows software AS-i Control Tools (see chapter 9.1)(addressing directly or with the AS-i address assistant).

Furthermore you can use a hand held addressing device.

If you don’t have neither a PC nor a hand held addressing device, address assigning of the AS-i slaves is also possible with the AS-i/PROFIBUS Gateway using the push buttons. How it works is described as follows.

7.5.1 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.

Chose the displayed address as your target address by pressing the 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 10. Otherwise, the detected slaves are displayed again as described in chapter 7.3.

7.5.2 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 is 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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7.6 Programming the Address in Case of Configuration Errors

7.6.1 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" 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.

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.

7.6.2 Manual Address Assignment

Note

If several slaves fail, they cannot be replaced automatically by the AS-i master. You must set their addresses manually. If this should not be done via the Modbusinterface (using the AS-i Control Tools) or with a hand held addressing device, you can set them 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 7.4). 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.

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 10). When all faulty assignment are eliminated the display is empty.

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7.7 Adjusting the Modbus-Address and Interface-Configuration

Note

The addressing of the AS-i/Modbus Gateway as a Modbus node can only be done on the gateway. It is not possible to change the address via Modbus.
Changing the Modbus node address is possible only if there is no Modbus communication.

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 Modbus node address is shown on the LCD screen. With every push of the ‘set’ button the node address is incremented.

If the button is pressed for more then 5 seconds the Modbus node address is counted up automatically until the ‘set’ button is released.

If the desired Modbus node address is displayed it can be stored non-volatile in the EEPROM by pushing the ‘mode’ button.

The configuration of baud-rate, parity and the number of stop-bits follows, which is coded in the table below. Like changing the address, the ‘set’ button changes the value and the ‘mode’ button writes it to the EEPROM.

Display	Baudrate	Parity	Stopbits	Display	Baudrate	Parity	Stopbits
10	1200	no	1	50	19200	no	1
11	1200	odd	1	51	19200	odd	1
12	1200	even	1	52	19200	even	1
13	1200	no	2	53	19200	no	2
20	2400	no	1	60	28800	no	1
21	2400	odd	1	61	28800	odd	1
22	2400	even	1	62	28800	even	1
23	2400	no	2	63	28800	no	2
30	4800	no	1	70	38400	no	1
31	4800	odd	1	71	38400	odd	1
32	4800	even	1	72	38400	even	1
33	4800	no	2	73	38400	no	2
40	9600	no	1	80	57600	no	1
41	9600	odd	1	81	57600	odd	1
42	9600	even	1	82	57600	even	1
43	9600	no	2	83	57600	no	2

As default, Modbus-address 1, baud-rate 9600 bps, no parity and one stop-bit is chosen (40). While changing these parameters no Modbus-communication is available.

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7.8 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 10.

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8 Operation via Modbus

The AS-i/Modbus Gateway consists of an AS-i Master and Modbus slave.

Seen from the AS-Interface, the AS-i/Modbus Gateway is an Master, because it initiates AS-i communication and the AS-i slaves only respond.

On the side of Modbus the AS-i/Modbus Gateway only reacts after an query from an Modbus-Master. Therefore it is an Modbus-Slave.

8.1 Configuring the Interface

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

Start bits	1	
Data bits	8	(LSB 2^0 is send first)
Stop bits	adjustable	(see chapter 2.6)
Parity	1 or 2	(see chapter 2.6)

For the transmission speed, you can select 1200, 2400, 4800, 9600, 19200, 28800, 38400 or 57600 baud, whereas 9600 baud, no parity and one stop-bit is pre-selected (see chapter 2.6).

8.2 Message Structure

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

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

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

Functioncode *F* Code of Modbus-function to be executed by the slave. Under certain circumstances the slave could answer with an error-telegram. In this case the function-code in the response-message is increased by 128.

Databytes N_1 ... N_n Field to hold user-data.
The number of bytes is variable. In the case of AS-i/Modbus Gateway this field can exceed to the maximum of 30 bytes.

Checksum C_{lo}, C_{hi} Low- and high-byte of the checksum over all preceding telegram-bytes (CRC-16).

After connecting all telegrams bytes to one large binary-number B the CRC-16 is calculated al follows:

$$CRC - 16 = (B * 100000_{hex}) \bmod 18005_{hex}$$

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

8.3 Modbus Functions

The following functions are supported:

8.3.1 Function 1: "*Read Coil Status*"

This function allows to read the discrete outputs.

