FACTORY AUTOMATION

Manual

VAG-DN-K5

AS-Interface/DeviceNet Gateway

PEPPERL+FUCHS

Table of Contents

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1 Declaration of Conformity

The AS-i/DeviceNet Gateway has been developed and produced in accordance with the applicable European standards and directives.

Note

Notice

The declaration of conformity can be ordered 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 Introduction

4.1 Overview

The AS-i/DeviceNet-Gateway is a master/slave gateway designed to allow communication between an AS-i network and a DeviceNet network. The gateway acts as a simple DeviceNet device and can be classified as a Group 2 slave only. Baud rates from 125k to 500k baud can be implemented. The MAC ID and baud rate are configured using the selector buttons located on the front panel.

The gateway is a master for the AS-i network. All the features of the AS-i network are available when using the gateway, including 31 node capability, 5 ms scan time, noise immunity, two wire unshielded power/communication cable, and immediate fault identification. By using the selector buttons, the user can configure node addresses on the AS-i network and change the modes of operation from protected operating mode (run mode) to configuration mode (projecting mode).

The gateway is a slave for the DeviceNet network, consuming one node on DeviceNet. Quick connection to DeviceNet is obtained through the 5 position, open style connector located on the front panel of the gateway. Communication supported by the gateway is polled I/O and explicit messaging. Strobed I/O is not supported.

4.2 Features

The AS-i/DeviceNet Gateway...

- allows simple connection between AS-i and DeviceNet networks.
- enhances features of both networks.
- is classified as a Group 2 slave only.
- has dual function LCD display.
- has immediate error diagnostics.

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5 Description

5.1 LED Indicators

Indicator	Color	Description
power	Green	Gateway power
MNS	Green/Red	Module/Network status
config err	Red	Configuration error
U ASI	Green	AS-i Cable sufficiently powered
ASI aktiv	Green	Normal operation active
prg enable	Green	Automatic addressing enable
prj mode	Yellow	Configuration mode

5.2 Power supply concepts

Note

The AS-i/DeviceNet gateway can be offered with three different power supply concepts, "master power supply N", "master power supply A" and "master power supply DeviceNet". These concepts are described below.

5.2.1 Terminals of a device with power supply 'N'

At the bottom of the unit there are 10 terminals for power supply and for the AS-i network. The jumper setting ("J+", "J-") decides wether AS-i is powered by a separate AS-i power supply or by the power supply of the master.

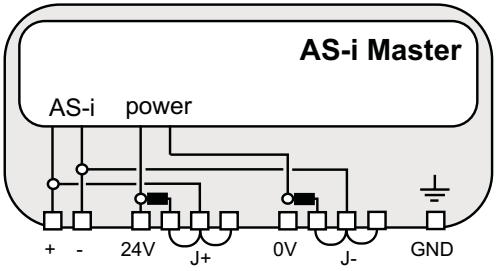

Figure 5.1: Terminals of a device with power supply 'N'

The individual 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 (18-30V)

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0V Master power supply, negative terminal

GND Ground terminal

J+, J- Jumpers for selecting the AS-i's power supply

"int pwr" position (closed):
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 plug connector is in position "int pwr", the AS-i network is powered by the masters 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.

Warning

For the following wiring scheme the maximum current through the AS-i master is 2A.

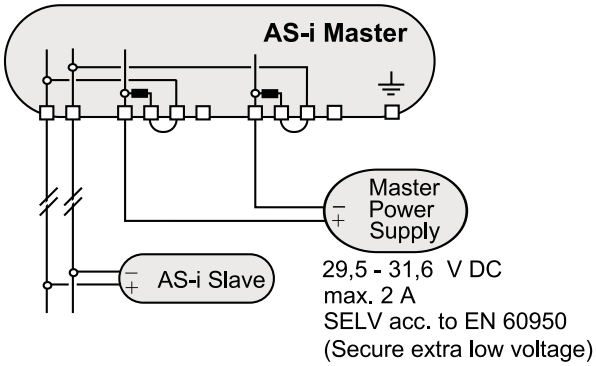

Figure 5.2: Operation without AS-i power supply

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Operation with AS-i power supply

