Installation and user manual

4 - 20 mA module

Wigersma & Sikkema

Since 1921

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Preface

- This manual provides important information about the use of the 4 -20 mA module. Please read this manual carefully.
- Various remark and warnings in this manual are marked with symbols. Read these carefully and take measures were necessary.

The symbols used have the following meaning:

	**REMARK**	Suggestions and recommendations to make tasks easier.
	**NOTE**	A note draws user's attention to potential problems.
	**WARNING**	If the procedure is not carried out correctly, a dangerous situation may develop, or data or settings may be lost.
	**ESD**	Electrostatic discharges (ESD) can cause damage to internal electrical components if you do not take precautions. ESD is caused by static electricity and the damage caused is usually permanent.

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1 Introduction

The 4 - 20 mA signal is widely used in the process industry. A 4 - 20 mA current loop is a two-wire electrical connection, fed by a constant voltage and connected to an inverter that converts a quantity to be measured into a direct current between 4 and 20 mA. This is a signal transmission standard for industrial instrumentation and communication where 4 mA represents zero per cent of the measured quantity and 20 mA represents 100 per cent.

From the 1950s, it is still the standard in many deployment areas due to its easy installation and automatic control of cable breakage. Furthermore, the current signal is much more insensitive to noise than a voltage signal, so it transmits a reliable signal even over longer distances.

Wigersma & Sikkema's 4 - 20 mA module provides the function to convert measurement data from a UNIGAS 300 or a pulse signal coming from a gas meter to an analogue 4 - 20 mA signal.

The 4 - 20 mA module is placed in an ISC230B in one of the 20-pin connectors, see also chapter 3.1. The ISC230B takes care of the Ex safe separation of the connections of the UNIGAS 300 or a gas meter. This eliminates the need for additional Ex interfaces for the 4 - 20 mA signal. The ISC230B can also be used to supply the UNIGAS 300.

The 4 - 20 mA module is equipped with two analogue 4 - 20 mA outputs and two digital electronic relay outputs. The outputs are galvanically isolated from each other and, related to the ISC230B, galvanically isolated according to common industrial standards. The outputs are polarity-independent and equipped with measures for ESD. In addition to the 4 - 20 mA outputs, the module has two pulse outputs. These can be used to transmit pulses from the equipment connected to the ISC230B.

The 4 – 20 mA module can periodically read out measurement data (such as pressure and temperature) from the UNIGAS 300, via the upper optical port (port 2). The period time is adjustable and is normally set equal to the measurement time of the UNIGAS 300. The read measurement data can optionally be transferred to the 4 - 20mA outputs, with the conversion to the 4 - 20 mA signal being freely adjustable/scalable.

The 4 - 20 mA module is equipped with functions for processing LF or HF pulses from a gas meter. For the purpose of near-time determination of the flow rate, LF pulse signals can be processed based on period time and HF pulse signals can be processed based on an adjustable measuring time, allowing accurate determination of the flow rate. Both 4 - 20mA outputs can additionally be set for pulse output based on the flow rate.

In addition, the 4 - 20 mA module can be configured to determine the converted flow rate on the basis of the conversion factor read from a connected UNIGAS 300 (via connection to port 2) equipped with a plug-in module or CI module.

A standard application may include a gas meter where an LF output of the gas meter is connected to an UNIGAS 300 for billing purposes and where the HF pulse output of the gas meter is connected to an ISC230B with 4 - 20 mA module for controlling an industrial process with a 4 - 20 mA signal.

Possible outgoing 4 - 20 mA signals are:

1. Flow rate
2. Press
3. Temperature
4. Correction factor
5. Z-value
6. Z/Zb value

The outputs can then be linked to a control application/system by a user.

Multiple ISC230B devices equipped with a 4 - 20 mA module can be connected via the local bus of the ISC230B, allowing the number of 4 - 20 mA outputs to be expanded.

The 4 - 20 mA module is set up using UNITOOL service software via a USB-C port. This does not require the 4 - 20 mA module to be installed in an ISC230B.

2 Data model 4 - 20 mA module

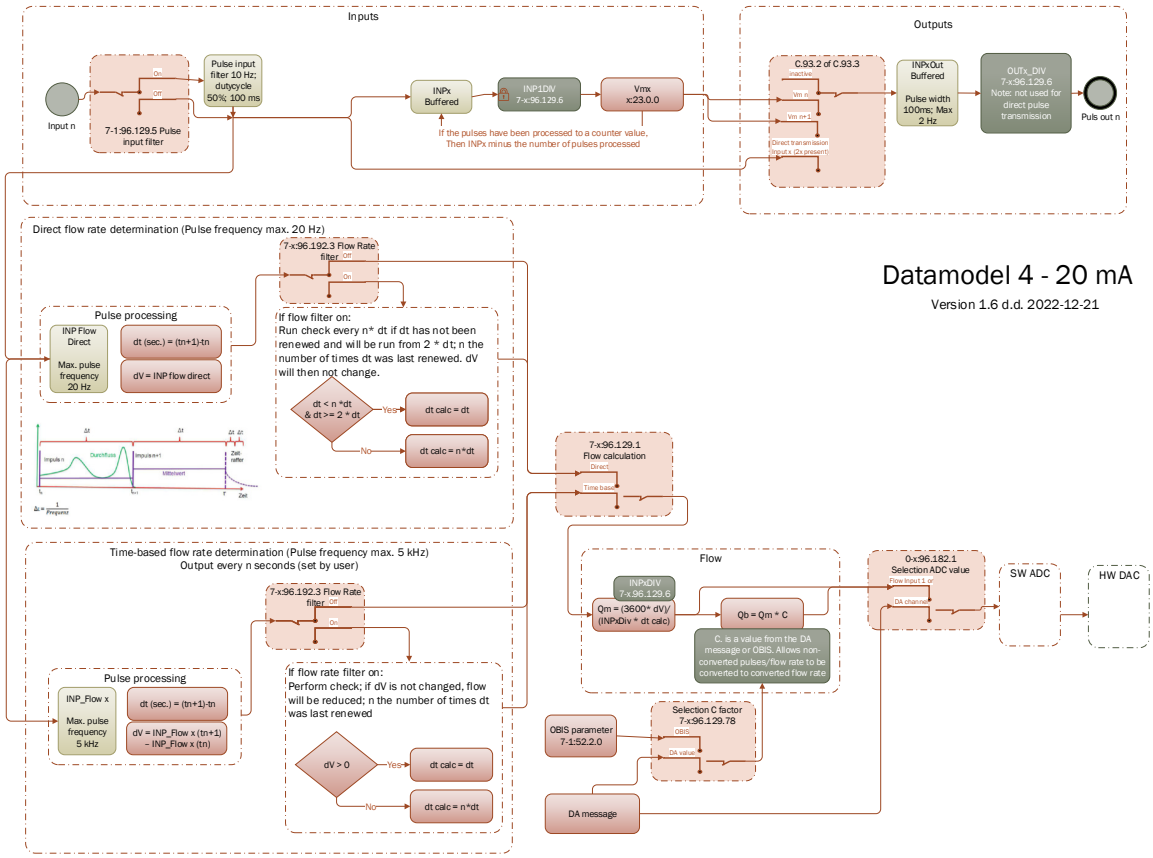


Figure 1. Data model 4 - 20 mA module.

