L-2693

TESTMATE™
IN-LINE MONITOR

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Table of Contents

1 General Safety Precautions

These operating instructions contain the key instructions for properly and safely operating the TIM.

1.1 Obligations and Liability

- The basic prerequisite for the safe and proper handling and operation of the TIM is knowledge of the safety instructions and warnings.
- These operating instructions in general, and the safety precautions in particular, are to be adhered by all those who work with the TIM.
- Adherence is to be maintained to pertinent accident prevention regulations applicable at the site where the product is used.
- The safety precautions listed herein are limited solely to using the TIM.

The TIM has been designed and constructed in accordance with the current state of the art and recognized safety regulations. Nevertheless, hazards may be posed to the life and limb of the individual using the product or to third parties. Risk of damage may be posed to the product or other equipment and property. The TIM is to be used as follows:

- solely for its designated use
- only when in a safe, perfect condition
- Any faults or malfunctions which might impair safety are to be properly repaired or remedied *immediately*.

Our General Terms and Conditions apply. They are made available to the owner upon concluding purchase of the product at the latest. Any and all warranty and liability claims for personal injuries and damage to property shall be excluded in the event they are attributable to one or more of the following causes:

- improper use of the TIM or use deviating from its designated use
- improper assembly, installation, commissioning, operation and maintenance of the TIM
- operating the TIM when the system equipment or systems are defective
- modifications to the product made by the user or purchaser
- improper monitoring of product components subject to wear and tear
- improperly performed repair work

1.2 Explanation of Symbols and Warnings, etc.

The following designations and symbols are used in this manual to designate hazards, etc.:

1.2.1 Basic Symbols

This symbol designates safety instructions whose non-observance may pose a hazard to individuals.

This symbol designates safety instructions whose non-observance may result in the injury of individuals by electric shock.

This symbol provides important instructions and tips for the proper handling and operation of the TIM.

Non-adherence to these instructions may result in damage to the TIM or in damage to its immediate surroundings.

This symbol designates tips for usage and other particularly useful information.

This information helps you to optimally utilize all the features offered by your TIM.

1.3 Proper/Designated Use

The TestMate In-line Monitor (TIM) was developed for the continuous monitoring of particulate contamination in hydraulic systems.

Analyzing the size and quantity of contamination enables quality standards to be verified and documented and the requisite optimization measures to be implemented.

Any other use shall be deemed to be improper and not in keeping with the product designated use. The manufacturer will not assume any liability for any damage resulting from such use.

Proper or designated use of the product extends to the following:

- Maintaining adherence to all the instructions contained herein.
- Performing requisite inspection and maintenance work.

1.4 Improper Use

- Any use deviating from the proper/designated use described above is prohibited.
- Improper use may result in hazard to life and limb.
- Example of improper use:
  - improper connection of the TIM pressure and return flow lines.

1.5 Safety Devices

- Prior to starting up the product each time, make sure that all the safety devices are properly fitted to the hydraulic system in which the product is to be used and are in proper working order.
- Safety devices may not be removed until the product has been shut down and secured against being restarted (e.g. warning sign or padlock on the main switch).

- When the product is supplied in partial consignments, the safety devices are to be applied by the operator as specified by law/pertinent regulations.

1.6 Informal Safety Precautions

- Make sure to always keep the operating instructions in the vicinity of the product.
- Apart from the operating instructions, any and all general and local regulations pertaining to accident prevention and environmental protection are to be made available and observance to be maintained to them.
- Make sure to keep the safety and hazard symbols and warnings on the product in a legible condition.
- The power plug/cord of the product is to always be pulled before opening any components of the product. Tests conducted with the housing open may only be performed by properly trained, certified electricians. This also applies to all repair work or to any modifications to electric components approved by us.
- The hoses and connection fittings are to be checked daily for leakage (visual check). The electrical components of the product are to also be regularly checked (visual check once a month). Any loose connections or damaged cables are to be replaced immediately.

***Warning:* Pressurized fluids pose a hazard to life and limb. Consequently, the safety regulations pertaining to working with pressurized liquids are to be adhered to at all time!**

1.7 Instructions to Be Followed in the Event of an Emergency

In the event of an emergency, immediately disconnect the TIM from the power supply and from the hydraulic system! Properly dispose of any exiting fluid in accordance with environmental guidelines.

1.8 Training and Instruction of Personnel

- The TIM may only be operated by properly trained and instructed personnel.
- The areas of responsibility of your staff must be established in a clear-cut manner.
- Staff undergoing training may not use the TIM unless supervised by an experienced staff member.

Individuals / Activity	Individuals undergoing training	Individuals with technical training/ engineering background	Electrician	Supervisor with the appropriate authority
Packing Transportation	X	X		X
Commissioning		X	X	X
Operation	X	X	X	X
Troubleshooting/ locating the source of malfunction		X	X	X
Remedying of mechanical faults		X		X
Remedying of electrical faults			X	X
Maintenance and servicing	X	X	X	X
Repair work				X
Shutdown/ decommissioning Storage	X	X	X	X

1.9 Safety Measures to Be Followed in Normal Operation

- Do not operate the TIM unless all the safety devices function properly.
- The product is to be checked once a day for external damage and the proper functioning of the safety devices.

1.10 Electrical Hazards

- Any work involving the power supply may only be done by a properly trained, certified electrician.

- Make sure to check the electrical equipment of the product on a regular basis. Any loose connections or damaged cables are to be remedied/replaced immediately.
- If work to live components is required, a second individual is required who can switch off the product at the main switch as may prove necessary.

1.11 Maintenance, Servicing and Troubleshooting

- The prescribed adjustment, maintenance/servicing and inspection work is to be conducted in a timely fashion.
- All operating media is to be protected/isolated for the event that the product is accidentally started up.
- The TIM is to be disconnected from the power supply and protected against being inadvertently switched back on when performing any maintenance, servicing, inspection or repair work.
- Any screwed fittings which have been undone/removed are to be checked to see that they have been properly resecured.
- Always check the product to see that it functions properly when performing maintenance and servicing work.

1.12 Modifications to the TIM

- Do not make any modifications (design modifications, extensions) to the TIM without the prior consent of the manufacturer.
- Any design modifications or extensions may not be made without Schroeder Industries LLC’s express prior written approval.
- Immediately replace any machine components which are not in perfect condition.
- Only use original (OEM) spare parts and consumables. When using non-OEM components it cannot be ensured that they have been designed and manufactured so as to comply with loading and safety requirements.

1.13 Cleaning the TIM and Disposal of the Media and Agents Used

- The cleaning agents and flushing oils used are to be handled and disposed of properly.
- To this end, the manufacturer’s instructions pertaining to possible use, wearing of protective clothing and gear, and proper disposal are to be adhered to.

Some cleaning agents may pose a health hazard, especially when undiluted.

Transportation, Packing, Storage, Disposal

1.14 Transportation & Packing

- The TIM comes wrapped/packed in plastic sheeting.
- When receiving and unpacking the unit check it for damage in transit. Report any damage to the forwarding agent immediately.
- The packing material is to be disposed of as specified by law or national regulations. It can be reused.

