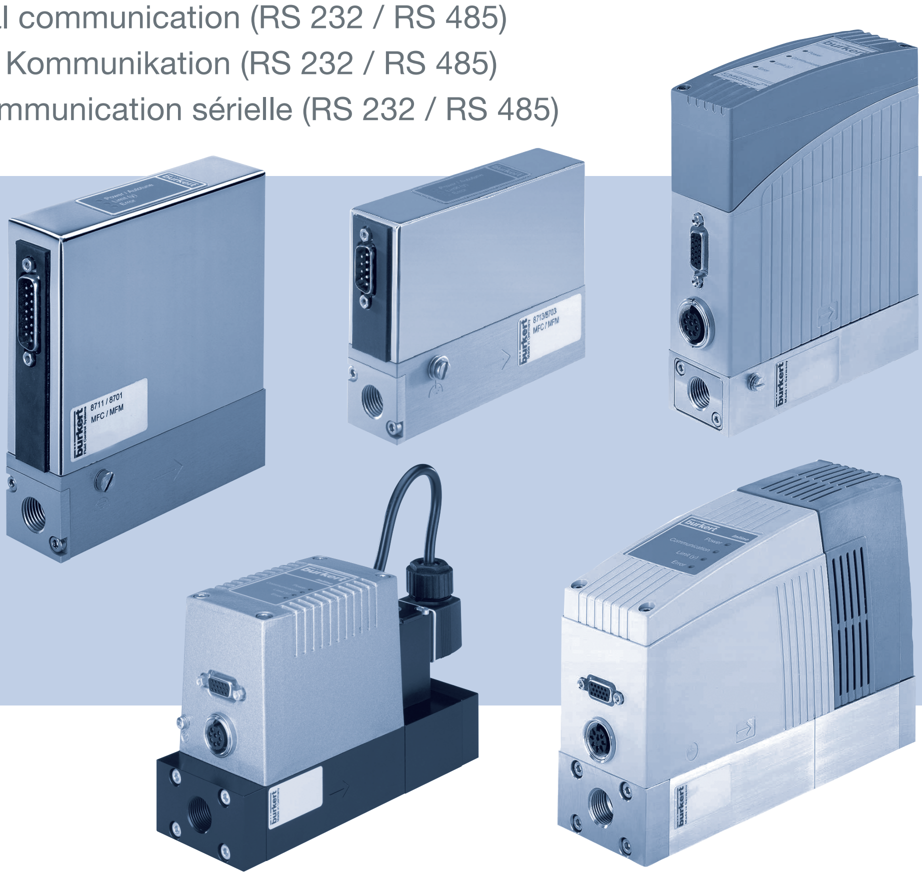
Type XXXX

MFC Family
- Digital Communication

Fieldbus devices and serial communication (RS 232 / RS 485)
Feldbusgeräte und serielle Kommunikation (RS 232 / RS 485)
Appareils bus terrain et communication sérielle (RS 232 / RS 485)



Supplement to Operating Instructions

Ergänzung zur Bedienungsanleitung
Complément aux instructions de service

MAN 1000311624 EN Version: C Status: RL (released | freigegeben) printed: 27.04.2018

We reserve the right to make technical changes without notice.
Technische Änderungen vorbehalten!
Sous réserve de modifications techniques.

Operating Instructions 1804/11_EU-ML_00804553 / Original DE

Description of Communication with MFC Family Devices

Contents

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1. SUPPLEMENTARY OPERATING INSTRUCTIONS

The Supplementary Operating Instructions describe communication with MFC family devices.

Safety Information!

Safety instructions and information for using the device may be found in the corresponding operating instructions.

- The operating instructions must be read and understood.

1.1. Symbols

DANGER!

Warns of an immediate danger!

- Failure to observe the warning may result in a fatal or serious injury.

WARNING!

Warns of a potentially dangerous situation!

- Failure to observe the warning may result in serious injuries or death.

CAUTION!

Warns of a possible danger!

- Failure to observe this warning may result in a moderate or minor injury.

NOTE!

Warns of damage to property!

- Failure to observe the warning may result in damage to the device or the equipment.

Indicates important additional information, tips, and recommendations which are important for your safety and the flawless functioning of the device.

Refers to information in these operating instructions or in other documentation.

→ Designates a procedure that must be carried out.

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2. GENERAL INFORMATION

2.1. Contact Addresses

Germany

Contact address:

Bürkert Fluid Control System
Sales Center
Chr.-Bürkert-Str. 13-17
D-74653 Ingelfingen
Phone: 07940 - 10 91 111
Fax: 07940 - 10 91 448
E-mail: info@burkert.com

International

Contact addresses can be found on the final pages of the printed operating instructions.

And also on the Internet at:

www.burkert.com

2.2. Information on the Internet

The operating instructions and data sheets for device types can be found on the Internet at:

www.burkert.com

2.3. English terms

English technical terms and proper nouns appear just as they were in the original German version (i.e. in English). The English variables and function names, etc. that were used in the German version are also unchanged in the English version.

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3. SERIAL COMMUNICATION

3.1. General Information

3.1.1. RS232 - Driver included in the device

(e.g. for types 8626/8006, 8716/8706, 8712/8702)

MFC / MFM	PC (SUB-D 9-pin plug)
RS232 TxD (pin 6 SUB-HD socket)	Pin 2
RS232 RxD (pin 14 SUB-HD socket)	Pin 3
RS232 GND (pin 15 SUB-HD socket)	Pin 5

3.1.2. RS232 - Driver not included in the device

(e.g. for type 8711/8701)

MFC / MFM		
TxD	From device	(pin 15 SUB-D plug)
RxD	From device	(pin 14 SUB-D plug)
GND	From device	(pin 11 SUB-D plug)

3.1.3. Transfer protocol

Transfer channels

The following lines are used for the serial interface:

Wire-conducted communication

GND	Ground
RxD	Reception line (as seen by MFC)
TxD	Transmission line (as seen by MFC)

Data format

The layout of the serial interface protocol is as follows:

Transfer rate	Standard 9600 Bd (differs from HART)
Data bits	8
Parity	None (differs from HART)
Stop bits	1
Hardware handshake	No

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Telegram

General Information

The layout of the transmission telegram is based on the HART protocol. HART is a master slave protocol, i.e. each transmission is started by a master device (PC or manual operating unit). The slave device (field device, MFC / MFM) responds only to a master telegram if the device was addressed by the telegram.
Exception: Burst message

Additional information about the HART protocol may be found under:

http://www.hartcomm.org/

http://www.romilly.co.uk/

A distinction is drawn between short frame and long frame telegrams. They consist of the following characters:

Short frame

Preamble	2 – 20 bytes 0xFF
Delimiter	1 byte Master → Slave 0x02 Slave → Master 0x06 Burst message 0x01
Address	1 byte (Master address + Burst info + Polling address)
Command	1 byte
Byte count	1 byte
Status	2 bytes, for slave Master (for meaning see “3.3. Error messages”)
Data	0 – 255 bytes
Checksum	1 byte

Long frame

Preamble	2 – 20 bytes 0xFF
Delimiter	1 byte Master → Slave 0x82 Slave → Master 0x86 Burst message 0x81
Address	5 bytes
Command	5 bytes
Byte count	1 byte
Status	2 bytes, for slave Master (for meaning see “3.3. Error messages”)
Data	0 – 255 bytes
Checksum	1 byte

Preamble

The preamble consists of 2 to 20 0xFF characters (differs from HART). It is used to synchronize the data transfer.

Delimiter

Telegrams are distinguished from each other mainly by the delimiter:

Message type	Short frame	Long frame
Master → Slave	0x02	0x82
Slave → Master	0x06	0x86
Burst message from slave	0x01	0x81

Master:	PC or manual operating unit
Slave:	Field device, MFC/MFM

Address

The address field contains both the master address and the slave address of the message. One byte is used for this purpose in a short frame, while 5 bytes are used in a long frame. Each device must respond to a long frame address of 0 (= broadcast address), i.e. bit 0/1=X, bits 0 – 37=0.

The highest-order bit in both formats indicates which master is involved in communication.

(1: Primary master, continuously connected hosts;
0:Secondary master, manual operating units)

Short frame address (1 byte)

Bit 7	0 Secondary master
	1 Primary master
Bit 6	0 Not in burst mode
	1 In burst mode (not supported)
Bits 0 – 5	Polling address (0 – 32), bit 5 = MSB, bit 0 = LSB
m b x x x x x x	
	x Polling address
	b Burst info
	m Master address

Long frame address (5 bytes)

Bit 39	0: Secondary master
	1: Primary master
Bit 38	0: Not in burst mode
	1: In burst mode (not supported)
Bits 32 – 37	Manufacturer's ID code (0x78 = Buerkert),
	Bit 37 = MSB, bit 32 = LSB

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Bits 24 – 31	Device type code (0xEE = Mass flow controller/meter), Bit 31 = MSB, bit 24 = LSB
Bits 0 – 23	Device ID number, Bit 23 = MSB, bit 0 = LSB (matches the device serial number) Each field unit must respond to address 0 (bits 0 – 23 = 0).

```
      Bit 37              Bit 23                           Bit 0
      |                   |                                |
mb    x x x x x x x   y y y y y y y y  z z z z z z z z   z z z z z z z z  z z z z z z z z
```

z	Device ID number
y	Device type code
x	Manufacturer's ID code
b	Burst info
m	Master address

Command

Commands are divided into the following categories in conformity with HART:

Universal commands	Commands 0 – 30
Standard commands	Commands 32 – 126
Device-specific command	Commands 128 – 253
	(reserved: 31, 127, 254, 255)

Byte count

The byte count indicates how many more bytes come before the checksum, i.e. the number of status bytes + number of data bytes. This results in a maximum total number of 255 status and data bytes.

Response code

Transferred only from the slave to the master in a response telegram. Consists of 2 bytes. The status bytes are used to detect communication errors or for the operating status of the slave device.

Data

Data bytes, depending on the command. A maximum of 255 data bytes can be transferred.

- Float – IEEE 754 single precision (4 bytes) float

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Checksum

The checksum is an XOR (exclusive OR, anticoincidence) combination of all bytes from the starting byte (delimiter) up to and including the last data byte.

An XOR combination is the logical combination function of two logical values ("0" and "1"). It yields a result of "1" if one but not both of the two values is "1".

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3.2. Commands

Command number **Command name**	**0x00** **ReadUniqueIdentifier**	
Request		
Command	0x00	
Byte count	0	
Data	-	
Response		
Command	0x00	
Byte count	14 (18)	
Status	*2 bytes, device status*	
Data	12 (16) bytes	
	0	"254" (expansion)
	1	manufacturer identification code
	2	manufacturer's device type code
	3	number of preambles required
	4	universal command revision
	5	device-specific command revision
	6	software revision
	7	hardware revision
	8	device function flags
	9 – 11	device ID number [1]
	(12	common-practice command revision) [1]
	(13	common tables revision) [2]
	(14	data link revision) [2]
	(15	device family code) [2]
Description HART-Universal Command 0.		

[1] *First byte transferred: MSB*
[2] *Reserved for later versions*

Command number **Command name**	**0x01** **ReadPrimaryVariable**
Request	
Command	0x01
Byte count	0
Data	-
Response	
Command	0x01
Byte count	7
Status	*2 bytes, device status*
Data	5 bytes
	0 PV units code
	1 – 4 primary variable (float) [1)]
Description HART-Universal Command 1. PV Unit 0 x 39 → % PV Actual flow X (±) (see also "3.3.3. Codings and units")	

Example:
All data as hexadecimal numbers (prefix 0x) short frame
Primary master
Short address 0
→ Data sent
← Data received

- Read Primary Variable
  → 0xFF 0xFF 0x02 0x80 0x01 0x00 0x83
  ← 0xFF 0xFF 0x06 0x80 0x01 0x07 0x00 0x00 0x39 0x41 0xC8 0x00 0x00
  0x30 0x39 for PV Unit = %
  0x41C80000 = 25.0 IEEE 754 floating point

[1)] *First byte transferred: MSB*

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Command number Command name	0x03 ReadCurrentAndFourDynamicVariables	
Request		
Command	0x03	
Byte count	0	
Data	-	
Response		
Command	0x03	
Byte count	26	
Status	*2 bytes, device status*	
Data	24 bytes	
	0 – 3	current (mA) (float) [1)]
	4	PV units code
	5 – 8	primary variable (float) [1)]
	9	SV units code
	10 – 13	secondary variable (float) [1)]
	14	TV units code
	15 – 18	third variable (float) [1)]
	19	FV units code
	20 – 23	fourth variable (float) [1)]

Description

HART-Universal Command 3.

New variable assignment as of firmware version A.00.28.09:

current	Actual flow scaled to 4 – 20 mA
PV Unit	%
PV	Actual flow X (±)
SV Unit	%
SV	Set-point value flow W
TV Unit	%
TV	Positioning set-point value y 2 (valve duty cycle)
FV Unit	sec
FV	Device sampling time, since power-on or SyncTA command

[1)] *First byte transferred: MSB*

Command number	0x06	
Command name	WritePollingAddress	
Request		
Command	0x06	
Byte count	1	
Data	1 byte	
	0	polling address
Response		
Command	0x06	
Byte count	3	
Status	*2 bytes, device status*	
Data	1 byte	
	0	polling address
Description		
HART-Universal Command 6:		
Command for changing the HART polling address.		

