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1 Electrical Connection

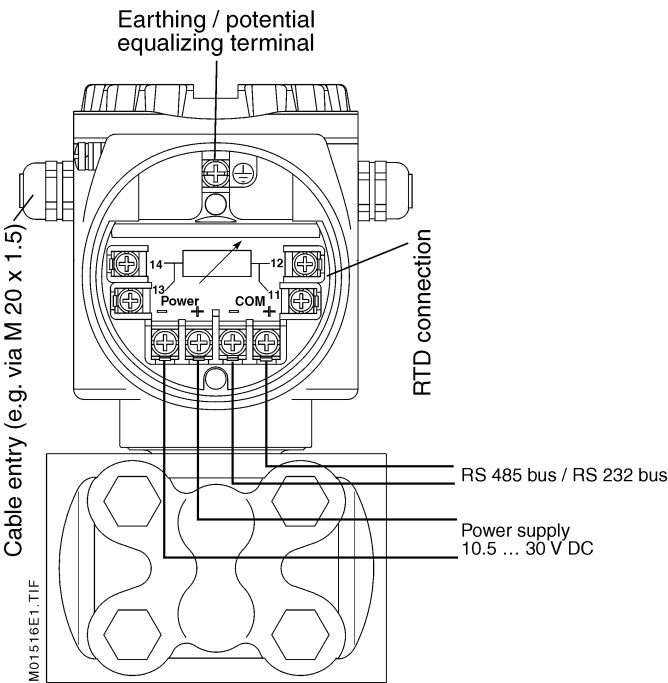
The relevant guidelines must be observed during the electrical installation!

Since the transmitter has no switch-off elements, overcurrent protection devices or mains disconnection possibilities must be provided on the system side (overvoltage protection at option).

Check that the existing operating voltage corresponds to that indicated on the type plate. For power supply and output signal, the same lines are used. **Consult the enclosed connection diagram!** Depending on the supplied model, the electrical connection is made via cable entry 1/2-14 NPT or M 20 x 1.5 or via plug Han 8 U. The screw terminals are suitable for wire cross-sections up to 2.5 mm².

Assignment for RS 232

RxD COM (+)
TxD COM (-)
Ground Power (-)



2 Device Mode

The device uses two modes. An "Operate" mode and a "Config" mode can be selected. The "Operate" mode provides only the process parameters and some further parameters, that allow a simple configuration of the device. These parameters are shown in the chapter Register Map. In the "Config" mode the device can be configured with the SMART VISION "Modbus-DTM".

It is possible to change the device mode from "Operate" to "Config." and vice versa by pressing simultaneously the keys 100 %, 0 % and write protection . The keys must be pressed at least 3 sec during power up. The following table shows which keys have to be pressed.

Caution: During configuration (Config. mode) open-loop controls / control systems (PLS, SPS ...) should be separated from the transmitter.

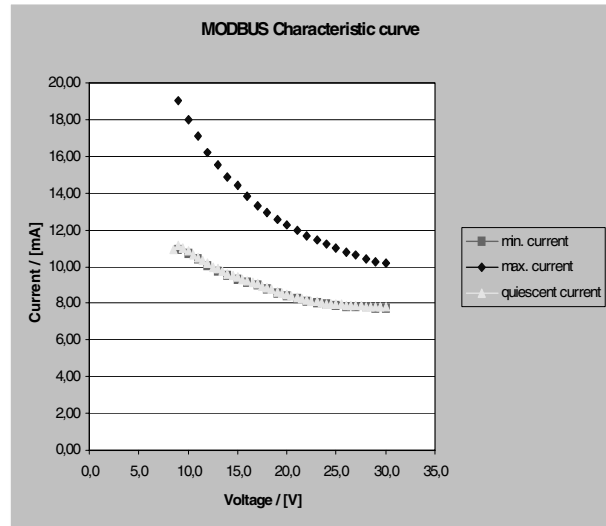
Key 0%	Key 100%	Write protection key	Device mode
X	X	-	Operate
X	X	X	Configuration

X = pressed key (during power up)



3 Important Information For Users

The transmitter operates on terminal voltage of 10.5V – 30V dc. The quiescent supply current is 10mA typically. The transmitting supply current does not exceed 25mA.