1.15 Storage

- Make sure to store the TIM in a clean, dry place, in the original packing, if possible. Do not remove the packing until you are ready to install the unit.
- If the TIM is to be put into storage for an extended period of time, it should be completely drained (if necessary, using n-heptane) so as to prevent it from gumming up.
- The cleaning agents and flushing oils used are to be handled and disposed of properly.

1.15.1 Storage conditions

Storage temperature:	-20°C ... +85°C / -4°F ... + 185°F
Relative humidity:	max. 90%, non-condensing
Practical storage life:	max. 6 months

1.16 Disposal / Recycling and Decommissioning

- When decommissioning and/or disposing of the TIM, adherence is to be maintained to local guidelines and regulations pertaining to occupational safety and environmental protection. This applies in particular to the oil in the unit, components covered with oil and electronic components.
- After disassembling the unit and separating the various materials, they can be reused or disposed of properly in accordance with local regulations.

2. Scope of Delivery

The TestMate In-line Monitor (TIM) comes packaged and factory-assembled ready for operation. Before commissioning the TIM, check the contents of the package to make sure everything is present.

The TIM comes with the following:

Pos.	Qty.	Description
1	1 pc.	TestMate In-line Monitor , factory-assembled and ready for operation
-	1 pc.	Connector Cable TIM <-> PC
-	1 pc.	operating and maintenance instructions

3. Technical Description

3.1 Designated Use

The TestMate In-line Monitor TIM-H are stationary measurement units for the continuous monitoring of particulate contamination in hydraulic systems.

They were specifically developed for test station applications where the following are needed: measured value capturing in the hydraulic system and remote display at the operator desk, in addition to data storage and archiving on a PC.

Particulate contamination is captured using an infrared fiber optic measurement cell patented by Schroeder. Readings can be outputted as particle counts or cleanliness classes according to NAS 1638 or ISO 4406:1987 OR SAE AS 4059 or ISO 4406:1999.

Capturing of particulate contamination is done in the following particle size ranges:

TIM H				
Particle counts / NAS-Channels	4..6µm$_{(c)}$	6..14µm$_{(c)}$	14..21µm$_{(c)}$	>21µm$_{(c)}$
ISO-Channels	>4µm$_{(c)}$	>6µm$_{(c)}$	14µm$_{(c)}$	

The TIM is designed for connection to low-pressure hydraulic lines from which a small current of oil is diverted for measurement and analysis purposes.

By adjusting internal orifices the sensors can be configured for various pressure/viscosity ranges by the manufacturer Schroeder Industries (see chapter “Hydraulic Diagram” and “Mode Code”).

Thanks to the integrated pressure relief valve, the in-line monitor is protected against pressure loads of up to 5000 psi/ 350 bars.

The measured cleanliness classes or particle counts are continuously outputted via various (in part optional) electric outputs (relays, PLC interface, serial display ports, analog electric output 4-20mA, field bus interface), and can thus be captured/read out via a PLC, analog voltmeter or a PC.

3.2 Design Features

The in-line monitor consists of the following components:

- aluminum casing
- hydraulic ports: “inlet” and “outlet”
- fiber optic infrared measurement cell
- pressure relief valve

3.3 Restrictions Pertaining to the Use of the TIM

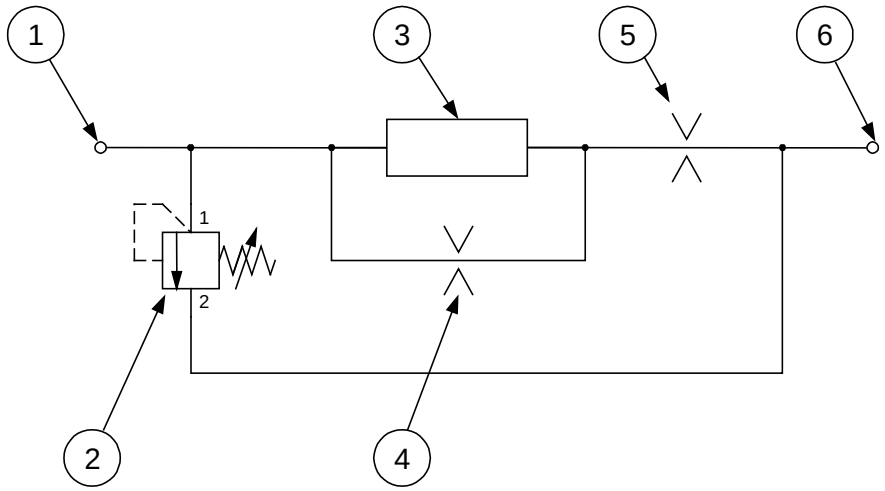
It is recommended that the TIM-H only be used in connection with mineral oils (or mineral-oil-based raffinates). The TIM-H is qualified for phosphate esters.

Please contact us first before using the unit with other fluids.

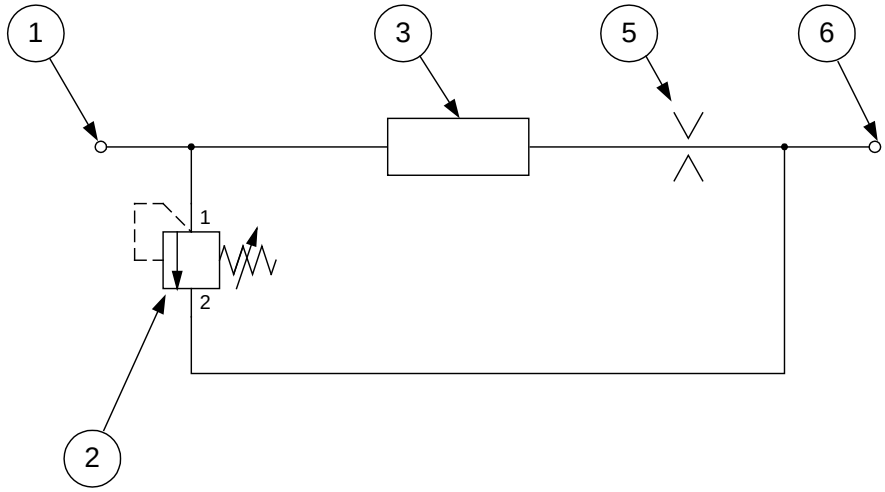
3.4 Hydraulic diagram

Legend:	
Pos.	**Description**
1	Inlet
2	Pressure relief valve, 40 bars
3	Fiber optic infrared measurement cell
4	Bypass with orifice
5	Outlet orifice
6	Outlet

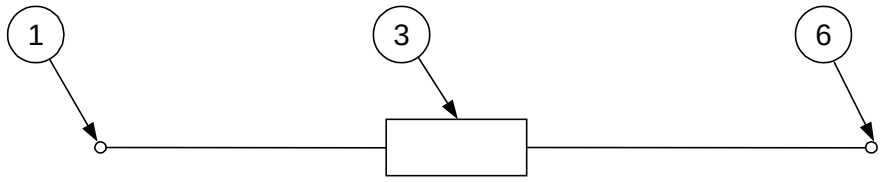
3.4.1 Hydraulic diagram for Pressure-Viscosity Ranges 1 and 2