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Command number	**0x27**	
Command name	**EepromControl**	
Request		
Command	0x27	
Byte count	1	
Data	1 byte	
	0	= Write to EEPROM
	1	= Copy content of EEPROM to RAM
Response		
Command	0x27	
Byte count	3	
Status	*2 bytes, device status*	
Data	1 byte	
	0	= Write to EEPROM
	1	= Copy content of EEPROM to RAM
Description		
HART-Universal Command 39.		
Command to write/read parameters (for example the polling address) to/from EEPROM.		

Command number	0x80	
Command name	ReadVersion	
Request		
Command	0x80	
Byte count	0	
Data	-	
Response		
Command	0x80	
Byte count	36 [2) 3) 4) 5)]	
Status	*2 bytes, device status*	
Data	34 bytes	
	0 – 1	Device type (unsigned int), e.g. 8626
	2	Device number, z. B. 1
	3 – 6	Device ID number (unsigned long) [1)]
	7 – 10	Device serial number (unsigned long) [1)]
	11 – 14	Software ID number (unsigned long) [1)]
	15	Software version x (x.y.z.cc): A – Z
	16	Software version y (x.y.z.cc): 0 – 99
	17	Software version z (x.y.z.cc): 0 – 99
	18	Software version cc (x.y.z.cc): 0 – 99
	19	EEPROM layout version x (x.y): A – Z [2)]
	20	EEPROM layout version y (x.y): 0 – 99 [2)]
	21	Table_x version (x.y): A – Z [3)]
	22	Table_y version (x.y): 0 – 99 [3)]
	23 – 26	Bios ID number (unsigned long) [4)]
	27	Bios version x (x.y.z.cc): A – Z [4)]
	28	Bios version y (x.y.z.cc): 0 – 99 [4)]
	29	Bios version z (x.y.z.cc): 0 – 99 [4)]
	30	Bios version cc (x.y.z.cc): 0 – 99 [4)]
	31	MFi software version x (x.y): A – Z [5)]
	32	MFi software version y (x.y): 0 – 99 [5)]
	33	MFi software version x (x.y): A – Z [5)]
Description		
Command to read device information and the software version.		

1) *First byte transferred: LSB*
2) *Version-dependent – available with firmware version A.00.29.02 or later*
3) *Version-dependent – available with firmware version A.00.63.00 or later*
4) *Version-dependent – available with firmware version A.00.64.00 or later*
5) *Version-dependent – available with firmware version A.00.83.03 or later*

Command number	**0x92**	
Command name	**ExtSetpoint**	
Request		
Command	0x92	
Byte count	5	
Data	1 byte	
	0	Internal set-point value settings
	1	External set-point value settings
	4 bytes	
	0 – 3	Set-point value [%] (float) [1)]
Response		
Command	0x92	
Byte count	7	
Status	*2 bytes, device status*	
Data	1 byte	
	0	Internal set-point value settings
	1	External set-point value settings
	4 bytes	
	0 – 3	Set-point value [%] (float) [1)]

Description

Available as of firmware version A.00.28.09.

Determines the set-point value settings and describes the external set-point value as a percentage:
Internal = analog - the set-point value settings is assigned by the analog set-point value signal that is created
External = digital via serial interface

Do not use this command if you are using a bus device (PROFIBUS, DeviceNet, etc.). The digital set-point value settings via the serial interface has a higher priority.

[1)] *First byte transferred: MSB*

Example:
All data as hexadecimal numbers (prefix 0x) short frame
Primary master
Short address 0
→ Data sent
← Data received

- Set-point value settings digital 0.0% (→ 0x00000000 IEEE 754)
  → 0xFF 0xFF 0x02 0x80 0x92 0x05 0x01 0x00 0x00 0x00 0x00 0x14
  ← 0xFF 0xFF 0x06 0x80 0x92 0x07 0x00 0x00 0x01 0x00 0x00 0x00 0x00 0x12

- Set-point value settings digital 50.0% (→ 0x42480000 IEEE 754)
  → 0xFF 0xFF 0x02 0x80 0x92 0x05 0x01 0x42 0x48 0x00 0x00 0x1E
  ← 0xFF 0xFF 0x06 0x80 0x92 0x07 0x00 0x00 0x01 0x42 0x48 0x00 0x00 0x18

- Set-point value settings digital 100.0% (→ 0x42C80000 IEEE 754)
  → 0xFF 0xFF 0x02 0x80 0x92 0x05 0x01 0x42 0xC8 0x00 0x00 0x9E
  ← 0xFF 0xFF 0x06 0x80 0x92 0x07 0x00 0x00 0x01 0x42 0xC8 0x00 0x00 0x98
- Switch set-point value settings to analog set-point value settings:
  → 0xFF 0xFF 0x02 0x80 0x92 0x05 0x00 0x00 0x00 0x00 0x00 0x15
  ← FF FF 06 80 92 07 00 00 00 ....

Command number	**0x93**
Command name	**GetAddDeviceInfo**
Request	
Command	0x93
Byte count	0
Data	-
Response	
Command	0x93
Byte count	10
Status	*2 bytes, device status*
Data	8 bytes
	0 – 1 *Bit field ERRORS* [1]
	2 – 3 *Bit field OTHERS* [1]
	4 – 5 *Bit field LIMITS* [1]
	6 – 7 *Reserved (bit field)* [1]
Description	

Available as of firmware version A.00.28.09.

Command for reading additional device information such as error bits, operating states (AutoTune, Safepos, etc.),
states of threshold values and binary inputs/outputs.

[1] *First byte transferred: LSB*

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Command number	0x94	
Command name	GetBusAddress	
Request		
Command	0x94	
Byte count	0	
Data	-	
Response		
Command	0x94	
Byte count	4	
Status	*2 bytes, device status*	
Data	2 bytes	
	0 – 1	Bus address (unsigned int) [1]

Description

Available as of firmware version A.00.28.09.

Command for reading the bus address (PROFIBUS, DeviceNet, etc.). If the connected device is not a bus device, the error "Access denied" is returned in the response.

[1] *First byte transferred: LSB*

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Command number	0x95	
Command name	SetBusAddress	
Request		
Command	0x95	
Byte count	2	
Data	2 bytes	
	0 – 1	Bus address (unsigned int) [1)]
Response		
Command	0x95	
Byte count	4	
Status	*2 bytes, device status*	
Data	2 bytes	
	0 – 1	Bus address (unsigned int) [1)]

Description

Available as of firmware version A.00.28.09.

Command for setting the bus address (PROFIBUS, DeviceNet, etc.). If the connected device is not a bus device, the error "Access denied" is returned in the response.

[1)] *First byte transferred: LSB*

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Command number	**0x96**	
Command name	**GetTotalizer**	
Request		
Command	0x96	
Byte count	1	
Data	1 byte	
	0	Index of calibration gases
Response		
Command	0x96	
Byte count	8	
Status	*2 bytes, device status*	
Data	1 byte	
		Index of calibration gases
		0 Gas 1
		1 Gas 2
	5 bytes	
	1	Unit
	2 – 5	Totalizer value (Float)
Description		
Available as of firmware version A.00.28.09.		
Reads the totalizer value for the gas with the selected index in the unit that was transferred (167 = Nl; in reference to 1013 mbar, 273 K).		

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Command number	0x97	
Command name	ClearTotalizer	
Request		
Command	0x97	
Byte count	1	
Data	1 byte	
	0 index of calibration gases	
Feedback		
Command	0x97	
Byte count	3	
Status	*2 bytes, device status*	
Data	1 byte	
		Index of calibration gases
		0 Gas 1
		1 Gas 2
Description		
Available as of firmware version A.00.28.09.		
Deletes the totalizer value of the corresponding gas.		

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Command number	**0x98**	
Command name	**ExtSetpointWithoutAnswer**	
Device types	**0xEE**	
Request		
Command	0x92	
Byte count	5	
Data	1 byte	
	0	Set-point value settings, internal
	1	Set-point value settings, external
	4 bytes	
	1 – 4	Set-point value [%] (float) [1)]
Response		
Command	-	
Byte count	-	
Status	-	
Data	-	

Description

Available as of firmware version A.00.51.06.

Determines the set-point value settings and describes the external set-point value as a percentage:
Internal = analog - the set-point value settings is assigned by the analog set-point value signal that is created
External = digital via serial interface

Do not use this command if you are using a bus device (PROFIBUS, DeviceNet, etc.). The digital set-point value settings via the serial interface has a higher priority.

No response **is sent for this** command.

[1)] *First byte transferred: MSB*

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3.3. Error messages

2 bytes, device status

Error messages are saved in the device status. If the device status is 0, no error occurred.

3.3.1. First status byte

Communication error	
Error code	0x82
Error name	overflow
Description	UART error, receive buffer, overflow was detected.
Error code	0x88
Error name	checksum
Description	An incorrect checksum was received.
Error code	0x90
Error name	framing
Description	UART error, framing error was detected.
Error code	0xA0
Error name	overrun
Description	UART error, overrun error was detected.
Error code	0xC0
Error name	parity
Description	UART error, parity error was detected.

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Command error	
Error code	0x02
Error name	**invalid_selection**
Description	An invalid data range was selected.
Error code	0x03
Error name	**parameter_too_large**
Description	Transfer parameter too large. It may be a table or array index from the data range, i.e. an incorrect value range.
Error code	0x04
Error name	**parameter_too_small**
Description	Transfer parameter too small. It may be a table or array index from the data range, i.e. too low for the value range.
Error code	0x05
Error name	**too_few_data_bytes**
Description	Not enough data bytes were received.
Error code	0x07
Error name	**write_protected**
Description	Device is write-protected.
Error code	0x10
Error name	**access_restricted**
Description	The command that was sent cannot be executed (currently). Access was denied. The cause could be, for example, that the necessary access rights are lacking or the command is not permitted in the current operating mode.
Error code	0x40
Error name	**no_command**
Description	Invalid/incorrect command, i.e. the command that was received is not supported by the device.

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Device status	
Error code	0x20
Error name	device_busy
Description	Device is busy.

Internal device-specific error messages	
Error code	0x01
Error name	timeout
Description	The time limit was exceeded, i.e. too much time passed between a valid received delimiter and a complete command.
Error code	0x41
Error name	wrong_command
Description	Incorrect command structure, i.e. the command is valid and exists, but the number of bytes transferred does not match. Only 1 byte was transferred for a 2-byte variable.

3.3.2. Second status byte

Second status byte	
Bit 7	Field device malfunction
Bit 6	reserved for future purposes
Bit 5	reserved for future purposes
Bit 4	reserved for future purposes
Bit 3	reserved for future purposes
Bit 2	reserved for future purposes
Bit 1	reserved for future purposes
Bit 0	reserved for future purposes

UART errors take precedence in error detection.
Multiple UART errors cannot be detected simultaneously.

3.3.3. Codings and units

Manufacturer coding (HART standard)		
Hex	**Dec**	**Description**
0x78	120	Buerkert
0xFA	250	not used
0x FB	251	none
0xFC	252	unknown
0xFD	253	special

Units (HART standard)			
Hex	**Dec**	**Unit**	**Description**
0x33	51	sec	Seconds
0x39	57	%	Percent
0xA7	167	Nl	Normalized liters (reference condition p = 1015 $mbar^{abs}$, T = 273,15 K
0xFA	250	-	not used
0xFB	251	-	none
0xFC	252	-	unknown
0xFD	253	-	special

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4. PROFIBUS DP START-UP

4.1. Address setting for BUS devices

4.1.1. Devices without rotary switch for address setting

The BUS address of devices can be set either with the Bürkert configuration tool MassFlowCommunicator in the "Views" → "PROFIBUS/DeviceNet/CANopen" view or directly with the BUS master.

After an address is changed, it must be initialized on the slave and also on the master. Depending on the BUS, it may be necessary to send an appropriate telegram.

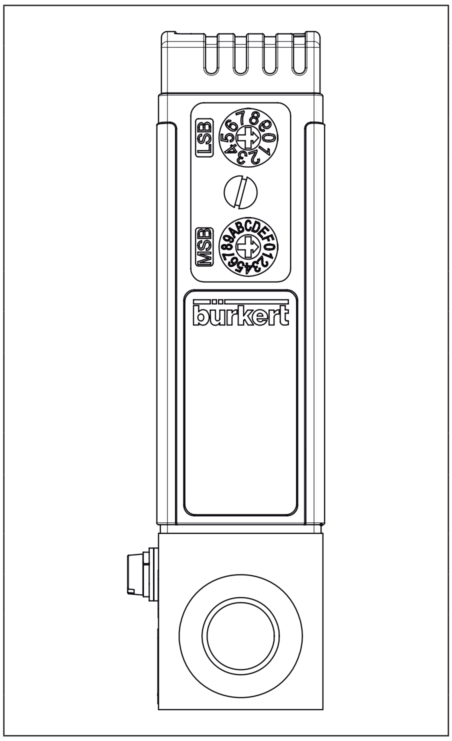
> **!** To ensure the setting was made without problems, a device reset should be performed (turn the electrical power off and back on).

4.1.2. Devices with rotary switch for address setting

When the device is turned on, the address set as the slave address on the rotary switches is applied. Valid addresses are:

- PROFIBUS 0 … 126
- DeviceNet 0 … 63
- CANopen 1 … 127

If the address has been set outside the permissible range, the address setting has the validity as described in section “4.1.1”.



LBS	Ones place, x 1		
	0 – 9	The number multiplied by 1	→ 0 – 9
MBS	Tens place, x 10		
	0 – 9	The number multiplied by 10	→ 0 – 90
	A		→ 100
	B		→ 110
	C		→ 120
	D		→ 130
	E		→ 140
	F		→ 150

Thus the address consists of LSB + MSB.

MSB	LBS	Address
0	1	1
6	3	63
A	0	100
C	7	127

> **!** If you want to make an address setting with the BUS master and there are rotary switches available, set the address to a value outside the valid range.

