



FACTORY AUTOMATION

# Manual

## VAG-MOD+-K5-R4

AS-Interface/Modbus Plus

Gateway Ip20



With regard to the supply of products, the current issue of the following document is applicable:  
The General Terms of Delivery for Products and Services of the Electrical Industry, as published by  
the Central Association of the 'Elektrotechnik und Elektroindustrie (ZVEI) e.V.',  
including the supplementary clause "Extended reservation of title"

We at Pepperl+Fuchs recognise a duty to make a contribution to the future.  
For this reason, this printed matter is produced on paper bleached without the use of chlorine.

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## 1 Declaration of Conformity

The AS-i Gateway VAG-MOD+-K5-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.



## AS-Interface Declaration of Conformity

issue date 16.12.1999

## **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.*





### **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.*



### 4 General Information

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

- VAG-MOD+-K5-R4



## 5 Connections, Displays and Operating Keys

On the front panel of the AS-i/Modbus Plus Gateways are:

- terminals to connect the power supply and the AS-i circuit
- a 9-pin SUB-D connector as Modbus Plus interface
- 7 LEDs
- a two-digit seven-segment display
- 2 push-buttons to configure the gateway

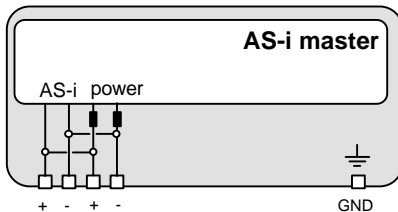
### 5.1 Power Supply Concepts and AS-i Connection Techniques

#### 5.1.1 AS-i Masters with power supply A



#### 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.*



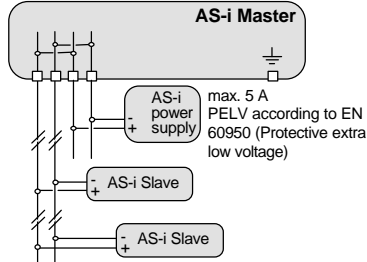
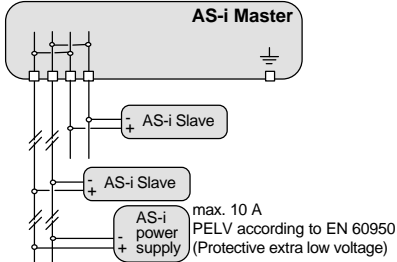
The terminals have the following functions:

- "+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.



Connection samples for the AS-i power supply:

**Warning**

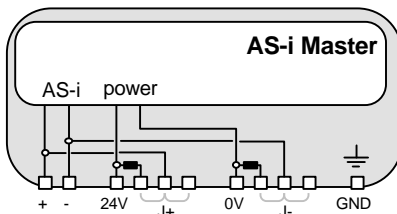


**Attention**

**In the wiring schemes above the current through the AS-i master must not exceed 5 A.**

## 5.1.2 AS-i Masters with power supply N

At the bottom of the unit there are 10 terminals for the power supply and the AS-i network. The jumper settings (J+, J-) decide whether AS-i is powered by a separate AS-i power supply or by the power supply that also provides the AS-i Master.



The terminals have the following functions:

- + "AS-i +", Actuator Sensor Interface, positive terminal  
This terminal is connected internally with the center contact of jumper "J+".
- "AS-i -", Actuator Sensor Interface, negative terminal  
This terminal is connected internally with the center contact of jumper "J-".
- 24V Master power supply, positive terminal (18 - 31.6 V DC)
- 0V Master power supply, negative terminal
- GND Ground terminal, used for better EMC.  
Should be connected with a short wire to machine GND.
- J+, J- Jumpers for selecting the power supply of AS-i  
"int pwr" position (closed):

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AS-i is powered by the master power supply.

Master power supply and AS-i network are then decoupled with coils.

"ext pwr" position (open):

With the jumper open (or missing), the AS-i network must be powered by a separate AS-i power supply.