3 Installation

3.1 Installing the 4 - 20 mA module

Electrostatic discharges (ESD) can cause damage to internal electrical components if you do not take precautions. ESD is caused by static electricity and the damage caused is usually permanent.

Inside the device in which the 4 - 20 mA module will be placed, there are parts connected to the mains voltage. Disconnect the mains voltage prior to work. Refer to the user manual of the device in which the 4 - 20 mA module will be placed.

The 4 - 20 mA module is inserted into the ISC230B and is installed as follows:

- ISC230B (see type plate on the left outside): there are 3 module connection slots (3). Place the 4 - 20 mA module on a free module connection slot. (Other modules may already be present).

  NOTE: when using a pulse-out module also, it must always be placed on the lowest of the three connection slots. The 4 - 20 mA may then be placed in one (or both other) two slots.

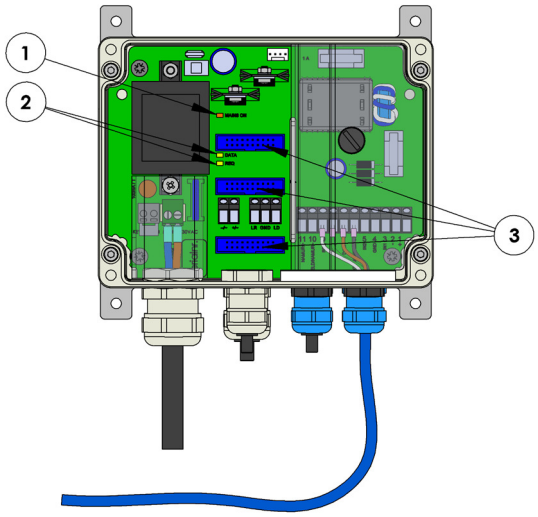


Figure 2

- If an incoming HF signal is connected to the ISC230B for the 4 - 20 mA, there should be the text *fmax: 20 Hz (LF)/ 5 kHz (HF)* on the type plate of the ISC230B.

If the module is used with a pulse-out module (NN2671), the maximum frequency is 20 Hz

3.2 Connecting the equipment to the 4 - 20 mA module

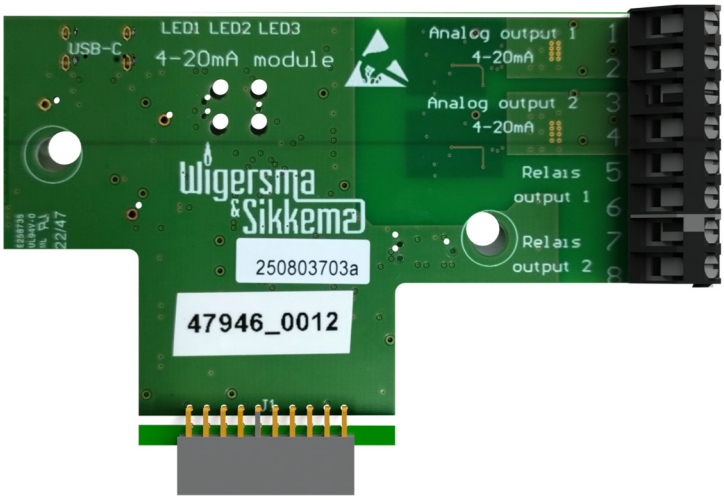


Figure 3. Connections of the 4 - 20 mA module

The pulse from the gas meter is connected to the ISC230B, which transmits the signal to the module. If present, UNIGAS 300 is connected to the ISC230B via the second optical port and a power supply cable is connected to the UNIGAS 300.
The 4 - 20 mA output is connected to the user's equipment (PLC) and provided with a maximum 30V power supply for the module. After this connection, a 2.5 mA current will flow to confirm the connection.
Periodically, the 4 - 20 mA module will read data from the UNIGAS 300. The data can then be converted back to a 4 - 20 mA output signal.
The two pulse inputs of the ISC230B can be used to perform a flow determination based on the incoming signals. When connected including UNIGAS 300, the converted flow can also be calculated. This flow value is then converted to a 4 - 20 mA signal.

In addition, the module has two pulse outputs.
The outputs are passive, i.e. the power supply must come from the user's side, see chapter 8 *Technical Specifications*.

4 Settings and indicators

4.1 Module front

Figure 4. Outputs of the 4 - 20 mA module

1. Connection terminals of the two analogue 4 - 20 mA signal outputs
2. Connection terminals of the two pulse outputs

4.2 Back of the module

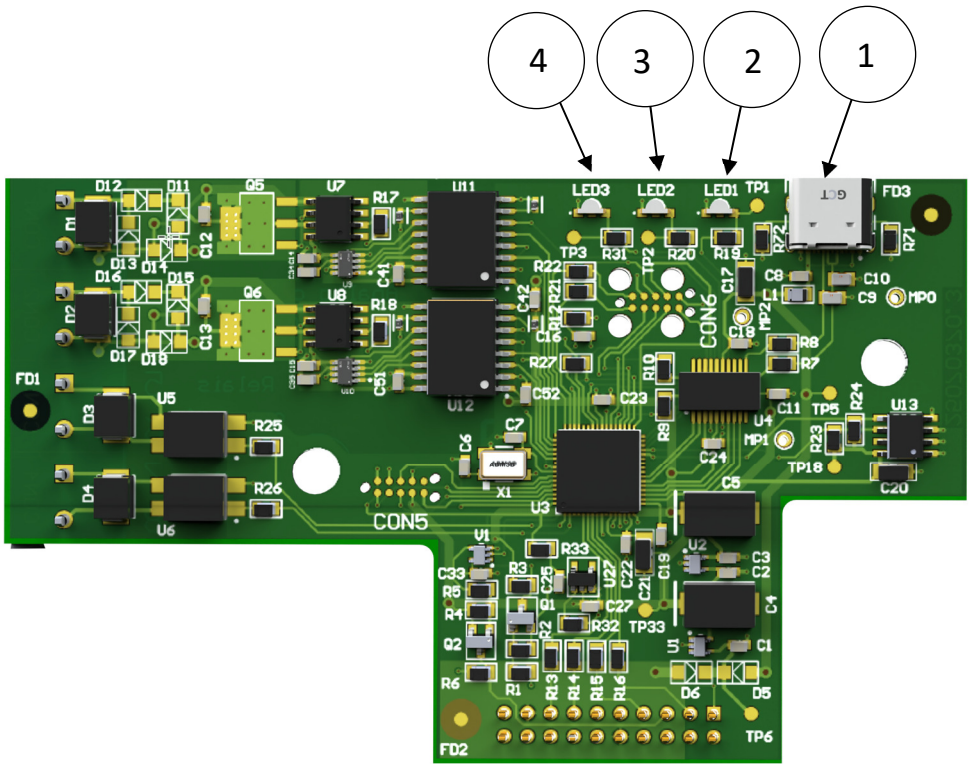


Figure 5: LEDs of the 4 - 20 mA module

1. USB-C port for programming 4 - 20 mA module (via UNITOOL)
2. LED1 for indication that 4 - 20 mA module is active (flashes every 10 seconds)
3. LED2 for indication signal on pulse output 1 (relay output 1, figure 1)
4. LED3 for indication signal on pulse output 2 (relay output 2, figure 1)

4.3 Flow rate signal

The 4 – 20 mA module can convert incoming pulse(s) to a flow rate. The flow rate can be made available as a signal on one of the 4 – 20 mA outputs (via a software ADC and a DAC). The incoming pulse(s) are connected to the pulse input of the ISC230B.