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4.2. Technical Data

GSD file	BUV10627.GSD
Symbols	BUV10627.BMP address 0 – 126
	Standard: 126

4.3. DP alarm mode

DP alarm mode is not supported.

Siemens-specific:

Use value "*DPV0*" in the hardware configurator. There is no change in the communication protocol.

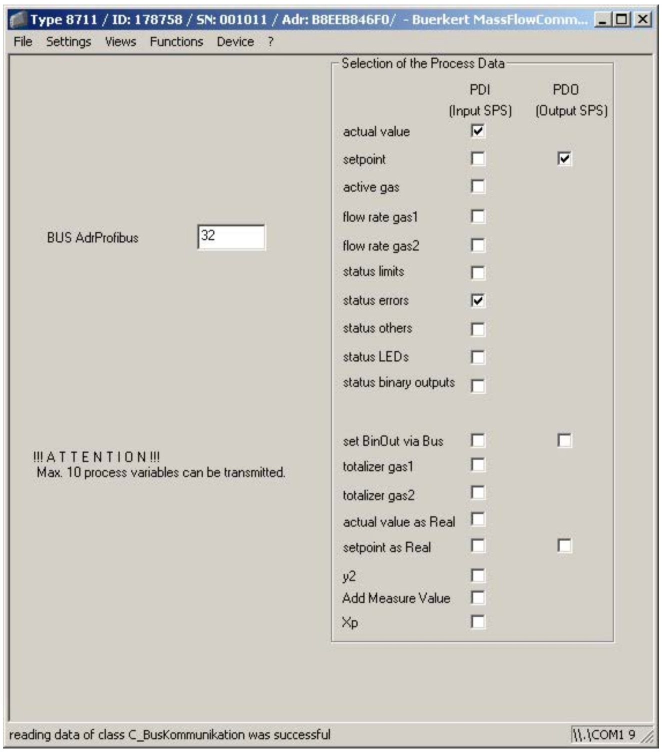
The value changes only the "alarm mode support".

Additional information is available in the Simatic S7 help.

4.4. PROFIBUS PDI/PDOs

You can make all settings required for bus communication in this input window. The important items are the BUS address of the device (BUS AdrProfibus) and the process data to be send (input SPS or PDIs) and to be received (output SPS or PDOs). They can be activated and deactivated with the option fields.

→ Apply the changed settings in the menu bar under "*Functions*" / "*Write Data to Device*".



No more than 10 process data items may be selected. This includes both process input data items and process output data items.

4.5. Explanation of variables used in cyclic data traffic

Process data	Explanation	Identifier
Actual value	Actual value (1 word = 2 bytes) Value range 0 – 1000	41,40,00 (HEX); PDI
Set-point	Set-point value (1 word = 2 bytes) Value range 0 – 1000	41,40,01 (HEX); PDI 81,40,01 (HEX); PDO
Active gas (used gas type)	whose calibration curve is used for control: gas 1 or gas 2 (1 word = 2 bytes) Value range 0 – 1	41,40,02 (HEX); PDI
Nominal flow Gas 1	Nominal flow in Nl/min of calibration for gas 1 float = 4 bytes	41,83,03 (HEX); PDI
Nominal flow Gas 2	Nominal flow in Nl/min of calibration for gas 2 float = 4 bytes	41,83,04 (HEX); PDI
Status limits	Read only Bit field for states of device-internal threshold value: (1 word = 2 bytes) see "9.1. Description of bit fields" min. value 0, max. value 65535	41,40,05 (HEX); PDI
Status errors	Read only Bit field for device errors that are present. (1 word = 2 bytes) see "9.1. Description of bit fields" min. value 0, max. value 65535	41,40,06 (HEX); PDI
Status others	Read only Bit field for current states in the controller. (1 word = 2 bytes) see "9.1. Description of bit fields" min. value 0, max. value 65535	41,40,07 (HEX); PDI
Status LEDs	Read only Bit field for communication states. (1 word = 2 bytes) see "9.1. Description of bit fields" min. value 0, max. value 65535	41,40,08 (HEX); PDI
Status binary outputs	Reserved bit field (1 word = 2 bytes) see "9.1. Description of bit fields"	41,40,09 (HEX) PDI
Default values via bus	Bit field for states of LEDs and binary outputs as they can be assigned by the bus. To do this, the corre-sponding functions must be configured in the device with the PC program. (1 word = 2 bytes) see "9.1. Description of bit fields"	41,40,0B (HEX); PDI 81,40,0B (HEX); PDO

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Process data	Explanation	Identifier
Totalizer value Gas 1	Totalizer value of calibration for gas 1 in Nl. Float = 4 bytes	41,83,03 (HEX); PDI
Totalizer value Gas 2	Totalizer value of calibration for gas 2 in Nl. Float = 4 bytes	41,83,0D (HEX); PDI
Actual value as float	(4 bytes) Default: 0 –1 00 % Parameterization of the unit. (see also "7.4. S-Analog Sensor Object")	41,83,0E (HEX) PDI 81,83,0E (HEX) PDO
Set-point as float	(4 bytes) Default: 0 – 100 % Parameterization of the unit. (see also "7.6. S-Single Stage Controller Object")	81,83,0E (HEX) PDO
Control output y2	(2 bytes) Only for MFC control output y2 of the controller, in units per thousand Value range 0 … 1000	41,40,10 (HEX); PDI
AddMeasureValue	Additional value as float (4 bytes) Value as a percentage This value is only supported by a few MFCs. If the value is not supported, 0% is returned.	41,83,11 (HEX); PDI
Xp	Additional pressure value (2 bytes) Value in units per thousand Value range 0 … 1000 This value is only supported by a few MFCs. If the value is not supported, 0% is returned.	41,40,12 (HEX); PDI

4.6. Acyclic data

See "7. Acyclic Data Transfer with PROFIBUS, DeviceNet and CANopen"

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5. DEVICENET START-UP

5.1. Terms

DeviceNet

DeviceNet is a field bus system based on the CAN protocol (Controller Area Network). It enables actuators and sensors (slaves) to be networked with higher-level controllers (master).

The DeviceNet profile "Mass Flow Controller Device" is supported with strict compliance to DeviceNet specifications.

With DeviceNet it is necessary to differentiate between cyclical or event-driven high-priority process messages (I/O messages) and acyclical low-priority management messages (explicit messages).

Protocol sequence

The protocol process conforms to the DeviceNet specification Release 2.0.

Technical Data

EDS file	BUER8626.EDS
Icons	BUER8626.ICO
Baudrate	125, 250, 500 kBit/s Factory setting 125 kBit/s
Address	0 – 63 Factory setting 63
Process data	5 static input assemblies 4 static output assemblies

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5.2. Configuration of Process Data

5 static input and 2 static output assemblies can be selected to transmit process data via an I/O connection. These assemblies contain selected attributes combined into one object so that process data can be transmitted collectively via an I/O connection.

The process data is selected by setting the device parameters *Active Input Assembly* and *Active Output Assembly* or - if supported by the DeviceNet-Master/Scanner - by setting *Produced Connection Path* and *Consumed Connection Path* when an I/O connection is initialized according to the DeviceNet specification.

Assembly Object general		
Name	Description of the input data attributes	Attribute address (class, instance attribute, data type)
ASS_NumberOfObjects		4, x, 1
ASS_Memberlist		4, x, 2
ASS_Data		4, x, 3

Assembly Object		
Direction data	Description of data attributes	Attribute address (class, instance attribute, data type)
Input / output	Not active	4, 0, 3
Input	Status byte + Flow(INT)	4, 2, 3
Input	Statusbyte + Flow(INT) + Setpoint(INT) + ActuatorOverrideByte + ValveDutyCycle(INT)	4, 6, 3
Output	Setpoint(INT)	4, 7, 3
Output	ActuatorOverrideByte + Setpoint(INT)	4, 8, 3
Input	Flow + status errors	4, 21, 3
Input	Flow + status errors + status limits	4, 22, 3
Input	Flow + status errors + status limits + status others	4, 23, 3

5.3. Acyclic data

See “7. Acyclic Data Transfer with PROFIBUS, DeviceNet and CANopen”

6. CANOPEN START-UP

6.1. CANopen general

6.1.1. Terms used

CANopen

CANopen is a field bus system based on the CAN protocol (Controller Area Network).

CANopen is a standard of CAN in Automation (CiA).

The CANopen communication model provides two methods of communication mechanisms:

- Unconfirmed transmission of data blocks of up to 8 bytes to transfer process data (**PDO** "Process Data Object") without additional overhead compared to SDO.
- Confirmed transmission of data between two nodes with direct access to entries of the object dictionary (**SDO** "Service Data Object") of the addressed node.

Protocol sequence

The protocol sequence complies with CANopen communication profile CiA draft standard 301 V 4.02.

6.1.2. Technical Data

EDS file	Buerkert_COP8626.EDS
Baudrate	20, 50, 100, 125, 250, 500, 800, 1000 kBit/s Factory setting 125 kBit/s
Address	1 – 127 Factory setting 127
Process data	4 TxPDOs 1 RxPDO

6.1.3. Assignment of process data objects

See "6.4. CANopen – Process Data Transfer"

Predefined ID connection set

CANopen defines a standard identifier allocaton scheme (see table below). These identifiers are available in the pre-operational state after node initialization.

Object	Identifier
NMT	0 hex
SYNC	80 hex
EMERGENCY	80 hex + address
1st TPDO	180 hex + address
1st RPDO	200 hex + address
2nd TPDO	280 hex + address
2nd RPDO	300 hex + address
3rd TPDO	380 hex + address
3rd RPDO	400 hex + address
4th TPDO	480 hex + address
4th RPDO	500 hex + address
TSDO	580 hex + address
RSDO	600 hex + address
NODE-GUARDING	700 hex + address

6.1.4. Error Control Service

To determine a non-active bus, the master must support one of the two error monitoring types, Node-Guarding or Heartbeat.

Integration of one of the two error monitoring types, Node-Guarding or Heartbeat, is mandatory.

In error monitoring of a CAN-based network, the NMT object detects local errors within a node. These errors can result in a reset or change of status, for example. The error definitions are not part of the specification.

Error monitoring occurs periodically during data transfer.

There are two methods of error monitoring:

Node-Guarding

Error monitoring involves the NMT master sending the Node-Guarding telegram. If the NMT slave does not respond within a defined time or if the communication status of the NMT slave has changed, the NMT master reports this to its NMT master application.

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If runtime monitoring is supported, the slave using the Node-Guarding time and fail factor of its object library to calculate the reacting time. If runtime monitoring is accessed, the NMT slave informs its local application of the event. If the values of runtime monitoring and the fail factor are zero (0), no runtime monitoring occurs.

Runtime monitoring of the slave starts as soon as the slave receives the first monitoring request. Usually this happens during the start phase or later.

Node Guarding is adjustable by the following objects:

Name	Description	Index, Subindex
		CANopen
Node-Guarding Time (monitoring time)	Read Write Defines the monitoring time in ms.	Dec: 4108, 0 Hex: 100C, 0 UNSIGNED32
Node-Guarding Fail Factor	Read Write Defines the reacting time for detcting a timeout. for example reacting time = monitoring time × fail factor.	Dec: 4109, 0 Hex: 100D, 0 UNSIGNED32

Heartbeat

With Heartbeat, a cyclical check determines whether the other node is still responding. If there is no Heartbeat message from the node, the monitoring node is informed. If the heartbeat objects are written with values not equal to 0, monitoring occurs after the change of status from INITIALIZING to PRE-OPERATIONAL. The Bootup message is the first one to have the heartbeat message. Using both mechanisms (Node-Guarding and Heartbeat) simultaneously is not permitted. If the objects of the heartbeat are not equal to zero (0), Heartbeat is used as the monitoring mechanism.

Heartbeat is adjusted with the following objects:

Name	Description	Index, Subindex
		CANopen
Consumer Heartbeat Time	Read Number of entries 1–127	Dec: 4118, 0 Hex: 1016, 0 UNSIGNED8
	Read Write Bits 31–24: Reserved Bits 23–16: Node ID of generator Bits 15–0: Heartbeat time	Dec: 4118, 1–127 Hex: 1016, 1–7 FUNSIGNED32
Producer Heartbeat Time	Read Write Defines the monitoring time in ms	Dec: 4109, 0 Hex: 100D, 0

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6.2. CANopen emergency

The emergency functions that are implemented comply with the "CiA draft standards 301".

6.2.1. Emergency machine

A device may be in one of two emergency states (see “Fig. 1: Emergency states”). Emergency objects are sent depending on transitions. Connections between the emergency status machine and the NMT status machine are defined in the device profiles.