The AS-i power supply can be connected to the jumper or to the AS-i cable in the field.

### Operation without AS-i power supply

When the jumpers are in position "int pwr", the AS-i network is powered by the master's power supply. For test purposes, it is possible to use a conventional 24 V DC power supply to supply the AS-i network. You get optimum results with a 30 V DC voltage source.

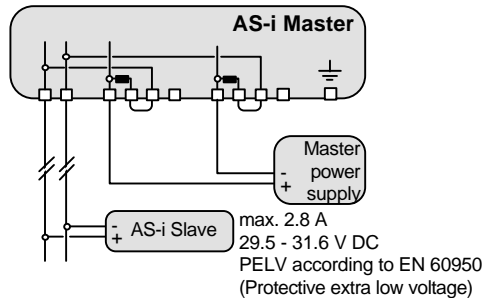


Attention

**For the following wiring scheme the current through the AS-i master must not exceed 2.8 A.**



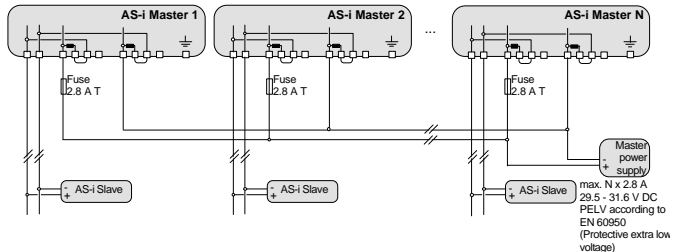
Warning



This connection technique serves also for providing more than one AS-i Master out of one master power supply because each AS-i circuit is decoupled with its own in the AS-i Master integrated coils.

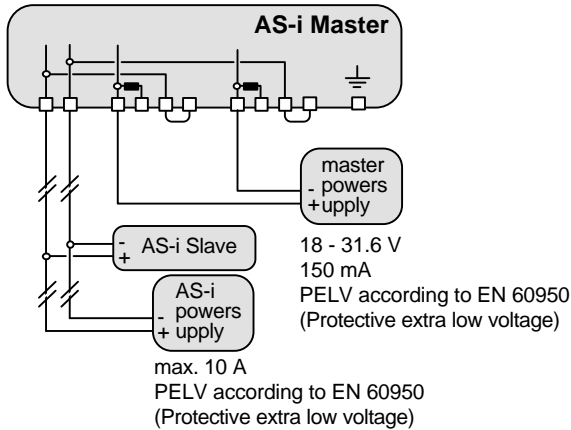


Warning

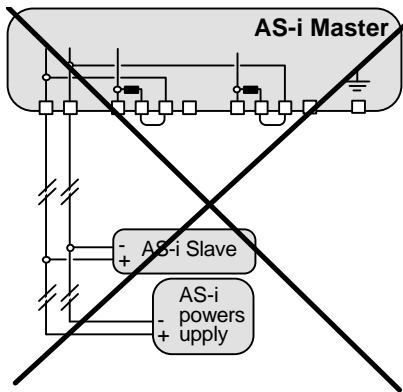


## Operation with AS-i power supply

In the jumper position "ext pwr" the AS-i network needs an additional AS-i power supply.



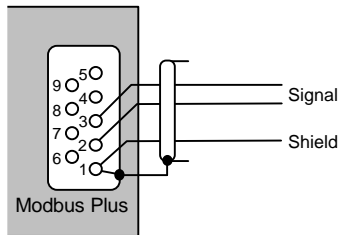
Do not try to provide the AS-i Master with power supply N out of the AS-i power supply of the AS-i circuit („backwards“), because the additional decoupling coils would burden the AS-i line and cause erroneous AS-i telegrams.





5.2 Modbus Plus Interface

According to the Modbus Plus specification the Modbus Plus interface connector is designed as a female 9 pin Sub-D connector. It is located on the right hand side of the front panel



The two wires for "Signal" are exchangeable

5.3 Display and Operating Elements

On the front panel of the AS-iModbus Plus Gateway are seven light-emitting diodes, a two-digit display and two push buttons.