The transmitter uses 2-wire half-duplex RS-485 Modbus.

The transmitter uses 8 bit Remote Terminal Unit (RTU) data transmission. The communication parameters are set at 8 data bits, 1 stop bit and no parity bit. These parameters are not configurable.

For communication via SMART VISION the DTM for Modbus have to be used.

The master gets an exception response if an error occurs after a request was received. The following error codes are possible:

Code	Name	Reason
01	ILLEGAL FUNCTION	Function code is not supported
02	ILLEGAL DATA ADDRESS	coil/register-address does not exist, parameter can not be accessed with the Modbus interface, only one half of a float value was written
03	ILLEGAL DATA VALUE	Value out of range, setting not accepted
04	SLAVE DEVICE FAILURE	Internal error
05	ACKNOWLEDGE	Does not appear
06	SLAVE DEVICE BUSY	Device is performing a reset to factory defaults or device is writing data to Flow Buffer Memory
07	NEGATIVE ACKNOWLEDGE	Does not appear
08	MEMORY PARITY ERROR	Error in Flow Buffer Memory

The master can poll diagnostic information. Therefore the Modbus-function code 08 is used. Following subcodes are supported:

Code	Name	Description
00	Return Query Data	Return same data as received
01	Restart Comm Option	Restart Modbus communication
02	Return Diagnostic Register	See diagnostic register
0A	Clear Counters and Diagnostic Register	Clear all supported counters and diagnostic register
0C	Return Bus Communication Error Count	CRC errors since last restart
0D	Return Bus Exception Error Count	Exceptions since last restart
0E	Return Slave Message Count	Quantity of messages addressed to the slave since last restart

Remarks on electromagnetic compatibility / power supply

The requirements of the electromagnetic compatibility (EMC) according to DIN EN 61000-4-5 have to be met. For this purpose all cables led into the transmitter must be screened! Special cables are not necessary. For the power supply / communication as well as for the connection of the PT100 resistance thermometer screened 4-wire cables must be used. On the part of the transmitter, the screen has to be applied on the EMC-compatible screw connection just as on the power supply / communication side. Please also observe that the power supply of the transmitter as well as of the communication unit and an optionally connected PC / Notebook are potential-free. Otherwise the data line has to be decoupled galvanically.

Contents of the diagnostic register:

Bit	Name	Description
0	EEPROM_ERROR	Eeprom error sensor or mainboard electronics
1	EEPROM_DATA_ERROR	Eeprom checksum error
2	ALARM_ROM	Rom checksum error
3	ALARM_RAM	Ram checksum error
4	MALFUNCTION	Device malfunction.
5	SW_MALFUNCTION	Software malfunction.
6	MEM_CHKSUM	Memory error.
7	MEASUREMENT	Failure in measurement.
8	MAINTENANCE	Maintenance required.

4 Parameters

Device mode	0=Operate, 1=Config
Baud Rate	1=1200 Baud 2=2400 Baud 3=4800 Baud 4=9600 Baud
Bus Address	1..247
Response Delay Time	0..200ms

Reset To Factory Data	1=Reset to factory data 1)
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1) due to this action (address 491) the device does not give a signal for max. 1 min.

Differential pressure unit	See Pressure Unit Table
Pressure unit	See Pressure Unit Table
Temperature unit	See Temperature Unit Table
Volume flow unit	See Volume Flow Unit Table
Mass flow unit / Volume flow unit	See Mass Flow Unit Table

Pressure Unit Table:

Unit code	Pressure unit
1	inches of water
2	inches of mercury
3	feet of water
4	millimeters of water
5	millimeters of mercury
6	pounds per square inch
7	Bar
8	Millibar
9	gram per square centimeter
10	kilogram per square centimeter
11	Pascal
12	Kilopascal
13	Torr
14	Atmospheres
117	Megapascal

Temperature Unit Table:

Unit code	Temperature unit
32	degree Celsius
33	degree Fahrenheit
34	degree Rankine
35	Kelvin

Volume Flow Unit Table:

