INSTRUCTION MANUAL

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MEASUREMENT SOLUTIONS

Modbus Manual Version 1.3
-
Modbus Manual for PF4/5

1. Table of contents

1 Modbus protocol

The PF4/5 can handle Modbus RTU (asynchronous communication over RS485) and Modbus TCP (client-server communication over Ethernet). Modbus ASCII is not supported.

For detailed information about Modbus protocol see:
(http://modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf).

Attention!
- Changes to register content (especially Holding Registers) in the PF4/5 can change the functionality of the PF4/5. This may cause the PF4/5 to become inoperable
- Changes of register contents should only be made with the necessary knowledge of the Modbus protocol

1.1. Structure of the Modbus protocol

1.1.1 Modbus RTU / TCP

1.1.1.1 Modbus RTU

Modbus RTU is an asynchronous communication protocol. The PF4/5 handles Modbus RTU over the included RS485 interface. The communication parameters are 19200 Baud, 8-bit data, no parity, one stop bit and cannot be changed.

1.1.1.2 Modbus TCP

Modbus TCP is a client-server communication protocol over Ethernet. The PF4/5 handles Modbus TCP over the port 502 and cannot be changed.

Modbus TCP needs a Modbus Application Protocol Header (MBAP 7 bytes) in front of the Protocol Data Unit (PDU).

Modbus commands are integrated in PDU. Every Modbus command has his own PDU.

Attention!
- **Active Modbus TCP Connection**
  If no Modbus request is sent during an active Modbus communication for more than 30 seconds, the active TCP socket is reset and must be reopened for a new Modbus request
- **Physical interruption of the Ethernet line**
  After a physical interruption of the Ethernet line, the Ethernet connection with the PF4/5 cannot be re-established for at least 30 seconds

1.1.1.3 Difference between Modbus RTU and TCP

A Modbus RTU message looks like:

Modbus RTU Message			
Slave ID	Command	Data	CRC
	PDU		

A Modbus TCP message includes a MBAP-Header and looks like:

Modbus TCP Message					
Transaction ID	Protocol ID	Length	Unit ID	Command	Data
MBAP-Header				PDU	

For detailed information look at (http://modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf).

1.2 Modbus Data Format

The Modbus protocol only specifies the 16-bit integer data type and is declared as “Big-Endian” protocol.

1.2.1 16-bit Integer Value

16-bit Integer for Modbus Devices

Modbus Field N	
MSB	LSB
12	34
Byte x	Byte x+1

For other data types, as 32-bit floating point, there is no specification how they should be mapped to the Modbus address range. It is up to the device manufacturer to specify this format.

1.2.2 32-bit Float corresponding to IEEE 754

MSB			LSB
SEEEEEEE	EMMMMMMM	MMMMMMMM	MMMMMMMM

S – Sign
E – Exponent
M - 23 bit Mantissa

32-bit Float for Rotronic Modbus Devices

The 32-Bit Float value is represented by two 16-bit registers. The 4 Bytes have to be mapped to the Modbus address range as shown below

Modbus Field N		Modbus Field N+1	
	LSB	MSB	
MMMMMMMM	MMMMMMMM	SEEEEEEE	EMMMMMMM
Byte x	Byte x+1	Byte x+2	Byte x+3

1.2.3 32-bit Integer Value

Example: Integer Value 0x12345678

MSB			LSB
12	34	56	78

32-bit Integer for Rotronic Modbus Devices

The 32-Bit Integer value represents two 16-bit registers. The 4 bytes of the 32-bit Integer value have to be mapped to the Modbus address range as shown below.

Modbus Field N		Modbus Field N+1	
	LSB	MSB	
56	78	12	34
Byte x	Byte x+1	Byte x+2	Byte x+3

Because there is no standard and it is mostly a matter of personal preference, it is configurable how the four bytes are being mapped to the two registers.

1.2.4 Selectable Swap Modes for Rotronic Devices

Selectable swap modes (see Device Specific Settings -> *Modbus Operation Mode*) only for 32-bit Float and 32-bit Integer values based on Little Endian memory organisation.

Swap Mode	Source Bytes	Target Bytes
No change	[a b] [c d]	[a b c d]
byte and word swap	[a b] [c d]	[d c b a]
byte swap	[a b] [c d]	[b a d c]
word swap **(Rotronic Default)**	[a b] [c d]	[c d a b]

2 PF4/5 Modbus Fields and Mapping

2.1 PF4/5 Modbus Fields

Primary Tables	Type	Read / Write	Coils / Registers	Function Code	
Coils	Bit	Read/Write	1 … 9’999	0x01	Read Coils
				0x05	Write Single Coil
				0x0F	Write Multiple Coils **(*)**
Discrete Inputs	Bit	Read Only	10’001 … 29’999	0x02	Read Discrete Inputs **(*)**
Input Registers	16-bit	Read Only	30’001 … 39’999	0x04	Read Input Register
Holding Registers	16-bit	Read/Write	40’001 … 49’999	0x03	Read Holding Registers
				0x06	Write Single Register
				0x10	Write Multiple Registers

Attention!
Coils and registers in Modbus are addressed starting at zero. Therefore coils numbered 1…16 are addressed as 0…15 or registers numbered e.g. 10'001…10'016 are addressed as 10'000…10'015.

Note!
Function Codes 0x02 and 0x0F are not supported by PF4/5 device.
The content of not specified coils/registers are undefined.

2.2 Device Specific Coils

With Modbus **Coils** you can get the state of one or more coils or activate/deactivate one or more coils.

Assisted Modbus commands are *Read Coils* (0x01), *Write Single Coil* (0x05). Modbus Command *Write Multiple Coils* (0x0F) is not supported.

2.2.1 Relay and Valve

Command to energize/de-energize the relay and/or the valve of the PF4/5 manually.

Attention!
If in Relay Settings the flag *Relay x Alarm OFF* is set, it is not possible to energize the relay x manually. The relay will be de-energized every measuring cycle, when alarm is off.

Coil	Name	Flags	Description
1	Relay	*	• Get state of relay • Switch relay ON/OFF
	➢ If in Relay Settings one or more *Relay Alarm Bits* are set, it is not possible to energize the relay manually. The relay will be de-energized every measuring cycle, when alarm is off		
2	Valve	*	• Get state of valve • Switch valve ON/OFF
	➢ **Note:** A Valve is only included in PF5 devices. In PF4 devices activating the Valve will have no effect		
2…8	Reserved		• Undefined
*	An energized relay/valve stays energized until the related coil is de-energized		

2.2.2 Sensor Actions

Direct sensor actions.

Attention!
Be careful to use these commands, due to any possible miss adjustments.

Modbus command *Write Multiple Coils* (0x0F) is not supported.

Coils	Name	Flags	Description
9	Zero Adjustment of Differential Pressure		• Zero adjust of the differential pressure sensor
	➢ This action takes about 15 seconds to execute. During this time, communication with the device is not possible		
10	Acquire Differential Pressure Data	*	• Acquire a previously set reference value (see Reference Value Settings)
11	Delete Acquired Differential Pressure Data		• Deletes all previously acquired values
12	Adjust Acquired Differential Pressure Data	!	• The acquired data will be transferred to the corresponding lookup table (*Customer Lookup Table*)
13	Acquire Humidity Data	*	• Acquire a previously set reference value (see Reference Value Settings)
			➢ Only available for devices including HC2A Probe
14	Delete Acquired Humidity Data		• Deletes all previously acquired values
			➢ Only available for devices including HC2A Probe
15	Adjust Acquired Humidity Data	!	• The acquired data will be transferred to the HC2A Probe
			➢ Only available for devices including HC2A Probe

	➢ This action takes about 2 seconds to execute. During this time, communication with the device is not possible		
16	Adjust Temperature Data	* !	• The previously set reference temperature (see Reference Value Settings) will be sent to the temperature sensor
			➢ Only available for devices including HC2A or Pt100 Probe

*	Before acquiring data, a reference value must be set (see Reference Value Settings) It's possible to acquire more than one reference value before executing the adjustment (not for temperature adjustment)
!	The device must be restarted to take over the new data (see Device Actions)

2.2.3 Device Actions

Direct device actions.

Attention!
Be careful to use these commands, due to any possible wrong configurations.

Modbus command *Write Multiple Coils* (0x0F) is **not** possible.

Coils	Name	Flags	Description
17	Reset Device		• Restart device
➢ The device will be restarted. Communication will get lost			
18	Store Device Settings	*	• All device-relevant data will be stored in the memory • Executing this command, will overwrite older (factory) settings in the memory
19	Restore All Device Settings	* !	• All device-relevant data will be restored from the memory to the device • All individual device settings by customer will be overwritten by the factory settings in memory
20	Restore Device Settings without Communication Data	* !	• All device-relevant data will be restored from the memory to the device except communication parameter (Ethernet, RS485) • All individual device settings by customer, except communication parameter (Ethernet, RS485) will be overwritten by the factory settings in memory
21 … 64	Reserved		• Undefined
65 … 9’999	Reserved		• Undefined • Gives back Modbus Exception Code 02
*	During these action, communication with the device is not possible		
!	**Attention!** All customer settings for the Differential Pressure (*Zero Adjustment* (Offset), *Acquired Data*, *Customer Lookup Table*) are also deleted		

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2.2.4 Example: Read Single Coil

2.2.4.1 Read Relay

Initial situation: The relays 1 is set, Valve (only PF5) doesn't exist.

RTU Example:

Transmit	01 01 00 00 00 01 fd ca
Receive	01 01 01 01 90 48

TCP Example:

Transmit	MBAP 01 01 00 00 00 01
Receive	MBAP 01 01 01 01

Field	Bytes	Value	Description
MBAP	7	MBAP	MBAP header (see Modbus RTU / TCP)
Checksum	2	CRC	CRC Checksum (see Modbus RTU / TCP)
RTU number	1	0x01	Modbus RTU Address (see Device Descriptions)
Function code	1	0x01	Read Single Coil
Starting address	2	0x0000	= 0, means address of the 1. coil (Attention! coil number – 1)
Quantity of coils	2	0x0001	= 1 1 to 7 gives the same result 1 byte (8 coils) 8 to 15 will give back 2 bytes (16 coils) etc.
Byte count	1	0x01	= 1 ≙ **N**, means quantity of coils / 8, if the remainder is different of 0 => N = N+1
Coil status (see Relay and Valve)	n	0x01	n = N or N+1 = 8 bits

Bit	State	State of Relais 1 to 6
0	**ON**	Coil 1 = Relais (ON = 1, OFF = 0)
1	OFF	Coil 2 = Valve (ON = 1, OFF = 0) (Valve exist only with PF5)
2	OFF	Not used
3	OFF	Not used
4	OFF	Not used
5	OFF	Not used
6	OFF	Not used
7	OFF	Not use

For detailed information about Modbus protocol *Read Single Coil* see:
(http://modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf).