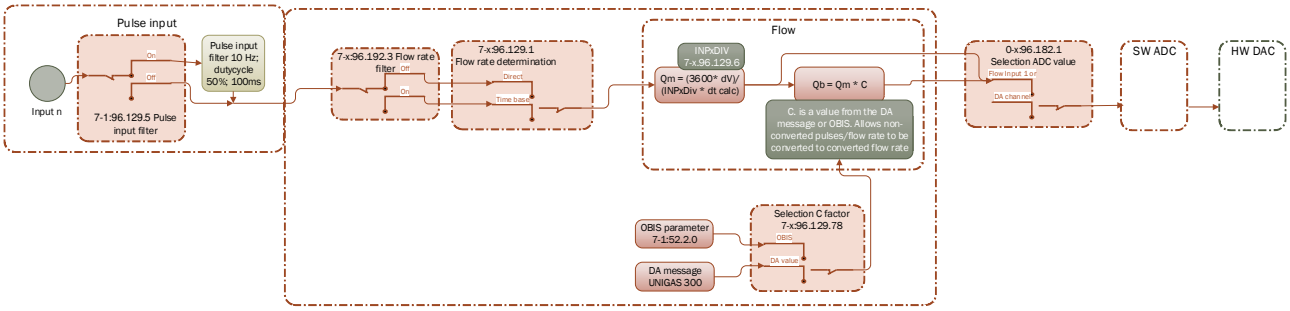


Figure 6:

There is a choice between two different flow calculations, which can be set per 4 - 20 mA output:

1. Time-based flow rate for HF pulse input (up to 5 kHz)
2. Direct flow for LF pulse input (maximum 20 Hz)

In addition, the following flow rate settings are important:

- Pulse divider factor (adjustable per input)
- Pulse input filter (10 Hz)

4.3.1 Converted/not converted flow rate

It is possible to convert either the non-converted flow rate (Qm) or the converted flow rate (Qb) to a 4 – 20 mA signal.

At *Qm* (flow rate at metering conditions), the flow rate is not converted. At *Qb (*converted flow rate), the non-converted flow rate is multiplied by a C-factor (conversion factor). The latter can be used to convert the flow rate at measurement conditions to a flow rate corresponding to a converted value, depending on the gas composition, pressure and temperature.

For the conversion factor, there is the possibility of using a fixed C-factor or the C-factor determined by the UNIGAS 300. This can be read from the UNIGAS under Menu 1-1, Position 2: C. (NOT Position 1: Cf !). If the conversion factor from the UNIGAS is used, the ISC230B must be connected to the UNIGAS 300 (Port 2 of UNIGAS 300), see connection diagram chapter 6.2. The fixed C-factor can be set (OBIS 7-1:52.2.0).

If initially no value can be retrieved from the UNIGAS 300, then set C-factor is used. If a C-factor is read from the UNIGAS 300, then the last correctly received C-factor is used.

4.3.2 Time-based flow rate

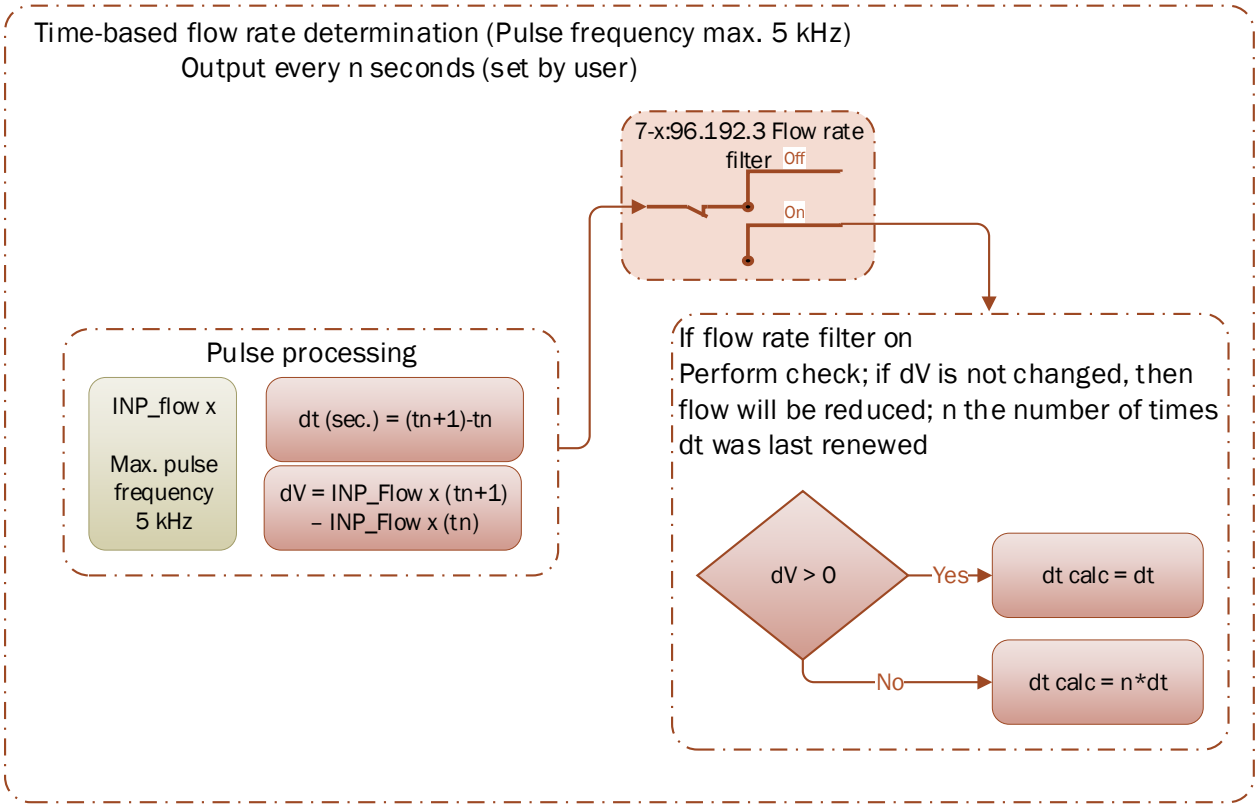


Figure 7

The maximum frequency for time-based flow is 5 kHz.