3.4.2 Hydraulic diagram for Pressure-Viscosity Ranges 3 and 4



3.4.3 Hydraulic diagram for TIM-H



4 Installation and Operation

4.1 Electrical Installation

4.1.1 Terminal Assignment

The casing of the in-line monitor features two size M16x1.5 heavy-gauge threaded cable fittings through which all the electrical supply and signal lines are routed into the casing.
The lines are connected to the terminals inside the casing. The terminals are featured as cage-clamp terminals and are suitable for the following conductor cross sections:
Terminals Power Supply up to 2.5 mm²
Terminals 1 – 23 up to 0.5 mm²

Power Terminal

Power supply	PE	Case Ground
	0 V	Supply Voltage 0 V
	0 V	Supply Voltage 0 V
	24 V	Supply Voltage 24 V
	24 V	Supply Voltage 24 V

Declaration:
1. Pair of clamps is for Supply Voltage.
2. Pair of clamps is for additional connection from a load.

Signal Terminal

Digital Output for PLC	1	PLC Ground
	2	24 V from PLC
	3	PNP Output to PLC
Serial RS 232 Display port	4	RS 232 Ground
	5	RS 232 TxD
	6	RS 232 RxD
Modul-port:	7	Assignment dependent upon output modul
	8	
	9	
	10	
	11	
	12	
„Alarm“ Relay	13	Relay 1, NO
	14	Relay 1, C
„Warning“ Relay	15	Relay 2, NO
	16	Relay 2, C
„Ready“ Relay	17	Ready Relay, NC
	18	Ready Relay, NO
	19	Ready Relay, C
Analog Input	20	Analog Supply +12 V
	21	Analog Signal Channel 1
	22	Analog Ground
	23	Analog Signal Channel 2

The terminal assignment of the module port varies according to the various optional output modules.

The terminal/pin assignments are shown in the following figure:

RS 232 Modul (Option –0)

RS 232	7	Free
	8	Free
	9	Ground
	10	Free
	11	TxD
	12	RxD

Analog Modul (Option –1)

Analog	7	4..20 mA (+)
	8	Free
	9	Free
	10	Free
	11	Free
	12	4..20 mA (-)

RS 485 Modul (Option –2)

RS 485	7	RB
	8	BUS 5V
	9	BUS Ground
	10	TB
	11	TA
	12	RA

Ethernet Modul (Option –3)

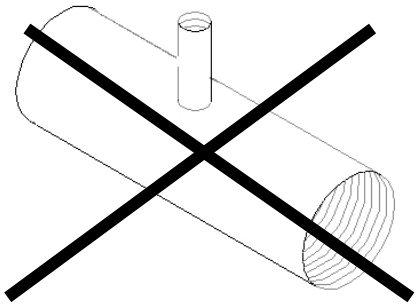
Ethernet	7	RxD+
	8	RxD-
	9	TxD+
	10	TxD-
	11	Free
	12	Free

There is a sticker inside the casing of the in-line monitor which shows the pin assignment for the respective model/configuration.

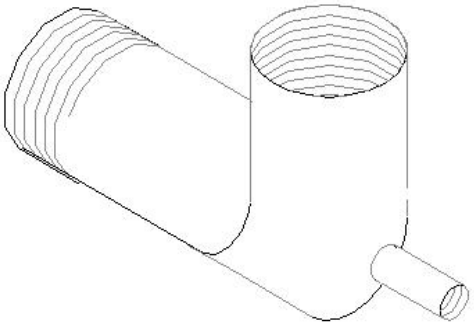
4.2 Electrical Installation

- Before continuing, check whether the TIM is suitable for your display/data capturing system by carefully examining the technical specifications.
- First connect the signal lines (pins/terminals 1 to 23).
- Then connect the supply voltage.
- TIM starts measurement operation as soon as the supply voltage is applied.

4.3 Select a Test point



WRONG !

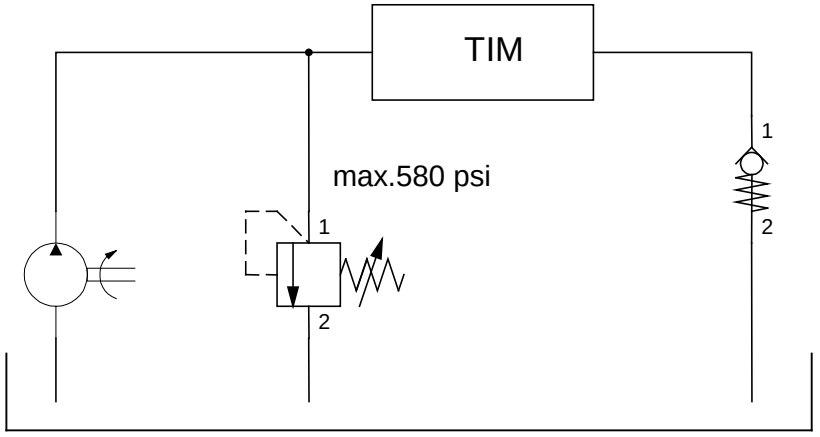


RIGHT !

4.4 Hydraulic Installation

Determine the system pressure of the hydraulic facility and see whether it is within the permissible range for the INLET port.

The pressure in the measurement cell may not exceed 580 psi.
When pressures exceeding 580 psi are capable of occurring at the inlet and pressure has not be relieved at the outlet, the TIM has to be protected by way of an additional pressure relief valve, as the integrated pressure relief valve doesn't open until a differential pressure of 580 psi between the inlet and outlet is reached.



Example of protecting the TIM when the pressure has not been relieved at the outlet.

Connect the TIM to your system as follows:

1. First connect the return-flow line (not supplied) to the OUTLET port of the TIM.

   Thread: G1/4 ISO 228Recommended internal diameter of line: >4mm
2. Now connect the other end of the return-flow to the system tank, for example.
3. Check the pressure at the measurement point; it has to be within the specified limits.
4. Now connect the measurement line (not supplied) to the INLET port of the TIM. Thread: G1/4 ISO 228 Recommended internal diameter of line (to prevent particle sedimentation): ≤ 4mm
5. Now connect the other end of the measurement line to the measurement point.

Warning: Oil starts to flow through the TIM as soon as the system has been connected to the pressure fitting. This is why it is vital that connection be done in the sequence specified above.
The return-line connector (OUTLET) must never be obstructed or closed off!

6. Installation of the TIM is now complete and now continuously outputs the measured values via the electrical interfaces.

4.5 Removing the TIM from the Hydraulic System

1. Disconnect the TIM from the voltage supply.
2. Disconnect the other electrical connectors.
3. Remove the measurement line from the hydraulic system ***first***, then from the INLET port of the TIM.
4. Remove the return-flow line from the OUTLET port of the TIM.

The TIM can now be removed.