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

Additionally this data could be read as „*Holding Register*“ (see chapter 8.3.3).

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

S: Lowest address within the transmit data area.

N: Number of discrete outputs, that should be transmitted.

B: Number of following data-bytes D1 to DB

D_1 ... D_B: State of the discrete outputs.
Every output is represented through one bit, with the lowest address transmitted first. This means, bit 1 (2^0) of D1 represents the state of output S and bit 8 (2^7) of D2 represents output S+15.

To achieve a short response time, S and N should be a multiple of 8. In all other cases, the master must sort in every bit to transmit, meaning high response time.

8.3.2 Function 2: "*Read Input Status*"

This function allows to read discrete inputs.

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

Additionally this data could be read as „*Input Register*“ (see chapter 8.3.4).

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

8.3.3 Function 3: "*Read Holding Registers*"

Parallel to the discrete in and outputs Modbus also supplies registers with word-wide access.

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

In the case of AS-i/Modbus Gateway it is possible to access the projected data of the

AS-i circuit (*PP*, *PCD* and *LPS*), the actual configuration, the user-memory of AS-i-Control and the registers to initiate functions of the AS-i master.

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

query message:	A	3	S_{hi}	S_{lo}	N_{hi}	N_{lo}	$C_{q,lo}$	$C_{q,hi}$

response message:	A	3	B	$D_{1,hi}$			$D_{N,hi}$	$D_{N,lo}$	$C_{r,lo}$	$C_{r,hi}$

S: Lowest address within the transmit data area.

N: Number of read/write-registers, that should be transmitted.

B: Number of following data-bytes $D_{1,hi}$ to $D_{N,lo}$

D_1 ... D_B: Values of the read/write-registers.

For every register 2 bytes are transmitted, with the low-byte first.

The AS-i/Modbus Gateway can transmit up to 15 registers in one telegram.

8.3.4 Function 4: "*Read Input Registers*"

This function allows to access the value of read-only-registers.

The read-only registers of the AS-i/Modbus Gateway s contains the configuration of the AS-i-slaves. Leaving out the function-code, the telegram-structure is equal to the one of function 3.

Additionally this data could be read as read-only-„Input“.

The AS-i/Modbus Gateway can transmit up to 15 registers in one telegram.

8.3.5 Function 5: "*Force Single Coil*“

Function for reading and writing of one single output.

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

S: Address to write.

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

8.3.6 Function 6: "*Preset Single Register*"

Function for writing one read/write-register.

query message:	A	6	S_{hi}	S_{lo}	D_{hi}	D_{lo}	$C_{q,lo}$	$C_{q,hi}$
response message:	A	6	S_{hi}	S_{lo}	D_{hi}	D_{lo}	$C_{r,lo}$	$C_{r,hi}$

S: Address of register to write.

D: New value for this register.

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8.3.7 Function 15: "*Force Multiple Coils*"

Function for setting of several discrete outputs.

query message:

A	15	S_{hi}	S_{lo}	N_{hi}	N_{lo}	B	D_1	
						D_B	$C_{q,lo}$	$C_{q,hi}$

response message:

A	15	S_{hi}	S_{lo}	N_{hi}	N_{lo}	$C_{r,lo}$	$C_{r,hi}$

S: Lowest address of coil-area to write.

N: Number of outputs to write.

B: Number of data-bytes to follow (D_1 to D_B).

D_1 ... D_B: States for the discrete outputs.

Every output is represented trough one bit, with the lowest address sent first. This means, in bit 1(2^0) of D_1 is transmitted the value of the output at address S and in bit 8 (2^7) of D_2 the one of address S+15.

To achieve a short response time, S and N should be a multiple of 8. In all other cases, the master must sort in every bit to transmit, meaning high response time.

8.3.8 Function 16: "*Preset Multiple Registers*"

Function for setting of several read/write-registers.

query message:

A	16	S_{hi}	S_{lo}	N_{hi}	N_{lo}	B	$D_{1,hi}$	$D_{1,lo}$	
						$D_{N,hi}$	$D_{N,lo}$	$C_{q,lo}$	$C_{q,hi}$

response message:

A	16	S_{hi}	S_{lo}	N_{hi}	N_{lo}	$C_{r,lo}$	$C_{r,hi}$

S: Lowest address of register-area to write.