Time-based flow can be used when processing an HF pulse input signal, or when the incoming pulses are not presented in real-time, but in the form of a pulse train (i.e. several pulses in a short period of time and then the next pulse in the next period). The maximum pulse input frequency for time-based flow is 5 kHz (see note for type ISC230B, see Chapter 3.1 on HF).

Here, the number of pulses (ΔV) received at the pulse input is determined per time interval (periodic) (t). The periodic time interval can be set by the user.

If a flow filter is active, then at a ΔV =0 the flow will be reduced

4.3.3 Direct flow determination

In direct flow determination (maximum pulse input frequency 20 Hz), the incoming pulse is directly processed and converted to a flow value. Here, the time between pulses is detected (Δt). If the flow filter is active, the following applies: If no pulse is received during the period n x Δt (where n is an integer and n >= 2) then a new flow value is generated, however, where ΔV is equal to the previous ΔV, the calculated Δt calc = n x Δt (previous period). In this process, the flow rate is thus reduced according to an e-curve.

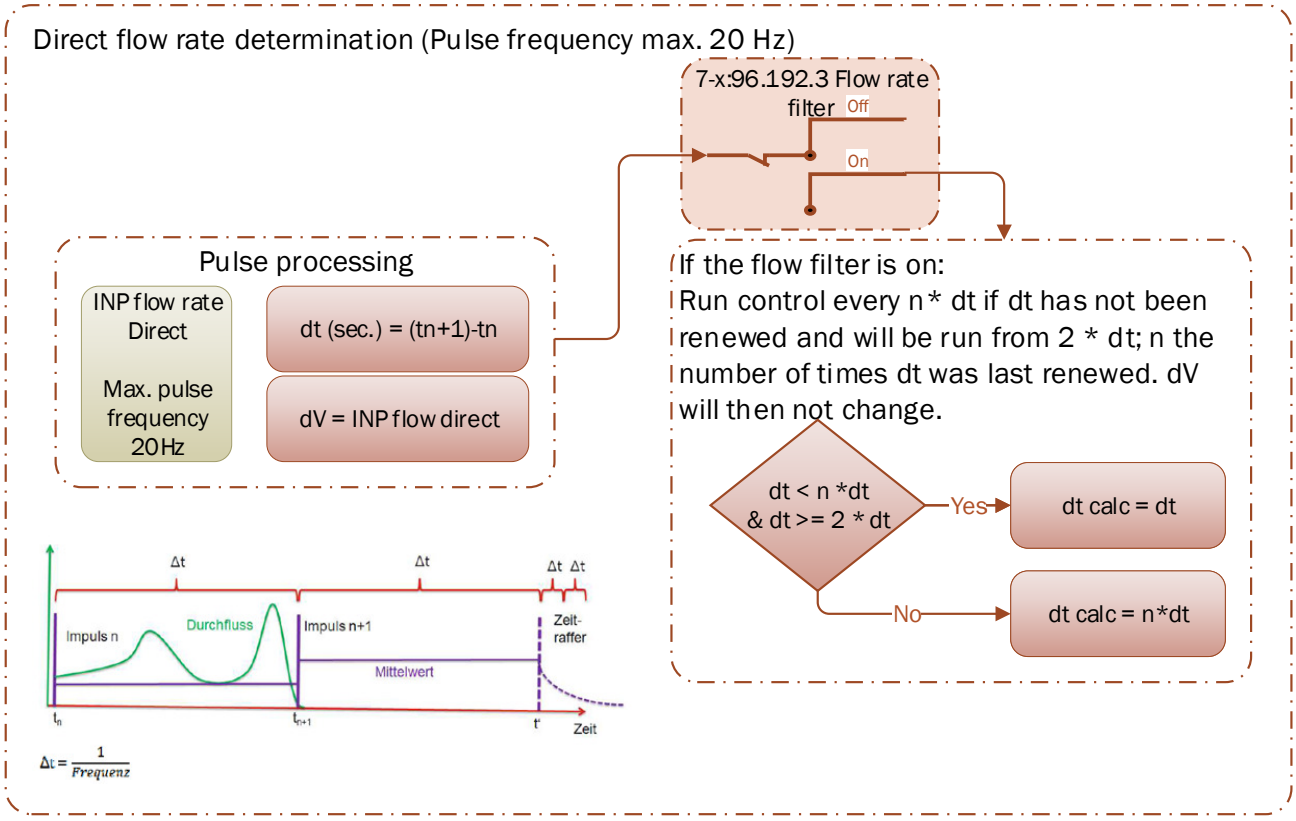


Figure 8

4.3.4 Flow filter

In addition, the user has the option of enabling a "flow filter" (OBIS 7-1:96.129.3 or 7-2:96.129.3). By enabling the flow filter, the flow rate will be reduced if no pulses have been received for a certain time.

If no pulses are received, then when the flow filter is switched on, the flow rate will not go to 0 immediately, but will be reduced periodically.

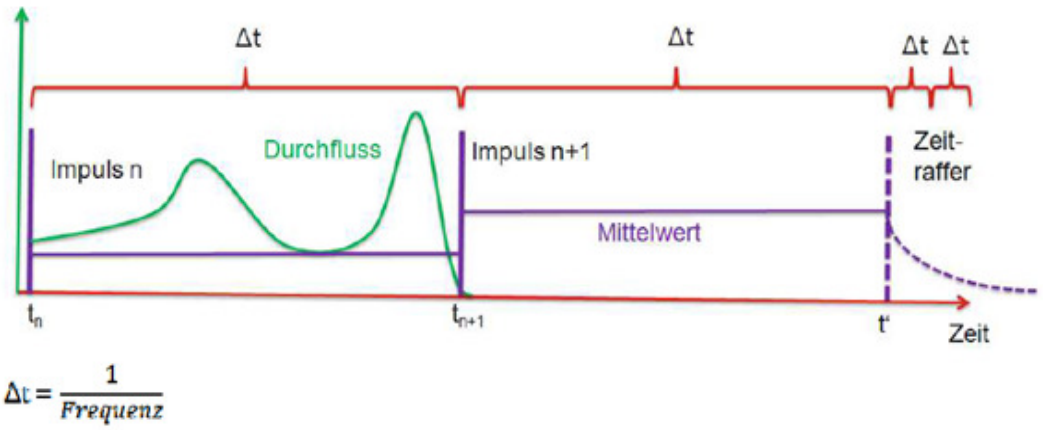


Figure 9

4.4 Pulse signal

To ensure that contact bouncing in the gas meter does not give extra pulses, the user can activate a filter on the pulse input (OBIS 7-1:96.129.5 or 7-2:96.129.5). This is a low pass filter with and frequency of 10 Hz and a duty-cycle of 50% with a minimum pulse width of 100 ms.

Besides determining a flow rate, pulses can also be transmitted.