- power The master's power supply is sufficient.
- Modbus Plus Network indicator LED  
The network indicator LED is not accessible to the user in normal operation but can be used for test purposes. It displays node status by flashing repetitive patterns. The patterns are:

LED Pattern	Operating state
Six flashes per second	The node is working normally. It is successfully receiving and passing the token. All nodes on a healthy network flash this pattern.
One flash per second	The node is off-line just after power-up or after exiting the four flashes per second mode. In this state, the node monitors the network and builds a table of active nodes and token-holding nodes. After being in this state for 5 seconds, the node attempts to go to its normal operating state (indicated by 6 flashes/second).
2 flashes, then off for 2 seconds	The node is permanently in the "never-getting-token state". It hears the token being passed among the other nodes, but it never receives the token itself. Check the network for an open circuit or defective termination.

LED Pattern	Operating state
3 flashes, then off for 1.7 seconds	The node is not hearing the token passing among the other nodes. It periodically claims the token but cannot find another node to which to pass it. Check the network for an open circuit or defective termination.
4 flashes, then off for 1.4 Secs	This node has heard a valid message from a node using a network address identical to its own address. The node remains in this state for as long as it continues to hear the duplicate address. If the duplicate address is not heard for 5 seconds, the node changes to one flash/second 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.

## 6 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.

### 6.1 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.



*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.*

**Note**

### 6.2 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.



*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.*

**Note**

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

### 6.3 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

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.

## 7 Operating the AS-i/Modbus Plus Gateway

### 7.1 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 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.In



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

configuration mode or when an AS-i Control program is started automatically the device can leave the Off-line phase.

In protected mode, if the Modbus Plus communication is interrupted, the AS-i Master switches to the off-line phase after the watchdog time of the Modbus Plus has expired unless an AS-i Control program is running and was started automatically.

#### 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<sup>1</sup> 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.

### 7.2 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.*

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

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 detected 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 Plus Gateway is in configuration mode.

## 7.3 Protected Operating Mode



**Note**

*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.*

### 7.3.1 Switching to Protected Operating Mode



**Note**

*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.



**Note**

*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.

### 7.3.2 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 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".

### 7.4 Assigning an AS-i Address in Configuration Mode

#### 7.4.1 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.

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 11. Otherwise, the detected slaves are displayed again as described in chapter 7.2.

#### 7.4.2 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 is will get the address zero and the display shows "00".

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

### 7.5 Programming the Address in Case of Configuration Errors

#### 7.5.1 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" 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.



*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.*

### 7.5.2 Manual Address Assignment



*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 Modbus Plus interface (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 7.3). 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.

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

### 7.6 Adjusting the Modbus Plus Node Address



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

*Changing the Modbus Plus node address is possible only if there is no Modbus Plus 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 Plus 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 than 5 seconds the Modbus Plus node address is counted up automatically until the "set" button is released.

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

The AS-i/Modbus Plus Gateway's node address can range from 1 to 64. Node address 1 is set on delivery.



The access of the AS-i data via the Modbus Plus can be via 8 routing paths. Therefore it is necessary to quote the address of the AS-i/Modbus Plus Gateway and the routing path (1-8). (e.g. 2,1: address 2, routing path 1).

#### 7.7 Error Messages



**Attention**

*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 11.*



## 8 Operation As Modbus Plus Node

In this chapter you will learn all about operating the AS-i/Modbus Plus Gateway in a Modbus Plus network.

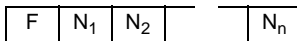
The AS-i/Modbus Plus Gateway consists of an AS-i master and Modbus Plus slave.

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

On the side of Modbus Plus the AS-i/Modbus Plus Gateway only reacts after an query from another Modbus Plus peer. Therefore it acts like an Modbus Plus slave.

### 8.1 Message Structure

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



Functioncode F

Code of Modbus Plus 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<sub>1</sub> ... N<sub>n</sub> Field to hold user data.