N: Number of read/write-registers to set.

B: Number of data-bytes to follow ($D_{1,hi}$ to $D_{N,lo}$).

$D_{1,hi}$ ... $D_{N,lo}$: Values for the registers to set.
For every register 2 bytes were transmitted, with the value of the lowest register first.

The AS-i/Modbus Gateway can transmit up to 15 registers in one telegram.

8.3.9 Function 17: "*Report Slave ID*"

This function is not supported.

8.3.10 Function 7: "*Read Exception Status*"

All *execution control*-functions in the AS-i/Modbus Gateway are initiated via writing specified registers or outputs. Because Modbus is not able to give execution-reply for those functions, the reply is buffered in the *exception status.*

query message:

A	7	$C_{q,lo}$	$C_{q,hi}$

response message:

A	7	D	$C_{r,lo}$	$C_{r,hi}$

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D: Value of last function in *execution control*.

The MSB (2^7) describes, if an error occurred while execution the called function:

$2^7 = 0$: no error
$2^7 = 1$: error.

In the lower 4 bits the functions *Write_Parameters()* and *Execute_Command()* place the slave-response.

8.3.11 Function 8: "Diagnostics"

This function is a Modbus service function.

query message:	A	8	D_{hi}	D_{lo}	$I_{q,hi}$	$I_{q,lo}$	$C_{q,lo}$	$C_{q,hi}$
response message:	A	8	D_{hi}	D_{lo}	$I_{r,hi}$	$I_{r,lo}$	$C_{r,lo}$	$C_{r,hi}$

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

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

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

The AS-i/Modbus Gateway accepts the following Diagnostic Codes:

D = 0: *return query data*

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

D = 1: *restart comm option*

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

In the case of AS-i/Modbus Gateway the following actions are initiated:

The Listen Only Mode is deactivated.
The Modbus-errorcounters are reset.
The Modbus-watchdog is reset.
In going trough the Offline-Phase, the AS-i master restarts the AS-i circuit.

D = 2: *return diagnostic register*

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

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The status-bits are defined as follows:

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

D = 4: *force listen only mode*

The Modbus slave is set to *Listen Only Mode*. All following telegrams except *restart comm option* are ignored. For correct function I_q must hold the value 0000_{hex}.

After power-on-reset the *Listen Only Mode* is switched off.

D = 10: *clear counters and diagnostic registers*

The Modbus error counters will be reset.

D = 11: *return bus message count*

The response data field returns the quantity of messages that the slave has detected on the communication system since its last restart, clear counters operation or power-up.

D = 12: *return bus CRC error count*

The response data field returns the quantity of CRC errors encountered by the slave since its last restart, clear counters operation, or power-up.

D = 13: *return bus exception error count*

The response data field returns the quantity of Modbus exceptions responses returned by the slave since its last restart, clear counters operation, or power-up.

D = 14: *return slave message count*

The response data field returns the quantity of messages addressed to the slave, or broadcast, that the slave has processed since its last restart, clear counters operation, or power-up.

D = 15: *return slave no response count*

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The response data field returns the quantity of messages addressed to the slave for which it returns no response (neither a normal response nor an exception response), since its last restart, clear counters operation, or power-up.

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

8.3.12 Function 65: user defined function #1

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

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

P: Defines the part of version-information.

B: Number of data-bytes D1 to DB

D_1 ... D_B: Version-information as null-terminated string.

P = 1: Name of the Master (32 characters, B = 33).

P = 2: Version of the Master (16 characters, B = 17).

P = 3: Installed software (32 characters, B = 33).

else: Version number (8 characters, B = 9).

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

The single characters have the following significance:

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

The position of the characters within the string is defined as follows:

„CBFE....DOA...WT“

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8.3.13 Function 66: user defined function #2

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

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

S: First address of program-bytes to write.

D: 16 program-bytes.

8.3.14 Function 67: user defined function #3

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

query message:	A	67	2	S_{hi}	S_{lo}	$C_{q,lo}$	$C_{q,hi}$				
response message:	A	67	18	S_{hi}	S_{lo}	D_1			D_{16}	$C_{r,lo}$	$C_{r,hi}$

S: First address of program-bytes to read.

D: 16 program-bytes.