The incoming pulses on one and two pulse inputs are handled separately. Here, the incoming pulses will be detected on the falling edge of the pulse signal. The incoming pulses are processed by means of a pulse partial factor and then issued with a pulse output partial factor on the pulse output, present on the 4 - 20mA module. The outgoing pulses always have a pulse width of 100 ms and a maximum frequency of 2 Hz. In case the frequency of the incoming pulses is faster than 2 Hz, pulses are buffered by the module.

5 Managing settings via UNITOOL software

The module can be connected to a laptop equipped with the UNITOOL software via a USB-C cable. This does not require the module to be inserted in the ISC230B.

5.1 Flow rate

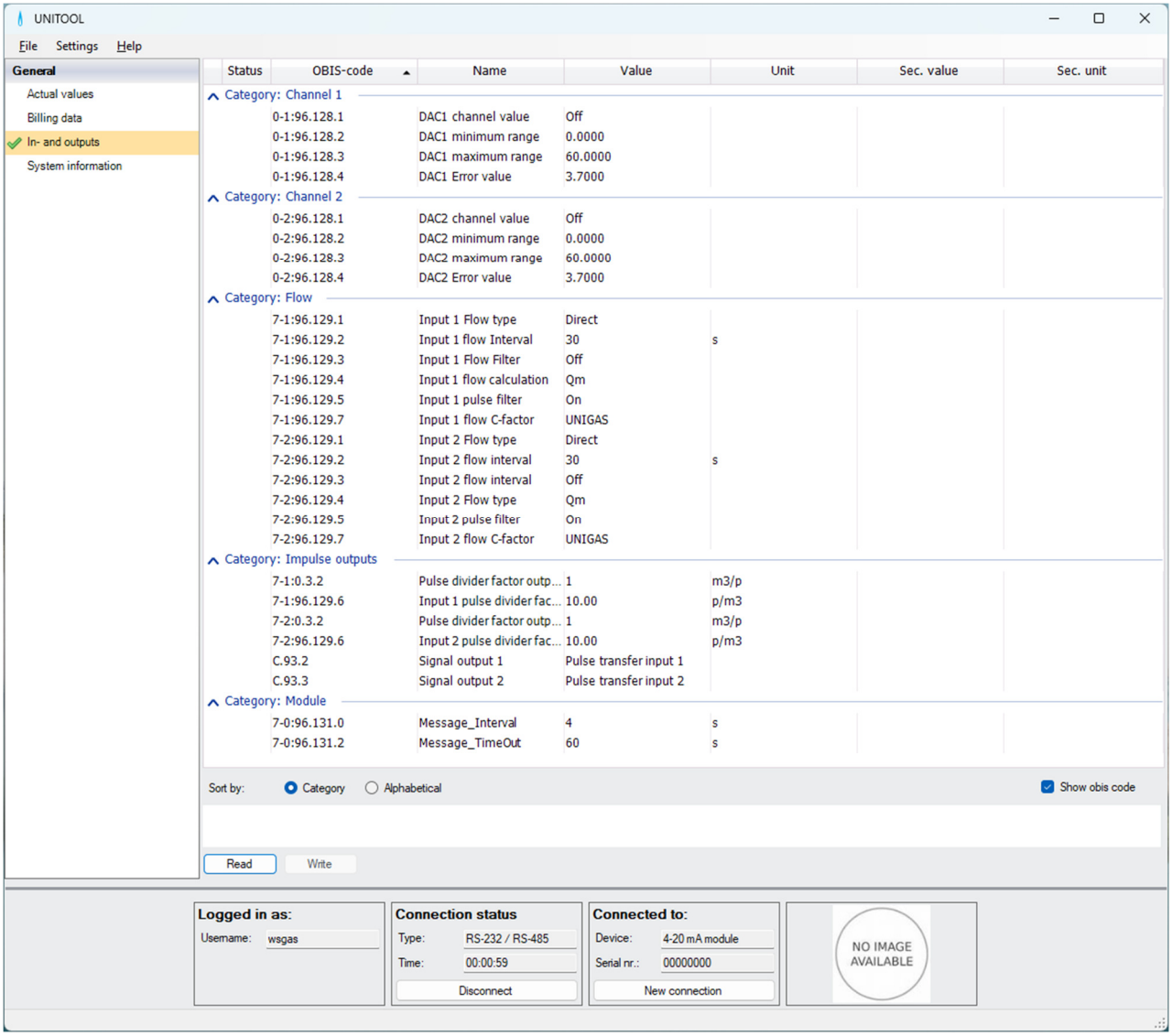


Figure 10

5.1.1 Category: Flow rate 1 or 2

Input flow type: Enter *Direct* or *Time-based* here. With direct flow determination, the incoming pulse is processed directly and converted to a flow rate. Here, Δt between pulses is detected.

Flow rate interval: Interval time value *n* for time-based flow rate

Flow filter: On or Off. By switching on the flow filter, the flow rate will be reduced

Flow rate calculation: *Qm* (not converted) or *Qb* (converted)

Filter: This is the filter to filter any thundering of the gas meter contacts.

Flow C-factor: Determine which conversion factor should be used. From the UNIGAS 300 or a fixed value to be programmed here. From the UNIGAS 300 or a fixed value programmed here in UNITOOL under Current values, top left in the menu.

Important: When connecting a gas meter, the input 1 (or 2) pulse division factor must also be entered, see 7-1:96.129.6

The min-max. values at 4 and 20 mA are programmed in the next step.

5.1.2 Category: Channel 1 or 2

DAC channel value: selection for which value is to be converted to a 4 - 20 mA signal:
DAC minimum range: Example for flow rate, the minimum flow rate of the system gives 4 mA
DAC maximum range: for example for flow, the maximum flow rate of the system gives 20 mA
DAC Error value: to be set in case there is an error in the module. Typically 3.7 mA

5.2 Category: Pulse outputs

Pulse division factor output allows the output signal to be divided by the end user

Input pulse part factor: This should be equal to the gas meter part factor. NOTE: in p/m^3

Signal output: pulse output from the input, or values from the UNIGAS 300.

Tip when installing the flow output: switch pulse output on to pass-through pulse, the LED will then light up with each pulse, so one can see the pulse and frequency.