The number of bytes is variable. In the case of AS-i/Modbus Plus Gateway this field can exceed to the maximum of 30 bytes.

This Modbus message is embedded in a Modbus Plus frame.

### 8.2 Modbus Functions

The following Modbus functions are supported:

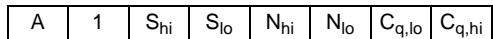
#### 8.2.1 Function 1: "Read Coil Status"

This function allows to read the discrete outputs.

In the case of AS-i/Modbus Gateway it is possible to access the output-data (actual-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 8.2.3).

query message:



response message:



S: Lowest address within the transmit data area.

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

B: Number of following data-bytes D<sub>1</sub> to D<sub>B</sub>

D<sub>1</sub> ... D<sub>B</sub>: State of the discrete outputs.

Every output is represented through one bit, with the lowest address transmitted first. This means, bit 1 (2<sup>0</sup>) of D<sub>1</sub> represents the state of output S and bit 8 (2<sup>7</sup>) of D<sub>2</sub> 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.

## 8.2.2 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 8.2.4).

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

## 8.2.3 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.

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

query message:	A	3	S <sub>hi</sub>	S <sub>lo</sub>	N <sub>hi</sub>	N <sub>lo</sub>	C <sub>q,lo</sub>	C <sub>q,hi</sub>	
response message:	A	3	B	D <sub>1,hi</sub>		D <sub>N,hi</sub>	D <sub>N,lo</sub>	C <sub>r,lo</sub>	C <sub>r,hi</sub>

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<sub>1,hi</sub> to D<sub>N,lo</sub>

D<sub>1</sub> ... D<sub>B</sub>: 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.

## 8.2.4 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.

## 8.2.5 Function 5: "Force Single Coil"

Function for reading and writing of one single output.

query message:	A	5	S <sub>hi</sub>	S <sub>lo</sub>	D	0	C <sub>q,lo</sub>	C <sub>q,hi</sub>
response message:	A	5	S <sub>hi</sub>	S <sub>lo</sub>	D	0	C <sub>r,lo</sub>	C <sub>r,hi</sub>

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- S: Address to write.
- D: State of the output:  
Only two values are valid:  
00<sub>hex</sub>: The output will be set to 0.  
FF<sub>hex</sub>: The output will be set to 1.

### 8.2.6 Function 6: "Preset Single Register"

Function for writing one read/write-register.

query message:	A	6	S <sub>hi</sub>	S <sub>lo</sub>	D <sub>hi</sub>	D <sub>lo</sub>	C <sub>q,lo</sub>	C <sub>q,hi</sub>
----------------	---	---	-----------------	-----------------	-----------------	-----------------	-------------------	-------------------

response message:	A	6	S <sub>hi</sub>	S <sub>lo</sub>	D <sub>hi</sub>	D <sub>lo</sub>	C <sub>r,lo</sub>	C <sub>r,hi</sub>
-------------------	---	---	-----------------	-----------------	-----------------	-----------------	-------------------	-------------------

- S: Address of register to write.
- D: New value for this register.

### 8.2.7 Function 15: "Force Multiple Coils"

Function for setting of several discrete outputs.

query message:	A	15	S <sub>hi</sub>	S <sub>lo</sub>	N <sub>hi</sub>	N <sub>lo</sub>	B	D <sub>1</sub>	
								D <sub>B</sub>	C <sub>q,lo</sub> C <sub>q,hi</sub>

response message:	A	15	S <sub>hi</sub>	S <sub>lo</sub>	N <sub>hi</sub>	N <sub>lo</sub>	C <sub>r,lo</sub>	C <sub>r,hi</sub>
-------------------	---	----	-----------------	-----------------	-----------------	-----------------	-------------------	-------------------

- S: Lowest address of coil-area to write.
- N: Number of outputs to write.
- B: Number of data-bytes to follow (D<sub>1</sub> to D<sub>B</sub> ).
- D<sub>1</sub> ... D<sub>B</sub>: States for the discrete outputs.