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9 Address-Table of the Modbus Interfaces

9.1 Discrete Outputs („*Coils*“)

The discrete outputs of a Modbus slave can be read by function 1 and manipulated by function 5 and 15.

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

Additionally all data, that is addressable as *„Coil “*, could also be accessed as *„Holding Register“* (see chapter 9.3).

To achieve a short response time, it is advisable to use the Modbus functions 1 and 15 only with both start addresses and quantity of outputs divisible by eight. In all other cases the master must costly sort in every bit to transmit.

Output Data Image ODI	
Address	**Data element**
0	slave 0, connector D0
1	slave 0, connector D1
2	slave 0, connector D2
3	slave 0, connector D3
4	slave 1, connector D0
5	slave 1, connector D1
...	...
122	slave 30, connector D2
123	slave 30, connector D3
124	slave 31, connector D0
125	slave 31, connector D1
126	slave 31, connector D2
127	slave 31, connector D3

***Host-Interface* Flags**	
Address	**Data element**
128	„*Data_Exchange_Active*“ (inverted!)
129	„Off-line“
130	„*Auto_Address_Enable*“ (inverted!)

Data_Exchange_Active: If this output is set, no data-transmission between the AS-i/Modbus Gateway and the AS-i-slaves is possible.

Off-line: This output sets the Master to off-line phase.

Auto_Address_Enable: This output blocks automatic slave-address programming.

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List of Projected Slaves (*LPS*)	
Address	**Data element**
200	AS-i slave 0
201	AS-i slave 1
202	AS-i slave 2
...	...
230	AS-i slave 30
231	AS-i slave 31

Parameter Image *(PI)*	
Address	**Data element**
300	slave 0, connector P0
301	slave 0, connector P1
302	slave 0, connector P2
303	slave 0, connector P3
304	slave 1, connector P0
305	slave 1, connector P1
...	...
422	slave 30, connector P2
423	slave 30, connector P3
424	slave 31, connector P0
425	slave 31, connector P1
426	slave 31, connector P2
427	Slave 31, connector P3

Parameters Projected *(PP)*	
Address	**Data element**
500	slave 0, connector P0
501	slave 0, connector P1
502	slave 0, connector P2
503	slave 0, connector P3
504	slave 1, connector P0
505	slave 1, connector P1
...	...
622	slave 30, connector P2
623	slave 30, connector P3
624	slave 31, connector P0
625	slave 31, connector P1
626	slave 31, connector P2
627	slave 31, connector P3

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9.2 Discrete Inputs („*Inputs*“)

The discrete inputs of a Modbus slave can be read by function 2.

In the case of AS-i/Modbus Gateway it is possible to access the input data (sensor data) of the AS-i circuit, the *LAS* (List of active slaves), the *LDS* (List of detected slaves) and the flags of *Execution-Control*.

Additionally all data, that is addressable as *“Input“* could be also accessed as *“Input Register“* (see chapter 1.0.4).

To achieve a short response time, it is advisable to use the Modbus function 2 only with start addresses divisible by eight. In all other cases the master must costly sort in every bit to transmit.

Input Data Image *(IDI)*	
Address	**Data element**
0	slave 0, connector D0
1	slave 0, connector D1
2	slave 0, connector D2
3	slave 0, connector D3
4	slave 1, connector D0
5	slave 1, connector D1
...	...
122	slave 30, connector D2
123	slave 30, connector D3
124	slave 31, connector D0
125	slave 31, connector D1
126	slave 31, connector D2
127	slave 31, connector D3

Flags of the *Execution Control*	
Address	**Data element**
128	„Config_OK“
129	„LDS.0“
130	„Auto_Address_Assign“
131	„Auto_Address_Available“
132	„Configuration_Active“
133	„Normal_Operation_Active“
134	„APF / not APO“
135	„Offline_Ready“

Config_OK: There is no configuration error.

LDS.0: An AS-i slave with address zero is existing.

Auto_Address_Assign: Automatic programming is allowed.

Auto_Address_Available: Automatic programming is possible.

Configuration_Active: The configuration mode is active.

Normal_Operation_Active: The normal operation mode is active.

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APF / not APO: An AS-i power fail occurred.

Offline_Ready: The off-line phase is active.