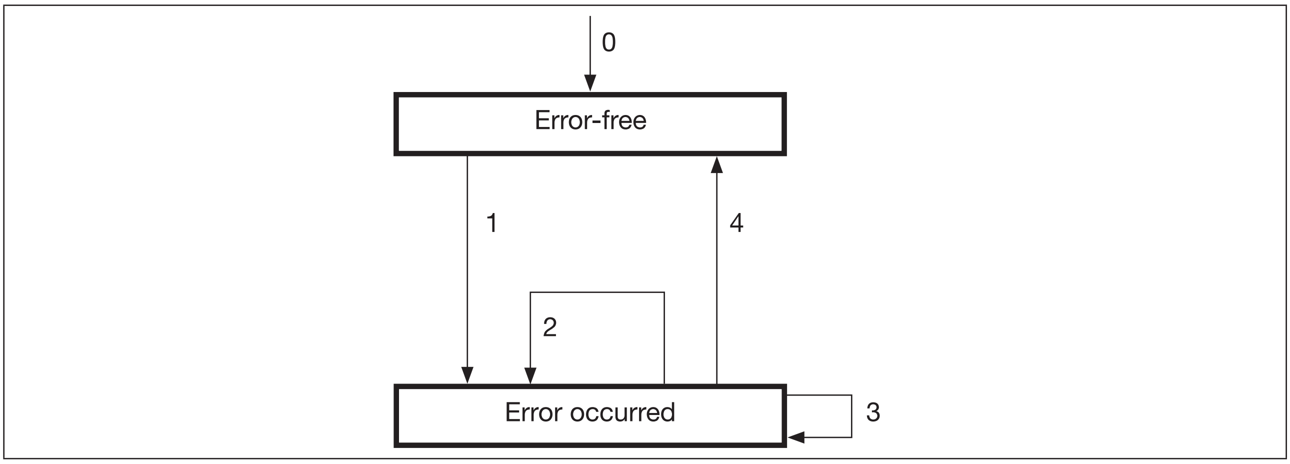

Fig. 1: Emergency states

0 If no error is determined, the device goes into an error-free status after initialization. No error message is sent.

1 The device determines there is an internal error, which is displayed in the first three bytes of the emergency message (error code and error register). The device goes into error status. An emergency object is sent with the corresponding error code and error register. The error code is entered in object 1003H (pre-defined error field).

2 One, but not all errors have disappeared. An emergency message containing error code 0000 (error reset), can be sent with the remaining errors in the error register and in the manufacturer-specific error field.

3 A new error has occurred in the device. The device remains in the error status and sends an emergency object with the corresponding error code. The new error code is entered at the upper end of the array of error codes (1003H). It must be guaranteed that error codes are sorted by time (oldest error - highest subindex; see “Object 1003h: Pre-defined error field”).

4 All errors have been eliminated. The device goes into error-free status and sends an emergency object with the error code "Reset error / no error".

6.2.2. Diagnostic object data

The diagnostic telegram consists of 8 bytes with the data shown in the following illustration:

Diagnostic object data.

Byte	0	1	2	3	4	5	6	7
Table of Contents	Emergency error code (see "Table of diagnostic error", page 42)		Error register (object 1001H)	Manufacturer-specific error field				

The following two items are added to all errors:

Object 1001h: Error register

Name	Description of the input data attribute	Index, Subindex
Error register	All errors that occur on the device are mapped on this object.	Dec: 4097, 0 Hex: 1001, 0 UNSIGNED8

This object is an error register for the device. The device is able to represent internal errors in this byte.

This entry is mandatory for all devices. It is part of an emergency object.

Bit	M/O	Description
0	M	General error
1	O	Current
2	O	Voltage
3	O	Temperature
4	O	Communication error (overflow, error status)
5	O	Device-specific
6	O	Reserved (always 0)
7	O	Manufacturer-specific

If a bit is set to 1, the specified error has occurred. The only mandatory error that must be indicated is a general error. A general error is indicated in every error situation.

Object 1003h: Pre-defined error field

Name	Description of the input data attribute	Index, Subindex
Error Register	The object contains errors that have occurred in the device.	Dec: 4099, 0-10 Hex: 1003, 0-A UNSIGNED32

The object for index 1003h contains errors that have occurred in the device and were indicated by the emergency object. Thus it returns an error history.

1. The entry for subindex 0 contains the number of actual errors that occurred in the array. Errors are recorded in the array beginning at subindex 1.
2. The most recent error is saved in subindex 1, while older errors have been moved further down in the list.
3. Writing a "0" to subindex 0 deletes the entire error history (clears the array). Values greater than 0 must not be be written. This results in an abort message (error code: 0609 0030h).
4. Error numbers are of type UNSIGNED32 and consist of a 16-bit error code and an additional 16-bit information field which is manufacturer-specific. The 2 lower-order bytes (LSB) contain the error code, while the 2 higher-order bytes contain the additional information (MSB). If the object is supported, it must consist of at least two different entries: the length entry at subindex 0h and at least one error for sub-index 1H.

Byte	MSB	LSB
	Additional information	Error code

Fig. 2: Structure of the pre-defined error field

The following table gives an overview of implemented diagnostic error codes:

Table of diagnostic error

Error description	Emergency Error code	Content of error register (object 1001H)	Content of the pre-defined error field (object 1003H)	Content of the manufacturer-specific error field
	Hex	Hex	Hex Dec	Hex
Current out of range	2200	03	00002200 8704	
Error LED >power LED<	FF00	81	0001FF00 130816	Byte 0: 01
Error LED >communication LED<	FF00	81	0002FF00 196352	Byte 0: 02
Error LED >limit LED<	FF00	81	0003FF00 261888	Byte 0: 03
Error LED	FF00	81	0004FF00 327424	Byte 0: 04
Error BinOut >BinOut 1<	FF10	81	0001FF10 130832	Byte 0: 01
Error BinOut >BinOut 2<	FF10	81	0002FF10 196368	Byte 0: 02
Error internal supply voltage	3200	05	00003200 12800	
Error sensor supply voltage	3210	05	00003210 12816	
Error sensor fault	5030	21	00005030 20528	
Error after autotune	FF20	81	0000FF20 65312	
Error bus module MFI	FF30	81	0000FF30 65328	
Stack overflow	6100	21	00006100 24832	
CAN queue overrun	8110	01	00008110 33040	
CAN in error passive mode	8120	11	00008210 33296	

6.3. CANopen – Service Data Transfer

Data transfer between two nodes is described in the client/server model. An SDO client (initiating node) has direct access to individual entries in the object directory of an SDO server and is able to upload or download data records of any length to or from a server. The data record to be transferred can be specified by indicating a 16-bit index and 8-bit subindex. Since one message identifier is required for each transfer direction, two CAN identifiers are required for a connection between an SDO client and an SDO server. The connection between a client and a server is also referred to as an SDO channel.

The Bürkert field device has an SDO channel and supports the following transfer types:

Segmented Transfer

Segmented transfer makes it possible to transfer 7 bytes per transfer sequence. At the beginning, an initialization sequence a 16-bit index and 8-bit subindex is transferred. This is followed by confirmed, segmented transfer of data.

Expedited [1] Transfer

Expedited transfer allows for faster transfer of 4 bytes per transfer sequence. It is normally used whenever the size of the data being transferred does not exceed 4 bytes.

An SDO message is structured as follows:

ID	DLC	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
-	8	CMD	Index		Subindex	Data bytes			

The transfer is specified in byte 1 by control bytes. For an overview of the meaning of different control bytes, see the following table.

Process	CMD	Note
Master requests data from slave	40h	
Slave responds	42h	(valid data bytes not specified)
	43h	(4 valid data bytes)
	47h	(3 valid data bytes)
	4Bh	(2 valid data bytes)
	4Fh	(1 valid data byte)
Master writes to slave	22h	(valid data bytes not specified)
	23h	(4 valid data bytes)
	27h	(3 valid data bytes)
	2Bh	(2 valid data bytes)
	2Fh	(1 valid data byte)
Slave responds	60h	

[1] *Expedited: accelerated*

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6.4. CANopen – Process Data Transfer

All available process data objects are mapped. Only selected process data objects have valid values.

6.4.1. Received PDOs

Received PDOs are data that has been received by the device (MFC). This is output data as seen by the PLC.

Received PDO		
Byte	**RxPDO0**	
0	Lower byte	Set-point value
1	Higher-order byte	
2	Lower byte	Set binary output via bus
3	Higher-order byte	
4	Byte 0	Set-point value as Float
5	Byte 1	
6	Byte 2	
7	Byte 3	

The following bit field makes it possible to select objects for the process data transfer.

Process data	Explanation		Identification
BUS_PDOs	Bit field to select objects for the process data transfer (Tx)		Dec: 16896, 1 Hex: 4200, 1 INTEGER16
	Bit 0	-	
	Bit 1	Set-point value	
	Bit 2	-	
	Bit 3	-	
	Bit 4	-	
	Bit 5	-	
	Bit 6	-	
	Bit 7	-	
	Bit 8	-	
	Bit 9	-	
	Bit 10	-	
	Bit 11	Default values via bus	
	Bit 12	-	
	Bit 13	-	
	Bit 14	-	
	Bit 15	Set-point value as Float	

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The bit field can be defined by SDO access.

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
600h+ID	8	22	4200H		01H	Bit field			

6.4.2. Transmitted PDOs

Transmitted PDOs are data that has been sent to the device (MFC). This is input data as seen by the PLC.

Transmitted PDO								
Byte	TxPDO0		TxPDO1		TxPDO2		TxPDO3	
0	Byte 0	Actual value	Byte 0	Status limits	Byte 0	Totalizer (of the active gas)	Byte 0	Actual value as Float
1	Byte 1		Byte 1		Byte 1		Byte 1	
2	Byte 0	Set-point value	Byte 0	Status others	Byte 2		Byte 2	
3	Byte 1		Byte 1		Byte 3		Byte 3	
4	Byte 0	Active gas	Byte 0	AddMea-sureValue	Byte 0	Flow rate (of the active gas)	Byte 0	Set-point value as Float
5	Byte 1		Byte 1		Byte 1		Byte 1	
6	Byte 0	Status errors	Byte 2		Byte 2		Byte 2	
7	Byte 1		Byte 3		Byte 3		Byte 3	

The following bit field makes it possible to select objects for the process data transfer.

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Process data	Explanation		Identification
BUS_PDIs	Bit field to select objects for the process data transfer (Tx)		Dec: 16896, 2 Hex: 4200, 2 UNSIGNED32
	Bit 0	Actual value	
	Bit 1	Set-point value	
	Bit 2	Active gas	
	Bit 3	Nominal flow gas 1	
	Bit 4	Nominal flow gas 2	
	Bit 5	Status limits	
	Bit 6	Status errors	
	Bit 7	Status others	
	Bit 8	-	
	Bit 9	-	
	Bit 10	-	
	Bit 11	-	
	Bit 12	Totalizer value gas 1	
	Bit 13	Totalizer value gas 1	
	Bit 14	Actual value as Float	
	Bit 15	Set-point value as Float	
	Bit 16	-	
	Bit 17	AddMeasureValue	
	Bit 18	Xp (not supported yet)	

The bit field can be defined by SDO access.

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
600h+ID	8	22	4200H		02H	Bit field			

6.4.3. Transmission Type

Index	Subindex	Parameter	Length	Access
1800h	0	Number of subindices		Read
	1	COB ID used by the PDO		Read/write
	2	Transmission Type		Read/write
	5	Inhibit Time		Read/write

The transfer type (subindex 2) defines the type of transmission/reception for the PDO.

The following table explains how the entry is used. If an attempt is made to set the value of the variable to an entry that is not supported, an error message (abort code: 0609 0030h) is generated.

Transmission Type	Trigger condition of the PDO (B= both required, E= one required)			PDO transfer
	SYNC	RTR	Event	
0	B	-	B	synchronous, acyclic
1-240	E	-	-	synchronous, cyclic
241-251	-	-	-	reserved
252	B	B	-	synchronous, after RTR
253	-	E	-	asynchronous, after RTR
254	-	E	E	asynchronous, manufacturer-specific event
255	-	E	E	asynchronous, device-specific event

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6.4.4. Overview of the mapped objects

Process data	Explanation	Identification
Actual value	Actual value (1 word = 2 bytes) Value range 0 – 1000	RX (receive) Dec: 12288, 1 Hex: 3000, 1 INTEGER16
Set-point	Set-point value (1 word = 2 bytes) Value range 0 – 1000	Tx, Rx Dec: 12288, 2 Hex: 3000, 2 UNSIGNED16
Active gas	Calibration of this gas is used for control, gas 1 or gas 2 (1 word = 2 bytes) value range 0 – 1	RX (receive) Dec: 12288, 3 Hex: 3000, 3 UNSIGNED16
Nominal flow Gas 1	Nominal flow in Nl/min of calibration for gas 1 float = 4 bytes	RX (receive) Dec: 12288, 4 Hex: 3000, 4 REAL32
Nominal flow Gas 2	Nominal flow in Nl/min of calibration for gas 2 float = 4 bytes	RX (receive) Dec: 12288, 5 Hex: 3000, 5 REAL32
Status limits	Bit field for states of device-internal threshold value: (1 word = 2 bytes) see "9.1. Description of bit fields"	RX (receive) Dec: 12288, 6 Hex: 3000, 6 UNSIGNED16
Status errors	Bit field for device errors that are present. (1 word = 2 bytes) see "9.1. Description of bit fields"	RX (receive) Dec: 12288, 7 Hex: 3000, 7 UNSIGNED16
Status others	Bit field for current states in the controller. (1 word = 2 bytes) see "9.1. Description of bit fields"	RX (receive) Dec: 12288, 8 Hex: 3000, 8 UNSIGNED16

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Process data	Explanation	Identification
Default values via bus	Bit field for states of LEDs and binary outputs if they can be assigned by the bus. To do this, the relevant functions must be configured in the device with the PC program. (1 word = 2 bytes) see "9.1. Description of bit fields"	Tx (send) Dec: 12288, 12 Hex: 3000, C UNSIGNED16
Totalizer value Gas 1	Totalizer value of calibration for gas 1 in Nl. Float = 4 bytes	RX (receive) Dec: 12288, 13 Hex: 3000, D REAL32
Totalizer value Gas 2	Totalizer value of calibration for gas 2 in Nl. Float = 4 bytes	RX (receive) Dec: 12288, 14 Hex: 3000, E REAL32
Actual value as float	Actual value as Float (4 bytes) Value range 0 – 1000 Other units can be parameterized by the value of the flow unit from the "7.4. S-Analog Sensor Object". e.g. units per thousand, Nl/min and the calibrated unit	Tx, Rx Dec: 8960, 3 Hex: 2300, 3 REAL32
Set-point as float	Set-point value as Float (4 bytes) Value range 0 – 1000 Other units can be parameterized by the value of the flow unit from the "7.6. S-Single Stage Controller Object". e.g. units per thousand, Nl/min and the calibrated unit	RX (receive) Dec: 8448, 4 Hex: 2100, 4 REAL32
AddMeasureValue	Read only Additional value as float (4 bytes) Value as a percentage This value is only supported by a few MFCs. If the value is not supported, 0% is returned.	Dec: 12288, 46 Hex: 3000, 2E REAL32
Xp (currently not supported)	Read only Additional pressure value (2 bytes) Value in units per thousand Value range 0 – 1000 This value is only supported by a few MFCs. If the value is not supported, 0% is returned.	Dec: 12288, 47 Hex: 3000, 2F UNSIGNED16

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6.5. CANopen – Communication Object

Name	Description of the input data attribute	Index, Subindex
		CANopen
Node ID	Read Write Bus address Address by which the CANopen master communicates with the device. 1 – 127 Default: 127	Dec: 16384, 1 Hex: 4000, 1 UNSIGNED8
Baudrate	Read Write 0 - 1000 kb 1 – 800 kb 2 – 500 kb 3 – 250 kb 4 – 125 kb 5 – 100 kb 6 – 50 kb 7 – 20 kb 8 - 10 kb Default: 4 = 125 kb	Dec: 16384, 1 Hex: 4000, 1 UNSIGNED8

To activate modified values, an "NMT" reset must be sent.
If values are changed with the MassFlowCommunicator program, a hardware reset is required.