Every output is represented trough one bit, with the lowest address sent first. This means, in bit 1(2<sup>0</sup>) of D<sub>1</sub> is transmitted the value of the output at address S and in bit 8 (2<sup>7</sup>) of D<sub>2</sub> 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.

### 8.2.8 Function 16: "Preset Multiple Registers"

Function for setting of several read/write-registers.

query message:	A	16	S <sub>hi</sub>	S <sub>lo</sub>	N <sub>hi</sub>	N <sub>lo</sub>	B	D <sub>1,hi</sub>	D <sub>1,lo</sub>	
								D <sub>N,hi</sub>	D <sub>N,lo</sub>	C <sub>q,lo</sub> C <sub>q,hi</sub>

response message:	A	16	S <sub>hi</sub>	S <sub>lo</sub>	N <sub>hi</sub>	N <sub>lo</sub>	C <sub>r,lo</sub>	C <sub>r,hi</sub>
-------------------	---	----	-----------------	-----------------	-----------------	-----------------	-------------------	-------------------

- S: Lowest address of register-area to write.
- N: Number of read/write-registers to set.
- B: Number of data-bytes to follow (D<sub>1,hi</sub> to D<sub>N,lo</sub> ).

$D_{1,hi} \dots D_{N,lo}$ : 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.

## 8.2.9 Function 17: "Report Slave ID"

This function is not supported.

## 8.2.10 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	$C_{r,lo}$	$C_{r,hi}$
---	---	---	------------	------------

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.

## 8.2.11 Function 8: "Diagnostics"

This function is a Modbus Plus service function.

query message: 

8	$D_{hi}$	$D_{lo}$	$I_{q,hi}$	$I_{q,lo}$
---	----------	----------	------------	------------

response message: 

8	$D_{hi}$	$D_{lo}$	$I_{r,hi}$	$I_{r,lo}$
---	----------	----------	------------	------------

D: "Diagnostic Code", defines the type of service function.

$I_q$ : "Information Field", in the query message gives extra parameters to the service function.

$I_r$ : "Information Field", in the respond message holds reaction values of the Modbus Plus slave.

The AS i/Modbus Plus Gateway accepts the following *Diagnostic Code*:

D = 21: See Modbus Plus documentation.

## 8.3 Global Data

When the AS-i/Modbus Plus Gateway passes the token on the Modbus Plus network, it broadcasts five words of global information to all other nodes. The information is contained in the token frame.

It consists of the following data:

1. word: execution control flags
- 2.+3. word: List of detected slaves (LDS)
- 4.+5. word: List of activated slaves (LAS)

Flags of the Execution Control		
Word	Bit	Data element
1	15-8	not used
	7	"Offline_Ready" (The off-line phase is active)
	6	"APF / not APO" (An AS i power fail occurred)
	5	"Normal_Operation_Active" (The normal operation mode is active)
	4	"Configuration_Active" (The configuration mode is active)
	3	"Auto_Address_Available" (Automatic programming is possible)
	2	"Auto_Address_Assign" (Automatic programming is allowed)
	1	"LDS.0" (An AS i slave with address zero is existing)
	0	"Config_OK" (There is no configuration error)

List of detected slaves LDS			List of activated slaves LAS		
Word	Bit	Data element	Word	Bit	Data element
2	15	AS i slave 0	4	15	AS i slave 0
	14	AS i slave 1		14	AS i slave 1
	...	...		...	...
	1	AS i slave 14		1	AS i slave 14
	0	AS i slave 15		0	AS i slave 15
3	15	AS i slave 16	5	15	AS i slave 16
	14	AS i slave 17		14	AS i slave 17
	...	...		...	...
	1	AS i slave 30		1#	AS i slave 30
	0	AS i slave 31		0	AS i slave 31





## 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.

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

## 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.

*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
141	15	AS-i slave 15
	0	AS-i slave 16
	1	AS-i slave 17
	..	...
	14	AS-i slave 30
	15	AS-i slave 31

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

## AS-i/ModbusPlus Gateway Address-Table of the Modbus Interfaces

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 <i>Execution Control</i>		
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 <i>Execution Control</i>		
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!)