List of Activated Slaves *(LAS)*	
Address	**Data element**
300	AS-i Slave 0
301	AS-i Slave 1
302	AS-i Slave 2
...	...
330	AS-i Slave 30
331	AS-i Slave 31

List of Detected Slaves *(LDS)*	
Address	**Data element**
400	AS-i Slave 0
401	AS-i Slave 1
402	AS-i Slave 2
...	...
430	AS-i Slave 30
431	AS-i Slave 31

9.3 Read/Write-Registers („*Holding Registers*“)

The read/write-registers of a Modbus slave can be read by function 3 and manipulated by the function 6 and 16.

In the case of AS-i/Modbus Gateway in these registers the project data for the AS-i circuit, the user memory of AS-i Control and the registers for function execution resides.

Additionally all as *„Coil “* addressable data can be reached by this function.

The AS-i/Modbus Gateway can transmit up to 15 registers in one telegram.

Addresses with index correspond with the bits or bytes within one register: „Address-Bit“ corresponds to the value 2 bit and „AddressByte“ corresponds to the lower-/upper half of the accessed register.

Output Data Image *(ODI)*		
Address	**Bit**	**Data element**
0	0-3	data for slave 3
	4-7	data for slave 2
	8-11	data for slave 1
	12-15	reserved
1	0-3	data for slave 7
	4-7	data for slave 6
	8-11	data for slave 5
	12-15	data for slave 4

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Output Data Image *(ODI)*		
Address	**Bit**	**Data element**
2	0-3	data for slave 11
...	...	...
6	12-15	data for slave 24
7	0-3	data for slave 31
	4-7	data for slave 30
	8-11	data for slave 29
	12-15	data for slave 28

The bits 0, 4, 8 and 12 are connected with the data connection D0 of the AS-i slaves,
bits 1, 5, 9 and 13 with D1,
bits 2, 6, 10 and 14 with D2,
bits 3, 7, 11 and 15 with D3.

Flags of the *Host Interface*		
Address	**Bit**	**Data element**
8	0	„*Data_Exchange_Active*“ (inverted!)
	1	„Off-line
	2	“„*Auto_Address_Enable*“ (inverted!)

Parameter Image *(PI)*	
Address	**Data element**
100	parameter for slave 0
101	parameter for slave 1
102	parameter for slave 2
...	...
130	parameter for slave 30
131	parameter for slave 31

List of Projected Slaves *(LPS)*		
Address	**Bit**	**Data-element**
140	0	AS-i slave 0
	1	AS-i slave 1
	2	AS-i slave 2
	...	...
	14	AS-i slave 14
	15	AS-i slave 15
141	0	AS-i slave 16
	1	AS-i slave 17
	..	...
	14	AS-i slave 30
	15	AS-i slave 31

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Parameters Projected *(PP)*	
Address	**Data element**
200	projected par. of slave 0
201	projected par. of slave 1
202	projected par. of slave 2
...	...
230	projected par. of slave 30
231	projected par. of slave 31

Permanent Config. Data *(PCD)*	
Address	**Data element**
300	permanent conf. of slave 0
301	permanent conf. of slave 1
302	permanent conf. of slave 2
...	...
330	permanent conf. of slave 30
331	permanent conf. of slave 31

In the lower 4 bits (2^0 to 2^3) of the permanent configuration data the identification-code resides, in the second lower nibble (2^4 to 2^7) the I/O-configuration.

Execution Control and Host Interface Flags		
Address	**Bit**	**Data element**
399	0	*„Config_OK“*
	1	*„LDS.0“*
	2	*„Auto_Address_Assign“*
	3	*„Auto_Address_Available“*
	4	*„Configuration_Active“*
	5	*„Normal_Operation_Active“*
	6	*„APF / not APO“*
	7	*„Offline_Ready“*
399	8	*„Data_Exchange_Active“* (inverted!)
	9	*„Off-line“*
	10	*„Auto_Address_Enable“* (inverted!)

unpacked AS-i Control user memory	
Address	**Data element**
400	Byte M 0
401	Byte M 1
402	Byte M 2
...	...
525	Byte M 125
526	Byte M 126
527	Byte M 127

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Input Data Image *(IDI)*		
Address	**Bit**	**Data element**
600	0-3	data from slave 3
	4-7	data from slave 2
	8-11	data from slave 1
	12-15	reserved
601	0-3	data from slave 7
	4-7	data from slave 6
	8-11	data from slave 5
	12-15	data from slave 4
602	0-3	data from slave 11
...	...	...
606	12-15	data from slave 24
607	0-3	data from slave 32
	4-7	data from slave 30
	8-11	data from slave 29
	12-15	data from slave 28

The bits 0, 4, 8 and 12 are connected with the data connection D0 of the AS-i slaves,
bits 1, 5, 9 and 13 with D1,
bits 2, 6, 10 and 14 with D2,
bits 3, 7, 11 and 15 with D3.