6.6. Acyclic data

See “7. Acyclic Data Transfer with PROFIBUS, DeviceNet and CANopen”

7. ACYCLIC DATA TRANSFER WITH PROFIBUS, DEVICENET AND CANOPEN

7.1. CANopen-Manufactory Object

Manufactory Object		
Name	**Description of the input data attributes**	**Index, Subindex**
		CANopen
Device Type	Read only CANopen profile No profile supported Entry 0	Dec: 4096, 0 Hex: 1000, 0 UNSIGNED32
Device Name	Read only Device name	Dec: 4104, 0 Hex: 1008, 0 VISIBLE_STRING
Hardware Version	Read only Hardware version e.g. "A"	Dec: 4105, 0 Hex: 1009, 0 VISIBLE_STRING
Software Version	Read only Software version e.g. "A01.00"	Dec: 4106, 0 Hex: 100A, 0 VISIBLE_STRING

7.2. CANopen-Identity Object

Identity Object		
Name	Description of the input data attributes	Index, Subindex
		CANopen
Vendor ID	Read only vendor's ID number. Bürkert's CANopen vendor ID 39h	Dec: 4120, 1 Hex: 1018, 1 UNSIGNED32
Product Code	Read only product code of the device.	Dec: 4120, 2 Hex: 1018, 2 UNSIGNED32
Revision Number	Read only This is a structure of two UNSIGNED16 values. It is the Bürkert CANopen communications version number.	Dec: 4120, 3 Hex: 1018, 3 UNSIGNED32
Serial Number	Read only The device serial number specified on the rating plate.	Dec: 4120, 4 Hex: 1018, 4 UNSIGNED32

7.3. DeviceNet S-Identity Object

S-Identity Object		
Name	Description of the input data attributes	Attribute address (class, instanceattribute; data type)
		DVN
Vendor ID	Read only vendor's ID number. Bürkerts DeviceNet vendor ID 57h	Dec: 1, 1, 1 Hex: 1, 1, 1 UINT
Device Type	Read only Numeric device identifier Identification of the general product type. This is type 0 (generic device).	Dec: 1, 1, 2 Hex: 1, 1, 2 UINT
Product Code	Read only The product code is 2, corresponding to the eds file.	Dec: 1, 1, 3 Hex: 1, 1, 3 UINT
Revision	Read only Revision of the element representing the identity object. This is a structure of two bytes.	Dec: 1, 1, 4 Hex: 1, 1, 4 WORD
Status	Read only Combined status of the device.	Dec: 1, 1, 5 Hex: 1, 1, 5 WORD
Serial Number	Read only Serial number that is unique for all Bürkert devices.	Dec: 1, 1, 6 Hex: 1, 1, 6 UDINT
Product Name	Read only MFC/MFM	Dec: 1, 1, 7 Hex: 1, 1, 7 SHORT_STRING

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7.4. S-Analog Sensor Object

S-Analog Sensor Object				
Name	Description of the input data attributes	Attribute address (class, instanceattribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	CANopen
Data Type	Read Write Describes the data format of the actual value and the "Flow Full Scale" (nominal flow) Hex 0xC3 INT 0xCA REAL	Dec: 49, 1, 3 Hex: 31, 1, 3 USINT	Dec: 1, 3 Hex: 1, 3	Dec: 8448, 1 Hex: 2100, 1 UNSIGNED8
Data Units	Read Write min. value 2048, max. value 4103 list of units see “9.2. Table of units” "% " "Units per thousand" and the calibrated device unit	Dec: 49, 1, 4 Hex: 31, 1, 4 UINT	Dec: 1, 4 Hex: 1, 4	Dec: 8448, 2 Hex: 2100, 2 UNSIGNED16
Reading Valid	Read only Min. value 0, max. value 1	Dec: 49, 1, 5 Hex: 31, 1, 5 BOOL	Dec: 1, 5 Hex: 1, 5	Dec: 8448, 3 Hex: 2100, 3 UNSIGNED8
Actual value	Read only Depends on the settings under data type and data units.	Dec: 49, 1, 6 Hex: 31, 1, 6 INT Or REAL	Dec: 1, 6 Hex: 1, 6	Dec: 8448, 4 Hex: 2100, 4 INTEGER16 **Or** Dec: 8448, 5 Hex: 2100, 5 REAL32
Status	Read only This is not supported yet. The return value is always 0.	Dec: 49, 1, 7 Hex: 31, 1, 7 BYTE	Dec: 1, 7 Hex: 1, 7	Dec: 8448, 6 Hex: 2100, 6 UNSIGNED8

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S-Analog Sensor Object				
Name	Description of the input data attributes	Attribute address (class, instanceattribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	CANopen
Flow Full Scale	Read only Depends on the settings under data type and data units.	Dec: 49, 1, 10 Hex: 31, 1, A INT Or REAL	Dec: 1, 10 Hex: 1, A	Dec: 8448, 7 Hex: 2100, 7 INTEGER16 **Or** Dec: 8448, 8 Hex: 2100, 8 REAL32

7.5. S-Analog Actuator Object

S-Analog Actuator Object				
Name	Description of the input data attributes	Attribute address (class, instance attribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	DPV1
Data Type	Read Write Describes the data format of the "value" Hex 0xC3 INT 0xCA REAL	Dec: 50, 1, 3 Hex: 32, 1, 3 USiNT	Dec: 1, 53 Hex: 1, 35	Dec: 8704, 1 Hex: 2200, 1 UNSIGNED8
Data Units	Read Write min. value 2048 max. value 4103 Possible units are: "% " "Units per thousand" 0x800 "Units per thousand" 0x1007 "% "	Dec: 50, 1, 4 Hex: 32, 1, 4 UINT	Dec: 1, 54 Hex: 1, 36	Dec: 8704, 2 Hex: 2200, 2 UNSIGNED16

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S-Analog Actuator Object				
Name	Description of the input data attributes	Attribute address (class, instance attribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	DPV1
Actuator Override (overwrite control output)	Read Write 0 Normal operation of the controller and binary input controls the valve 1 off / closed 2 on / open -flow is restricted by the pressure and orifice of the valve 3 Hold function active for control output to the valve 64 Valve control output is controlled by the set-point value. The min. and max. ramp up and down times (ramps, etc.) apply. Read only 65 Similar to 64, except that the percentage entry for the control output is only within the working range of the valve 66 Calibration mode active 67 Autotune mode active 68 Safety mode active	Dec: 50, 1, 5 Hex: 32, 1, 5 USINT	Dec: 1, 55 Hex: 1, 37	Dec: 8704, 3 Hex: 2200, 3 UNSIGNED8
Valve Value (control output to valve)	Read only The valve duty cycle. The value format depends on the data type. The value unit is defined by the value of the unit.	Dec: 50, 1, 6 Hex: 32, 1, 6 INT Or REAL	Dec: 1, 56 Hex: 1, 38	Dec: 8704, 4 Hex: 2200, 4 INTEGER16 **Or** Dec: 8704, 5 Hex: 2200, 5 REAL32
Status	Read only This is not supported yet. The return value is always 0.	Dec: 50, 1, 7 Hex: 32, 1, 7 BYTE	Dec: 1, 57 Hex: 1, 39	Dec: 8704,6 Hex: 2200, 6 UNSIGNED8

7.6. S-Single Stage Controller Object

S-Single Stage Controller Object				
Name	Description of the input data attributes	Attribute address (class, instance attribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	CANopen
Data Type	Read Write Describes the data type of the set-point value Hex 0xC3 INT0 0xCAREAL	Dec: 51, 1, 3 Hex: 33, 1, 3 USINT	Dec: 1, 103 Hex: 1, 67	Dec: 8960, 1 Hex: 2300, 1 UNSIGNED8
Data Units	Read Write min. value 2048, max. value 4103 list of units see "9.2. Table of units" "% " "Units per thousand" and the calibrated device unit	Dec: 51, 1, 6 Hex: 33, 1, 6 UINT	Dec: 1, 104 Hex: 1, 68	Dec: 8960, 2 Hex: 2300, 2 UNSIGNED16
Set-point	Read Write The value format depends on the data type. The value unit is defined by the value of the unit.	Dec: 51, 1, 6 Hex: 33, 1, 6 INT Or REAL	Dec: 1, 106 Hex: 1, 6A	Dec: 8960, 3 Hex: 2300, 3 INTEGER16 **Or** Dec: 8960, 4 Hex: 2300, 4 REAL32
Status	Read only This is not supported yet. The return value is always 0.	Dec: 51, 1, 6 Hex: 33, 1, 6 BYTE	Dec: 1, 107 Hex: 1, 6B	Dec: 8960, 5 Hex: 2300, 5 UNSIGNED8

7.7. Bürkert General Description Object

Bürkert General Description Object				
Name	Description of the input data attributes	Attribute address (class, instance attribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	CANopen
Device Ident Number	Read only Bürkert identifications number of the device min. value 0, max. value 99999999	Dec: 101, 1, 1 Hex: 65, 1, 1 UDINT	Dec: 0, 101 Hex: 0, 65	Dec: 8192, 1 Hex: 2000, 1 UNSIGNED32
Device Serial Number	Read only Bürkert serial number of the device min. value 0, max. value 4294967295	Dec: 101, 1, 2 Hex: 65, 1, 2 UDINT	Dec: 0, 102 Hex: 0, 66	Dec: 8192, 2 Hex: 2000, 2 UNSIGNED32
Device Type	Read only Bürkert type number of the device min. value 0, max. value 65535	Dec: 101, 1, 3 Hex: 65, 1, 3 UINT	Dec: 0, 103 Hex: 0, 67	Dec: 8192, 3 Hex: 2000, 3 UNSIGNED16
Ident Number printed circuit board	Read only Ident number of the printed circuit board min. value 0, max. value 99999999	Dec: 101, 1, 4 Hex: 65, 1, 4 UDINT	Dec: 0, 104 Hex: 0, 68	Dec: 8192, 4 Hex: 2000, 4 UNSIGNED32
Revision Number Hardware (Hardware revision)	Read only Revision number of the printed circuit board min. value A‘, max. value Z‘	Dec: 101, 1, 5 Hex: 65, 1, 5 USINT	Dec: 0, 105 Hex: 0, 69	Dec: 8192, 5 Hex: 2000, 5 UNSIGNED8

7.8. Bürkert MFC Family Object

Bürkert MFC Family Object				
Name	Description of the input data attributes	Attribute address (class, instance attribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	CANopen
Actual value (actual value (x))	Read only Value in units per thousand of the active gas min. value 0, max. value 1000	Dec: 110, 1, 1 Hex: 6E, 1, 1 UINT	Dec: 1, 151 Hex: 1, 97	Dec: 12288, 1 Hex: 3000, 1 UNSIGNED16