2.2.5 Example: Write Single Coil

2.2.5.1 Set State of Relay

RTU Example:

Transmit	01 05 00 00 ff 00 8c 3a
Receive	01 05 00 00 ff 00 8c 3a

TCP Example:

Transmit	MBAP 01 05 00 00 ff 00
Receive	MBAP 01 05 00 00 ff 00

Field	Bytes	Value	Description
MBAP	7	MBAP	MBAP header (see Modbus RTU / TCP)
Checksum	2	CRC	CRC Checksum (see Modbus RTU / TCP)
RTU number	1	0x01	Modbus RTU Address (see Device Descriptions)
Function code	1	0x05	Write Single Coil
Starting address	2	0x0000	= 0, means address of the 1. Coil (relay) (Attention! coil number – 1)
Output value	2	0xff00	0xff00 for setting the selected coil 0x0000 for resetting the selected coil

Test the change with Modbus commands in example Read Relay.

For detailed information about Modbus protocol *Write Single Coil* see: (http://modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf).

2.2.6 Example: Reset Device

RTU Example:

Transmit	01 05 00 10 ff 00 8d ff
Receive	01 05 00 10 ff 00 8d ff

TCP Example:

Transmit	MBAP 01 05 00 10 ff 00
Receive	MBAP 01 05 00 10 ff 00

Field	Bytes	Value	Description
MBAP	7	MBAP	MBAP header (see Modbus RTU / TCP)
Checksum	2	CRC	CRC Checksum (see Modbus RTU / TCP)
RTU number	1	0x01	Modbus RTU Address (see Device Descriptions)
Function code	1	0x05	Write Single Coil

Starting address	2	0x0010	= 16, means address of the 17. Coil (Reset Device) (Attention! coil number – 1)
Output value	2	0xff00	0xff00 for setting the selected action

For detailed information about Modbus protocol *Write Single Coil* see:
(http://modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf).

2.3 Device Specific Discrete Inputs (read only)

There are no active PF4/5 **Discrete Inputs**.

2.4 Device Specific Input Registers (read only)

With Modbus **Input Registers** you can read some device specific data of the PF4/5 device.

Assisted Modbus command is *Read Input Registers* (0x04).

2.4.1 Device Data

PF4/5-specific data.

Register	Name	Flags	Description
30'001	Serial Number	i	• Serial number of the PF4/5 device (part 1)
30'002		i	• Serial number of the PF4/5 device (part 2)
30'003	Serial Number HC2A Probe Only if HC2A is used	i	• Serial number of the HC2A-probe (part 1)
30'004		i	• Serial number of the HC2A-probe (part 2)
30'005	Device Name	"	• Device name (part 1 – character 1 & 2) *e.g. "PF"*
30'006		"	• Device name (part 2 – character 3 & 4) *e.g. "5 "*
30'007		"	• Device name (part 3 – character 5 & 6) *e.g. "+ "*
30'008		"	• Device name (part 4 – character 7 & 8) *e.g. "HC"*
30'009		"	• Device name (part 5 – character 9 & 10) *e.g. "2 "*
30'010		"	• Device name (part 6 – character 11 & 12) *e.g. " "*
30'011	Differential Pressure Sensor Type (*) Only for PF5 (**) Only for PF4		

No.	Shows differential pressure sensor type
0	PF5: ± 10Pa (*)
1	PF5: ± 25Pa (*)
2	PF5: ± 50Pa (*)
3	PF5: ± 100Pa (*)
4	PF5: ± 250Pa (*)
5	PF5: ± 500Pa (*)
6	PF5: ± 1000Pa (* by order only)
7	PF5: ± 2500Pa (* by order only)
8	PF5: ± 5000Pa (* by order only)
7	PF5: ± 7500Pa (* by order only)
8	PF5: ± 15kPa (* by order only)
11..15	Not used
16	PF4: ± 10Pa (**)
17	PF4: ± 25Pa (**)
18	PF4: ± 50Pa (**)
19	PF4: ± 100Pa (**)
20	PF4: ± 250Pa (**)
21	PF4: ± 500Pa (**)
22…	Not used

30'012	Hardware Version		• Hardware version
30'013	Production Date	i t	• Production date (part 1)
30'014		i t	• Production date (part 2)
30'015	Device Type For bit 0 to 2 only one selection is possible		

Bit	Shows type of device
0	PFx solo
1	PFx + PT100 Probe
2	PFx + HC2A Probe
3	0

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<table>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>4</td><td>PF4/5 (0 = PF4; 1 = PF5)</td></tr>
<tr><td>5</td><td>Flow (0 = Off; 1 = On)</td></tr>
<tr><td>6…15</td><td>0</td></tr>
</table>
0 = deactivated; 1 = activated
</td></tr>
<tr><td>30’016</td><td>Interface Type

More than one selection is possible</td><td></td><td>
<table>
<tr><th>Bit</th><th>Shows included communication interfaces</th></tr>
<tr><td>0</td><td>Ethernet</td></tr>
<tr><td>1</td><td>0 (Not used)</td></tr>
<tr><td>2</td><td>RS485</td></tr>
<tr><td>13…15</td><td>0</td></tr>
</table>
0 = deactivated; 1 = activated
</td></tr>
<tr><td>30’017</td><td>State of Alarms

(*) If HC2A or PT100 probe is connected

(**) If option Flow is selected

More than one active alarm is possible</td><td></td><td>
<table>
<tr><th>Bit</th><th>Shows state of alarm bits</th></tr>
<tr><td>0</td><td>Alarm Differential Pressure Low</td></tr>
<tr><td>1</td><td>Alarm Differential Pressure High</td></tr>
<tr><td>2</td><td>Alarm Humidity Low (*)</td></tr>
<tr><td>3</td><td>Alarm Humidity High (*)</td></tr>
<tr><td>4</td><td>Alarm Temperature Low (*)</td></tr>
<tr><td>5</td><td>Alarm Temperature High (*)</td></tr>
<tr><td>6</td><td>Alarm Calculation Low (*)</td></tr>
<tr><td>7</td><td>Alarm Calculation High (*)</td></tr>
<tr><td>8</td><td>Alarm Analog Input Low</td></tr>
<tr><td>9</td><td>Alarm Analog Input High</td></tr>
<tr><td>10</td><td>Alarm Flow Low (**)</td></tr>
<tr><td>11</td><td>Alarm Flow High (**)</td></tr>
<tr><td>12</td><td>Alarm Volume Low (**)</td></tr>
<tr><td>13</td><td>Alarm Volume High (**)</td></tr>
<tr><td>14…15</td><td>0</td></tr>
</table>
0 = alarm OFF; 1 = alarm ON
</td></tr>
<tr><td>30’018</td><td>State of Pre-Alarms

(*) If HC2A or PT100 probe is connected

(**) If option Flow is selected

More than one active alarm is possible</td><td></td><td>
<table>
<tr><th>Bit</th><th>Shows state of pre-alarm bits</th></tr>
<tr><td>0</td><td>Pre-Alarm Differential Pressure Low</td></tr>
<tr><td>1</td><td>Pre-Alarm Differential Pressure High</td></tr>
<tr><td>2</td><td>Pre-Alarm Humidity Low (*)</td></tr>
<tr><td>3</td><td>Pre-Alarm Humidity High (*)</td></tr>
<tr><td>4</td><td>Pre-Alarm Temperature Low (*)</td></tr>
<tr><td>5</td><td>Pre-Alarm Temperature High (*)</td></tr>
<tr><td>6</td><td>Pre-Alarm Calculation Low (*)</td></tr>
<tr><td>7</td><td>Pre-Alarm Calculation High (*)</td></tr>
<tr><td>8</td><td>Pre-Alarm Analog Input Low</td></tr>
<tr><td>9</td><td>Pre-Alarm Analog Input High</td></tr>
<tr><td>10</td><td>Pre-Alarm Flow Low (**)</td></tr>
<tr><td>11</td><td>Pre-Alarm Flow High (**)</td></tr>
<tr><td>12</td><td>Pre-Alarm Volume Low (**)</td></tr>
<tr><td>13</td><td>Pre-Alarm Volume High (**)</td></tr>
<tr><td>14…15</td><td>0</td></tr>
</table>
0 = alarm OFF; 1 = alarm ON
</td></tr>
<tr><td>30’019</td><td>State of Other Alarms

(*) If HC2A or PT100 probe is connected.
More than one active alarm is possible</td><td></td><td>
<table>
<tr><th>Bit</th><th>Shows state of other alarm bits</th></tr>
<tr><td>0</td><td>Maximal/minimal sensor limit exceeded</td></tr>
<tr><td>1</td><td>No communication with sensor possible</td></tr>
<tr><td>2</td><td>Missing Probe (*)</td></tr>
<tr><td>3</td><td>Fix Value(s) is(are) activated</td></tr>
</table>
</td></tr>
</table>

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<table>
<tr><td></td><td></td><td></td><td>
<table><tr><td>14…15</td><td>0</td></tr></table>
0 = alarm OFF; 1 = alarm ON
</td></tr>
<tr><td>30’020</td><td>State of Relay and Valve

(*) Only if PF5 device is used</td><td></td><td>
<table>
<tr><th>Bit</th><th>Shows state of relay and valve bits</th></tr>
<tr><td>0</td><td>Relay</td></tr>
<tr><td>1…7</td><td>0</td></tr>
<tr><td>8</td><td>Valve (*)</td></tr>
<tr><td>9…15</td><td>0</td></tr>
</table>
0 = deactivated; 1 = activated
</td></tr>
<tr><td>30’021</td><td>Numbers of Analog Outputs</td><td></td><td>
<table>
<tr><th>No.</th><th>Shows number of analog outputs</th></tr>
<tr><td>1</td><td>1 Analog Output</td></tr>
<tr><td>2</td><td>2 Analog Outputs</td></tr>
<tr><td>3</td><td>3 Analog Outputs</td></tr>
</table>
</td></tr>
<tr><td>30’022</td><td>Device Address</td><td></td><td>• Device address
➢ Device address is the same as RS485 address</td></tr>
<tr><td>30’023</td><td rowspan="3">MAC-Address
Only if Ethernet is used</td><td rowspan="3"></td><td>Ethernet MAC address, e.g. C8-8E-D1-20-00-2F
• Ethernet MAC address (part 1) (e.g. 0xC88E)</td></tr>
<tr><td>30’024</td><td>• Ethernet MAC address (part 2) (e.g. 0xD120)</td></tr>
<tr><td>30’025</td><td>• Ethernet MAC address (part 3) (e.g. 0x002F)</td></tr>
<tr><td>30’026</td><td rowspan="2">Fixed IP Ethernet Address
Only if Ethernet is used</td><td>i</td><td>Fixed IP Address, e.g. 192.168.100.101
• Ethernet IP address (part 1) (e.g. 0xC0A8)</td></tr>
<tr><td>30’027</td><td>i</td><td>• Ethernet IP address (part 2) (e.g. 0x6465)</td></tr>
<tr><td>30'028</td><td>DHCP State
Only if Ethernet is used</td><td></td><td>DHCP State: On or Off
➢ ON: IP Address will be received from DHCP Server
➢ Off: Fixed IP Address will be used</td></tr>
<tr><td>30’029</td><td rowspan="2">DHCP IP Ethernet Address
Only if Ethernet is used and DHCP is ON, otherwise DHCP IP Address = 0.0.0.0</td><td>i</td><td>DHCP IP Address, e.g. 192.168.100.151
• DHCP Ethernet IP address (part 1) (e.g. 0xC0A8)</td></tr>
<tr><td>30’030</td><td>i</td><td>• DHCP Ethernet IP address (part 2) (e.g. 0x6597)</td></tr>
<tr><td>30’031 … 31’000</td><td>Reserved</td><td></td><td>• Undefined
• Gives back Modbus Exception Code 02</td></tr>
</table>

2.4.2 Current Values: Float Values

Current values in 32-bit IEEE754 float format of all PF4/5 sensors.