Flags of the *Execution Control*		
Address	**Bit**	**Data element**
608	0	„Config_OK“
	1	„LDS.0“
	2	„Auto_Address_Assign“
	3	„Auto_Address_Available“
	4	„Configuration_Active“
	5	„Normal_Operation_Active“
	6	„APF / not APO“
	7	„Offline_Ready“

List of Activated Slaves *(LAS)*		
Address	**Bit**	**Data element**
609	0	AS-i slave 0
	1	AS-i slave 1
	2	AS-i slave 2
	...	...
	14	AS-i slave 14
	15	AS-i slave 15
610	0	AS-i-Slave 16
	1	AS-i slave 17
	...	...
	14	AS-i slave 30
	15	AS-i-Slave 31

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List of Detected Slaves *(LDS)*		
Address	**Bit**	**Data element**
611	0	AS-i slave 0
	1	AS-i slave 1
	2	AS-i slave 2
	...	...
	14	AS-i slave 14
	15	AS-i slave 15
612	0	AS-i slave 16
	1	AS-i slave 17
	...	...
	14	AS-i slave 30
	15	AS-i slave 31

Configuration Data Image CDI	
Address	**Data element**
700	configuration of slave 0
701	configuration of slave 1
702	configuration of slave 2
...	...
730	configuration of slave 30
731	configuration of slave 31

In the lower 4 bits (2^0 to 2^3) of the permanent configuration data the identification-code resides, in the second lower nibble (2^4 to 2^7) the I/O-configuration.

Flag of the *Execution Control*		
Address	**Bit**	**Data-element**
799	0	*„Config_OK“*
	1	*„LDS.0“*
	2	*„Auto_Address_Assign“*
	3	*„Auto_Address_Available“*
	4	*„Configuration_Active“*
	5	*„Normal_Operation_Active“*
	6	*„APF / not APO“*
	7	*„Offline_Ready“*
799	8	*„Data_Exchange_Active“* (inverted!)
	9	*„Off-line“*
	10	*„Auto_Address_Enable“* (inverted!)

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packed AS-i Control user memory		
Address		**Data element**
800	high	Byte M 0
800	low	Byte M 1
801	high	Byte M 2
...	...	...
862	low	Byte M 125
863	high	Byte M 126
863	low	Byte M 127

Functions of the *Execution Control*	
Address	**Function**
1000	Set_Operation_Mode
1001, 1002	Change_Slave_Address
1003	Store_Actual_Parameters
1004	Store_Actual_Configuration
1005, 1006	Execute_Command

Set_Operation_Mode:

A zero in register 1000 activates the protected mode. All other values switch on the configuration mode.

Change_Slave_Address:

This function will be executed, if a value is written to register 1002. The value written is the new address of the slave. The old slaves address must be written to register 1001 before.

Store_Actual_Parameters:

If a value different to zero is written to register 1003, the actual parameters (*PI*) will be stored as parameters projected (*PP*).

Store_Actual_Configuration:

If a value different to zero is written to register 1004, the actual AS-i configuration will be stored as projected configuration (*PCD*, *LPS*).

Execute_Command:

This function will be executed, if a value is written to register 1006.
The value written will be sent as information-part to a slave, which address has been written before to register 1005.

The return-values of the functions are accessible in the *exception status*.

Further Functions	
Address	**Function**
1007	Disable front panel buttons
1008	Modbus watchdog
1009	Start/stop of control program

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Disable front panel buttons:

If a value different from zero is written to register 1007, the buttons on the front panel of the AS-i/Modbus Gateway will be disabled. Until a zero is written to this register or the master is restarted, operation is only possible via Modbus.

Modbus-watchdog:

This register is used to hold the delay time for the Modbus watchdog in units of 10 ms.
If this time (max. 2,55 sec.) is exceeded after the last Modbus message, the master assumes the connection is disturbed and deactivates the AS-i circuit (Off-line Phase).
With a time-out of zero seconds the Modbus-watchdog is disabled.
The register 1008 corresponds to the maximum time between two Modbus telegrams, or if the value is 0 the watchdog wasn't set.