Warning

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

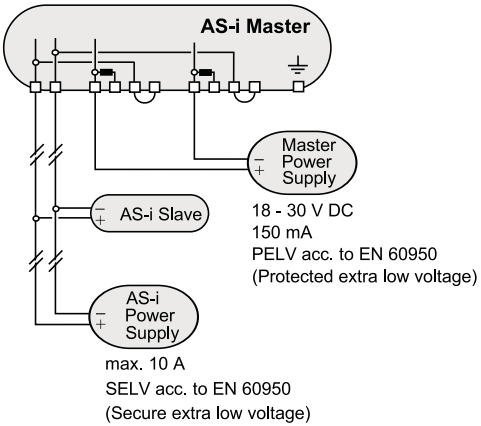

Figure 5.3: Operation with AS-i power supply

5.2.2 Terminals of a device 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 by the AS-i line (the power consumption is about 180 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 gets switched on, the master starts to operate.

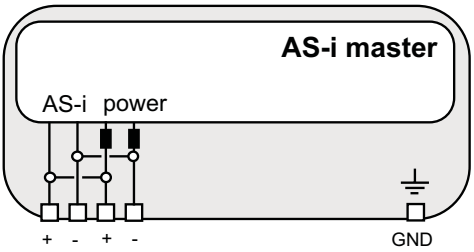

Figure 5.4: Terminals of a device with power supply 'A'

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The individual terminals have the following functions:

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

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

GND Ground terminal

Connection samples for the AS-i power supply facilities:

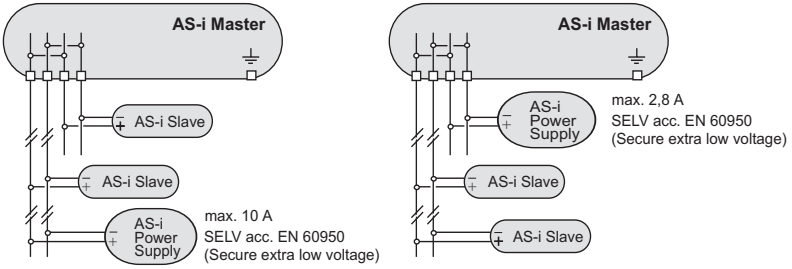

Figure 5.5: Connection samples for the AS-i power supply facilities

Attention

In the wiring schemes above the maximum current through the AS-i master is 2,8 A.

5.2.3 Terminals of a Device With Power Supply DeviceNet

The AS-i circuit must be powered by an AS-i power supply as follows:

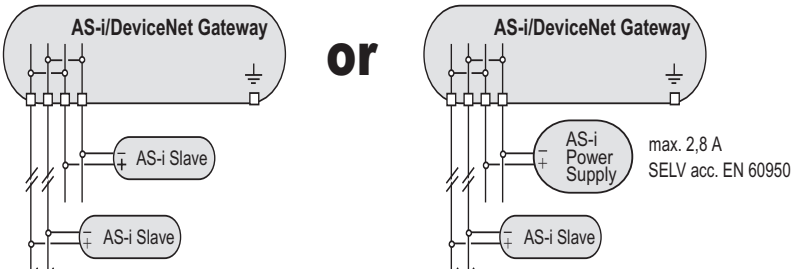

Figure 5.6: Terminals of a Device With Power Supply DeviceNet

The AS-i/DeviceNet Gateway itself is powered by DeviceNet.

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5.3 AS-i Network Connection

At the base of the gateway are 3 terminals for the connection of the AS-i network. The individual terminals are as follows:

Terminal	Description
+ (double)	The positive terminal for the AS-i Network
- (double)	The negative terminal for the AS-i Network
GND	Ground terminal

5.4 DeviceNet Connection

Terminal	Signal	Function	Color
1	V+	DeviceNet Power	Red
2	CAN_H	Signal High	White
3	SHIELD	Shield	n/a
4	CAN_L	Signal Low	Blue
5	V-	DeviceNet Power	Black

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6 Configuration

6.1 Setting MAC ID and Baud Rate

To set the MAC ID and baud rate, refer to the front panel of the gateway. Locate the two buttons on the front panel marked "*mode*" and "*set*". By pressing both buttons simultaneously for approximately 5 seconds, the actual MAC ID will appear on the LCD display. MAC ID can be changed by pressing the "*set*" button until the desired MAC ID has been reached. To store the MAC ID, press the "*mode*" button. Now the LCD screen displays a 0, 1, or 2. See the chart below for the meaning of the code.