Note!
These values are changing every measurement cycle, so always read the two corresponding registers in one Modbus command.

Register	Name	Flags	Description
31’001	Humidity	f *	• Current humidity value (part 1)
31’002		f *	• Current humidity value (part 2)
31’003	Temperature	f *	• Current temperature value (part 1)
31’004		f *	• Current temperature value (part 2)
31’005	Differential Pressure	f *	• Current differential pressure value (part 1)
31’006		f *	• Current differential pressure value (part 2)
31’007	Calculation	f *	• Current calculation value (part 1)
31’008		f *	• Current calculation value (part 2)
31’009	Analog Input	f *	• Current analog input value (part 1)
31’010		f *	• Current analog input value (part 2)
31’011	Flow	f *	• Current flow value (part 1)
31’012		f *	• Current flow value (part 2)
31’013	Volume Flow	f *	• Current volume flow value (part 1)
31’014		f *	• Current volume flow value (part 2)
31’015	Ambient Pressure	f *	• Current ambient pressure value (part 1)
31’016		f *	• Current ambient pressure value (part 2)
31’017	Internal Temperature	f *	• Current internal temperature value (part 1)
31’018		f *	• Current internal temperature value (part 2)
31’019 … 31’999	Reserved		• Undefined • Gives back Modbus Exception Code 02

2.4.3 Current Values: Integer Values

Current values in 16-bit integer format of all PF4/5 sensors, updated every measurement cycle.

The current values are the result of the reduction to 16-bit values of the multiplication of the current 32-bit IEEE754 float values (see Current Values: Float Values) and the corresponding scaling values (see Integer Value Scaling).

Register	Name	Flags	Description
32’001	Humidity	*	• Current humidity value
32’002	Temperature	*	• Current temperature value
32’003	Differential Pressure	*	• Current differential pressure value
32’004	Calculation	*	• Current calculation value
32’005	Analog Input	*	• Current analog input value
32’006	Flow	*	• Current flow value
32’007	Internal Temperature	*	• Current volume flow value
32’008	Ambient Pressure	*	• Current ambient pressure value

32’009	Internal Temperature	*	• Current internal temperature value
32’010 … 39’999	Reserved		• Undefined • Gives back Modbus Exception Code 02

2.4.4 Explanation of Flags

i	These are 32-bit values, separated in two succeeding registers (16-bits). How to bring together part 1 and part 2 of the 32-bit value, depends on the *Swap Mode* of the Modbus communication (see Device Specific Settings and Selectable Swap Modes for Rotronic Devices)
t	Represents the Unix Time (UTC) since 1.1.1970 in seconds
“	Character values separated in succeeding registers. 2 characters per register
f	These are float-values (32-bit IEEE754), separated in two succeeding registers (16-bits). How to bring together part 1 and part 2 of the 32-bit float-value, depends on the *Swap Mode* of the Modbus communication (see Device Specific Settings and Selectable Swap Modes for Rotronic Devices)
*****	The showed values depend also of the selected unit (see Value Unit)

2.4.5 Example: Read Input Register

2.4.5.1 Read Current Values: Float Value (Registers 31'001 to 31'006)

RTU Example:

Transmit	01 04 79 18 00 06 e9 53
Receive	01 04 0c 41 f3 70 a3 41 ba 00 00 3d 80 e9 a2 97 8a

TCP Example:

Transmit	MBAP 01 04 79 18 00 06
Receive	MBAP 01 04 0c 41 f3 70 a3 41 ba 00 00 3d 80 e9 a2

Field	Bytes	Value	Description
MBAP	7	MBAP	MBAP header (see Modbus RTU / TCP)
Checksum	2	CRC	CRC Checksum (see Modbus RTU / TCP)
RTU number	1	0x01	Modbus RTU Address (see Device Descriptions)
Function code	1	0x04	Read Discret Inputs
Starting address	2	0x7918	= 31'000 (Attention! register number – 1)
Quantity of input registers	2	0x0006	= 6, means read 6 registers
Byte count	1	0x0c	= 12 ≙ **2 * N**, means numbers of returned bytes
Input registers (see Current Values: Float Values)	**2 * N**	0x41f370a3	= 30.43 %rh Humidity
		0x41ba0000	= 23.25 °C Temperature
		0x3d80e9a2	= 0.063 Pa Differential Pressure

For detailed information about Modbus protocol *Read Discrete Inputs* see:
(http://modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf).

2.5 Device Specific Holding Registers

Via the Modbus **Holding Registers** you can read and write device specific data to the PF4/5.

Assisted Modbus commands are *Read Holding Registers* (0x03), *Write Single Register* (0x06) and *Write Multiple Registers* (0x10).

Attention!

Changes to register content in the PF4/5 can change the functionality of the PF4/5. This may cause the PF4/5 to become inoperable.

Changes of register contents should only be made with the necessary knowledge of the Modbus protocol.

Notes!

Most of the *Specific Holding Registers* cannot be validated, if Modbus command *Write Multiple Register* is used.

Changing values in the Holding Registers needs normally a restart of the device (see Device Actions).

Changing values in the Holding Registers will always change the FDA settings of the internal device data except, changing the reference value registers of the Reference Value Settings.

2.5.1 Value Type

Selection of the possible calculation and analog input modes.

Register	Name	Flags	Description
40’001	Calculation Type Only if HC2A is used		**No.** / **Select Calculation** 0 Dew Point 1 Frost Point 2 Wet Bulb Temperature 3 Enthalpy 4 Vapour Concentration 5 Specific Humidity 6 Mixing Ratio 7 Saturation Vapour Concentration 8 Vapour Partial Pressure 9 Vapour Saturation Pressure
40’002	Analog Input Type		**No.** / **Shows the analog input type** 0 Voltage (0 ... 10V) 1 Current (0 ... 24mA)
40’003 ... 40’099	Reserved		• Undefined • Gives back Modbus Exception Code 02

2.5.2 Value Unit

Select the unit shown on display for the different sensors and calculation values.

Register	Name	Flags	Description	
41'001	Temperature *For Calculation:* Dew Point, Frost Point, Wet Bulb Temperature		**No.**	**Shows selectable temperature units**
			0	°C
			1	°F
41'002	Differential Pressure		**No.**	**Shows selectable differential pressure units**
			0	Pa
			1	inH_2O
			2	mpsi
			3	mbar
			4	mmHg
			5	mmH_2O
			6	Torr
			7	g/cm^2
41'003	Ambient Pressure *For Calculation:* Vapour Partial Pressure Vapour Saturation Pressure		**No.**	**Shows selectable ambient pressure units**
			0	hPa
			1	inHg
			2	psi
41'004	*For Calculation only:* Enthalpy Only if HC2A is used		**No.**	**Shows selectable enthalpy units**
			0	kJ/kg
			1	BTI/lb
41'005	*For Calculation only:* Vapour Concentration Volume Only if HC2A is used		**No.**	**Shows selectable volume units**
			0	g/m^3
			1	g/ft^3
41'006	*For Calculation only:* Vapour Concentration Weight Only if HC2A is used		**No.**	**Shows selectable weight units**
			0	g/kg
			1	gr/lb
41'007	Flow Only if Flow is activated		**No.**	**Shows selectable flow units**
			0	m/s
			1	km/h
			2	ft/s
			3	mph
41'008	Volume Flow Only if Flow is activated		**No.**	**Shows selectable volume flow units**
			0	m3/h
			1	m3/min
			0	l/min
			3	l/s
			4	cfm
			5	cfs

41’009	Duct Area Only if Flow is activated		<table><tr><th>No.</th><th>Shows selectable volume flow units</th></tr><tr><td>0</td><td>cm^2</td></tr><tr><td>1</td><td>m^2</td></tr><tr><td>2</td><td>in^2</td></tr><tr><td>3</td><td>ft^2</td></tr></table>
41’010	Humidity Unit String Only if HC2A is used	“ !	• Characters 1 & 2 of the unit of Humidity
41’011		“ !	• Characters 3 & 4 of the unit of Humidity
41’012		“ !	• Characters 5 of the unit of Humidity
	➢ Customer selectable unit for Humidity (maximal 5 characters). If there are only space characters in these registers, the unit for Humidity will be ”**%rh**”		
41’013	Analog Input Unit String	“ !	• Characters 1 & 2 of the unit of the analog input
41’014		“ !	• Characters 3 & 4 of the unit of the analog input
	➢ Customer selectable unit for Analog Input (maximal 4 characters). If there are only space characters in these registers, the unit for Analog Input will be ”**V**”, resp. ”**mA**”, depending on the value of ***Analog Input Type*** (see Value Type or Analog Input Settings). be ”**V**”, resp. ”**mA**” will only be showed if ***Auto Unit*** bit is set (see Analog Input Settings).		
41’015 … 41’099	Reserved		• Undefined • Gives back Modbus Exception Code 02

2.5.3 Integer Value Scaling

Selection of the scaling factor of the current values for data conversion float to integer. Scaling factor should be between 1 and 1000.