Start/Stop of ctrl. program:

Trough writing this registers the control program can be stopped or restarted.
This register consists of the following bits:

2^0: *„start_flag“*
With this bit set, the control program will be executed, if the AS-i Master gives the possibility.

2^1: *„reset_bit“*
The control program must be read from the EEPROM before start.
This is necessary after every download.
This bit is write only.

2_2: *„config_error_cont“*
With this bit cleared the Control program will be stopped, if an configuration-error occurs in the AS-i circuit.

2_3: *„auto_start“*
If AS-i Control has stopped the Control program, the execution can be resumed trough pressing the set-button or a start command via Modbus.

2^4: *„counter_map“*
If this bit is set, the counters can be reached within the user-memory in the address range of M 96.0 to M 125.7.

2^7: *„control_active“*
This bit set indicates an active Control program.
This bit is read only.

9.4 Read-Only-Registers („*Input Registers*“)

The read-only registers of a Modbus slave can be accessed by function 4. Additionally all data can be accessed by function 3 as shown in chapter 9.3.

In the case of AS-i/Modbus Gateway these registers hold the configuration data image of the AS-i slaves.

Additionally all as *„Input“* addressable data can be reached by this function.

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The AS-i/Modbus Gateway can transmit up to 15 registers in one telegram.

Addresses with index correspond with the bits or bytes within one register: „Address-Bit“ corresponds to the value 2 bit and „AddressByte“ corresponds to the lower-/upper half of the accessed register.

Data Input Image IDI		
Address	**Bit**	**Data element**
0	0-3	data from slave 3
	4-7	data from slave 2
	8-11	data from slave 1
	12-15	data from slave 0
1	0-3	data from slave 7
	4-7	data from slave 6
	8-11	data from slave 5
	12-15	data from slave 4
2	0-3	data from slave 11
...	...	...
6	12-15	data from slave 24
7	0-3	data from slave 31
	4-7	data from slave 30
	8-11	data from slave 29
	12-15	data from slave 28

The bits 0, 4, 8 and 12 are connected with the data connection D0 of the AS-i slaves,
bits 1, 5, 9 and 13 with D1,
bits 2, 6, 10 and 14 with D2,
bits 3, 7, 11 and 15 with D3.

Flag of the *Execution Control*		
Address	**Bit**	**Data element**
8	0	„Config_OK“
	1	„LDS.0“
	2	„Auto_Address_Assign“
	3	„Auto_Address_Available“
	4	„Configuration_Active“
	5	„Normal_Operation_Active“
	6	„APF / not APO“
	7	„Offline_Ready“

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List of Activated Slaves *(LAS)*		
Address	**Bit**	**Data element**
9	0	AS-i slave 0
	1	AS-i slave 1
	2	AS-i slave 2
	...	...
	14	AS-i slave 14
	15	AS-i slave 15
10	0	AS-i slave 16
	1	AS-i slave 17
	...	...
	14	AS-i slave 30
	15	AS-i slave 31

List of Detected Slaves *(LDS)*		
Address	**Bit**	**Data element**
11	0	AS-i slave 0
	1	AS-i slave 1
	2	AS-i slave 2
	...	...
	14	AS-i slave 14
	15	AS-i slave 15
12	0	AS-i slave 16
	1	AS-i slave 17
	...	...
	14	AS-i slave 30
	15	AS-i slave 31

Configuration Data Image *(CDI)*	
Address	**Data element**
100	configuration of slave 0
101	configuration of slave 1
102	configuration of slave 2
...	...
130	configuration of slave 30
131	configuration of slave 31

Note

In the lower 4 bits (2^0 to 2^3) of the configuration data resides the identification-code and in the second lower nibble (2^4 to 2^7) the I/O-configuration.

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10 Appendix: Displays of 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 7.4.2).

During manual address programming, the slave address display has a different meaning (see chapter 7.5 and 7.6).

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:

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 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 from the host via the interface.
83	Program reset of the AS-i Control programm: The AS-i Control programm is just readed 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.
95	Error while changing slave address in protected operating mode: The configuration error caused by one slave too many (instad by missing slave).

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11 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 LCD 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 "mode"-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 LCD 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. 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.
The configuration of the master is now finished.	

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