5 Description of the Measurement Modes

5.1 Mode M1: Measure

Continuous measurement without any special switching functions.

The current measured result is outputted via the interfaces upon the measurement interval elapsing.

5.2 Mode M2: Measure + switch

Continuous measurement: relays 1 and 2 are switched in accordance with the measurement channels, switching functions and limits set.

The current measured result is outputted via the interfaces upon the measurement interval elapsing.

5.3 Mode M3: Filter to

Measurement mode: relay 1 is closed until 5 consecutive measurements reach or fall below the target cleanliness set. Measurement in mode 3 is then stopped.

If relay 1 has opened, it stays open until measurement is renewed. (Restarting measurement can be done via the bus interface, the RS-232 display interface, or by switching off the supply voltage and then switching it back on.)

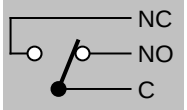
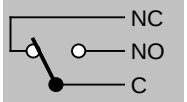
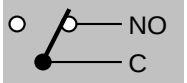
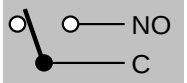
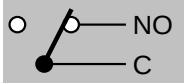
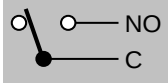
5.4 Mode M4: Filter from to

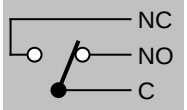
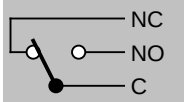
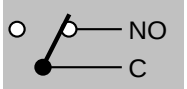
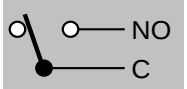
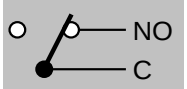
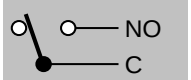
Measurement mode: relay 1 is closed until 5 consecutive measurements reach or fall below the target cleanliness (lower limit) set.

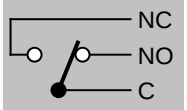
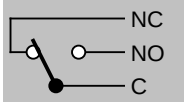
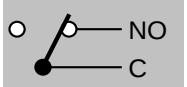
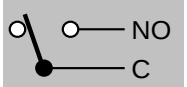
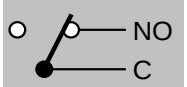
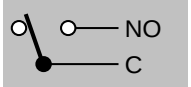
The relay is then opened and the test cycle time starts. Upon the test cycle time elapsing, relay 1 is closed and a measurement conducted.

When the upper cleanliness value (upper limit) is attained or exceeded, relay 1 stays closed until the mean value again reaches or falls below the set target cleanliness (lower limit) value during 5 measurements.

If the upper cleanliness value (upper limit) is not achieved or exceeded, relay 1 is opened again and the test cycle time is restarted

	Ready Relay on	**Ready Relay off**	**Relay 1 on**	**Relay 1 off**	**Relay 2 on**	**Relay 2 off**
						
M1						
	TIM ready for operation	TIM not ready for operation	Measurement currently in progress	Measurement stopped	After the first measured value is available: Flow error	Flow rate within set range
M2 (Measuring channel: 1 / 2 / 3 / 4 / 5 / 6 / 9 / 10)						
Exceed	TIM ready for operation	TIM not ready for operation	≥ upper limit	After switching the unit on or starting a measurement Goes out again when ≤ lower limit	≥ upper limit	After switching the unit on or starting a measurement Goes out again when ≤ lower limit
Fall below	TIM ready for operation	TIM not ready for operation	≤ lower limit	After switching the unit on or starting a measurement Goes out again when ≥ upper limit	≤ lower limit	After switching the unit on or starting a measurement Goes out again when ≥ upper limit
Within range	TIM ready for operation	TIM not ready for operation	Lower limit ≤ measured value ≤ upper limit	After switching the unit on or starting a measurement Goes out again when < lower limit or > upper limit	Lower limit ≤ measured value ≤ upper limit	After switching the unit on or starting a measurement or Measured value < lower limit or Measured value > upper limit
Out of range	TIM ready for operation	TIM not ready for operation	Measured value ≤ lower limit or Measured value ≥ upper	After switching the unit on or starting a measurement	Measured value ≤ lower limit or Measured value	After switching the unit on or starting a measurement

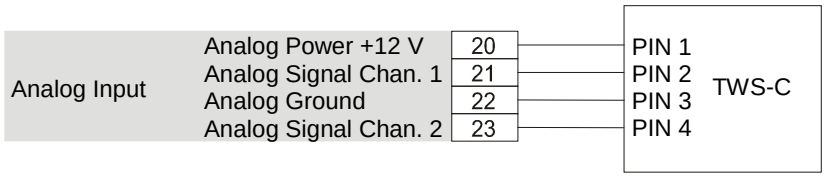
	Ready Relay on 	**Ready Relay off** 	**Relay 1 on** 	**Relay 1 off** 	**Relay 2 on** 	**Relay 2 off** 
			limit	or Lower limit < measured value < upper limit	≥ upper limit	or Lower limit < measured value < upper limit
No function	TIM ready for operation	TIM not ready for operation		Always off		Always off
M2 (Measuring channel: 7 and 8)						
Exceed	TIM ready for operation	TIM not ready for operation	A value ≥ respective upper limit	After switching the unit on or starting a measurement Goes out again when all values ≤ respective lower limit	A value ≥ respective upper limit	A value ≥ respective upper limit
Fall below	TIM ready for operation	TIM not ready for operation	All values ≤ respective lower limit	After switching the unit on or starting a measurement Goes out again when a value ≥ respective upper limit	All values ≤ respective lower limit	After switching the unit on or starting a measurement Goes out again when a value ≥ respective upper limit
Within range	TIM ready for operation	TIM not ready for operation	Respective lower limit ≤ all values ≤ respective upper limit	After switching the unit on or starting a measurement Goes out again when the respective lower limit < all values < upper limit	Respective lower limit ≤ all values ≤ respective upper limit	After switching the unit on or starting a measurement Goes out again when the respective lower limit < all values < upper limit

	Ready Relay on 	**Ready Relay off** 	**Relay 1 on** 	**Relay 1 off** 	**Relay 2 on** 	**Relay 2 off** 
Out of range	TIM ready for operation	TIM not ready for operation	A value ≤ respective lower limit or a value ≥ respective upper limit	After switching the unit on or starting a measurement Goes out again when the respective lower limit < all values < upper limit	A value ≤ respective lower limit or a value ≥ respective upper limit	After switching the unit on or starting a measurement Goes out again when the respective lower limit < all values < upper limit
No function	TIM ready for operation	TIM not ready for operation		Always off		Always off
M3						
	TIM ready for operation	TIM not ready for operation	Measurement is currently in progress and one or more of the last 5 measured values > limit	5 consecutive measured values ≤ limit or measurement stopped	After the first measured value is available: Flow error	Flow rate within set range
M4						
Start or result of check measurement after test cycle time ≥ upper limit	TIM ready for operation	TIM not ready for operation	Measurement is currently in progress and one or more of the last 5 measured values > limit	5 consecutive measured values ≤ limit or measurement stopped	After the first measured value is available: Flow error	Flow rate within set range
Upon the test cycle time elapsing for the duration of a check measurement			Test cycle time has elapsed	Goes out again when measured value < upper limit Restart test cycle time		