CODE	BAUD RATE
0	125k Baud
1	250k Baud
2	500k Baud

Press the "*set*" button until the desired code is reached. Again press the "*mode*" button to store the baud rate. The setting of the MAC ID and baud rate is complete.

Note

The MAC ID and baud rate cannot be changed via software.

6.2 I/O Data Interpretation

6.2.1 Input Data

Data sent from the AS-i slaves to the gateway consumes 17 bytes of data. All data sent will use fragmented I/O.

These 17 bytes of data are as follows:

Byte 0	AS-i status:
bit 7	*Offline Ready*
bit 6	*AS-i Power Fail*
bit 5	*Normal Operation Active*
bit 4	*Configuration Active*
bit 3	*Auto Address Available*
bit 2	*Auto Address Assign*
bit 1	*LDS 0*
bit 0	*Configuration OK*

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Byte 1

0	0	0	0	D3.1	D2.1	D1.1	D0.1	(Slave 1)

(D3.1 = Data bit 3 of Slave 1)

Byte 2

D3.2	D2.2	D1.2	D0.2	D3.3	D2.3	D1.3	D0.3	(Slave 2, Slave 3)

•••

Byte 16

D3.30	D2.30	D1.30	D0.30	D3.31	D2.31	D1.31	D0.31	(Slave 30, Slave 31)

6.2.2 Output Data

Data sent to the AS-i slaves from the gateway consumes 17 bytes of data. All data sent will use fragmented I/O.

These 17 bytes of data are as follows:

Byte 0	Host Flags:
bit 1	Set Offline Mode
bit 0	Set Data Exchange Inactive

Byte 1

0	0	0	0	D3.1	D2.1	D1.1	D0.1	(Slave 1)

(D3.1 = Data bit 3 of Slave 1)

Byte 2

D3.2	D2.2	D1.2	D0.2	D3.3	D2.3	D1.3	D0.3	(Slave 2, Slave 3)

•••

Byte 16

D3.30	D2.30	D1.30	D0.30	D3.31	D2.31	D1.31	D0.31	(Slave 30, Slave31)

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7 Operations

7.1 Operating the AS-i/DeviceNet Gateway

After gateway power up, all LCD segments and LEDs illuminate for approximately one second (self test). Afterward, the LEDs display the condition of their respective flags and the LCD displays the condition of the gateway according to the AS-i Master specifications:

40 **Offline Phase**

The gateway has not connected to the DeviceNet network and there is no data communication between the gateway and the DeviceNet master. The gateway will stay in the Offline Phase until the Master/ Slave connection has been established. If the AS-i network does not have sufficient power (the U ASI LED does not illuminate), the gateway will again stay in the Offline Phase.

41 **Detection Phase**

The system searches for slaves along the AS-i network. The gateway will remain in the Detection Phase until it finds at least one slave.

42 **Activation Phase**

The parameters are transmitted to all connected and recognized slaves. This enables access to the AS-i slaves' data connections.

43 **Start of Normal Operation**

In normal operation, the gateway can exchange data with all activated slaves. It transmits management messages, locates newly connected slaves and activates them. During normal operation, the AS-i network maintains the maximum cycle time of 5 ms.

7.2 Modes of Operation

7.2.1 Configuration Mode (Projecting mode)

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

You switch the master to configuration mode by pressing the "mode" button for at least five seconds. While in configuration mode, the yellow "prj mode" LED lights up.

The system then displays all slaves entered in the list of detected slaves (LDS) sequentially on the LCD screen at a rate of two addresses per second. If the display is empty, the list is empty, i.e. no slaves were recognized.

In the configuration mode, all recognized slaves are activated with the exception of slave zero.

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7.2.2 Protected Operating Mode (Run mode)

You leave the configuration mode by again pressing the "*mode*" button. If you press the button for more than five seconds, the master exits the configuration mode and simultaneously copies the actual to the setpoint configuration. When you press the button for less than five seconds, the system exits the configuration mode without copying the configuration.

In the protected operating mode, only slaves that are entered on the list of projected slaves (LPS) and whose actual configurations match the setpoint configurations will be activated.

While in the protected operating mode the gateway will not display any addresses on the LCD screen.

Note

If the system recognizes a slave with address zero on the AS-i, it cannot leave the configuration mode.