Register	Name	Flags	Description
42’001	Humidity Only if HC2A is used		• Scaling factor for the humidity value
42’002	Temperature Only if HC2A or Pt100 is used		• Scaling factor for the temperature value
42’003	Differential Pressure		• Scaling factor for the differential pressure value
42’004	Calculation Only if HC2A is used		• Scaling factor for the calculation value
42’005	Analog Input		• Scaling factor for the analog input value
42’006	Flow Only if Flow is activated		• Scaling factor for the flow value
42’007	Volume Flow Only if Flow is activated		• Scaling factor for the volume flow value
42’008	Ambient Pressure		• Scaling factor for the ambient pressure value
42’009	Internal Temperature		• Scaling factor for the internal temperature value
41’010 … 41’099	Reserved		• Undefined

			• Gives back Modbus Exception Code 02

2.5.4 Reference Value Settings

Settings of reference values for adjustments of differential pressure, humidity and temperature (see Sensor Actions).

Note!
Values in these registers are only valid until the next restart of the device.

Register	Name	Flags	Description
44'001	Humidity Only if HC2A is used	? f !	• Reference value humidity (part 1)
44'002		? f !	• Reference value humidity (part 2)
44'003	Temperature Only if HC2A or Pt100 is used	? f !	• Reference value temperature (part 1)
44'004		? f !	• Reference value temperature (part 2)
44'005	Differential Pressure	? f !	• Reference value differential pressure (part 1)
44'006		? f !	• Reference value differential pressure (part 2)
44'007 … 44'099	Reserved		• Undefined • Gives back Modbus Exception Code 02

2.5.5 Device Specific Settings

Device specific settings.

<table>
<tr><th>Register</th><th>Name</th><th>Flags</th><th>Description</th></tr>
<tr><td>44'101</td><td>Device Bits</td><td></td><td>
<table>
<tr><th>Bit</th><th>Shows device bits</th></tr>
<tr><td>0</td><td>Trend Enable (OFF/ON)</td></tr>
<tr><td>1…15</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td>44'102</td><td>Differential Pressure Filter and Filter Type</td><td></td><td>Filter value for the Differential Pressure
<table>
<tr><th>Value</th><th>Shows the selected Filter Type</th></tr>
<tr><td>0…10</td><td>Moving Average Filter</td></tr>
<tr><td>100…110</td><td>Smoothing Exponential Filter</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">44'103</td><td>Memory Write Protection</td><td></td><td>
<table>
<tr><th>No.</th><th>Shows value for device protection</th></tr>
<tr><td>171</td><td>Device Write Protection ON</td></tr>
<tr><td>x</td><td>Device Write Protection OFF</td></tr>
</table>
</td></tr>
<tr><td colspan="3">➢ After writing this command with Device Write Protection ON (171), it's not possible to overwrite the content of the memory until executing the same command with Device Write Protection OFF
➢ Be careful to use this command over Modbus! If writing Modbus commands to a device with Device Write Protection ON, you don't get an error back, because the Modbus writing process was successful - only writing to memory was not possible</td></tr>
</table>

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<table>
<tr><td>44’104</td><td>Menu Protection</td><td></td><td>• Menu protection (On/Off)
➢ If On, the menu of the device can only be activated by entering a correct code, using the keys</td></tr>
<tr><td>44’105</td><td>Menu Code</td><td></td><td>• Menu Code (0…9999)</td></tr>
<tr><td rowspan="2">44’106</td><td>Calculation Select</td><td></td><td><table><tr><th>No.</th><th>Shows selectable calculation</th></tr><tr><td>0</td><td>Dew Point</td></tr><tr><td>1</td><td>Frost Point</td></tr><tr><td>2</td><td>Wet Bulb Temperature</td></tr><tr><td>3</td><td>Enthalpy</td></tr><tr><td>4</td><td>Vapour Concentration</td></tr><tr><td>5</td><td>Specific Humidity</td></tr><tr><td>6</td><td>Mixing Ratio</td></tr><tr><td>7</td><td>Saturation Vapour Concentration</td></tr><tr><td>8</td><td>Vapour Partial Pressure</td></tr><tr><td>9</td><td>Vapour Saturation Pressure</td></tr></table></td></tr>
<tr><td colspan="3">➢ The same value as in Value Type -> Calculation Type</td></tr>
<tr><td>44’107</td><td>Device Number</td><td></td><td>• Device number (RS485 address) (0…63)
➢ The device number (RS485 address) is used in conjunction with a RS485 network
➢ Each network address should be unique
➢ Valid addresses are (0 Broadcast) 1…63
➢ Communication is normally lost, changing this value</td></tr>
<tr><td>44’108</td><td>Modbus Operation Mode</td><td></td><td><table><tr><th>No.</th><th>Shows Modbus operation mode</th></tr><tr><td>0</td><td>Modbus Word Swap</td></tr><tr><td>1</td><td>Modbus Byte Swap</td></tr><tr><td>2</td><td>Modbus Byte Word Swap</td></tr><tr><td>3</td><td>Modbus No Change</td></tr></table></td></tr>
<tr><td></td><td colspan="3">➢ See Selectable Swap Modes for Rotronic Devices</td></tr>
<tr><td>44’109</td><td>DHCP Server (On or Off)
Only if Ethernet is used</td><td>i !</td><td>DHCP Server: On or Off
➢ ON: IP Address will be received from DHCP Server
➢ Off: Fixed IP Address will be used</td></tr>
<tr><td>44’110</td><td rowspan="2">Fixed IP Ethernet Address
Only if Ethernet is used</td><td>i !</td><td>Fixed IP Address, e.g. 192.168.100.101
• Ethernet IP address (part 1) (e.g. 0xC0A8)</td></tr>
<tr><td>44’111</td><td>i !</td><td>• Ethernet IP address (part 2) (e.g. 0x6465)</td></tr>
<tr><td></td><td colspan="3">➢ Communication is normally lost, changing fixed IP address and DHCP is Off</td></tr>
<tr><td>44’112</td><td rowspan="2">Zero Adjust Repetition Time
Only if PF5 is active</td><td>i !</td><td>• Zero adjust repetition time (part 1)</td></tr>
<tr><td>44’113</td><td>i !</td><td>• Zero adjust repetition time (part 2)</td></tr>
<tr><td></td><td colspan="3">➢ Repeat time for the automatic zero point adjustment of differential pressure (in minutes)
➢ Attention! If 0, the repetition time is infinite</td></tr>
<tr><td>44’114 … 44’199</td><td>Reserved</td><td></td><td>• Undefined
• Gives back Modbus Exception Code 02</td></tr>
</table>

2.5.6 Device Descriptions

Name for the different parts of the device, which is clearly related with its function.

Register	Name	Flags	Description
44’201	Device	“ !	• Description device (part 1 – char. 1 & 2)
44’202		“ !	• Description device (part 2 – char. 3 & 4)
44’203		“ !	• Description device (part 3 – char. 5 & 6)
44’204		“ !	• Description device (part 4 – char. 7 & 8)
44’205		“ !	• Description device (part 5 – char. 9 & 10)
44’206		“ !	• Description device (part 6 – char. 11 & 12)
44’207	Differential Pressure	“ !	• Desc. diff. pressure sensor (part 1 – char. 1 & 2)
44’208		“ !	• Desc. diff. pressure sensor (part 2 – char. 3 & 4)
44’209		“ !	• Desc. diff. pressure sensor (part 3 – char. 5 & 6)
44’210		“ !	• Desc. diff. pressure sensor (part 4 – char. 7 & 8)
44’211		“ !	• Desc. diff. pressure sensor (part 5 – char. 9 & 10)
44’212		“ !	• Desc. diff. pressure sensor (part 6 – char. 11 & 12)
44’213	Relay	“ !	• Description relay 1 (part 1 – char. 1 & 2)
44’214		“ !	• Description relay 1 (part 2 – char. 3 & 4)
44’215		“ !	• Description relay 1 (part 3 – char. 5 & 6)
44’216		“ !	• Description relay 1 (part 4 – char. 7 & 8)
44’217		“ !	• Description relay 1 (part 5 – char. 9 & 10)
44’218		“ !	• Description relay 1 (part 6 – char. 11 & 12)
44’219	HC2A Probe Only if HC2A is used	“ !	• Description PF4/5 probe (part 1 – char. 1 & 2)
44’220		“ !	• Description PF4/5 probe (part 2 – char. 3 & 4)
44’221		“ !	• Description PF4/5 probe (part 3 – char. 5 & 6)
44’222		“ !	• Description PF4/5 probe (part 4 – char. 7 & 8)
44’223		“ !	• Description PF4/5 probe (part 5 – char. 9 & 10)
44’224		“ !	• Description probe (part 6 – char. 11 & 12)
44’225	Analog Input	“ !	• Description analog input 1 (part 1 – char. 1 & 2)
44’226		“ !	• Description analog input 1 (part 2 – char. 3 & 4)
44’227		“ !	• Description analog input 1 (part 3 – char. 5 & 6)
44’228		“ !	• Description analog input 1 (part 4 – char. 7 & 8)

44’229		“ !	• Description analog input 1 (part 5 – char. 9 & 10)
44’230		“ !	• Description analog input 1 (part 6 – char. 11 & 12)
44’231	Ambient Pressure	“ !	• Description ambient pressure (part 1 – char. 1 & 2)
44’232		“ !	• Description ambient pressure (part 2 – char. 3 & 4)
44’233		“ !	• Description ambient pressure (part 3 – char. 5 & 6)
44’234		“ !	• Description ambient pressure (part 4 – char. 7 & 8)
44’235		“ !	• Description ambient pressure (part 5 – char. 9 & 10)
44’236		“ !	• Description ambient pressure (part 6 – char. 11 & 12)
44’237	Flow Only if Flow is activated	“ !	• Description flow (part 1 – char. 1 & 2)
44’238		“ !	• Description flow (part 2 – char. 3 & 4)
44’239		“ !	• Description flow (part 3 – char. 5 & 6)
44’240		“ !	• Description flow (part 4 – char. 7 & 8)
44’241		“ !	• Description flow (part 5 – char. 9 & 10)
44’242		“ !	• Description flow (part 6 – char. 11 & 12)
44’243	Volume Flow Only if Flow is activated	“ !	• Description volume flow (part 1 – char. 1 & 2)
44’244		“ !	• Description volume flow (part 2 – char. 3 & 4)
44’245		“ !	• Description volume flow (part 3 – char. 5 & 6)
44’246		“ !	• Description volume flow (part 4 – char. 7 & 8)
44’247		“ !	• Description volume flow (part 5 – char. 9 & 10)
44’248		“ !	• Description volume flow (part 6 – char. 11 & 12)
44’249	Pt100 Only if Pt100 is used	“ !	• Description Pt100 (part 1 – char. 1 & 2)
44’250		“ !	• Description Pt100 (part 2 – char. 3 & 4)
44’251		“ !	• Description Pt100 (part 3 – char. 5 & 6)
44’252		“ !	• Description Pt100 (part 4 – char. 7 & 8)
44’253		“ !	• Description Pt100 (part 5 – char. 9 & 10)
44’254		“ !	• Description Pt100 (part 6 – char. 11 & 12)
44’255 … 44’399	Reserved		• Undefined • Gives back Modbus Exception Code 02

2.5.7 Fix Value Settings

Fixed values are used to simulate a measuring value for testing purposes. To activate *Fix Values*, you have to set the corresponding *Fix Value Bits* to *ON*.