Unit code	Volume flow unit
15	cubic feet per minute
16	US gallon per minute
17	liter per minute
18	Imperial gallon per minute
19	cubic meter per hour
22	US gallon per second
23	mega US gallon per day
24	liter per second
25	megaliter per day
26	cubic feet per second
27	cubic feet per day
28	cubic meter per second
29	cubic meter per day
30	Imperial gallon per hour
31	Imperial gallon per day
68	US gallon per day
130	cubic feet per hour
131	cubic meter per minute
132	barrel per second
133	barrel per minute
134	barrel per hour
135	barrel per day
136	US gallon per hour
137	Imperial gallon per second
138	liter per hour
242	mega cubic feet per day

Mass Flow Unit Table:

Unit code	Mass flow unit
70	gram per second
71	gram per minute
72	gram per hour
73	kilogram per second
74	kilogram per minute
75	kilogram per hour
76	kilogram per day
77	metric ton per minute
78	metric ton per hour
79	metric ton per day
80	pound per second
81	pound per minute
82	pound per hour
83	pound per day
84	short ton per minute
85	short ton per hour
86	short ton per day
87	long ton per hour
88	long ton per day

Zeropoint correction	Writing any value starts zeropoint correction
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Cal Point Hi DP	To perform a trim the process value has to be applied to the device and then the applied value has to be written to the corresponding register. It is possible to select the unit for the calibration.
Cal Point Lo DP	
Cal Point Hi P	
Cal Point Lo P	
Cal Unit DP/P	
Cal Point Hi T	
Cal Point Lo T	
Cal Unit T	

5 Flow Buffer

The mass flow or the volume flow can be integrated and stored in registers. A starting point has to be defined for the calculation of the flow value. The integration of the flow will start when the starting point is set. The time since the starting point was set is counted and stored in the parameter Flow Buffer Time.

The integration time constant is 1 sec. The flow is integrated in the RAM Parameter Flow Buffer Actual. After one hour, the calculated flow value is stored non volatile in one of the Flow Buffer Hour registers. Flow Buffer Actual is cleared and the flow will be integrated again. After another hour, the calculated flow value will be stored non volatile and so on. There are 23 Flow Buffer Hour registers. After 24 hours the contents of the Flow Buffer Hour registers and the last calculated flow value will be added up and stored in the Flow Buffer Day registers. Then the hour registers are cleared. In the Flow Buffer Day registers 35 values can be stored. It is a circular buffer. After 36 days the first day register will be overwritten. The value of the counted days will be set to one. The counting of the days is module 35, thus the value of the counted days points to the latest day value in the buffer. The other day registers will not be changed.

Flow Buffer Selection	0 = off, 1 = Volume Flow, 2 = Mass Flow / Standard Volume Flow
Flow Buffer Action	0 = stop 1 = start 2 = clear last hour and stop 3 = clear hour registers and stop 4 = clear day registers and stop 2) 5 = clear all and stop 2)
Flow Buffer Total	Total flow since starting point
Flow Buffer Actual	Flow since last hour
Flow Buffer Hour x	Flow in hour x since start of the last day
Flow Buffer Day	Flow on day x (x counted since start module 35)
Flow Buffer Time	Days Hours MiniSec since start (4 byte)

2) these actions can take up to 10 sec.

The daily values of the flow memory are stored in an additional data area in the EEPROM. If an error occurs in this area, it can be recognized but not removed. An error bit is set in diagnosis. Values which are not affected by this error can still be read. If a faulty value is stored again in the EEPROM and the error is eliminated in this way, the respective value can be read again. By clearing the daily memory, the error bit is reset.

All parameters in the buffer memory can be accessed in the "Operate" mode.

6 Optional Texts On Display

Under the Display menu an option User-Text can be selected. It allows displaying a string written via Modbus. The text is filed from register 1001 to 1007. The first 7 bytes are shown in the first line, the last bytes in the second line. It is only possible to write all 7 registers in an access with the function WriteMultipleRegister(16).

1st line	1001 H	1001 L	1002 H	1002 L	1003 H	1003 L	1004 H
2nd line	1004 L	1005 H	1005 L	1006 H	1006 L	1007 H	1007 L

Activation:

1. Press mode key "M".
2. Press key "+" (or key "-") as long as the menu option USER TEXT appears.
3. Acknowledge by mode key "M".
4. Display OK, i.e. the action is stored non-volatile.
5. Quit program via menu option "EXIT" using key "+" / "-".