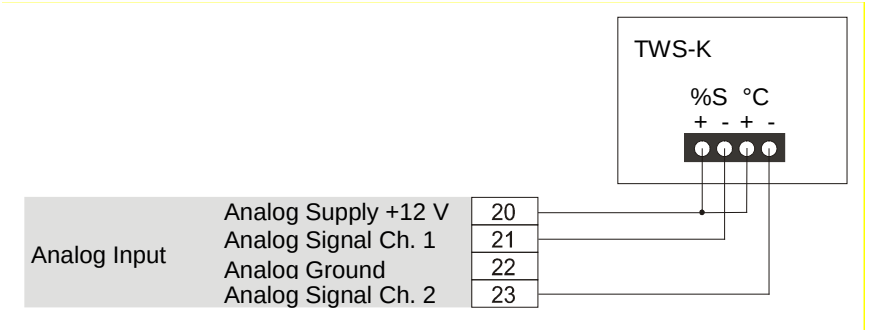
6 Analog Input

The 4..20 mA outputs of a Schroeder TestMate Water Sensors can be connected to both of the analog inputs.
The terminal assignment is shown below:

6.1 Connector TWS-C Series



6.2 Connector TWS-K Series

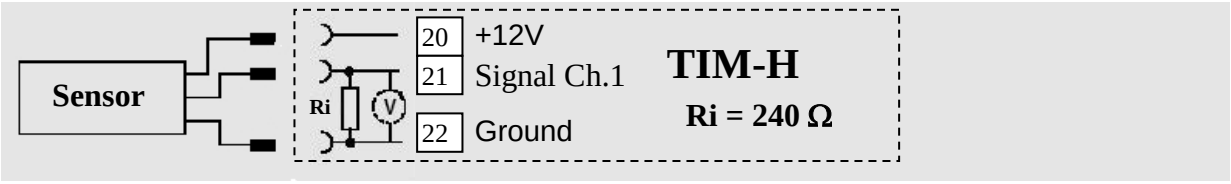


The water saturation (0% to 100%) and the temperature (-20°C to 120°C) can be used as a measurement channel in mode M2 to switch the relays.
In addition, this information is transmitted via the optional serial interfaces. (For more information, see *DIN Measurement Bus Module, RS232 Module* and *Ethernet Module*)

Consequently, particulate contamination and water-induced contamination can be monitored via a single bus link.

Connecting an analog 4..20 mA, 3-lead sensor of another manufacturer is possible.

Example:



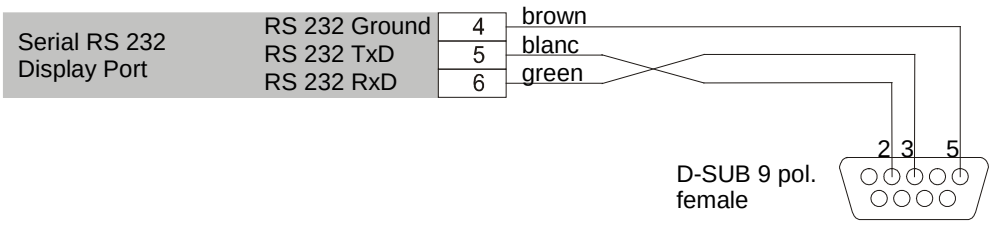
For more information, see sections *Configure 4..20 mA Input Channels* and *Display AD Channels* (in chapter: *Serial RS232 Display and Parameter Interface*).

7 Serial RS232 Display and Parameter Interface

Configuring the parameter settings of the in-line monitor can be done via the serial display interface (RS 232) or via an optional bus interface. This interface is also used to configure the TIM.

7.1 Configuration via the Serial RS232 Display Port

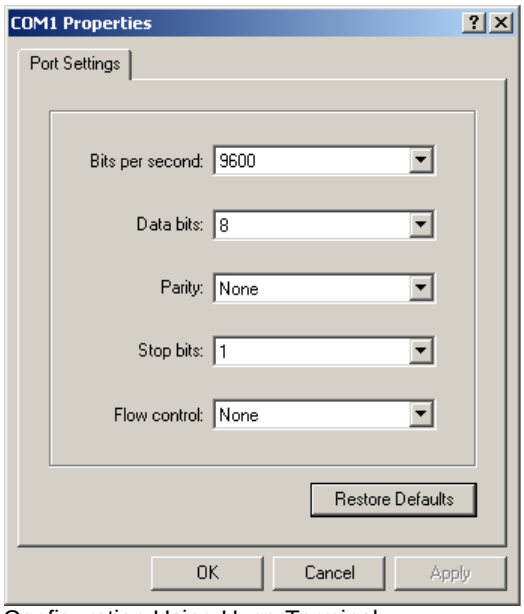
Disconnect the TIM from the voltage supply and switch your PC off.
Connect the serial RS 232 display port of the TIM to any non-occupied COM port of your PC as shown in the following schematic.



Connecting the Serial Display Port to a PC

Boot your PC and start a terminal program (e.g. HyperTerminal).
Configure the COM port as follows:

9600 baud, 8 data bits, 1 stop bit, no parity, no protocol



Configuration Using HyperTerminal

Reconnect the TIM to the voltage supply.

7.2 Outputs and Messages via the RS232 Interface

After being switched on the TIM is always in Display Mode:

- *Schroeder* first appears in the terminal window.
- After the measurement period elapses, the current measurement result is outputted (e.g. *ISO_Code: 25.22.20*) or a malfunction message appears
- If the flow rate through the sensor cell is too low, a malfunction message such as *"F XXX "* is displayed. “xxx” is the approximate flow in ml/min.
- If there is a malfunction, e.g. due to a damaged sensor cell or excess water or air content in the oil, “999999” is displayed.
- After the measurement is stopped (Mode M3: target cleanliness reached or via bus interface) a *Stop* message is displayed.
- In mode M4, after the target cleanliness is reached, the elapsed test cycle time is displayed in minutes, e.g. “*t 25”*

7.3 Configuration via the Serial RS232 Display Port

You can now proceed to Select Mode by pressing RETURN. (The *Ready* relay switches off as the sensor does not measure when in Select Mode.)

7.3.1 Select Mode

Texts appearing in the terminal window are shown in *italiTIM*.

The following appears in the display when you are in Select Mode:

Schroeder Industries
In-line monitor TIM2230
Hardware Version 3.0
Firmware Version 4.00 – 06/01/2004
Schroeder TestMate In-line monitor offline!
Measurement cycle stopped
Select mode:
x – Restart Measurement
p - To Parameter Mode
Press key (x, p) and Return!

To return to Display Mode, press the “x” key followed by RETURN. The following appears:

SCHROEDER ContaminationSensor online!
Measuring cycle restarted
x – Restart Measurement
p – Enter Parameter Mode
Press key (x, p) and Return

To access Parameter Mode, press the “p” key followed by RETURN. Parameter Mode enables you to configure TIM settings.