5.3 Category: Module

Interval read-out UNIGAS: Typically 25 seconds, at least 5 seconds. Adjustable from 0 to maximum 10 seconds. At 0 the readout is switched off.
Time out reading UNIGAS: Typically 60 seconds. Adjustable from 10 to maximum 60 seconds If no readout has taken place during this period, this will give an error value of 3.7 mA (*DAC Error value).*

5.4 4 - 20 mA output

The 4 – 20 mA value is calculated using the following formula:

$$4 - 20mA(Out) = \frac{[Waarde)\ ] - [\text{DACx minimaal Range}]}{[\text{DACx maximaal Range(max)}] - [\text{DACx minimaal Range}} * (20 - 4) + 4]$$

Example:
- 4 mA corresponds to 10 bar ([DACx minimaal Range])
- 20 mA corresponds to 25 bar ([DACx maximaal Range])
- Current pressure value ([*Value*]) = 16 bar

$4 - 20mA(Out)$ = ((16-10)/ (25-10)) * (20 - 4) +4 = 10.4 mA

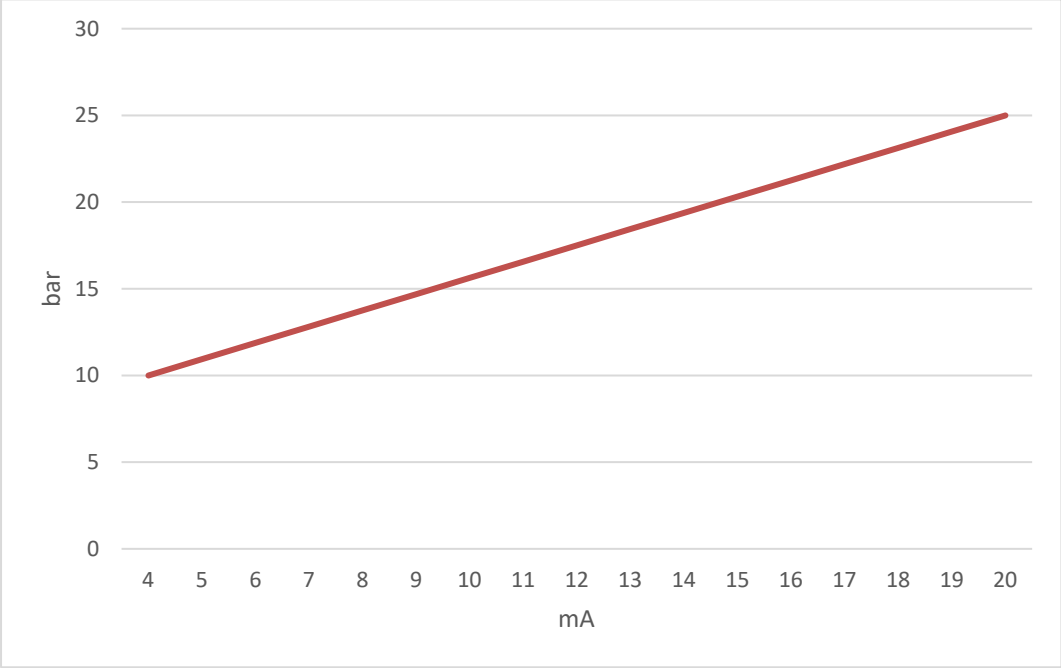
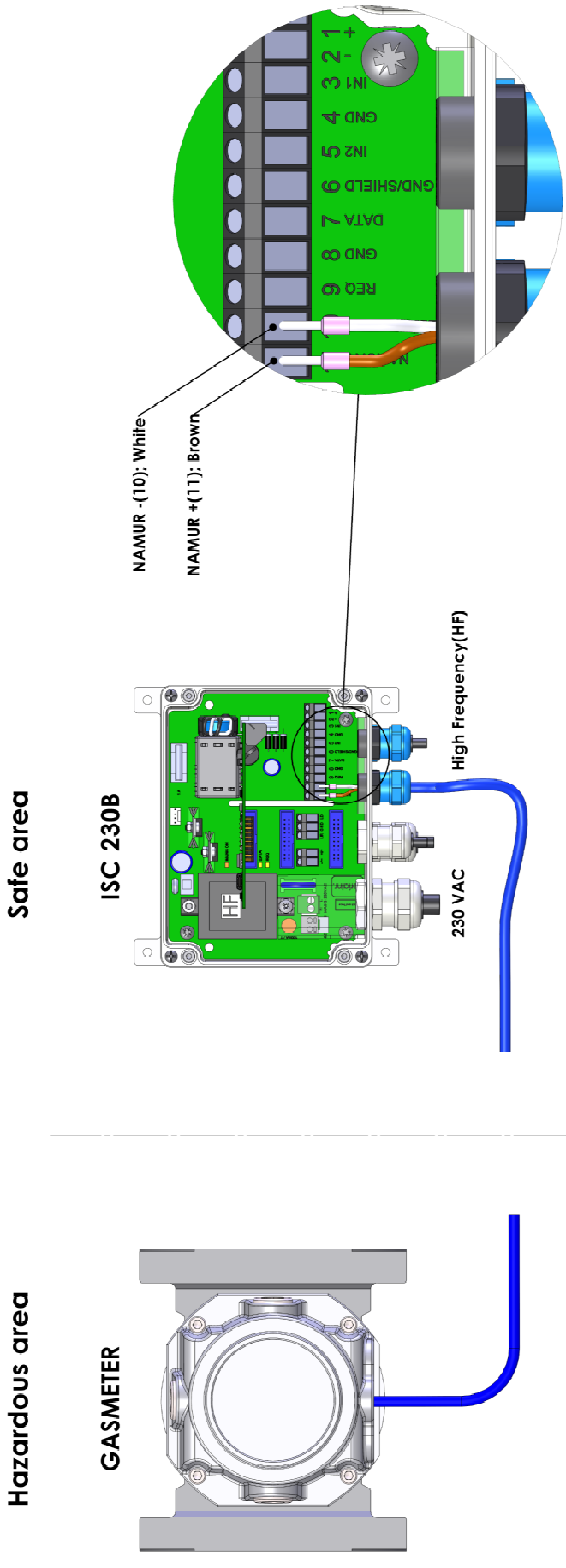