7 Register Map

All registers in this document are referenced to one. The Modbus messages are referenced to zero. This means that the number of the mapped register is one higher than the number that is sent in a Modbus message frame.

There is a difference between function code 3 and function code 4.

Function code 4 can be executed in less time than function code 3. Function code 4 is meant to access the process parameters, which possibly could be polled in a low cycle time (>100ms). Therefore the data of the parameters is held in an internal buffer, which has a low access time. Function code 3 should be used to access parameters non cyclic or with a high cycle time (>seconds).

By reading or writing 32 bit or 16 bit registers 4 or 2 byte are transmitted. If a parameter has a datatype which uses less bytes than that, the data is transmitted in the lower data bytes of the modbus message frame. The data bytes, that are not used, are set to zero. To access the following parameters the device mode has to be set to "Operate".

32-Bit-Register

Caution: over Function Code 04 it is faster to read as over Function Code 03.

Address	Parameter Name	Data Type	Function Code	Read/Write
21	Differential Pressure (DP)	Float	04	R
22	Pressure (P)	Float	04	R
23	Process Temperature (T)	Float	04	R
24	Normal Volume Flow/ Mass Flow (NVF/MF)	Float	04	R
25	Volume Flow (VF)	Float	04	R
26	Diagnosis1+2	Usign32	03,04	R
27	DiagnosisExtension3	Usign16	03,04	R
28	DiagnosisExtension1+2	Usign32	03,04	R
41	Upper Calibration Point DP	Float	03,06,16	R/W
42	Lower Calibration Point DP	Float	03,06,16	R/W
43	Upper Calibration Point P	Float	03,06,16	R/W
44	Lower Calibration Point P	Float	03,06,16	R/W
45	Calibration Unit Pressure	Usign16	03,06,16	R/W
46	Upper Calibration Point T	Float	03,06,16	R/W
47	Lower Calibration Point T	Float	03,06,16	R/W
48	Calibration Unit Temperature	Usign16	03,06,16	R/W
51	Damping Time Constant DP	Float	03,06,16	R/W
53	Damping Time Constant T	Float	03,06,16	R/W
54	Balance Oblique Sensor	Usign8	03,06,16	R/W
121	Flow Buffer Selection	Usign8	03,06,16	R/W
122	Flow Buffer Action	Usign8	03,06,16	R/W
123	Flow Buffer Time	Usign32	03	R
124	Flow Buffer Total	Float	03	R
125	Flow Actual	Float	03	R
126	Flow Buffer Hour 1	Float	03	R
127	Flow Buffer Hour 2	Float	03	R
	...			
148	Flow Buffer Hour 23	Float	03	R
156	FlowBuffer Day 1	Float	03	R
157	FlowBuffer Day 2	Float	03	R
	...			
190	Flow Buffer Day 35	Float	03	R

16-Bit-Register

Address	Parameter Name	Data Type	Function Code	Read/Write
401	Differential Pressure (DP)	1/2Float	04	R
402	"	1/2Float	04	R
403	Pressure (P)	1/2Float	04	R
404	"	1/2Float	04	R
405	Process Temperature (T)	1/2Float	04	R
406	"	1/2Float	04	R
407	Normal Volume Flow/ Mass Flow (NVF/MF)	1/2Float	04	R
408	"	1/2Float	04	R
409	Volume Flow(VF)	1/2Float	04	R
410	"	1/2Float	04	R
411	Diagnosis2	Usign16	03,04	R
412	Diagnosis1	Usign16	03,04	R
414	DiagnosisExtension3	Usign16	03,04	R
415	DiagnosisExtension2	Usign16	03,04	R
416	DiagnosisExtension1	Usign16	03,04	R
441	Upper Calibration Point DP	1/2Float	03,06,16	R/W
442	"	1/2Float		
443	Lower Calibration Point DP	1/2Float	03,06,16	R/W
444	"	1/2Float		
445	Upper Calibration Point P	1/2Float	03,06,16	R/W
446	"	1/2Float		
447	Lower Calibration Point P	1/2Float	03,06,16	R/W
448	"	1/2Float		
450	Calibration Unit Pressure	Usign16	03,06,16	R/W
451	Upper Calibration Point T	1/2Float	03,06,16	R/W
452	"	1/2Float		
453	Lower Calibration Point T	1/2Float	03,06,16	R/W
454	"	1/2Float		
456	Calibration Unit Temperature	Usign16	03,06,16	R/W
461	Damping Time Constant DP	1/2Float	03,06,16	R/W
462	"	1/2Float		
465	Damping Time Constante T	1/2Float	03,06,16	R/W
466	"	1/2Float		
468	Balance Oblique Sensor	Usign8	03,06,16	R/W
481	Differential Pressure Unit	Usign16	03,06,16	R/W
482	Pressure Unit	Usign16	03,06,16	R/W
483	Temperature Unit	Usign16	03,06,16	R/W
484	Mass Flow Unit / Volume Flow Unit	Usign16	03,06,16	R/W