7.3.2 Parameter Mode

The following appears in the display when you are in Parameter Mode:

Parameter Mode:
x - Go back
t - Measuring cycle time
m – Select measuring mode
2 – Limits Mode M2
3 – Limits Mode M3
4 – Limits Mode M4
b - Set DIN Bus Address and Name (for TIM models with DIN Bus module only)
e - Set IP Address (for TIM models with Ethernet Interface only
p – Pump protection
o – PLC Output Format
r - RS-232 Display Output Format
i – Current Output Format (for TIM models with analog module only)
c- Check Current Output (for TIM models with analog module only)
f – Flow check
s - Sensor Check
a - Configure 4..20 mA Input Channels
h - Display AD Channels
d – Recover factory default settings

Press key (x, t, m, 2, 3, 4, b, e, p, o, r, i, c, f, s , a, h, d) and Return!

7.3.3 Measuring Time

t = Measuring time is used to set the measurement time (20 s to 120 s).
When a time shorter than 20 s is set (for test purposes), it isn't stored in the EEPROM, which means that after resetting the TIM a measurement time between 20 s and 120 s is set.
No time <2 s > or 120 s can be set.
Current measuring cycle time (s) set to: 20
New value for measuring cycle time (s) (press Return only to keep setting): ***60 'Return'***
Current measuring cycle time (s) set to: 60
(The measured result has been extended in the example from 20s to 60s.)

7.3.4 Measuring Mode

m = Measuring mode enables the measurement mode to be selected (M1, M2, M3 or M4).
Current Mode: 3
1=M1, 2=M2, 3=M3, 4=M4
*Press key (1, 2, 3, 4) and Return (press Return only to keep setting)**2 'Return'***
Current value for measuring mode: 2

(The measurement mode has been changed in the example from M3 to M2.)

7.3.4.1 Settings for Measuring Mode M2

***2* = Limits Mode 2** enables the settings to be entered for measurement mode M2.
Measurement channel for relay 1 (alarm relay):

			TIM H
0	⇨	NAS/SAE Channel 0/A	> 4 µm
1	⇨	NAS/SAE Channel 1/B	> 6 µm
2	⇨	NAS/SAE Channel 2/C	> 14 µm
3	⇨	NAS/SAE Channel 3/D	> 21 µm
4	⇨	ISO Channel 0	> 4 µm
5	⇨	ISO Channel 1	> 6 µm
6	⇨	ISO Channel 2	> 14µm
7	⇨	NAS/SAE	Chan. 0-3 / A-D
8	⇨	ISO Code	ISO Chan. 0/1/2
9	⇨	Flow info	
10	⇨	LED current	
11	⇨	4..20 mA Input Channel 1	
12	⇨	4..20 mA Input Channel 2	

Limit function for relay 1 (alarm relay):

0 →No function
1 →Within range
2 →Out of range
3 →Upper limit exceeded (lower hysteresis limit)
4 →Lower limit fallen short of (upper hysteresis limit)

Limits for measurement channel, relay 1 (alarm relay):

Depending on the measurement channel selected, first the lower limit(s) is/are entered and then the upper limit(s).

Measurement channel for relay 2 (warning relay):

Measurement channels selected in the same manner as for relay 1.

Limit function for relay 2 (warning relay):

Limit functions selected in the same manner as for relay 1.

Limits for measurement channel, relay 2:

Entered in the same manner as for relay 1.

Example for TIM H:

Relay 1, measuring channel:
0=SAE A, 1=SAE B, 2=SAE C, 3=SAE D,
4=ISO ch.0, 5=ISO ch.1, 6=ISO ch.2, 7=SAE A..D,
8=ISO code, 9=flow, 10=LED
11=4..20 mA input ch.1, 12=4..20 mA input ch.2
Current setting: 3
New setting (press Return only to keep setting): ***8 'Return'***
Current setting: 8
Relay 1,switching function
(0=no function, 1= within range, 2=outside range, 3= exceed, 4=fall below)
Current setting: 4
New setting (press Return only to keep setting): ***'Return'***
Now the setting is : 4 (selected: limit exceeded)
Relay 1, lower limit 1:
Current setting: 17
New setting (press Return only to keep setting): ***16 'Return'***
Now the setting is: 16
Relay 1, upper limit 1:
Current setting: 20
*New setting (press Return only to keep setting):****'Return'***
Now the setting is: 20
Relay 1, lower limit 2:
Current setting: 15
New setting (press Return only to keep setting): ***14 'Return'***
Now the setting is: 14
Relay 1, upper limit 2:
Current setting: 18
New setting (press Return only to keep setting): ***17 'Return'***
Now the setting is: 17
Relay 1, lower limit 3:
Current setting: 13
New setting (press Return only to keep setting): ***12 'Return'***
Now the setting is: 12
Relay 1, upper limit 3:
Current setting: 15
New setting (press Return only to keep setting): ***'Return'***

Now the setting is: 15
(Since the ISO code has been selected, a three-part value has to be entered each for the lower and upper value, i.e. a total of 6 values. In the example shown above, the ISO code is 16/14/12 for the lower limit and 20/17/15 for the upper limit.)
0=SAE A, 1=SAE B, 2=SAE C, 3=SAE D,
4=ISO ch.0, 5=ISO ch.1, 6=ISO ch.2, 7=SAE A..D,
8=ISO code, 9=flow, 10=LED
11=4..20 mA input ch.1, 12=4..20 mA input ch.2
Current setting: 4
*New setting (press Return only to keep setting): **9 'Return**'*
Current setting is: 9 (selected: flow rate)
Relay 2, switching function
(0=no function, 1= within range, 2=outside range, 3= exceed, 4=fall below)
Current setting: 0
*New setting (press Return only to keep setting): **1 'Return**'*
Now the setting is: 1 (selected: Within range)
Relay 2, lower limit 1:
Current setting: 30
*New setting (press Return only to keep setting): **50 'Return**'*
Now the setting is: 50
Relay 2, upper limit 1:
Current setting: 150
*New setting (press Return only to keep setting):**'Return**'*
Now the setting is: 150

(50 and 150 ml/min were entered for the lower and upper value respectively.)

7.3.4.2 Settings for Measuring Mode M3

***3* = Limits Mode 3** enables the settings to be entered for measurement mode M3.
Example for TIM H:
Contamination Code Selection
0=SAE , 1=ISO
Current setting: 0
*New setting (press Return only to keep setting): **1 'Return'***
Now the setting is: 1
Lower limit 1:
Current setting: 5
*New setting (press Return only to keep setting): **16 'Return'***
Now the setting is: 16
Lower limit 2:
Current setting: 5
*New setting (press Return only to keep setting): **14 'Return'***
Now the setting is: 14
Lower limit 3:
Current setting: 5
*New setting (press Return only to keep setting): **12 'Return'***
Now the setting is: 12
(In the example, the target cleanliness for mode M3 has been changed from SAE 5A, 5B, 5C to ISO 16/14/12.)