7.2.3 Configuration Errors in the Protected Operating Mode

As long as there is no configuration error, the numeric display is turned off during the protected operating mode. Otherwise, the lowest address with a faulty assignment is displayed. A faulty assignment occurs when a slave has been recognized or configured (it has been entered on the LDS or on the LPS) but cannot be activated.

Pressing the "*set*" button displays the next higher faulty address.

7.3 Manual Programming of the Slave Address in Configuration Mode

7.3.1 Programming a Slave Address

Assigning an available address to a slave with address zero.

In the configuration mode, the addresses of all recognized slaves are displayed sequentially. To display the next available address, press the "*set*" button. Each time the "*set*" button is pressed, the next available address is displayed.

After determining the target address by pressing the "*set*" button, press and hold the "*set*" button for about five seconds. The address in the LCD display will flash. Release the "set" button and press it once again to reprogram the connected slave with the new address.

Any error will be displayed by its respective error code. Otherwise, the display shows the list of detected slaves (LDS) as described above.

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7.3.2 Erasing/Changing the Slave Address

Assigning address zero to a recognized slave

In the configuration mode, the addresses of all recognized slaves are displayed one after the other. After 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 recognized slave is displayed, this slave is reprogrammed for address zero and the display shows "00".

When you release the button, the display continues to display the list of detected slaves (LDS).

7.3.3 Replacing defective Slaves

A defective slave, whose address is currently flashing on the display, can be replaced by a slave with address zero. The new slave can be programmed to the original address by pressing the "*set*" button. However, this will only work if the configuration data of the twp slaves match (see Automatic Address Assignment below).

7.4 Automatic Address Programming

One of AS-i's most outstanding features is automatic address programming. If an AS-i slave fails, it is instantly recognized by the gateway. When the slave is replaced by a new one of address "0", it is automatically allocated the address of the failed slave, thereby eliminating any manual programming.

For successful automatic addressing, some requirements must be fulfilled:

1. The AS-i/DeviceNet-Gateway must be in protected operating mode.

2. The "Auto_Address_Assign" release flag must be set.

3. Only one of the configured slaves may not be recognized.

If these requirements are met the green (*prg enable*) LED illuminates.

If two slaves have different configuration data, i.e. replacing a 4 input smart node with a smart sensor, the automatic addressing will not be enabled.

Note

If the automatic addressing feature is enabled, one way to detect multiple slave failures is to check the green (prg enable) LED. If it is illuminated, only one slave has failed. However, if the LED is off, multiple slaves have failed.

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8 Appendix A

8.1 Specifications

ELECTRICAL

Supply Voltage	
DeviceNet	24 VDC (10-25 VDC)
AS-i	30 VDC

Current Consumption	
DeviceNet	< 150mA
AS-i	< 70mA

MECHANICAL

Protection (IEC)	Housing IP40 Terminals IP20
LED Indicators	See pg. 8 for description

Dimensions	
Millimeters	100 (H) x 100 (W) x 75 (D)
Mounting	35mm DIN rail or panel mounted

Connection	
DeviceNet	Phoenix Connector (5 position open style)
AS-i	Terminal Connectors

COMMUNICATIONS

DeviceNet	
Data Transmission Rates	125K, 250K, 500K baud
Distance Max.	500 meters @ 125K baud 200 meters @ 250K baud 100 meters @ 500K baud

AS-i	
Cycle Time	< 5ms
Distance Max.	100 meters without repeaters

ENVIRONMENT

Temperature Range	+32°F to +131°F

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9 Appendix B

9.1 DeviceNet Information

The AS-i/DeviceNet-Gateway operates as a group 2 slave device on the DeviceNet network, supporting polled I/O and explicit messaging. It does not support strobed I/O.

This appendix defines DeviceNet message types, class services and object classes that are supported by the AS-i/DeviceNet-Gateway.