Bürkert MFC Family Object				
Name	Description of the input data attributes	Attribute address (class, instance attribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	CANopen
Set-point (set-point (w))	Read Write Set-point value in units per thousand for the active gas min. value 0, max. value 1000	Dec: 110, 1, 2 Hex: 6E, 1, 2 UINT	Dec: 1,152 Hex: 1, 98	Dec: 12288, 2 Hex: 3000, 2 UNSIGNED16
Active gas	Read Write calibration of this gas is used for control. Gas 1 or gas 2 min. value 0, max. value 1	Dec: 110, 1, 3 Hex: 6E, 1, 3 UINT	Dec: 1,153 Hex: 1, 99	Dec: 12288, 3 Hex: 3000, 3 UNSIGNED16
Flow rate gas 1	Read only Nominal flow in Nl/min for calibration of gas 1 min. value 0, max. value 1.00E+39	Dec: 110,1,4 Hex: 6E, 1, 4 REAL	Dec: 1,154 Hex: 1, 9A	Dec: 12288, 4 Hex: 3000, 4 REAL32
Flow rate gas 2	Read only Nominal flow in Nl/min for calibration of gas 2 min. value 0, max. value 1.00E+39	Dec: 110, 1, 5 Hex: 6E, 1, 5 REAL	Dec: 1,155 Hex: 1, 9B	Dec: 12288, 5 Hex: 3000, 5 REAL32
Status limits	Read only Bit field for the status of device-internal threshold value. See "9.1. Description of bit fields" min. value 0, max. value 65535	Dec: 110, 1, 6 Hex: 6E, 1, 6 WORD	Dec: 1, 156 Hex: 1, 9C	Dec: 12288, 6 Hex: 3000, 6 UNSIGNED16
Status errors	Read only Bit field for device errors See "9.1. Description of bit fields" min. value 0, max. value 65535	Dec: 110, 1, 7 Hex: 6E, 1, 7 WORD	Dec: 1, 157 Hex: 1, 9D	Dec: 12288, 7 Hex: 3000, 7 UNSIGNED16
Status others	Read only Bit field for current controller states See "9.1. Description of bit fields" min. value 0, max. value 65535	Dec: 110, 1, 8 Hex: 6E, 1, 8 WORD	Dec: 1, 158 Hex: 1, 9E	Dec: 12288, 8 Hex: 3000, 8 UNSIGNED16
Status LEDs	Read only Bit field for communication states See "9.1. Description of bit fields" min. value 0, max. value 65535	Dec: 110, 1, 9 Hex: 6E, 1, 9 WORD	Dec: 1, 159 Hex: 1, 9F	Dec: 12288, 9 Hex: 3000,9 UNSIGNED16

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Bürkert MFC Family Object				
Name	**Description of the input data attributes**	**Attribute address (class, instance attribute; data type)**	**Slot, Index**	**Index, Subindex**
		DVN	**DPV1**	**CANopen**
Status binary outputs	Read only Bit field for states of binary outputs (reserved) See "9.1. Description of bit fields" min. value 0, max. value 65535	Dec: 110, 1, 10 Hex: 6E, 1, A WORD	Dec: 1, 160 Hex: 1, A0	Dec: 12288, 10 Hex: 3000, A UNSIGNED16
Status Hardware	Read only Bit field for the current status of binary input and output and the status of LEDs See "9.1. Description of bit fields" min. value 0, max. value 65535	Dec: 110, 1, 11 Hex: 6E, 1, B WORD	Dec: 1, 161 Hex: 1, A1	Dec: 12288, 11 Hex: 3000, B UNSIGNED16
Set BinOut via bus	Read Write Bit field for states of LEDs and binary outputs and for configuring them via BUS. The behavior of the device must be previously configured with the PC software. *MenuViews → DeviceSettings → Assignments of Inputs and Outputs.* min. value 0, max. value 65535	Dec: 110, 1, 12 Hex: 6E, 1, C WORD	Dec: 1, 162 Hex: 1, A2	Dec: 2288, 12 Hex: 3000, C UNSIGNED16
Totalizer gas 1	Read Write Totalizer value in Nl from the calibration for gas 1 min. value 0, max. value 1.00E+39	Dec: 110, 1, 13 Hex: 6E, 1, D REAL	Dec: 1, 163 Hex: 1, A3	Dec: 12288, 13 Hex: 3000, D REAL32
Totalizer gas 2	Read Write Totalizer value in Nl from the calibration for gas 2 min. value 0, max. value 1.00E+39	Dec: 110, 1, 14 Hex: 6E, 1, E REAL	Dec: 1, 164 Hex: 1, A4	Dec: 2288, 14 Hex: 3000, E REAL32
Max ramp time up	Read Write You can set the time delay (0 – 100 ⇒ 0 – 10 seconds) that delays a set-point value jump from 0% to 100% using a ramp function. min. value 0, max. value 100	Dec: 110, 1, 15 Hex: 6E, 1, F UINT	Dec: 1, 165 Hex: 1, A5	Dec: 12288, 15 Hex: 3000, F UNSIGNED16

Bürkert MFC Family Object				
Name	Description of the input data attributes	Attribute address (class, instance attribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	CANopen
Max ramp time down	Read Write You can set the time delay (0 – 100 ⇒ 0 – 10 seconds) that delays a set-point value jump from 100% to 0% using a ramp function. min. value 0, max. value 10	Dec: 110, 1, 16 Hex: 6E, 1, 10 UINT	Dec: 1, 166 Hex: 1, A6	Dec: 12288, 16 Hex: 3000, 10 UNSIGNED16
Dynamic behavior of the control	Read Write Change in the dynamic behavior of the controller. Can be set slower (values <1) and faster (values > 1) than the factory setting (value = 1) (step width 0,1) min. value 0.1, max. value 2	Dec: 110, 1, 17 Hex: 6E, 1, 11 REAL	Dec: 1, 167 Hex: 1, A7	Dec: 12288, 17 Hex: 3000, 11 REAL32
x_Limit1	Read Write Limit value for the first threshold value from the process value (x) in units per thousand for the active gas min. value 0, max. value 1000	Dec: 110, 1, 18 Hex: 6E, 1, 12 UINT	Dec: 1, 168 Hex: 1, A8	Dec: 12288, 18 Hex: 3000, 12 UNSIGNED16
x_Limit1 Hyst	Read Write Hysteresis for x_Limit1 in units per thousand min. value 0, max. value 1000	Dec: 110, 1, 19 Hex: 6E, 1, 13 UINT	Dec: 1, 169 Hex: 1, A9	Dec: 12288, 19 Hex: 3000, 13 UNSIGNED16
x_Limit2	Read Write Limit value for the second threshold value from the process value (x) in units per thousand for the active gas min. value 0, max. value 1000	Dec: 110, 1, 20 Hex: 6E, 1, 14 UINT	Dec: 1, 170 Hex: 1, AA	Dec: 12288, 20 Hex: 3000, 14 UNSIGNED16
x_Limit2 Hyst	Read Write Hysteresis for x_Limit2 in units per thousand min. value 0, max. value 1000	Dec: 110, 1, 21 Hex: 6E, 1, 15 UINT	Dec: 1, 171 Hex: 1, AB	Dec: 12288, 21 Hex: 3000, 15 UNSIGNED16
y2_Limit1	Read Write Limit value for the first threshold value from the control output (y2) in units per thousand (only via MFCs) min. value 0, max. value 1000	Dec: 110, 1, 22 Hex: 6E, 1, 16 UINT	Dec: 1, 172 Hex: 1, AC	Dec: 12288, 22 Hex: 3000, 16 UNSIGNED16

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Bürkert MFC Family Object				
Name	Description of the input data attributes	Attribute address (class, instance attribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	CANopen
y2_Limit1 Hyst	Read Write Hysteresis for y2_Limit1 in units per thousand min. value 0, max. value 1000	Dec: 110, 1, 23 Hex: 6E, 1, 17 UINT	Dec: 1, 173 Hex: 1, AD	Dec: 12288, 23 Hex: 3000, 17 UNSIGNED16
y2_Limit2	Read Write Limit value for the second threshold value from the control output (y2) in units per thousand (only via MFCs) min. value 0, max. value 1000	Dec: 110, 1, 24 Hex: 6E, 1, 18 UINT	Dec: 1, 174 Hex: 1, AE	Dec: 12288, 24 Hex: 3000, 18 UNSIGNED16
y2_Limit2 Hyst	Read Write Hysteresis for y2_Limit2 in units per thousand min. value 0, max. value 1000	Dec: 110, 1, 25 Hex: 6E, 1, 19 UINT	Dec: 1, 175 Hex: 1, AF	Dec: 12288, 25 Hex: 3000, 19 UNSIGNED16
Gas1 Totalizer Limit1	Read Write Limit value for the first threshold value of the totalizer for gas1 in Nl/min min. value 0, max. value 1.00E+39	Dec: 110, 1, 26 Hex: 6E, 1, 1A REAL	Dec: 1, 176 Hex: 1, B0	Dec: 12288, 26 Hex: 3000, 1A REAL32
Gas1 Totalizer Limit2	Read Write Limit value for the second threshold value from the totalizer for gas1 in Nl/min min. value 0, max. value 1.00E+39	Dec: 110, 1, 27 Hex: 6E, 1, 1B REAL	Dec: 1, 177 Hex: 1, B1	Dec: 12288, 27 Hex: 3000, 1 BREAL32
Gas2 Totalizer Limit1	Read Write Limit value for the first threshold value of the totalizer for gas2 in Nl/min min. value 0, max. value 1.00E+39	Dec: 110, 1, 28 Hex: 6E, 1, 1C REAL	Dec: 1, 178 Hex: 1, B2	Dec: 12288, 28 Hex: 3000,1C REAL32
Gas2 Totalizer Limit2	Read Write Limit value for the second threshold value from the totalizer for gas2 in Nl/min min. value 0, max. value 1.00E+39	Dec: 110, 1, 29 Hex: 6E, 1, 1D REAL	Dec: 1, 179 Hex: 1, B3	Dec: 12288, 29 Hex: 3000, 1D REAL32

Bürkert MFC Family Object				
Name	**Description of the input data attributes**	**Attribute address (class, instance attribute; data type)**	**Slot, Index**	**Index, Subindex**
		DVN	**DPV1**	**CANopen**
Gas1 SafeValue	Read Write Change in the flow rate of gas1 to which the device is set in case of an emergency in the system (value in units per thousand) min. value 0, max. value 1000	Dec: 110, 1, 30 Hex: 6E, 1, 1E UINT	Dec: 1, 180 Hex: 1, B4	Dec: 12288, 30 Hex: 3000, 1 EUNSIGNED16
Gas2 SafeValue	Read Write Change in the flow rate of gas2 to which the device is set in case of an emergency in the system (value in units per thousand) min. value 0, max. value 1000	Dec: 110, 1, 31 Hex: 6E, 1, 1F UINT	Dec: 1, 181 Hex: 1, B5	Dec: 12288, 31 Hex: 3000, 1F UNSIGNED16
Binary output 1 function-limits	Read Write Determines when binary output 1 is active. It is a logical OR operation of all "Binary output 1 functions" (in this case: group of limits; see "Bit field LIMITS" in "9.1. Description of bit fields" min. value 0, max. value 65535	Dec: 110, 1, 32 Hex: 6E, 1, 20 WORD	Dec: 1, 182 Hex: 1, B6	Dec: 12288, 32 Hex: 3000, 20 UNSIGNED16
Binary output 1 function-errors	Read Write Determines when binary output 1 is active. It is a logical OR operation of all "Binary output 1 functions" (in this case: group of errors; see "Bit field ERRORS" in "9.1. Description of bit fields" min. value 0, max. value 65535	Dec: 110, 1, 33 Hex: 6E, 1, 21 WORD	Dec: 1, 183 Hex: 1, B7	Dec: 12288, 33 Hex: 3000, 21 UNSIGNED16
Binary output 1 function-others	Read Write Determines when binary output 1 is active. It is a logical OR operation of all "Binary output 1 functions" (in this case: group of others; see "Bit field OTHERS" in "9.1. Description of bit fields") min. value 0, max. value 65535	Dec: 110, 1, 34 Hex: 6E, 1, 22 WORD	Dec: 1, 184 Hex: 1, B8	Dec: 12288, 34 Hex: 3000, 22 UNSIGNED16

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Bürkert MFC Family Object				
Name	Description of the input data attributes	Attribute address (class, instance attribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	CANopen
Binary output 1 mode of operation	Read Write Determines the opreting mode of binary output 1 0: normal, 1: inverse min. value 0, max. value 1	Dec: 110, 1, 35 Hex: 6E, 1, 23 UINT	Dec: 1, 185 Hex: 1, B9	Dec: 12288, 35 Hex: 3000, 23 UNSIGNED16
Binary output 2 function-limits	Read Write Determines when binary output 2 is active. It is a logical OR operation of all "Binary output 2 functions" (in this case: group of limits; see "Bit field LIMITS" in "9.1. Description of bit fields") min. value 0, max. value 65535	Dec: 110, 1, 36 Hex: 6E, 1, 24 WORD	Dec: 1, 186 Hex: 1, BA	Dec: 12288, 36 Hex: 3000, 24 UNSIGNED16
Binary output 2 function-errors	Read Write Determines when binary output 2 is active. It is a logical OR operation of all "Binary output 2 functions" (in this case: group of errors; see "Bit field ERRORS" in "9.1. Description of bit fields" min. value 0, max. value 65535	Dec: 110, 1, 37 Hex: 6E, 1, 25 WORD	Dec: 1, 187 Hex: 1, BB	Dec: 12288, 37 Hex: 3000, 25 UNSIGNED16
Binary output 2 function-others	Read Write Determines when binary output 2 is active. It is a logical OR operation of all "Binary output 2 functions" (in this case: group of others; see "Bit field OTHERS" in "9.1. Description of bit fields") min. value 0, max. value 65535	Dec: 110, 1, 38 Hex: 6E, 1, 26 WORD	Dec: 1, 188 Hex: 1, BC	Dec: 12288, 38 Hex: 3000, 26 UNSIGNED16
Binary output 2 mode of operation	Read Write Determines the operating mode of binary output 2 0: normal, 1: inverse min. value 0, max. value 1	Dec: 110, 1, 39 Hex: 6E, 1, 27 UINT	Dec: 1, 189 Hex: 1, BD	Dec: 12288, 39 Hex: 3000, 27 UNSIGNED16