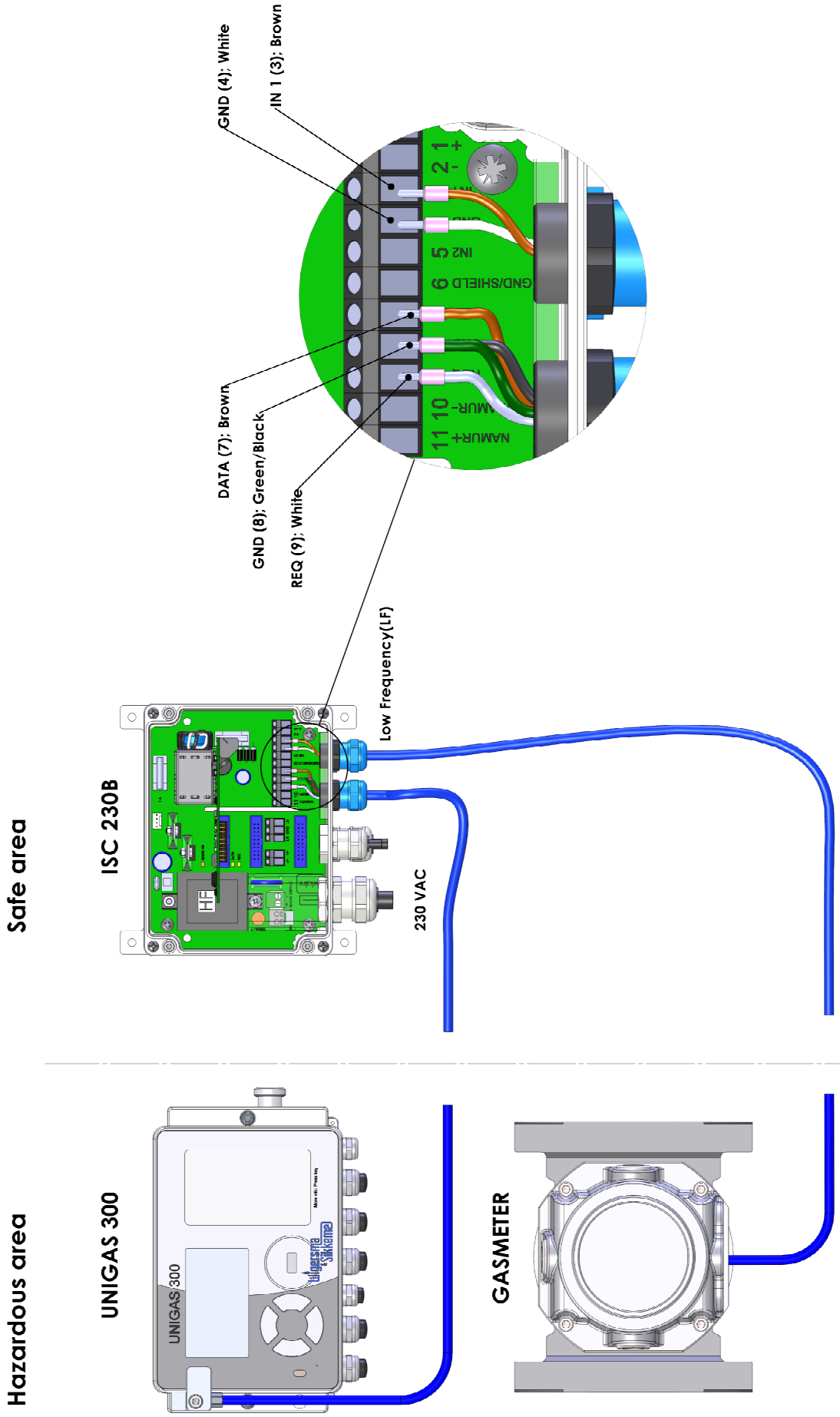
Figure 11

6 Connection diagrams

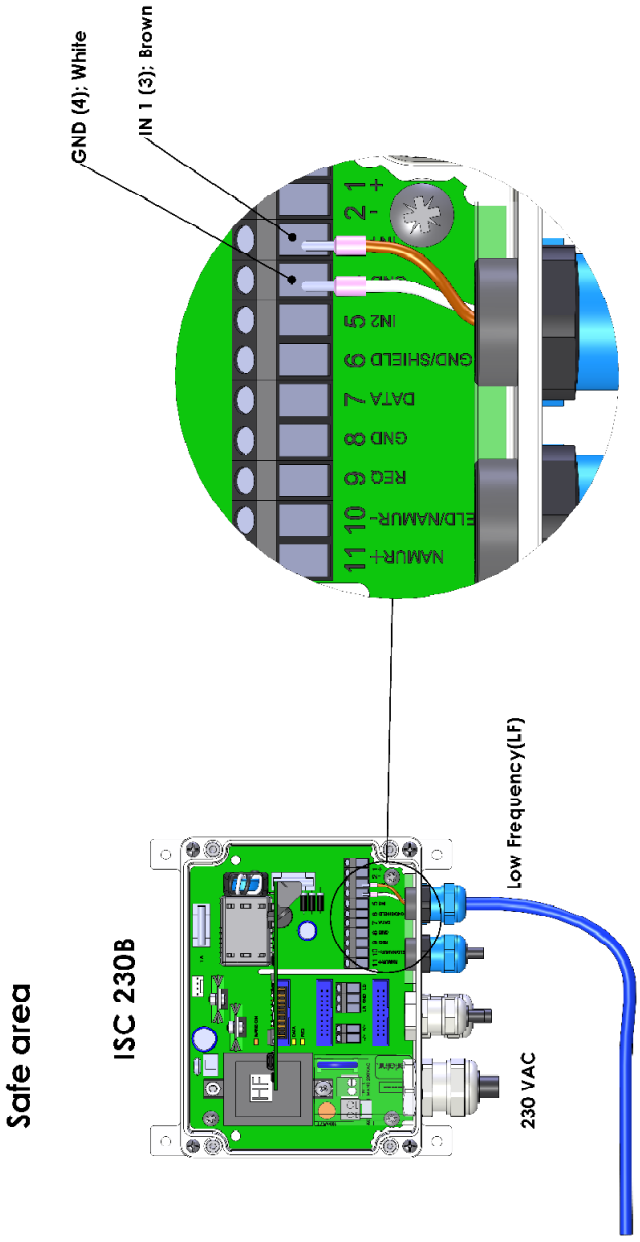
6.1 Connection directly to gas meter (HF); without conversion (UNIGAS 300)



6.2 Connect directly to gas meter (LF); with conversion so with cable to UNIGAS 300)



6.3 Connecting directly to gas meter (LF)



7 Parameters

Device data

Name	Unit	OBIS	Security level	Description
Device address	-	C.90.1		Device address
Firmware version		7-0:0.2.0		Firmware version
Firmware CRC		C.91.3		16-bit CRC value of the firmware

DA message

Security level: PWD3

OBIS	Name	Range	Unit	Default	Description
7-0:96.131.0	Message_Interval	0 -10	s	0	Interval for sending "DA" messages. If value 0 then "DA" is not sent
7-0:96.131.2	Message_TimeOut	10-60	s	60	Time out for error condition if no "DA" message is received.

DAC channel settings

Security level: PWD3

OBIS	Name	Range	Switch setting value	Default	Description
0-1:96.128.1	DAC1 channel value		L nibble: Off : 0 7-1:51.0.0: 1 7-1:42.0.0; 2 7-1:41.0.0; 3 7-1:53.0.0; 4 7-1:53.2.0; 5 7-1:52.2.0; 6 Pulse input 1 : A Pulse input 2 : B H nibble: no function	Off	Channel setting for DAC output 1
0-2:96.128.1	DAC2 channel value		L nibble: Off : 0 7-1:51.0.0: 1 7-1:42.0.0; 2 7-1:41.0.0; 3 7-1:53.0.0; 4 7-1:53.2.0; 5 7-1:52.2.0; 6 Pulse input 1 : A Pulse input 2 : B H nibble: no function	Off	Channel setting for DAC output 2

Security level: PWD3

OBIS	Name	Range	Unit	Default	Description
0-1:96.128.2	DAC1 minimum range	-9999999.9999 to 9999999.9999	-	0000000.0000	Minimum analogue value associated with 4 mA DAC1
0-1:96.128.3	DAC1 maximum range	-9999999.9999 to 9999999.9999	-	0000000.0000	Maximum analogue value associated with 20 mA DAC1
0-1:96.128.4	DAC1 Error value	1.0 - 22.0	mA	3.7	Error value DAC 1 output
0-2:96.128.4	DAC2 Error value	1.0 - 22.0	mA	3.7	Error value DAC 2 output
0-2:96.128.2	DAC2 minimum range	-9999999.9999 to 9999999.9999	-	0000000.0000	Minimum analogue value associated with 4 mA DAC2
0-2:96.128.3	DAC2 maximum range	-9999999.9999 to 9999999.9999	-	0000000.0000	Maximum analogue value associated with 20 mA DAC1