7.3.4.3 Settings for Measuring Mode M4

***4* = Limits Mode 4** enables the settings to be entered for measurement mode M4.
Contamination Code Selection
0=SAE , 1=ISO
Current setting: 0
*New setting (press Return only to keep setting): **1 'Return'***
Now the setting is: 1
Lower limit 1:
Current setting: 5
*New setting (press Return only to keep setting): **16 'Return'***
Now the setting is: 16
Lower limit 2:
Current setting: 5
*New setting (press Return only to keep setting): **14 'Return'***
Now the setting is: 14
Lower limit 3:
Current setting: 5
*New setting (press Return only to keep setting): **12 'Return'***
Now the setting is: 12
Upper limit 1:
Current setting: 8
*New setting (press Return only to keep setting):**22 'Return'***
Now the setting is: 22
Upper limit 2:

Current setting: 8
*New setting (press Return only to keep setting): **'Return'***
Now the setting is: 19
Upper limit 3:
Current setting: 8
*New setting (press Return only to keep setting): **16 'Return'***
Now the setting is: 16
Test cycle time in minutes:
Current setting: 60
*New setting (press Return only to keep setting): **120 'Return'***
Now the setting is: 120
(In the example, the target cleanliness for mode M4 has been changed from SAE 5A, 5B, 5C to ISO 16/14/12, the cleanliness class for a repeated flushing/scrubbing from SAE 8A, 8B, 8C to ISO 22/19/16, and the test cycle time from 60 min. to 120 min.)

7.3.4.4 Setting the DIN-BUS Address and Name (for TIM models with the DIN-BUS module, only)

b = Set DIN Bus Address and Name, the bus address for the DIN measurement bus and the measurement/sampling site designation are entered.
DIN Bus Address: 1
Measurement Point: SCHROEDER
*New value for DIN Bus Address (press Return only to keep setting): **2***
DIN Bus Address set to: 2
*New Measurement Point: (press Return only to keep setting): **Testpoint***
Measurement Point: Testpoint

Current DIN Bus Address: 2
Current Measurement Point: Testpoint
(In the example, the bus address has been changed from 1 to 2 and the measurement site from “SCHROEDER” to “Testpoint”.)
DIN-Bus Address: 1
Measuring Point: SCHROEDER

DIN-Bus Address fixed by DIP switch !
*New Measuring Point: (press Return only to keep setting): **Testpoint***
Measuring Point: Testpoint

Current DIN-BUS Address: 1
Current Measuring Point: TIM 2230
(In the example, the bus address has been changed from 1 to 2 and the measurement site from “SCHROEDER” to “Testpoint”. The DIN-BUS address couldn’t be changed as this is fixed by DIP switches.)

7.3.4.5 Setting the IP Address (for TIM models with Ethernet Interface, only)

When ***e = Set IP Address***, the IP address for the Ethernet interface is entered. The IP address has the following format: xxx.xxx.xxx.xxx, where “xxx” are values between 0 and 255.
Example:
IP address part 1:
Current setting: 129
New setting (press Return only to keep setting): 192
Current setting: 192

IP address part 2:
Current setting: 42
New setting (press Return only to keep setting): 168
Current setting: 168

IP address part 3:
Current setting: 14
New setting (press Return only to keep setting): 16
Current setting: 16

IP address part 4:
Current setting: 150
New setting (press Return only to keep setting): 36
Current setting: 36

In this example, the IP address has been changed from 129.42.14.150 to 192.168.16.36.

7.3.4.6 Setting Pump Protection

p = Pump protection, a pump controlled by the in-line monitor via relay 1 in operating modes M1, M3 and M4 can be protected against dry running. When no permissible flow rate is present upon the time entered elapsing subsequent to starting measurement or a flow rate error occurs (condition: larger than the lower limit for permissible flow rate (parameter 10)), measurement is discontinued and the pump switched off via relay 1. Entering 0 causes this function to be disabled.
Current Pump protection *time : 0 s*
New value for Pump protection *time (press Return only to keep setting): 10*
Now the value for Pump protection *time is: 10*
(In the example the switched-off function has been activated and a time of 10 s entered)

7.3.4.7 Setting the PLC Output Format

o = PLC Output Format enables a selection to be made as to whether the NAS/SAE classification (1 value) or the ISO code (3 values) is outputted via the PLC interface.
Current PLC Output Format: ISO

Enter 1 for SAE or 2 for ISO (press Return only to keep setting): 1
Selected PLC Output Format: SAE
Current PLC Output Format: SAE
PLC Output Frequency Divider: 1
New value (1..4) for PLC output frequency divider (press Return only to keep setting): 2
PLC output frequency divider set to: 2

(In the example the output format has been changed from ISO to SAE and the output frequency reduced by half.)

7.3.4.8 Setting the RS 232 Display Output Format

r = RS-232 Display Output Format enables a header to be entered (max. 25 characters) for outputting on the screen. In addition, a specification can also be made as to whether the following is to be displayed:

– the NAS/SAE maximum (one-part, i.e. in the form of xx; the highest value of the contamination classes determined in the 4 measurement channels is shown),
– the ISO code (TIM 213X and H: three-part in the form of xx.xx.xx; TIM 203X: two-part in the form of xx.xx),
– the flow rate (in form of FL xxx, with xxx=Flow rate in ml/min)
– or as an alternative, the ISO code and the flow rate
– the contamination class in SAE channel A / NAS channel 0
– the contamination class in SAE channel B / NAS channel 1
– the contamination class in SAE channel C / NAS channel 2
– the contamination class in SAE channel D / NAS channel 3
– the cumulative particle counts and the flow rate (in the form of K0,K1,K2,K3/F) (whereby Ki=cumulative particle counts in channel i and F = flow rate)

Example for TIM H:
Header in display output: SAE B
Measurement value in display output: SAE ch. B
Enter new header ('Return' = no header!):
New header in display output: 'no header'
Enter new measurement value ('Return' = keep current setting):
1 = SAE max. , 2 = ISO Code , 3 = Flow rate, 4 = Toggle ISO/Flow
5 = SAE ch. A, 6 = SAE ch. B, 7 = SAE ch. C, 8 = SAE ch. D
9 = cumulative particle counts / flow rate
New measurement value in display output: ISO code
(In the example the display output format of SAE channel B featuring the header “SAE B” has been changed to the ISO code without any header.)

7.3.4.9 Setting the Current Output Format (for TIM models with the analog module, only)

i = Current Output Format enables a selection to be made whether the NAS/SAE classification (1 value) or the particle information of the 4 channels is outputted via the current output.
Example for TIM H:
Current Output Format: 1

SAE max.
New Current Output Format:
(1=SAE max., 2=Particle Counts) (press Return only to keep setting): 2
Now the Current Output Format is: 2
Particle Counts

(In the example the output format for the current output has been changed from "SAE max." to "Particle counts".)

7.3.4.10 Setting "Check Current Output" (for TIM models with the analog module, only)

c = Check Current Output the 4..20mA output (optional) can be checked. When entering a current value under this menu point, that current is outputted on the 4-20mA output until leaving the select mode.
Example :
Check current output
Enter current (between 2.5 and 24.0 mA) as xx.x mA or enter 'x' to exit: ***10.0***
(In the example a current value of 10.0 mA is entered.)