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 <i>Execution Control</i>	
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

### *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<sup>0</sup>: „start\_flag“  
With this bit set, the control program will be executed, if the AS-i Master gives the possibility.
- 2<sup>1</sup>: „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<sup>2</sup>: „config\_error\_cont“  
With this bit cleared the Control program will be stopped, if an configuration-error occurs in the AS-i circuit.
- 2<sup>3</sup>: „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<sup>4</sup>: „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<sup>7</sup>: „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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## AS-i/ModbusPlus Gateway Address-Table of the Modbus Interfaces

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 <i>Execution Control</i>		
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“

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
10	15	AS-i slave 15
	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
12	15	AS-i slave 15
	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.*

## 10 Peer Cop<sup>1</sup>

- AS-i output data (actuator data) will send as "Specific Input Data" to the AS-i/Modbus Plus Gateway.
- AS-i input data (sensor data) (together with the Execution Control Flags and the slave lists LDS and LAS) will send as "Global Data" from the gateway.

Because of the limited buffer length the AS-i/Modbus Plus Gateway can not receive 'specific input data' from all Modbus Plus addresses.



### Note

*The AS-i/Modbus Plus Gateway can receive 'specific input data' only from the Modbus Plus nodes 1 - 62. Therefore it can not received data over the Peer Cop from the Modbus Plus nodes 63 and 64.*

As soon as the gateway receives AS-i output data over the Peer Cop from a specific Modbus Plus node, the writing of AS-i output data out of other Peer Cop nodes or through Modbus commands will be blocked. Because of that it is prevented, that two Modbus Plus nodes write different AS-i output data at the same time, what leads to indifferent states at the AS-i slaves. Each attempt of other Peer Cop nodes to write AS-i output data, will be ignored.

If the Peer Cop node, sending the output data, shows no more Modbus Plus networking, so all AS-i output datas will be resetted. Stays this Peer Cop node in this state for more than 60s, it is proceeding on the assumption, that this node is no more active and the writing of AS-i output data will be allowed again from other Peer Cop nodes or through Modbus Plus commands.



### Attention

*If the Modbus Plus Master have no normal Modbus Plus networking for more then 60s, then it is possible, that an other Modbus Plus participant, sending also 8 words output data, sends these output data to the AS-i/Modbus Plus Gateway instead of to the master.*

### Arrangement of data in "Global Data"

By Peer Cop-able gateways in the data field "Global Data" () will be added to the existing 5 words further 8 words input data.

1. word: Execution Control Flags
- 2.+3. word: LDS
- 4.+5. word: LAS
6. word: IDI of AS-i slave 28 to 31
  - bits 12...15: slave 31 (bit 12 for D0)
  - bits 8...11: slave 30 (bit 8 for D0)
  - bits 4...7: slave 29 (bit 4 for D0)
  - bits 0...3: slave 28 (bit 0 for D0)

1. The Peer Cop function is implemented by the Bihi+Wiedemann AS-i Modbus Plus Gateways since August 1999.

7. word: IDI of AS-i slave 24 to 27

...

12. word. IDI of AS-i slave 0 to 3

**Arrangement of data in "Specific Input Data"**

1. word: ODI of AS-i slave 28 to 31  
bits 12...15: slave 31 (bit 12 for D0)  
bits 8...11: slave 30 (bit 8 for D0)  
bits 4...7: slave 29 (bit 4 for D0)  
bits 0...3: slave 28 (bit 0 for D0)

2. word: ODI of AS-i slave 24 to 27

...

8. word. ODI of AS-i slave 0 to 3

## 11 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 7.3.2).

During manual address programming, the slave address display has a different meaning (see chapter 7.4 and 7.5).

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:

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.
50	Peer Prozessor Interface is defect.
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).





## 12 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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