Flow rate settings

Security level: PWD3

OBIS	Name	Switch setting value	Default	Description
7-1:96.129.1	Input 1 Flow type	L nibble: Time based: 1 Direct; 2 H nibble: no function	Direct	Flow filter type for Pulse input 1
7-2:96.129.1	Input 2 Flow type	L nibble: Time based: 1 Direct; 2 H nibble: no function	Direct	Flow filter type for Pulse input 2
7-1:96.129.3	Input 1 Flow Filter	L nibble: Off: 0 On; 1 H nibble: no function	Off	Flow filter active input 1
7-2:96.129.3	Input 2 Flow Filter	L nibble: Off: 0 On; 1 H nibble: no function	Off	Flow filter active input 2
7-1:96.129.4	Input 1 flow calculation	L nibble: Qm: 1 Qb; 2 H nibble: no function	Qm	Flow type calculation for flow input 1
7-2:96.129.4	Input 2 flow calculation	L nibble: Qm: 1 Qb; 2 H nibble: no function	Qm	Flow type calculation for flow input 2
7-1:96.129.7	Input 1 flow C-factor	L nibble: Obis: 1 DA; 2 H nibble: no function	DA	Determine whether to use a fixed C-factor (OBIS 7-1:52.2.0) or the C-factor value from the DA message
7-2:96.129.7	Input 2 flow C-factor	L nibble: Obis: 1 DA; 2 H nibble: no function	DA	Determine whether to use a fixed C-factor (OBIS 7-1:52.2.0) or the C-factor value from the DA message

Security level: PWD3

OBIS	Name	Range	Unit	Default	Description
7-1:96.129.2	Input 1 flow Interval	1 - 120	s	30	Interval (Δt) for the time base flow filter. Pulse input 1
7-2:96.129.2	Input 2 flow interval	1 - 120	s	30	Interval (Δt) for the time base flow filter. Pulse input 2

Pulse input setting
Security level: PWD2

OBIS	Name	setting range	Unit	Default	Description
7-1:96.129.6	Input 1 pulse divider factor	0.01 – 100000.00	p/m3	10.00	Sub-factor Pulse input 1
7-2:96.129.6	Input 2 pulse divider factor	0.01 – 100000.00	p/m3	10.00	Sub-factor Pulse input 2

OBIS	Name	setting range	Unit	Default	Description
7-1:52.2.0	C	0.5000 – 100.0000	-	0.5000	conversion value by which the volume is converted. This is used, if the value cannot be extracted from the "DA" message.

Security level: PWD3

OBIS	Name	Switch setting value	Default	Description
7-1:96.129.5	Input 1 pulse filter	L nibble: Off: 0 On : 1 H nibble: no function	On	Setting for input 1; If on, a 5 Hz filter is active on the pulse input (dc 50% minimum pulse width 100ms)
7-2:96.129.5	Input 2 pulse filter	L nibble: Off: 0 On : 1 H nibble: no function	On	Setting for input 2; If on, a 5 Hz filter is active on the pulse input (dc 50% minimum pulse width 100ms)

Pulse outputs
Security level: PWD3

OBIS	Name	setting range	Default	Description
C.93.2	Signal output 1	L nibble: Off : 0 Vm1: 3 Vm2: 5 Throughput pulse input 1: 8 Throughput pulse input 2: 9 H nibble: no function	Off	Selector switch for pulse output 1
C.93.3	Signal output 2	L nibble: Off : 0 Vm1: 3 Vm2: 5 Throughput pulse input 1: 8 Throughput pulse input 2: 9 H nibble: no function	Off	Selector switch for pulse output 2

8 Maintenance

The 4 - 20 mA module does not require any maintenance. For maintenance of the equipment in which the module is installed, refer to the user manual of the relevant equipment.

9 Technical specification

General

• Support devices	compatible with all ISC230B and all UNIGAS 300 devices. to be placed in a module slot of an ISC230B.
• Processor type	MSP430FR5259
• Supply	by ISC230B, 30 mA nominal
• Weight	40 g
• Dimensions	84 x 64 x 16 mm
• Operating	temperature- 25 °C to + 55 °C
• Remote software update	no; only local
• Watchdog	yes

Serial ports/ communication via ISC230B

• Communication with UNIGAS 300	connected to UNIGAS 300 communication port 2 (consumer port)
• Baud rate	9600
• Connection at ISC230B	7 (DATA), 8 (GND), 9 (REQ)

Communication protocol

• IEC 62056 (1107) mode C, VDEW 2.0 protocol for acquisition systems	
• Baud rate	9600

Pulse inputs via ISC230B

• Input IN1 LF	reed or transistor, max 1 kHz DC 50 %,
• Input IN1 HF*	NAMUR, HF max 5 kHz DC 50%
• Input IN2 LF	reed or transistor, max 1 kHz DC 50 %
• Connection at ISC230B IN 1 LF3	(IN1), 4 (GND)
• Connection at ISC230B IN 1 HF	11 (NAMUR +), 10 (NAMUR -)
• Connection at ISC230B IN 2 LF	5 (IN1), 4 (GND)
• Pulse input dividers (configurable)	0.01 - 100000.00 p/m³
• LF pulse input debounce filters	5 Hz; 100 ms; can be switched on

* Only for ISC230B produced from 01-2023.

Analog output 4 - 20 mA

• 4 - 20 mA outputs	two; separately configurable
• Current range	3.5 mA - 23 mA
• Error and overflow	low end of high end configurable
• Accuracy	< +/- 0.1 % FS
• Maximum loop voltage	30 V
• Rated Insulation voltage to ISC230B	300 V AC
• Output at failure or power down ISC230B	2.5 mA
• EMC protection	36 V 600 W transient suppression

Digital releay outputs

• Pulse outputs 1 and 2	configurable to IN1 or IN2
• Max. output frequency	2 Hz
• Pulse width100	ms
• Pulse ratio	0.01 - 100 m³/p configurable
• EMC protection	400 V 600 W transient suppression
• Max contact signal	125 V AC and 100 mA eff.
• On resistance<	30 R
• Rated Insulation voltage to ISC230B	300 V AC

Flow calculation 4 - 20 mA output

• Configurable	for each 4 - 20 mA output
• Calculation method	*Period* and *Time based*
• Flow decline filter for period based	can be switched on/ off
• Flow types	Qm (at measurement conditions) or Qb (at base conditions)

Status indicator

• 3 Status indicator LEDs	heartbeat every 10 seconds 2x digital output active (100ms on)

Service software PC platform

• UNITOOL	Windows 10/ 11
• Port for configuration	USB-C

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