9.1.1 DeviceNet Message Types

The gateway supports the following message types:

CAN Identifier Field	Group 2 Message Type
10xxxxxx111	Duplicate MAC ID Check Messages
10xxxxxx110	Unconnected Explicit Request Messages
10xxxxxx101	Master I/O Poll Command Message
10xxxxxx100	Master Explicit Request Message

Note

xxxxxx = AS-i/DeviceNet-Gateway node address

9.1.2 DeviceNet Class Services

The gateway supports the following class services and instance services:

Service Name	Service Code
Reset	0x05
Get_Attribute_Single	0x0E
Set_Attribute_Single	0x10
Allocate Master/ Slave_Connection_Set	0x4B
Release Master/ Slave_Connection_Set	0x4C

9.1.3 DeviceNet Object Classes

The gateway supports the following DeviceNet object classes:

Class	Object
1	Identify
3	DeviceNet
5	Connection
15	Parameter

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9.2 Identify Object

Class Code: 1

Number of Instances: 1

Instance Attributes

Attribute ID	Access Rule	Name	DeviceNet Data Type	Data Value
1	Get	Vendor	UINT	39(hex)
2	Get	Product Type	UINT	0
3	Get	Product Code	UINT	8C3A(hex)
4	Get	Revision Major Revision Minor Revision	Structure of: USINT USINT	 0 2
5	Get	Status	WORD	see chart below
6	Get	Serial Number	UDINT	unique 32 bit number
7	Get	Product Name String Length ASCII String	Structure of: USINT STRING	 9 "VAG-DN-K5"

Status

bit 0	owned	0 = not owned 1 = owned (Group 2 allocated to master)
bit 1	reserved	always 0
bit 2	configured	always 0
bit 3	reserved	always 0
bit 4-7	vendor specific	all 0
bit 8	minor cfg fault	0 = no fault 1 = minor configuration fault
bit 9	minor device fault	0 = no fault 1 = minor device fault
bit 10	major cfg fault	0 = no fault 1 = major configuration fault
bit 11	major device fault	0 = no fault 1 = major device fault
bit 12,13	reserved	always 0
bit 14,15	reserved	always 0

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Common Services

Service Code	Class	Instance	Service Name
0x05	No	Yes	Reset
0x0E	Yes	Yes	Get_Attribute_Single

9.3 DeviceNet Object

Class Code: 3

Number of Instances: 1

Instance Attributes

Attribute ID	Access Rule	Name	DeviceNet Data Type	Data Value
1	Get	MAC ID	USINT	Range 0-63
2	Get	Baud Rate	USINT	Range 0-2
3	Get	BOI	BOOL	Range 0-1
4	Get	Bus-off Counter	USINT	Range 0-255
5	Get	Allocation Information Allocation Choice Byte Master's Node Address	Structure of: BYTE USINT	 0-63 = Master Address 255 = unallocated

Common Services

Service Code	Class	Instance	Service Name
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single
0x4B	No	Yes	Allocate_M/S_Connection_Set
0x4C	No	Yes	Release_M/S_Connection_Set

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9.4 Connection Object

Class Code: 5

Number of Instances: 2

Instance 1 Attributes (Explicit Message Connection)

Attribute ID	Access Rule	Name	DeviceNet Data Type	Data Value
1	Get	State	USINT	0 = nonexistent 3 = established
2	Get	Instance Type	USINT	0 = explicit message
3	Get	Transport Class Trigger	USINT	83(hex)
4	Get	Produced Connection ID	UINT	10xxxxxx011(binary) xxxxxx=node address
5	Get	Consumed Connection ID	UINT	10xxxxxx100(binary) xxxxxx=node address
6	Get	Initial Comm. Characteristics	USINT	21(hex)
7	Get	Produced Connection Size	UINT	7
8	Get	Consumed Connection Size	UINT	7
9	Get/Set	Expected Packet Rate	UINT	0 (msec)
12	Get	Watchdog Timeout Action	USINT	1 = auto delete
13	Get	Produced Connection Path Length	USINT	0
14	Get	Produced Connection Path		null (no data)
15	Get	Consumed Connection Path Length	USINT	0
16	Get	Consumed Connection Path		null (no data)

Common Services

Service Code	Class	Instance	Service Name
0x05	Yes	Yes	Reset
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

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Instance 2 Attributes (Polled I/O Message Connection)