Bürkert MFC Family Object				
Name	Description of the input data attributes	Attribute address (class, instance attribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	CANopen
Binary input 1 function	Read Write Determines the function of binary input 1 (for a description see "Operating Instructions") min. value 0, max. value 65535	Dec: 110, 1, 40 Hex: 6E, 1, 28 UINT	Dec: 1, 190 Hex: 1, BE	Dec: 12288, 40 Hex: 3000, 28 UNSIGNED16
Binary input 2 function	Read Write Determines the function of binary input 2 (for a description see "Operating Instructions") min. value 0, max. value 65535	Dec: 110, 1, 41 Hex: 6E, 1, 29 UINT	Dec: 1, 191 Hex: 1, BF	Dec: 12288, 41 Hex: 3000, 29 UNSIGNED16
Binary input 3 function	Read Write Determines the function of binary input 3 (for a description see "Operating Instructions") min. value 0, max. value 65535	Dec: 110, 1, 42 Hex: 6E, 1, 2A UINT	Dec: 1, 192 Hex: 1, C0	Dec: 12288, 42 Hex: 3000, 2A UNSIGNED16
Control output y2	Read only for MFC only. control output y2 of controller in units per thousand min. value 0, max. value 1000	Dec: 110, 1, 44 Hex: 6E, 1, 2C UINT	Dec: 1, 194 Hex: 1, C2	Dec: 12288, 44 Hex: 3000, 2C UNSIGNED16
MFC mode	Read Write Activation of the Autotune function. The controller must be in normal mode. (ModusMFC = 0) Autotune can be activated by writing a value of 2.	Dec: 110, 1, 46 Hex: 6E, 1, 2E UINT	Dec: 1, 196 Hex: 1, C4	Dec: 12288, 46 Hex: 3000, 2E UNSIGNED16
AddMeasu-reValue	Read only Additional value as float (4 bytes) Value as a percentage This value is only supported by a few MFCs. If the value is not supported, 0% is returned.	Dec: 110,1,47 Hex: 6E, 1, 2D REAL	Dec: 1, 197 Hex: 1, C5	Dec: 12288, 47 Hex: 3000, 2D REAL32

Bürkert MFC Family Object				
Name	Description of the input data attributes	Attribute address (class, instance attribute; data type)	Slot, Index	Index, Subindex
		DVN	DPV1	CANopen
Xp	Read only Additional pressure measurement value (2 bytes) Value in units per thousand min. value 0, max. value 1000 This value is only supported by a few MFCs. If the value is not supported, 0 is returned.	Dec: 110,1,48 Hex: 6E, 1, 30 UINT	Dec: 1, 198 Hex: 1, C6	Dec: 12288, 48 Hex: 3000, 30 UNSIGNED16

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8. STARTING UP THE MODBUS

8.1. General Information

The MFC supports the Modbus communication protocol as of firmware A.00.90 for devices with digital set-point setting (version RS485 e.g. 8713).
Firmware versions higher than A.00.96 are support the Modbus communication protocol for analog devices.

The Modbus operates according to a master-slave method. In this case the MFC is designed as the slave. Adjustable addresses are 1 to 32.

The BUS address of the devices can be set either with the Bürkert configuration tool MassFlowCommunicator in the view “HART / Modbus COM Settings” or directly via the Modbus master. If an address change is set via the Modbus master, the new address is not valid until the next commands are issued.

The communication is monitored by a timeout detection. If a timeout occurs, the device is set to a safe state (set-point value is set to 0, causing the valve to close).

For analog devices the setpoint from analog input is active after a timeout.

The timeout can be specified via the holding register Timeout Detection Time , the default value is 60 (seconds). The timeout detection can be deactivated by a value of 0. For analog devices the timeout detection cannot be deactivated.

Communication is via Modbus RTU. The preset communication parameters are:

Transfer rate: 9600 baud

Start bit: 1

Data bits: 8

Stop bits: 1

Parity: none

8.2. Modbus in general

The Modbus protocol was developed by Modicon for programmable controllers and has evolved into a widely used communication protocol in the industry.

A Modbus master can address individual slaves. The slaves send back a telegram (reply) on request which was individually addressed to them. The Modbus protocol defines the format for the request from the master by entering in the protocol the device address, a function code for specifying the requested action, all data to be transmitted and a checksum. The reply telegram of the slaves is also specified with the aid of the Modbus protocol. It includes fields for acknowledgement of the implemented action, for all data to be sent back and for a checksum. If an error occurs on receipt of the telegram or if the slave cannot execute the requested action, the slave sends back an error telegram.

The following diagram shows the structure of a command:

Request from master
Device address
Function code
• Data

Reply telegram from slave
Device address
Function code
• Data

Checksum	Checksum

The request:

The function code in the request informs the addressed slave which action is to be executed. The data bytes include all additional information that the slave requires to execute the action.
E.g. if the function code 03 requests the slave to read out the holding register and to send back its contents. The data field must include the following information: Start register and the number of registers to be read. In this case one register corresponds to one WORD (2 bytes). The slave can use the checksum to determine the validity of the telegram contents.

The reply:

The structure of the reply corresponds to the request telegram one. If an error occurs, an error code is sent instead of the function code. In this case the data includes a code which describes the error. The master can use the checksum to determine the validity of the telegram contents.

Example of Modbus communication (Read Input Register commands)

The request specifies the initial register and the number of input registers to be read.
In the following example the value of the totalizer is requested from the device with address 1.

Request

Field name	Value	
Slave address	0x01	
Function	0x04	(Read Input Register)
Initial address high	0x00	
Initial address low	0x0A	
Number of high registers	0x00	
Number of low registers	0x02	
Error check	CRC	(high byte)
Error check	CRC	(low byte)

The register data in the reply is compressed as two bytes per register.

The reply is transferred as soon as the data has been completely assembled.

Here is an example of the reply to the previous request:

Field name	Value	
Slave address	0x01	
Function	0x04	
Byte count	0x04	
Data1 high byte	0x00	
Data1 low byte	0x00	
Data2 high byte	0x09	
Data2 low byte	0x04	
Error check	CRC	(high byte)
Error check	CRC	(low byte)

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Exceptional reply

If a master device sends a request to a slave device, the master device expects a normal reply When the master has transferred a request, one of the four events may occur:

- If the slave device receives the request without a data transfer error and the request can be processed normally, a normal reply is sent back.
- If the slave device does not receive the request due to a data transfer error, no reply is sent back. The master device program determines a timeout for the request.
- If the slave device determines a data transfer error, no reply is sent back. The master device program determines a timeout for the request.
- If the slave device receives the request without a data transfer error, but the request cannot be processed (e.g. to read out a non-existent register), an exceptional reply is sent back which informs the master device about the type of error. The exceptional reply has two fields that distinguishes it from a normal reply.

Function code field

If the answer is normal, the slave sends back a copy of the function code included in the original request in the appropriate field of the reply. If the reply is an exception, the value of the function code is exactly 0x80 hexadecimal numbers higher than it would be in a normal reply.

Data field

If the reply is an exception, the slave sends an exception code in the data field, that defines the operating status of the slave which caused the exception.

Example of an exceptional reply

Request (Read Input Register 0x68) register is outside the validity range

Field name	Value	
Slave address	0x01	
Function	0x04	
Initial address high	0x00	
Initial address low	0x68 (invalid register)	
Number of high registers	0x00	
Number of low registers	0x01	
Error check	CRC	(high byte)
Error check	CRC	(low byte)

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Response

Field name	Value	
Slave address	0x01	
Function	0x84	
Data field	0x02	
Error check	CRC	(high byte)
Error check	CRC	(low byte)

In this example the master addresses a request to slave device 01. The function code 04 stands for "Read Input Register". The register address in the device is outside the address validity range and this is why the slave sends an exceptional reply with the indicated exception code 02 (Illegal Data Address).

Implemented exceptional replies

Code	Name	Description
00		Not an error
01	ILLEGAL FUNCTION	Function code is not supported
02	ILLEGAL DATA ADDRESS	The data address is not permitted in the device
03	ILLEGAL DATA VALUE	A value included in the request field is incorrect for the device
04	SLAVE DEVICE FAILURE	Internal device error

Number formats

Data type	Description	Length (bytes)
UINT8	Unsigned integer, 8 bit	1
UINT16	Unsigned integer, 16 bit	2
UINT32	Unsigned integer, 32 bit	4
FLOAT32	Floating-point number in accordance with IEEE-754 The Float32 value is saved in two successive addresses, the first address includes the most significant word (sign, exponent, and upper part of the mantissa), and the second address the least significant word (lower part of the mantissa)	4

More technical information can be found at www.modbus.org.

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8.3. Modbus register and communication objects

8.3.1. Modbus register lists

Up to firmware A.00.99 only Modbus register list 0 is supported.

Started with firmware A.01.00 several register lists are supported for communication with the device. The default list is 0. The register's data description can be found in the specific documentation.

The selection of the used register list is made in the MassFlowCommunicator at the menu item „*Views → HART / Modbus → COM settings”* under „*Modbus used register list*“.

8.3.2. Holding register

These 16-bit values can be read and changed by the master.

Valid commands

Code	Name	Broadcast
0x03	Read Holding Register	No
0x06	Write Single Register	No
0x10	Write Multiple Register	No

Valid addresses

see below

Holding register of register list 0 (default)

Register address in MFC	Number of registers	Designation / Description	R/W	Format
0001	1	Reset Device At a value of 1, the device is reset Clearing the value is needless.	W	UINT16
0002	1	Reset Totalizator At a value of 1 the value of the current totalizator is deleted. Clearing the value is needless.	W	UINT16
0003	1	Set-point (in units per thousand) Set-point value of gas flow rate / set-point value in per mill for the active gas min. value 0, max. value 1000	R/W	UINT16

Register address in MFC	Number of registers	Designation / Description	R/W	Format
0004	1	Active gas Active Gas / calibration of this gas is used for control. Value Gas 0 Gas 1 1 Gas 2	R/W	UINT16
0005	1	Actuator Override Defines the behavior of the set-point setting 0 normal mode of the controller and binary input controls the valve 1 off / closed 2 on / open, the flow rate is restricted by the pressure and the orifice of the valve 3 correcting variable to the valve is frozen 64 correcting variable to the valve is controlled by the value of the set-point value. The min. and max. ramp up and down times (ramps, etc.) apply. Read only 65 similar to 64, however percentage of the correcting variable only within the working area of the valve 66 Calibration mode active 67 Autotune mode active 68 Safety mode active	R/W	UINT8
0006	1	ModeMFC Activation of the Autotune function. The controller must be in normal mode (modeMFC = 0) Autotune can be activated by writing a value of 2.	R/W	UINT8
0007	1	Modbus Device Address Device address / Bus address Address which the Modbus master uses to communicate with the device. Min. value 1, max. value 32	R/W	UINT8
0008…0009	2	Set-point as float Set-point as float (4 byte) Value in the calibrated device unit, see input register → “Data Unit”	R/W	FLOAT32

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Register address in MFC	Number of registers	Designation / Description	R/W	Format
0010	1	Timeout Detection Time (In Second) Timeout detection is implemented in the MFC device. The detection time can be specified by this register. The default value is 60 (seconds) If the time between two pollings is longer than the specified time, a timeout will be detected. After timeout detection the device will be set into a safety mode. In this case the set point will be set to 0 and the valve will be closed. The timeout detection can be disabled by a value of 0. Range: 0 - 60 Attention please: This value will be stored non volatile from firmware version A.00.96.	R/W	UINT16
0011	1	Baudrate Defines the baud rate of the Modbus communication Value / Baud rate / Support 0 / 300 / not supported 1 / 600 / not supported 2 / 1200 / not supported 3 / 2400 / not supported 4 / 4800 / not supported **5** / **9600** / supported 6 / 19200 / supported 7 / 38400 / supported 8 / 57600 / not supported 9 / 115200 / not supported Attention please: • A changed value will be active after a device reset. • This register is available from firmware version A.00.96.	R/W	UINT8
0012	1	Parity Defines the parity bit of the Modbus communication Value / Parity **0** / **NONE** 1 / ODD 2 / EVEN Attention please: • A changed value will be active after a device reset. • This register is available from firmware version A.00.96.	R/W	UINT8

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Register address in MFC	Number of registers	Designation / Description	R/W	Format
0013	1	Stopbit Defines the number of stop bits of the Modbus communication. Value Number of Stop bit 1 1 Stop bit 2 2 Stop bits Attention please: • A changed value will be active after a device reset. • This value will be stored non volatile from firmware version A.01.00.	R/W	UINT8

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Holding register of register list 1

Register Address in MFC	Number of Register	Name / Description	R/W	Type
0000…0001	2	Actual Flow Actual value as Float Value range -3.39E+38 – 3.39E38 Unit see Holding Register → "Unit Flow Value"	R	FLOAT32
0002…0003	2	Medium temperature Temperatur in °C	R	FLOAT32
0004…0005	2	Totalizer Totalizer in unit Nl. (0 °C / 1013 mbar)	R	FLOAT32
0006…0007	2	Set-Point as float Set-point value as Float Value is based on the calibrated device unit. See also Holding Register → "Unit Flow Value"	R/W	FLOAT32
0008…0009	2	Analog Input Signal in per cent The measured analog signal will be transmitted in a range of 0 – 100.0%	R	FLOAT32
0010…0011	2	Control Output to Valve (y2) For MFC only. Control output y2 of controller in % (0 – 100.0 %)	R	FLOAT32
0012	1	Status Limits Status limits / Bit field for the status of device-internal threshold value. See "9.1.1. Bit field LIMITS" min. value 0, max. value 65535	R	UINT16
0013	1	Status Errors Status errors / Bit field for device errors See "9.1.2. Bit field ERRORS" min. value 0, max. value 65535	R	UINT16