Note!
The selected fixed values should be in valid ranges. Valid ranges depends on selected measuring value and selected unit.

<table>
<tr><th>Register</th><th>Name</th><th>Flags</th><th>Description</th></tr>
<tr><td>44’401</td><td>Fix Value Bits</td><td>!</td><td>
<table>
<tr><th>Bit</th><th>Shows the fix value bits</th></tr>
<tr><td>0</td><td>Differential Pressure</td></tr>
<tr><td>1</td><td>Humidity (Only if HC2A is used)</td></tr>
<tr><td>2</td><td>Temperature (Only if HC2A or Pt100 is used)</td></tr>
<tr><td>3</td><td>Calculation (Only if HC2A is used)</td></tr>
<tr><td>4</td><td>Analog Input</td></tr>
<tr><td>5</td><td>Ambient Pressure</td></tr>
<tr><td>6</td><td>Flow (Only if Flow is activated)</td></tr>
<tr><td>7</td><td>Volume Flow (Only if Flow is activated)</td></tr>
<tr><td>8…15</td><td>Reserved</td></tr>
</table>
0 = fix value is OFF, 1 = fix value is ON
</td></tr>
<tr><td>44’402</td><td rowspan="2">Differential Pressure</td><td>f !</td><td>• Fix value differential pressure (part 1)</td></tr>
<tr><td>44’403</td><td>f !</td><td>• Fix value differential pressure (part 2)</td></tr>
<tr><td>44’404</td><td rowspan="2">Humidity
Only if HC2A is used</td><td>f !</td><td>• Fix value humidity (part 1)</td></tr>
<tr><td>44’405</td><td>f !</td><td>• Fix value humidity (part 2)</td></tr>
<tr><td>44’406</td><td rowspan="2">Temperature
Only if HC2A or Pt100 is used</td><td>f !</td><td>• Fix value temperature (part 1)</td></tr>
<tr><td>44’407</td><td>f !</td><td>• Fix value temperature (part 2)</td></tr>
<tr><td>44’408</td><td rowspan="2">Calculation
Only if HC2A is used</td><td>f !</td><td>• Fix value calculation (part 1)</td></tr>
<tr><td>44’409</td><td>f !</td><td>• Fix value calculation (part 2)</td></tr>
<tr><td>44’410</td><td rowspan="2">Analog Input</td><td>f !</td><td>• Fix value analog Input (part 1)</td></tr>
<tr><td>44’411</td><td>f !</td><td>• Fix value analog Input (part 2)</td></tr>
<tr><td>44’412</td><td rowspan="2">Ambient Pressure</td><td>f !</td><td>• Fix value ambient pressure (part 1)</td></tr>
<tr><td>44’413</td><td>f !</td><td>• Fix value ambient pressure (part 2)</td></tr>
<tr><td>44’414</td><td rowspan="2">Flow
Only if Flow is activated</td><td>f !</td><td>• Fix value flow (part 1)</td></tr>
<tr><td>44’415</td><td>f !</td><td>• Fix value flow (part 2)</td></tr>
<tr><td>44’416</td><td rowspan="2">Volume Flow
Only if Flow is activated</td><td>f !</td><td>• Fix value volume flow (part 1)</td></tr>
<tr><td>44’417</td><td>f !</td><td>• Fix value volume flow (part 2)</td></tr>
<tr><td>44’418 …
44’499</td><td>Reserved</td><td></td><td>• Undefined
• Gives back Modbus Exception Code 02</td></tr>
</table>

2.5.8 Analog Output Settings

The PF4/5 can provide up to three analog output signals. The measured sensor values can be spent individually on every analog output.

<table>
<tr><th>Register</th><th>Name</th><th>Flags</th><th>Description</th></tr>
<tr><td>44’501</td><td>Source for Analog Output 1

(Depends on device type)</td><td></td><td>
<table>
<tr><th>No.</th><th>Shows selected source for PF4/5 solo</th></tr>
<tr><td>0</td><td>Unused</td></tr>
<tr><td>1</td><td>Differential Pressure</td></tr>
<tr><td>2</td><td>Not valid! Don't use!</td></tr>
<tr><td>3</td><td>Not valid! Don't use!</td></tr>
<tr><td>4</td><td>Not valid! Don't use!</td></tr>
<tr><td>5</td><td>Analog Input</td></tr>
<tr><td>6</td><td>Ambient Pressure</td></tr>
<tr><td>7</td><td>Flow (Use only if Flow is activated)</td></tr>
<tr><td>8</td><td>Volume Flow (Use only if Flow is activated)</td></tr>
</table>
<table>
<tr><th>No.</th><th>Shows selected source for PF4/5 + HC2A</th></tr>
<tr><td>0</td><td>Unused</td></tr>
<tr><td>1</td><td>Differential Pressure</td></tr>
<tr><td>2</td><td>HC2A Humidity</td></tr>
<tr><td>3</td><td>HC2A Temperature</td></tr>
<tr><td>4</td><td>HC2A Calculation</td></tr>
<tr><td>5</td><td>Analog Input</td></tr>
<tr><td>6</td><td>Ambient Pressure</td></tr>
<tr><td>7</td><td>Flow (Use only if Flow is activated)</td></tr>
<tr><td>8</td><td>Volume Flow (Use only if Flow is activated)</td></tr>
</table>
<table>
<tr><th>No.</th><th>Shows selected source for PF4/5 + Pt100</th></tr>
<tr><td>0</td><td>Unused</td></tr>
<tr><td>1</td><td>Differential Pressure</td></tr>
<tr><td>2</td><td>Not valid! Don't use!</td></tr>
<tr><td>3</td><td>Pt100 Temperature</td></tr>
<tr><td>4</td><td>Not valid! Don't use!</td></tr>
<tr><td>5</td><td>Analog Input</td></tr>
<tr><td>6</td><td>Ambient Pressure</td></tr>
<tr><td>7</td><td>Flow (Use only if Flow is activated)</td></tr>
<tr><td>8</td><td>Volume Flow (Use only if Flow is activated)</td></tr>
</table>
</td></tr>
<tr><td>44’502</td><td>Output Range Analog Output 1</td><td></td><td>
<table>
<tr><th>No.</th><th>Shows selected output range</th></tr>
<tr><td>0</td><td>Output Range 0…1V</td></tr>
<tr><td>1</td><td>Output Range 0…5V</td></tr>
</table>
</td></tr>
</table>

			2 Output Range 0…10V 3 Output Range 0…20mA 4 Output Range 4…20mA
44’503	Processing Scale Low 1	f !	• Customer selectable scale low 1 (part 1)
44’504		f !	• Customer selectable scale low 1 (part 2)
44’505	Processing Scale High 1	f !	• Customer selectable scale high 1 (part 1)
44’506		f !	• Customer selectable scale high 1 (part 2)
	➢ Example see below		
44’507	Source for Analog Output 2 (Depends on device type)	(!)	No. – Shows selected source - Same as for Analog Output 1
44’508	Output Range Analog Output 2	(!)	No. – Shows selected output range - Same as for Analog Output 1
44’509	Processing Scale Low 2	f !	• Customer selectable scale low 2 (part 1)
44’510		f !	• Customer selectable scale low 2 (part 2)
44’511	Processing Scale High 2	f !	• Customer selectable scale high 2 (part 1)
44’512		f !	• Customer selectable scale high 2 (part 2)
	➢ Example see below		
44’513	Source for Analog Output 3 (Depends on device type)		No. – Shows select source - Same as for Analog Output 1
44’514	Output Range Analog Output 3		No. – Shows selected output range - Same as for Analog Output 1
44’515	Processing Scale Low 2	f !	• Customer selectable scale low 3 (part 1)
44’516		f !	• Customer selectable scale low 3 (part 2)
44’517	Processing Scale High 2	f !	• Customer selectable scale high 3 (part 1)
44’518		f !	• Customer selectable scale high 3 (part 2)
	➢ Example see below		
44’519	Analog Output 1 Current Load		• Load Resistor for DAC1 (0 … 500 Ω)
44’520	Analog Output 2 Current Load		• Load Resistor for DAC2 (0 … 500 Ω)
44’521	Analog Output 3 Current Load		• Load Resistor for DAC3 (0 … 500 Ω)
	➢ Load Resistor are only for *Output Range* 0…20mA / 4…20mA for compensation		
44’522 … 44’599	Reserved		• Undefined • Gives back Modbus Exception Code 02

Description of the analog output

The output range of the measured sensor *Source* can be scaled to the processing area (*Scale Low* and *Scale High*).

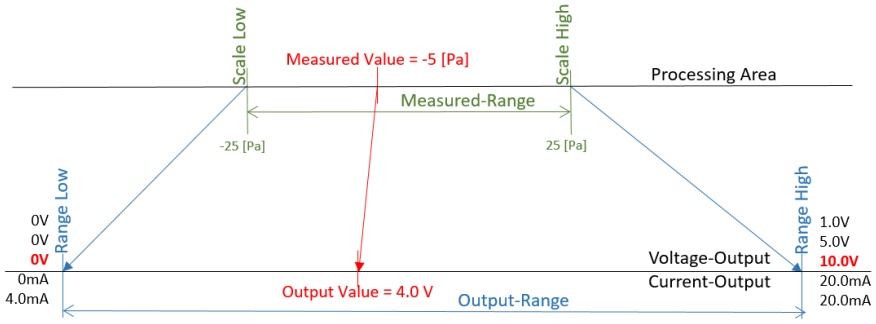
The output range of the analog outputs depends of the selected *Output Stage* and cannot be changed.

The *Scale Low* value will be projected to *Range Low* value and the *Scale High* value to *Range High* value of the selected *Output Range* (0…1V, 0…5V, 0…10V, 0…20mA, 4…20mA).