Attribute ID	Access Rule	Name	DeviceNet Data Type	Data Value
1	Get	State	USINT	0 = nonexistent 1 = configuring 3 = established 4 = timed out
2	Get	Instance Type	USINT	1 = I/O message
3	Get	Transport Class Trigger	USINT	82(hex)
4	Get	Produced Connection ID	UINT	01111xxxxxx(binary) xxxxxx=node address
5	Get	Consumed Connection ID	UINT	10xxxxxx101(binary) xxxxxx=node address
6	Get	Initial Comm. Characteristics	USINT	01(hex)
7	Get	Produced Connection Size	UINT	1
8	Get	Consumed Connection Size	UINT	1
9	Get/Set	Expected Packet Rate	UINT	0 (msec)
12	Get	Watchdog Timeout Action	USINT	0 = timeout(default) 1 = auto delete 2 = auto reset
13	Get	Produced Connection Path Length	USINT	6
14	Get	Produced Connection Path	Structure of: USINT USINT USINT USINT USINT USINT	 20(hex) 04(hex) 24(hex) 01(hex) 30(hex) 03(hex)
15	Get	Consumed Connection Path Length	USINT	6
16	Get	Consumed Connection Path	Structure of: USINT USINT USINT USINT USINT USINT	 20(hex) 04(hex) 24(hex) 02(hex) 30(hex) 03(hex)

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Common Services

Service Code	Class	Instance	Service Name
0x05	Yes	Yes	Reset
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

9.5 Parameter Object

Class Code: 15

Number of Instances 135

Instance	Access Rule	Name	DeviceNet Data Type	Default Data Value
1-31	Set	Permanent_Parameter	UINT	15
32	Get	Parameter_Result	UINT	15
33-63	Set	Parameter	UINT	15
64	Get	Last_Write_Result	UINT	0
65-95	Set	Permanent_Configuration	UINT	0
96-127	Get	Actual_Configuration	UINT	0
128	Set	Set_Operation_Mode	UINT	protected
129	Set	Set_Auto_Address_Enable	UINT	disabled
130	Set	Change_Slave_Address	UINT	0
131	Set	Store_Actual_Parameters	UINT	no
132	Set	Store_Actual_Configuration	UINT	no
133	Set	List_of_Projected_Slaves(LPS)	UDINT	0
134	Get	List_of_Detected_Slaves(LDS)	UDINT	0
135	Get	List_of_Activated_Slaves(LAS)	UDINT	0

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9.6 Definitions of Parameter Object Properties

Instance:	1-31
Name:	Permanent_Parameter
Definition:	A permanent setting for the parameters of all slaves connected to AS-i. Parameter settings will not be lost if a power failure occurs. Can only change in run mode.
Instance:	33-63
Name:	Parameter
Definition:	A setting for the parameters of all slaves connected to AS-i. Parameters set will be lost if a power failure occurs. Can only change in run mode.
Instance:	65-95
Name:	Permanent_Configuration
Definition:	The configuration of all slaves connected to AS-i. The number is a combination of the I/O code and the ID code. Refer to slave manufacturer data sheets for further information on these codes. Can only change in configuration mode.
Instance:	128
Name:	Set_Operation_Mode
Definition:	Either protected mode or configuration mode.
Instance:	129
Name:	Set_Auto_Address_Enable
Definition:	This configures the gateway for either accepting or rejecting the auto address feature.

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Instance:	130
Name:	Change_Slave_Address
Definition:	This command changes the address of a slave connected to the AS-i network. The format for changing an address is as follows: Old Address(hex), New Address(hex), combine the numbers and convert to decimal. Example: Old Address = 31(1F hex); New Address = 30(1E hex). Combining the numbers = 1F1E. Converting to decimal = 7966.
Instance:	131
Name:	Store_Actual_Parameters
Definition:	This stores the parameter changes made to the slaves in Instances 33-63.
Instance:	132
Name:	Store_Actual_Configuration
Definition:	This will write the Permanent_Configuration to the Actual_Configuration.
Instance:	133
Name:	List_of_Projected_Slaves(LPS)
Definition:	A 32 bit unsigned value in the range of 0 - 4,294,967,294 where every bit corresponds to one AS-i slave. Slave 0 (LSB) cannot be projected, so this bit is always 0. Example: if slaves 1-15 are connected to AS-i the binary interpretation would be 1111 1111 1111 1110 and the decimal interpretation would be 65534.

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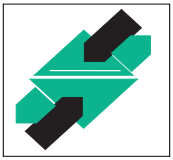
  - Photoelectric sensors
- Incremental and absolute rotary encoders
- Counters and control equipment
- ID systems
- AS-Interface

Areas of Application

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



Process Automation Division

Product Range

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

Areas of Application

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

Service Area

Worldwide sales, customer service and consultation via competent and reliable Pepperl+Fuchs associates ensure that you can contact us wherever or whenever you need us. We have subsidiaries worldwide for your convenience.

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