485	Volume Flow Unit	Usign16	03,06,16	R/W
491	Factory Reset	Usign16	03,06,16	R/W
492	Write Lock	Usign16	03,06,16	R/W
493	MV Block on/off	Usign8	03,06,16	R/W
501	Device Mode	Usign8	03,06,16	R/W
502	Baud Rate	Usign8	03,06,16	R/W
503	Bus Address	Usign8	03,06,16	R/W
504	Response Delay Time	Usign8	03,06,16	R/W
602	Flow Buffer Selection	Usign8	03,06,16	R/W
604	Flow Buffer Action	Usign8	03,06,16	R/W
605	Flow Buffer Time (MSW)	Usign16	03	R
606	Flow Buffer Time (LSW)	Usign 16	03	R
607	Flow Buffer Total	1/2Float	03	R
608	"	1/2Float	03	R
609	Flow Actual	1/2Float	03	R
610	"	1/2Float	03	R
611	Flow Buffer Hour 1	1/2Float	03	R
612	"	1/2Float	03	R
613	Flow Buffer Hour 2	1/2Float	03	R
614	"	1/2Float	03	R
655	Flow Buffer Hour 23	1/2Float	03	R
656	"	1/2Float	03	R
671	Flow Buffer Day 1	1/2Float	03	R
672	"	1/2Float	03	R
673	Flow Buffer Day 2	1/2Float	03	R
674	"	1/2Float	03	R
739	Flow Buffer Day 35	1/2Float	03	R
740	"	1/2Float	03	R

Coils

Ad- dress	Parameter- name	Function Code	Read/ Write	Meaning
1	Diagnosis	01,02	R	Hardware error
2	"	01,02	R	Memory error
3	"	01,05	R	Measurement error
4	"	01,02	R	Configuration invalid
5	"	01,05	R	Maintenace required
6	Diagnosis- Extension	01,02	R	EEPROM error mainboard
7	"	01,02	R	EEPROM error sensor
8	"	01,02	R	max. write cyles EEPROM mainboard
9	"	01,02	R	max. write cyles EEPROM sensor
10	"	01,02	R	EEPROM error electronic data
11	"	01,02	R	EEPROM error sensor data.
12	"	01,02	R	EEPROM error user data
13	"	01,02	R	EEPROM error factory default data
14	"	01,02	R	Saving eeprom data
15	"	01,02	R	Device busy
16	"	01,02	R	ROM error
17	"	01,02	R	RAM error
18	"	01,02	R	Device malfunction
19	"	01,02	R	Software malfunction
20	"	01,02	R	-
21	"	01,02	R	Multivariable differential pressure input out of range
22	"	01,02	R	Multivariable pressure in- put out of range
23	"	01,02	R	Multivariable tempera- ture input out of range
24	"	01,02	R	Temperature transducer block temperature input out of limits
25	"	01,02	R	Temperature transducer block temperature input out of range
26	"	01,02	R	Pressure transducer block main pressure input out of limits
27	"	01,02	R	Pressure transducer block main pressure input out of range
28	"	01,02	R	Pressure transducer block temperature input out of limits
29	"	01,02	R	Pressure transducer block static pressure in- put out of limits

8 Contact

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