It applies: *Scale High* must be greater than *Scale Low*

Scale Low and *Scale High* should not exceed the range of ±100'000'000.0

Example:



Calculation of the resulting value (Output Value):

$$\boldsymbol{Output\ Value} = \frac{(\boldsymbol{Measured\ Value} - \boldsymbol{Scale\ Low}) * (\boldsymbol{Range\ High} - \boldsymbol{Range\ Low})}{(\boldsymbol{Scale\ High} - \boldsymbol{Scale\ Low})} + \boldsymbol{Range\ Low}$$

2.5.9 Display Settings

Adjustments to the PF4/5 display concerning appearance and content can be configured.

<table>
<tr><th>Register</th><th>Name</th><th>Flags</th><th>Description</th></tr>
<tr><td>44’601</td><td>Display Bits</td><td></td><td>• Not yet used, undefined</td></tr>
<tr><td>44’602</td><td>Display Row 1

(Depends on device type)</td><td></td><td>
<table>
<tr><th>No.</th><th>Shows selected source for PF4/5 + solo</th></tr>
<tr><td>0</td><td>No value displayed</td></tr>
<tr><td>1</td><td>Differential Pressure</td></tr>
<tr><td>2</td><td>Not valid! Don't use!</td></tr>
<tr><td>3</td><td>Not valid! Don't use!</td></tr>
<tr><td>4</td><td>Not valid! Don't use!</td></tr>
<tr><td>5</td><td>Analog Input</td></tr>
<tr><td>6</td><td>Ambient Pressure</td></tr>
<tr><td>7</td><td>Flow (Use only if Flow is activated)</td></tr>
<tr><td>8</td><td>Volume Flow (Use only if Flow is activated)</td></tr>
</table>
<table>
<tr><th>No.</th><th>Shows selected source for PF4/5 + HC2A</th></tr>
<tr><td>0</td><td>No value displayed</td></tr>
<tr><td>1</td><td>Differential Pressure</td></tr>
<tr><td>2</td><td>HC2A Humidity</td></tr>
<tr><td>3</td><td>HC2A Temperature</td></tr>
<tr><td>4</td><td>HC2A Calculation</td></tr>
<tr><td>5</td><td>Analog Input</td></tr>
<tr><td>6</td><td>Ambient Pressure</td></tr>
<tr><td>7</td><td>Flow (Use only if Flow is activated)</td></tr>
<tr><td>8</td><td>Volume Flow (Use only if Flow is activated)</td></tr>
</table>
<table>
<tr><th>No.</th><th>Shows selected source for PF4/5 + Pt100</th></tr>
<tr><td>0</td><td>No value displayed</td></tr>
<tr><td>1</td><td>Differential Pressure</td></tr>
<tr><td>2</td><td>Not valid! Don't use!</td></tr>
<tr><td>3</td><td>Pt100 Temperature</td></tr>
<tr><td>4</td><td>Not valid! Don't use!</td></tr>
<tr><td>5</td><td>Analog Input</td></tr>
<tr><td>6</td><td>Ambient Pressure</td></tr>
<tr><td>7</td><td>Flow (Use only if Flow is activated)</td></tr>
<tr><td>8</td><td>Volume Flow (Use only if Flow is activated)</td></tr>
</table>
</td></tr>
<tr><td>44’603</td><td>Display Row 2
(Depends on device type)</td><td></td><td>
<table>
<tr><th>No.</th><th>Shows selected source</th></tr>
<tr><td>-</td><td>Same as for Display Row 1</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td>44’604</td><td>Display Row 3
(Depends on device type)</td><td></td><td>
<table>
<tr><th>No.</th><th>Shows selected source</th></tr>
<tr><td>-</td><td>Same as for Display Row 1</td></tr>
</table>
</td></tr>
<tr><td>44’605</td><td>Display Row 4

(Depends on device type)</td><td></td><td>
<table>
<tr><th>No.</th><th>Shows selected source for PF4/5 + solo</th></tr>
<tr><td>0</td><td>No value displayed</td></tr>
<tr><td>1</td><td>Differential Pressure</td></tr>
<tr><td>2</td><td>Not valid! Don't use!</td></tr>
<tr><td>3</td><td>Not valid! Don't use!</td></tr>
<tr><td>4</td><td>Not valid! Don't use!</td></tr>
<tr><td>5</td><td>Analog Input</td></tr>
<tr><td>6</td><td>Ambient Pressure</td></tr>
<tr><td>7</td><td>Flow (Use only if Flow is activated)</td></tr>
<tr><td>8</td><td>Volume Flow (Use only if Flow is activated)</td></tr>
<tr><td>9</td><td>Flow Duct Area (Use only if Flow is activated)</td></tr>
</table>
<table>
<tr><th>No.</th><th>Shows selected source for PF4/5 + HC2A</th></tr>
<tr><td>0</td><td>No value displayed</td></tr>
<tr><td>1</td><td>Differential Pressure</td></tr>
<tr><td>2</td><td>HC2A Humidity</td></tr>
<tr><td>3</td><td>HC2A Temperature</td></tr>
<tr><td>4</td><td>HC2A Calculation</td></tr>
<tr><td>5</td><td>Analog Input</td></tr>
<tr><td>6</td><td>Ambient Pressure</td></tr>
<tr><td>7</td><td>Flow (Only if Flow is activated)</td></tr>
<tr><td>8</td><td>Volume Flow (Only if Flow is activated)</td></tr>
<tr><td>9</td><td>Flow Duct Area (Only if Flow is activated)</td></tr>
</table>
<table>
<tr><th>No.</th><th>Shows selected source for PF4/5 + Pt100</th></tr>
<tr><td>0</td><td>No value displayed</td></tr>
<tr><td>1</td><td>Differential Pressure</td></tr>
<tr><td>2</td><td>Not valid! Don't use!</td></tr>
<tr><td>3</td><td>Pt100 Temperature</td></tr>
<tr><td>4</td><td>Not valid! Don't use!</td></tr>
<tr><td>5</td><td>Analog Input</td></tr>
<tr><td>6</td><td>Ambient Pressure</td></tr>
<tr><td>7</td><td>Flow (Only if Flow is activated)</td></tr>
<tr><td>8</td><td>Volume Flow (Only if Flow is activated)</td></tr>
<tr><td>9</td><td>Flow Duct Area (Only if Flow is activated)</td></tr>
</table>
</td></tr>
<tr><td>44’606</td><td>Pixel Color</td><td>! E</td><td>• Color for pixel</td></tr>
<tr><td>44’607</td><td>Pixel Color Alarm</td><td>! E</td><td>• Color for alarm</td></tr>
<tr><td>44’608</td><td>Pixel Color Pre-Alarm</td><td>! E</td><td>• Color for pre-alarm</td></tr>
<tr><td>44’609</td><td>Pixel Color Background</td><td>! E</td><td>• Color for background</td></tr>
</table>

<table>
<tr><td>44’610</td><td>Display Brightness</td><td></td><td><table><tr><th>No.</th><th>Shows select display brightness</th></tr><tr><td>0</td><td>Display brightness 20%</td></tr><tr><td>1</td><td>Display brightness 30%</td></tr><tr><td>2</td><td>Display brightness 40%</td></tr><tr><td>3</td><td>Display brightness 50%</td></tr><tr><td>4</td><td>Display brightness 60%</td></tr><tr><td>5</td><td>Display brightness 70%</td></tr><tr><td>6</td><td>Display brightness 80%</td></tr><tr><td>7</td><td>Display brightness 90%</td></tr><tr><td>8</td><td>Display brightness 100%</td></tr></table></td></tr>
<tr><td>44’611 … 44’699</td><td>Reserved</td><td></td><td>• Undefined
• Gives back Modbus Exception Code 02</td></tr>
</table>

2.5.10 Alarm Settings

For most sensors, it is possible to set alarm values for a *Low* and *High* level with *Hysteresis* and pre-alarms values to *Low* and *High* level.

Values of the selected sensor, which are located below the low alarm or above the high alarm (or pre-alarm), trigger an alarm (or pre-alarm). The value specified for the alarm function *Hysteresis* is used for both the *Low* and the *High* alarm. *Hysteresis* is not used for pre-alarm.

To activate the alarm, you have to set the corresponding *Alarm Bit* to *ON*.

Note!
Be sure to select alarm values inside the operating range of the sensors. Valid ranges depends on selected measuring value and selected unit.

<table>
<tr><th>Register</th><th>Name</th><th>Flags</th><th>Description</th></tr>
<tr><td>44’701</td><td>Alarm Bits