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Register Address in MFC	Number of Register	Name / Description	R/W	Type
0014	1	Controller Function Defines the behavior of the set-point setting 0: Normal operation of the controller and binary input controls the valve 3: Hold function active for control output to the valve 22: off / closed 23: on / open -flow is restricted by the pressure and orifice of the valve 64: Valve control output is controlled by the set-point value. The min. and max. ramp up and down times (ramps, etc.) apply. Read only 65: Similar to 64, except that the percentage entry for the control output is only within the working range of the valve 66: Calibration mode active 67: Autotune mode active 68: Safety mode active	R/W	UINT16
0015	1	Baudrate Returns the Speed for Modbus Communication. Value / Baudrate / Support 0 / 300 / not supported 1 / 600 / not supported 2 / 1200 / not supported 3 / 2400 / not supported 4 / 4800 / not supported **5** / **9600** / supported 6 / 19200 / supported 7 / 38400 / supported 8 / 57600 / not supported 9 / 115200 / not supported Attention please: • A changed value will be active after a device reset..	R/W	UINT16
0016	1	Parity Defines the parity bit of the Modbus communication. Value / Parity **0** / **NONE** 1 / ODD 2 / EVEN Attention please: • A changed value will be active after a device reset..	R/W	UINT16

Register Address in MFC	Number of Register	Name / Description	R/W	Type
0017	1	Stopbit Defines the number of stop bits of the Modbus communication. Value Number of Stop bit 1 1 Stop bit 2 2 Stop bits Attention please: • A changed value will be active after a device reset..	R/W	UINT16
0018	1	Timeout Detection Time (In Second) Timeout detection is implemented in the MFC device. The detection time can be specified by this register. The default value is 60 (seconds) If the time between two pollings is longer than the specified time, a timeout will be detected. After timeout detection the device will be set into a safety mode. In this case the set point will be set to 0 and the valve will be closed. The timeout detection can be disabled by a value of 0. Range: 0 – 60	R/W	UINT16
0019	1	Modbus Device Address Address by which the Modbus master communicates with the device 1 – 32	R/W	UINT16
0020…0021	2	Flow Full Scale Unit see Holding Register → "Unit Flow Value"	R	FLOAT32
0022…0025	4	Unit Flow Value Unit of the flow value	R	UINT16 1)ASCII_2
0026…0029	4	Operating Medium Operating medium	R	UINT16 1)ASCII_2
0030…0031	2	Device Serial Number Bürkert serial number of the device min. value 0, max. value 4294967295	R	UINT32
0032	1	Version Number Hardware see description "Versions of the hardware", page 77	R	UINT16
0033	1	Version Number Software see description "Versions of the software", page 78	R	UINT16

Register Address in MFC	Number of Register	Name / Description	R/W	Type
0034	1	Active Gas Active Gas / calibration of this gas is used for control. Value Gas 0 Gas 1 1 Gas 2	R/W	UINT16
0035…0036	2	Device Type Bürkert type number of the device	R	UINT16 ASCII_2
0037	1	ModusMFC MFC Mode / Activation of the Autotune function. The controller must be in normal mode. (ModusMFC = 0) Autotune can be activated by writing a value of 2	R/W	UINT16
0038	1	Reset Totalizer A value of 1 will reset the Totalizer value of the actual gas. Clearing the value is needless.	W	UINT16
0039	1	Reset Device A value of 1 restarts the device. Clearing the value is needless.	W	UINT16

1) *ASCII_2*
An UINT16 value is interpreted as two characters. The high byte shows the first character.

e.g. 0x4142 → „AB“

e.g. Operating Medium “Luft” as 4 x UINT16
0x4C75
0x6674
0x0000
0x0000

e.g. Device Type“8713” as 2 x UINT16
0x3837
0x3133

Versions of the hardware

Returns 2 bytes, which are constructed as follows:
X.Y Range:
X 0 or ‚A‘ – ‚Z‘
Y ‚A‘ – ‚Z‘

e.g. 0x004B → K
0x414B → A.K

Versions of the software

Returns 4 bytes, which are constructed as follows
X.YY Range:

X ‚A‘ – ‚Z‘
YY 0 – 99

e.g. 0x4101 → A.01

8.3.3. Input Register

These 16-bit values can be read by the master.

Valid commands

Code	Name	Broadcast
0x04	Read Input Register	No

Valid addresses

see below

Input register of list 0 (default)

Register address in MFC	Number of registers	Designation / Description	R/W	Format
0001	1	Data Unit Calibrated device unit Min. value 2048, max. value 4103 List of the units see "9.2. Table of units"	R	UINT16
0002	1	Actual Flow Actual value (x) / value in units per thousand of the active gas Min. value -2000, max. value 2000	R	SINT16
0003…0004	2	Actual Flow Actual value as float Unit see: Input Register → "Data Unit" min value -3.39E+38, max value 3.39E38	R	FLOAT32
0005	1	Status errors Error conditions / bit field for device errors. see "9.1.2. Bit field ERRORS" min value -3.39E+38, max value 3.39E3	R	UINT16
0006	1	Status limits Status limits / Bit field for the status of device-internal threshold value see "9.1.1. Bit field LIMITS" min. value 0, max. value 65535	R	UINT16

Register address in MFC	Number of registers	Designation / Description	R/W	Format
0007	1	Control output to valve (y2) for MFC only. control output y2 of controller in units per thousand Min. value 0, max. value 1000	R	UINT16
0008…0009	2	Flow Full Scale Unit see: Input Register → “Data Unit” min. value 0, max. value 1.00E+39	R	FLOAT32
0010…0011	2	Totalizer Totalizator in Nl units. (0 °C / 1013mbar)	R	FLOAT32
0012…0019	8	Operating medium	R	8 x ASCII character
0020	1	Device type Bürkert type number of the device Min. value 0, max. value 65535	R	UINT16
0021…0022	2	Device Ident Number Bürkert identification number of the device Min. value 0, max. value 99999999	R	UINT32
0023…0024	2	Device Serial Number Bürkert serial number of the device Min. value 0, max. value 4294967295	R	UINT32
0025…0028	4	Version Number Software see Description of “Versions of the Software”	R	Ascii & UINT8
0029	1	Modbus baud rate Returns the Speed for Modbus Communication. Value Baud rate 0 300 1 600 2 1200 3 2400 4 4800 **5 9600** 6 19200 7 38400 8 57600 9 115200.	R	UINT8
0030	1	Medium temperature Temperature in 1/10 °C (231 = 23.1 °C)	R	UINT16

Versions of the Software

Returns 4 bytes, which are constructed as follows

X.YY.ZZ.CC

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Ranges:

X	65 – 90 (‘A’ – ’Z’ ASCII)
YY	0 – 99
ZZ	0 – 99
CC	0 – 99

Input register of list 1

Input registers aren’t supported while using Modbus register list 1.
Any read operation of input registers generates error “Illegal Data Address”.

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9. ANNEX

9.1. Description of bit fields

9.1.1. Bit field LIMITS

Bit field LIMITS	
Bit 0	x > Limit1_x
Bit 1	x < Limit1_x
Bit 2	x > Limit2_x
Bit 3	x < Limit2_x
Bit 4	w > Limit1_w
Bit 5	w < Limit1_w
Bit 6	w > Limit2_w
Bit 7	w < Limit2_w
Bit 8	y2 > Limit1_y2
Bit 9	y2 < Limit1_y2
Bit 10	y2 > Limit2_y2
Bit 11	y2 < Limit2_y2
Bit 12	Totalizer [active gas] > Limit1_Totalizer
Bit 13	Totalizer [active gas] < Limit1_Totalizer
Bit 14	Totalizer [active gas] > Limit2_Totalizer
Bit 15	Totalizer [active gas] < Limit2_Totalizer

9.1.2. Bit field ERRORS

Bit field ERRORS	
Bit 0	Current out of range
Bit 1	Error >Power LED
Bit 2	Error >Communication LED
Bit 3	Error >Limit LED
Bit 4	Error >Error LED
Bit 5	Error BinOut 1
Bit 6	Error BinOut 2
Bit 7	Error internal supply voltage
Bit 8	Error sensor supply voltage
Bit 9	Error data storage
Bit 10	RESERVED
Bit 11	RESERVED
Bit 12	Error sensor fault
Bit 13	Error after autotune
Bit 14	Error BusModule MFI
Bit 15	Stack overflow

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9.1.3. Bit field OTHERS

Bit field OTHERS	
Bit 0	Power on / Device power supply is on
Bit 1	Autotune active
Bit 2	Gas 1 active
Bit 3	Gas 2 active
Bit 4	Batch process active
Bit 5	BinIn 1 active / binary input 1 active
Bit 6	BinIn 2 active / binary input 2 active
Bit 7	BinIn 3 active / binary input 3 active
Bit 8	Set BinOut via Bus
Bit 9	Set to safety value / safety value active
Bit 10	Profile active
Bit 11	Valve control active
Bit 12	Close valve function active
Bit 13	Open valve function active
Bit 14	Valve hold function active
Bit 15	RESERVED

9.1.4. Bit field LEDs

Bit field LEDs	
Bit 0	Communication active
Bit 1	MFIBusstatusNotActive / no cyclical data traffic active
Bit 2	MFIBusstatusPdActive / device is properly connected
Bit 3	MFIBusstatusPrmError / error in parameter telegram
Bit 4	MFIBusstatusCfgError / error in configuration telegram
Bit 5	MFIBusstatusNoMaster / no connection to the master
Bit 6	MFIBusstatusSdOnly / There is an explicit messaging connection to the master. Acyclical communication only
Bit 7	MFIBusstatusTimeout / a timeout error has been detected
Bit 8	MFIBusstatusCriticalError / A critical error has been detected (for example double address configuration on the slave).
Bit 9	RESERVED
Bit 10	RESERVED
Bit 11	RESERVED
Bit 12	RESERVED
Bit 13	RESERVED
Bit 14	RESERVED
Bit 15	RESERVED

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9.1.5. Bit field BINARY OUTPUTS

Bit field BINARY OUTPUTS	
Bit 0	RESERVED
:	
Bit 15	RESERVED

9.1.6. Bit field HARDWARE

Bit field HARDWARE	
Bit 0	active >Power LED<
Bit 1	active >Communication LED
Bit 2	active >Limit LED
Bit 3	active >Error LED
Bit 4	Binary input 1 (BinIn 1) active
Bit 5	Binary input 2 (BinIn 2) active
Bit 6	Binary input 3 (BinIn 3) active
Bit 7	Binary output 1 (BinOut 1) active
Bit 8	Binary output 2 (BinOut 2) active
Bit 9	RESERVED
Bit 10	RESERVED
Bit 11	RESERVED
Bit 12	Valve completely close
Bit 13	Valve completely open
Bit 14	RESERVED
Bit 15	RESERVED

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9.1.7. Bit field BINARY OUT VIA BUS

Bit field BINARY OUT VIA BUS	
Bit 0	activate > Power LED
Bit 1	activate > Communication LED
Bit 2	activate > Limit LED
Bit 3	activate > Error LED
Bit 4	activate BinOut 1 / activates binary output 1 (BinOut 1)
Bit 5	activate BinOut 2 / activates binary output 2 (BinOut 2)
Bit 6	RESERVED
Bit 7	RESERVED
Bit 8	RESERVED
Bit 9	RESERVED
Bit 10	RESERVED
Bit 11	RESERVED
Bit 12	RESERVED
Bit 13	RESERVED
Bit 14	RESERVED
Bit 15	RESERVED

9.1.8. ERROR AT SENSOR FAULT

The following functions are available for selection:

Close valve completely	The valve is closed completely. The set-point value settings is not taken into consideration.
Open valve completely	The valve is closed opened. The set-point value settings is not taken into consideration.
Setpoint controls duty cycle 0 – 100 %	The set-point value settings controls the valve duty cycle. For example, a 10% set-point value default wouldset a valve duty cycle of 10%.
Setpoint controls duty cycle according to last autotune	The set-point value controls the valve duty cycle as a percentage in the valve working range determined by AutoTune.
Safety value controls duty cycle 0 – 100 %	The safety value saved in the device (0 –100%) controls the valve duty cycle directly.
Safety value controls duty cycle according to last autotune	The safety value saved in the device (0 – 100%) directly controls the valve duty cycle as a percentage in the valve working range determined by AutoTune.

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9.2. Table of units

Value(HEX)	Description
0x800	"Units per thousand”
0x801	"Nl/s"
0x802	"Nl/min"
0x803	"Nl/h"
0x804	“Sl/s”
0x805	"Sl/min"
0x806	"Sl/h"
0x807	"Nm3/s"
0x808	"Nm3/min“
0x809	"Nm3/h"
0x80A	"Sm3/s"
0x80B	"Sm3/min"
0x80C	"Sm3/h"
0x80D	"Ncm3/s”
0x80E	"Ncm3/min”
0x80F	"Ncm3/h"
0x810	"Scm3/s”
0x811	"Scm3/min”
0x812	"Scm3/h”
0x813	"kg/s”
0x814	"kg/min"
0x815	"kg/h”
Available as of firmware version A.00.67:	
0x816	“SCF/s"
0x817	"SCF/min”
0x818	“SCF/h"
0x819	“l/s”
0x81A	“l/min”
0x81B	“l/h”
0x81C	“ml/s”
0x81D	“ml/min”
0x81E	“ml/h”
Available as of firmware version A.07.02:	
0x81F	“Nml/sec“
0x820	“Nml/min“
0x821	“Nml/h“
0x822	“Sml/sec“
0x823	“Sml/min“

0x824	“Sml/h“
0x825	“g/sec“
0x826	“g/min“
0x827	“g/h“
0x1007	"%“

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