(Depends on device type)</td><td>f !</td><td><table><tr><th>No.</th><th>Shows selected source for PF4/5 + solo</th></tr><tr><td>0</td><td>Differential Pressure</td></tr><tr><td>1</td><td>Not valid! Don't use!</td></tr><tr><td>2</td><td>Not valid! Don't use!</td></tr><tr><td>3</td><td>Not valid! Don't use!</td></tr><tr><td>4</td><td>Analog Input</td></tr><tr><td>5</td><td>Flow (Use only if Flow is activated)</td></tr><tr><td>6</td><td>Volume Flow (Use only if Flow is activated)</td></tr></table><table><tr><th>No.</th><th>Shows selected source for PF4/5 + HC2A</th></tr><tr><td>0</td><td>Differential Pressure</td></tr><tr><td>1</td><td>HC2A Humidity</td></tr><tr><td>2</td><td>HC2A Temperature</td></tr><tr><td>3</td><td>HC2A Calculation</td></tr><tr><td>4</td><td>Analog Input</td></tr><tr><td>5</td><td>Flow (Use only if Flow is activated)</td></tr><tr><td>6</td><td>Volume Flow (Use only if Flow is activated)</td></tr></table></td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>No.</th><th>Shows selected source for PF4/5 + Pt100</th></tr>
<tr><td>0</td><td>Differential Pressure</td></tr>
<tr><td>1</td><td>Not valid! Don't use!</td></tr>
<tr><td>2</td><td>Pt100 Temperature</td></tr>
<tr><td>3</td><td>Not valid! Don't use!</td></tr>
<tr><td>4</td><td>Analog Input</td></tr>
<tr><td>5</td><td>Flow (Use only if Flow is activated)</td></tr>
<tr><td>6</td><td>Volume Flow (Use only if Flow is activated)</td></tr>
</table>
0 = Alarm Value is OFF, 1 = Alarm Value is ON
</td></tr>
<tr><td>44’702</td><td rowspan="2">Differential Pressure Low</td><td>f !</td><td>• Alarm value differential pressure low (part 1)</td></tr>
<tr><td>44’703</td><td>f !</td><td>• Alarm value differential pressure low (part 2)</td></tr>
<tr><td>44’704</td><td rowspan="2">Differential Pressure High</td><td>f !</td><td>• Alarm value differential pressure high (part 1)</td></tr>
<tr><td>44’705</td><td>f !</td><td>• Alarm value differential pressure high (part 2)</td></tr>
<tr><td>44’706</td><td rowspan="2">Differential Pressure Hysteresis</td><td>f !</td><td>• Alarm value differential pressure hysteresis (part 1)</td></tr>
<tr><td>44’707</td><td>f !</td><td>• Alarm value differential pressure hysteresis (part 2)</td></tr>
<tr><td>44’708</td><td rowspan="2">Differential Pressure Pre-Alarm Low</td><td>f !</td><td>• Pre-alarm value differential pressure low (part 1)</td></tr>
<tr><td>44’709</td><td>f !</td><td>• Pre-alarm value differential pressure low (part 2)</td></tr>
<tr><td>44’710</td><td rowspan="2">Differential Pressure Pre-Alarm High</td><td>f !</td><td>• Pre-alarm value differential pressure high (part 1)</td></tr>
<tr><td>44’711</td><td>f !</td><td>• Pre-alarm value differential pressure high (part 2)</td></tr>
<tr><td>44’712</td><td rowspan="2">Humidity Low
Use only if HC2A is used</td><td>f !</td><td>• Alarm value humidity low (part 1)</td></tr>
<tr><td>44’713</td><td>f !</td><td>• Alarm value humidity low (part 2)</td></tr>
<tr><td>44’714</td><td rowspan="2">Humidity High
Use only if HC2A is used</td><td>f !</td><td>• Alarm value humidity high (part 1)</td></tr>
<tr><td>44’715</td><td>f !</td><td>• Alarm value humidity high (part 2)</td></tr>
<tr><td>44’716</td><td rowspan="2">Humidity Hysteresis
Use only if HC2A is used</td><td>f !</td><td>• Alarm value humidity hysteresis (part 1)</td></tr>
<tr><td>44’717</td><td>f !</td><td>• Alarm value humidity hysteresis (part 2)</td></tr>
<tr><td>44’718</td><td rowspan="2">Humidity Pre-Alarm Low
Use only if HC2A is used</td><td>f !</td><td>• Pre-alarm value humidity low (part 1)</td></tr>
<tr><td>44’719</td><td>f !</td><td>• Pre-alarm value humidity low (part 2)</td></tr>
<tr><td>44’720</td><td rowspan="2">Humidity Pre-Alarm High
Use only if HC2A is used</td><td>f !</td><td>• Pre-alarm value humidity high (part 1)</td></tr>
<tr><td>44’721</td><td>f !</td><td>• Pre-alarm value humidity high (part 2)</td></tr>
<tr><td>44’722</td><td>Temperature Low</td><td>f !</td><td>• Alarm value temperature low (part 1)</td></tr>
</table>

44’723	Use only if HC2A or Pt100 is used	f !	• Alarm value temperature low (part 2)
44’724	Temperature High Use only if HC2A or Pt100 is used	f !	• Alarm value temperature high (part 1)
44’725		f !	• Alarm value temperature high (part 2)
44’726	Temperature Hysteresis Use only if HC2A or Pt100 is used	f !	• Alarm value temperature hysteresis (part 1)
44’727		f !	• Alarm value temperature hysteresis (part 2)
44’728	Temperature Pre-Alarm Low Use only if HC2A or Pt100 is used	f !	• Pre-alarm value temperature low (part 1)
44’729		f !	• Pre-alarm value temperature low (part 2)
44’730	Temperature Pre-Alarm High Use only if HC2A or Pt100 is used	f !	• Pre-alarm value temperature high (part 1)
44’731		f !	• Pre-alarm value temperature high (part 2)
44’732	Calculation Low Use only if HC2A is used	f !	• Alarm value calculation low (part 1)
44’733		f !	• Alarm value calculation low (part 2)
44’734	Calculation High Use only if HC2A is used	f !	• Alarm value calculation high (part 1)
44’735		f !	• Alarm value calculation high (part 2)
44’736	Calculation Hysteresis Use only if HC2A is used	f !	• Alarm value calculation hysteresis (part 1)
44’737		f !	• Alarm value calculation hysteresis (part 2)
44’738	Calculation Pre-Alarm Low Use only if HC2A is used	f !	• Pre-alarm value calculation low (part 1)
44’739		f !	• Pre-alarm value calculation low (part 2)
44’740	Calculation Pre-Alarm High Use only if HC2A is used	f !	• Pre-alarm value calculation high (part 1)
44’741		f !	• Pre-alarm value calculation high (part 2)
44’742	Analog Input Low	f !	• Alarm value analog input low (part 1)
44’743		f !	• Alarm value analog input low (part 2)
44’744	Analog Input High	f !	• Alarm value analog input high (part 1)
44’745		f !	• Alarm value analog input high (part 2)
44’746	Analog Input Hysteresis	f !	• Alarm value analog input hysteresis (part 1)
44’747		f !	• Alarm value analog input hysteresis (part 2)
44’748	Analog Input Pre-Alarm Low	f !	• Pre-alarm value analog input low (part 1)

44’749		f !	• Pre-alarm value analog input low (part 2)
44’750	Analog Input Pre-Alarm High	f !	• Pre-alarm value analog input high (part 1)
44’751		f !	• Pre-alarm value analog input high (part 2)
44’752	Flow Low Use only if Flow is activated	f !	• Alarm value flow low (part 1)
44’753		f !	• Alarm value flow low (part 2)
44’754	Flow High Use only if Flow is activated	f !	• Alarm value flow high (part 1)
44’755		f !	• Alarm value flow high (part 2)
44’756	Flow Hysteresis Use only if Flow is activated	f !	• Alarm value flow hysteresis (part 1)
44’757		f !	• Alarm value flow hysteresis (part 2)
44’758	Flow Pre-Alarm Low Use only if Flow is activated	f !	• Pre-alarm value flow low (part 1)
44’759		f !	• Pre-alarm value flow low (part 2)
44’760	Flow Pre-Alarm High Use only if Flow is activated	f !	• Pre-alarm value flow high (part 1)
44’761		f !	• Pre-alarm value flow high (part 2)
44’762	Volume Flow Low Use only if Flow is activated	f !	• Alarm value volume flow low (part 1)
44’763		f !	• Alarm value volume flow low (part 2)
44’764	Volume Flow High Use only if Flow is activated	f !	• Alarm value volume flow high (part 1)
44’765		f !	• Alarm value volume flow high (part 2)
44’766	Volume Flow Hysteresis Use only if Flow is activated	f !	• Alarm value volume flow hysteresis (part 1)
44’767		f !	• Alarm value volume flow hysteresis (part 2)
44’768	Volume Flow Pre-Alarm Low Use only if Flow is activated	f !	• Pre-alarm value volume flow low (part 1)
44’769		f !	• Pre-alarm value volume flow low (part 2)
44’770	Volume Flow Pre-Alarm High Use only if Flow is activated	f !	• Pre-alarm value volume flow high (part 1)
44’771		f !	• Pre-alarm value volume flow high (part 2)
44’772 … 44’799	Reserved		• Undefined • Gives back Modbus Exception Code 02

2.5.11 Relay Settings

Setting of relays for all sensors.

Note!
In order to make use of the PF4/5 relay output, you must first enable the *Alarm Bits* and set the corresponding *Alarm Levels* (low and high) for each sensor that you want to monitor (see Alarm Settings).
Be aware that more than one *Alarm Source* can activate the relay

Register	Name	Flags	Description	
44’801	Alarm Level Differential Pressure		**No.**	**Shows selected alarm level**
			0	Off (No differential pressure alarm)
			1	Low (*Differential Pressure Low* alarm)
			2	High (*Differential Pressure High* alarm)
			3	Low or High
44’802	Alarm Level Humidity Use only if HC2A is used		**No.**	**Shows selected alarm level**
			-	Same as for *Alarm Level Differential Pressure*
44’803	Alarm Level Temperature Use only if HC2A or Pt100 is used		**No.**	**Shows selected alarm level**
			-	Same as for *Alarm Level Differential Pressure*
44’804	Alarm Level Calculation Use only if HC2A is used		**No.**	**Shows selected alarm level**
			-	Same as for *Alarm Level Differential Pressure*
44’805	Alarm Level Analog Input		**No.**	**Shows selected alarm level**
			-	Same as for *Alarm Level Differential Pressure*
44’806	Alarm Level Flow Use only if Flow is activated		**No.**	**Shows selected alarm level**
			-	Same as for *Alarm Level Differential Pressure*
44’807	Alarm Level Volume Flow Use only if Flow is activated		**No.**	**Shows selected alarm level**
			-	Same as for *Alarm Level Differential Pressure*
44’808	Alarm Off		**No.**	**Shows selected alarm Off sequence**
			0	Alarm never ends! ➢ The relay stays energized until it will be de-energized manually
			1	Off when alarm ends ➢ The relay will be de-energized as soon as the alarm condition ends
			2	Off after *Timeout* ➢ The relay will remain energized for the specified

			duration (*Timeout*) even if the alarm condition has ended 3 Off after alarm ends or after ***Timeout***
44’809	On Delay	!	• On delay time for relay (0 … 65536 [s])
	➢ If alarm condition occurs, the relay will be energized after specified OnDelay time		
44’810	Alarm Time	!	• Maximal alarm time for relay (0 … 65536 [s])
	➢ Time in seconds between the occurrence of the trigger criterion and the de-energizing of the relay. This timeout will be active when *Off after Timeout* is chosen		
44’811	Mute On/Off		• If *ON*: It’s possible to mute the alarm for *Mute Time*
44’812	Mute Time	!	• Mute time (0 … 65536 [s])
	➢ Time in seconds the relay will be muted before the alarm went on again (if alarm is still active)		
44’813… 44’899	Reserved		• Undefined • Gives back Modbus Exception Code 02

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2.5.12 Analog Input Settings

The input range of the analog input covers 0 to 10.0 [V] resp. 0 to 24.0 [mA], depending on *Analog Input Type*.

Register	Name	Flags	Description
44'901	Analog Input Bits		**Bit** / **Description of the Analog Input bits** 0: Auto Unit ➢ See below 1…15: Reserved
44'902	Analog Input Type		**No.** / **Select Analog Input Source** 0: Voltage (0 … 10V) 1: Current (0 … 24mA)
	➢ The same value as in Value Type -> Analog Input Select		
44'903	Input Range Low	f !	• Customer selectable input range (low level) (part 1)
44'904		f !	• Customer selectable input range (low level) (part 2)
44'905	Input Range High	f !	• Customer selectable input range (high level) (part 1)
44'906		f !	• Customer selectable input range (high level) (part 2)
44'907	Processing Range Scale Low	f !	• Customer selectable proc. range scale low (part 1)
44'908		f !	• Customer selectable proc. range scale low (part 2)
44'909	Processing Range Scale High	f !	• Customer selectable proc. range scale high (part 1)
44'910		f !	• Customer selectable proc. range scale high (part 2)
	➢ Example see below		
44'911 … 44'999	Reserved		• Undefined • Gives back Modbus Exception Code 02

Auto Unit: **Off** the text in the field *Unit: Analog Input String* in the section Value Unit will be showed.

Auto Unit: **On** if the field *Unit: Analog Input String* in the section Value Unit is empty, the following automatic unit string will be used:

Analog Input Select	***Voltage***	***Current***
Auto Unit	"V"	"mA"

If the field *Unit: Analog Input String* in the section Value Unit is not empty, e.g. set to "ppm", the unit in the field *Unit: Analog Input String* will be used, in this case "ppm".

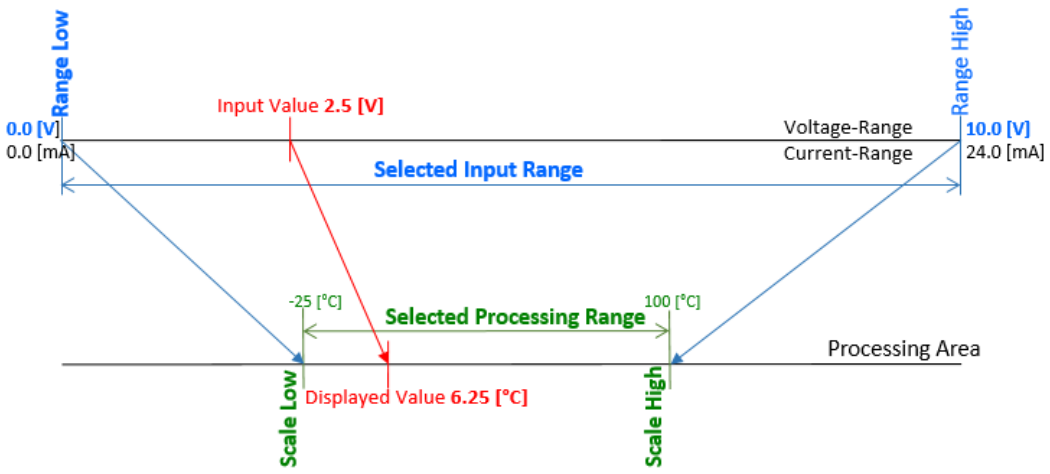
Description of the analog input

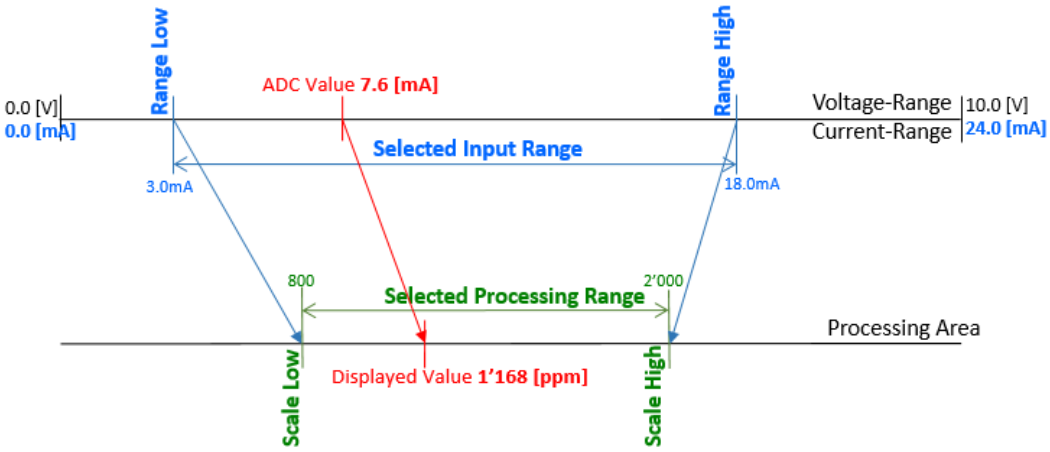
The input range of the analog input covers 0.0 [V] to 10.0 [V] resp. 0.0 [mA] to 24.0 [mA], depending on *Analog Input Type*.

The input range (***Range Low / High***) of the analog input can be scaled to a processing area (***Scale Low / High***).

Note!
Range High must be greater than ***Range Low*** and ***Scale High*** must be greater or equal ***Scale Low***.
Don't exceed the selected maximal and minimal limits of the input range.

Examples:





Calculation of the resulting value (*Displayed Value*):

$$Displayed\ Value = \frac{(ADC\ Value - Range\ Low) * (Scale\ High - Scale\ Low)}{(Range\ High - Range\ Low)} + Scale\ Low$$

2.5.13 Flow Settings

Setting of flow specific values.

Register	Name	Flags	Description
45’001	Flow Bits		**Bit** / **Description of the Flow bits** 0: OFF – Flow measurement is OFF 0: ON – Flow measurement is ON 1…15: Reserved
45’002	Duct Area Only if Flow is activated	f !	• Customer selectable flow area (part 1)
45'003		f !	• Customer selectable flow area (part 2)
45’004	KL Factor Only if Flow is activated	f !	• Customer selectable flow KL factor (part 1)
45’005		f !	• Customer selectable flow KL factor (part 2)
45’006 … 45’099	Reserved		• Undefined • Gives back Modbus Exception Code 02

Duct Area: Channel area for the calculation of the volume flow. Unit is defined in Value Unit

KL Factor: Actual KL factor for the calculation of the volume flow

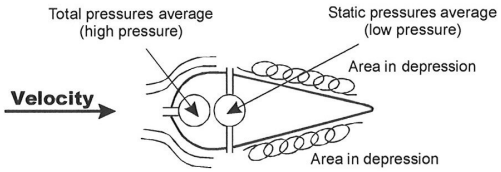
- **Calculation formula**

Velocity (m/s)* = $K_L \times \sqrt{Pt\text{-}Ps}$
with Pt and Ps in Pa

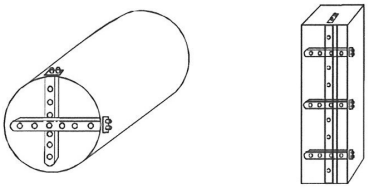
Air flow (m^3/h)* = $K_L \times \sqrt{Pd} \times S \times 3600$
with Pd in Pa and S in m^2

K_L : DEBIMO blade factor
Pt : total pressure
Ps : static pressure
S : duct section (m2)
Pd = Pt - Ps = dynamic pressure
Factor of velocity calculation K_L = 1

* Theoretical, with the specific weight of the air 1,2Kg /



- **Mounting examples**



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2.5.14 Explanation of Flags

“	Character values separated in succeeding registers. 2 characters per register
?	After restart of the device, the *Reference Values* are always set to 0.0
f	These are float values (32-bit IEEE754), separated in two succeeding registers (16-bits). How to bring together part 1 and part 2 of the 32-bit float-value, depends on the *Swap Mode* of the Modbus communication (see Device Specific Settings and Selectable Swap Modes for Rotronic Devices)
!	**Attention!** It is not possible to verify the value, written to this register. Most of the *Specific Holding Registers* cannot be validated, if Modbus command *Write Multiple Register* is used
i	These are 32-bit values, separated in two succeeding registers (16-bits). How to bring together part 1 and part 2 of the 32-bit value, depends on the *Swap Mode* of the Modbus communication (see Selectable Swap Modes for Rotronic Devices)
E	Color Bits: Red Green Blue e.g. Red

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0

2.5.15 Example: Read Holding Register

2.5.15.1 Read Display Settings (Registers 44'602 to 44'605)

RTU Example:

Transmit	01 03 ae 39 00 04 b4 ec
Receive	01 03 08 00 01 00 02 00 03 00 06 8c d5

TCP Example:

Transmit	MBAP 01 03 ae 39 00 04
Receive	MBAP 01 03 08 00 01 00 02 00 03 00 06

Field	Bytes	Value	Description
MBAP	7	MBAP	MBAP header (see Modbus RTU / TCP)
Checksum	2	CRC	CRC Checksum (see Modbus RTU / TCP)
RTU number	1	0x01	Modbus RTU Address (see Device Specific Settings)
Function code	1	0x03	Read Holding Register
Starting address	2	0xae39	= 44'601 (Attention! register number – 1)
Quantity of registers	2	0x0004	= 4, means read 4 registers
Byte count	1	0x08	= 8 ≙ **2 * N**, means numbers of returned bytes
Register value (see Display Settings)	**2 * N**	0x0001	Display Row 1: Differential Pressure
		0x0002	Display Row 2: Humidity
		0x0003	Display Row 3: Temperature
		0x0006	Display Row 4: Ambient Pressure

For detailed information about Modbus protocol *Read Holding Register*, see:
(http://modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf).

2.5.16 Example: Write Holding Register

2.5.16.1 Write Display Settings (Registers 44'602 to 44'605)

RTU Example:

Transmit	01 10 ae 39 00 04 08 00 03 00 02 00 01 00 00 67 09
Receive	01 10 ae 39 00 04 31 2f

TCP Example:

Transmit	MBAP 01 10 ae 39 00 04 08 00 03 00 02 00 01 00 00
Receive	MBAP 01 10 ae 39 00 04

Field	Bytes	Value	Description
MBAP	7	MBAP	MBAP header (see Modbus RTU / TCP)
Checksum	2	CRC	CRC Checksum (see Modbus RTU / TCP)
RTU number	1	0x01	Modbus RTU Address (see Device Specific Settings)
Function code	1	0x10	Write Multiple Register
Starting address	2	0xae39	= 44'601 (Attention! register number – 1)
Quantity of registers	2	0x0004	= 4, means read 6 registers
Byte count	1	0x08	= 8 ≙ **2 * N**, means numbers of returned bytes
Register value (see Display Settings)	**2 * N**	0x0003	Display Row 1: Temperature
		0x0002	Display Row 2: Humidity
		0x0001	Display Row 3: Differential Pressure
		0x0000	Display Row 4: No value displayed

Note!
After writing a *Write Multiple Register* command, it needs a restart of the device to activate the selected changes (see Device Actions or Reset Device).

For detailed information about Modbus protocol *Write Multiple Register*, see:
(http://modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf).

3 Document Releases

Doc. Release	Datum	Bemerkung
E-M-PF4_PF5-Modbus	20.03.2019	Release Document
E-M-PF4_PF5-Modbus V1.2	12.04.2021	Version 2.1
E-M-PF4_PF5-Modbus V1.3	24.03.2023	Modbus RTU Address is the RS485-Adress