7.3.4.11 Flow Check

f = Flow check, four values are continuously outputted which inform the SCHROEDER service technician about whether the oil flow through the sensor is suitable for measuring particle counts.
The respective values represent the flow rate in ml/min as determined on the basis of the average flow-through time of the particles in the four particle size channels.
Air bubbles trapped in the oil are noticeable by virtue of the fact that the first value is/ the first two values are substantially lower than the other values.
Similarly, droplets in a second fluid phase like water, grease, etc. are also noticeable.
A "-" is outputted when no particles are counted in a channel.

Examples:
f
Check values: 121, 118, 124, 112 (flow rate OK)
Check values: 125, 130, 110 , - (flow rate OK, no particles in 4th channel)
Check values: 11, 48, 121, 102 (flow rate not OK; air bubbles might be present.)

7.3.4.12 Sensor Check

s = Sensor check enables the particle sensor to be checked (e.g. in the event of a malfunction, "999999" is outputted on the RS-232 display interface and the "Ready" relay is opened).
Example:
s
Sensor current ok! (253 digit)
Sensor current low! (1 digit) Possible reason: defective light source
Sensor current high! (820 digit) Water or air in the fluid or sensor clogged

7.3.4.13 Configuring the 4..20 mA Inputs

a = Configure 4..20 mA Input Channels enables the two analog 4..20 mA inputs to be configured. The following has to be entered for each input: the measured values for the 4 mA and 20 mA sensor current and a designation. (The designation is read out by CoCoS and used as an axis label.)
Example: (configuration for the SCHROEDER AquaSensor AS 2030 / 2330)

a
Channel 1 value for 4.0 mA:
Current setting: 0.0
New setting (press Return only to keep settings): ***'Return'***
Channel 1 value for 20.0 mA:
Current setting: 100.0
New setting (press Return only to keep settings): ***'Return'***
Channel 1 designation:
Current string: Fill level
New designation (max. 16 characters) ('Return' = no designation): ***%Saturation 'Return'***
Channel 2 value for 4.0 mA:
Current setting: 0.0
New setting (press Return only to keep settings): ***-20 'Return'***
Channel 2 value for 20.0 mA:
Current setting: 16.0
New setting (press Return only to keep settings): ***120 'Return'***
Channel 2 designation:
Current string: Pressure
New designation (max. 16 characters) ('Return' = no designation): ***Temperature 'Return'***

7.3.4.14 4..20 mA Inputs — Displaying the Current Measurement Values

h = Display AD Channels causes the current measurement values of the two analog 4..20 mA inputs to be displayed.
Example: (configuration for the SCHROEDER AquaSensor AS 203x / 233x)

h
Channel 1 4.0 mA Configuration Value: 0.0
Channel 1 20.0 mA Configuration Value: 100.0

%Saturation Value: 35.6

Channel 2 4.0 mA Configuration Value: -20.0
Channel 2 20.0 mA Configuration Value: 120.0

Temperature Value: 55.4

Press key (x, 'Return'): ***x 'Return'***
Pressing **Return** causes the values to be refreshed, pressing ***x Return*** causes you to exit the display and return to Parameter Mode.

7.3.4.15 Setting Default Values

d = Set default values causes all the values that can be set in the Parameter Mode menu to be reset to the factory default values (for more information, refer to *Parameter List*)
Factory default settings recovered!

After making your settings, don't forget to leave Parameter and Operating Mode before disconnecting from the program otherwise no measurements can be performed.

If you do forget, you can reset the in-line monitor by briefly interrupting the power supply. When restoring the power supply the in-line monitor automatically starts up in Display Mode.

8 Output Signals of the PLC Interface

Depending on the output format set (ISO code or NAS/SAE classes), either a three-part ISO code or the NAS/SAE classes of the four particle size channels (pulse-coded) is outputted by the PLC interface.

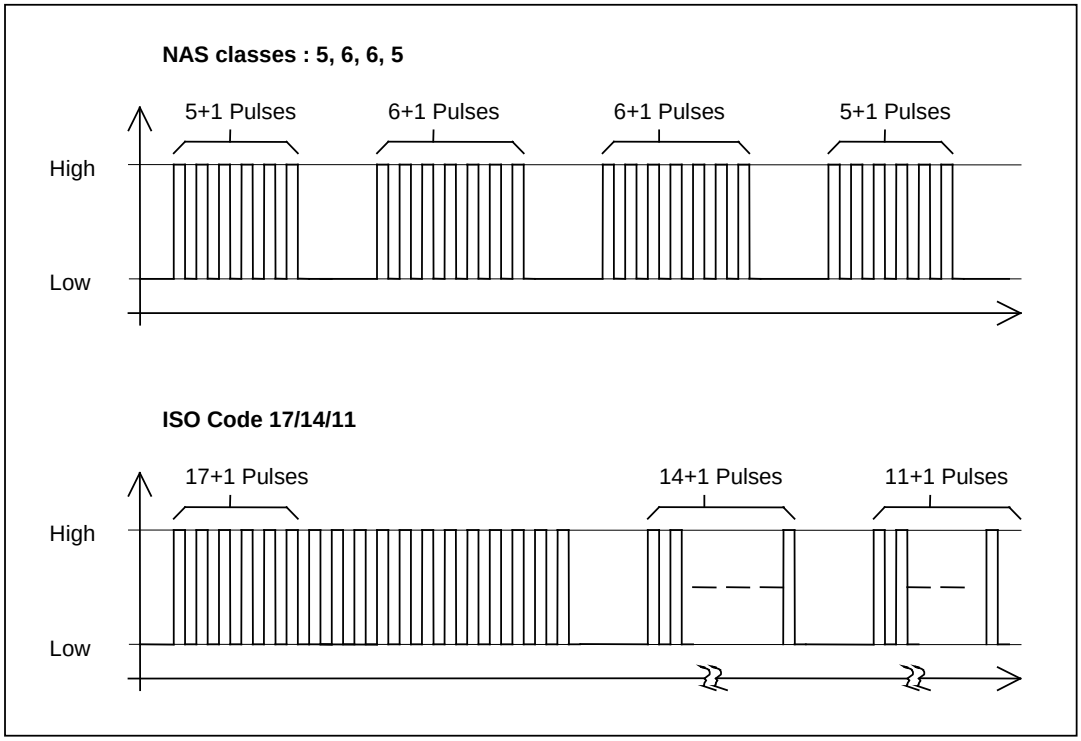
The number of pulses outputted corresponds to the ISO class + 1 or the NAS/SAE class + 1 (in so doing, also enabling a class "0" to be outputted.)

The pulse frequency amounts to ca. 10Hz (50 ms High / 50 ms Low). The pulse frequency normally amounts to ca. 10 Hz (50 ms High / 50 ms Low), however, in Parameter Mode it can divided by 2 (→100 ms High / 100 ms Low), 3 (→150 ms High / 150 ms Low) or 4 (→ 200 ms High / 200 ms Low).

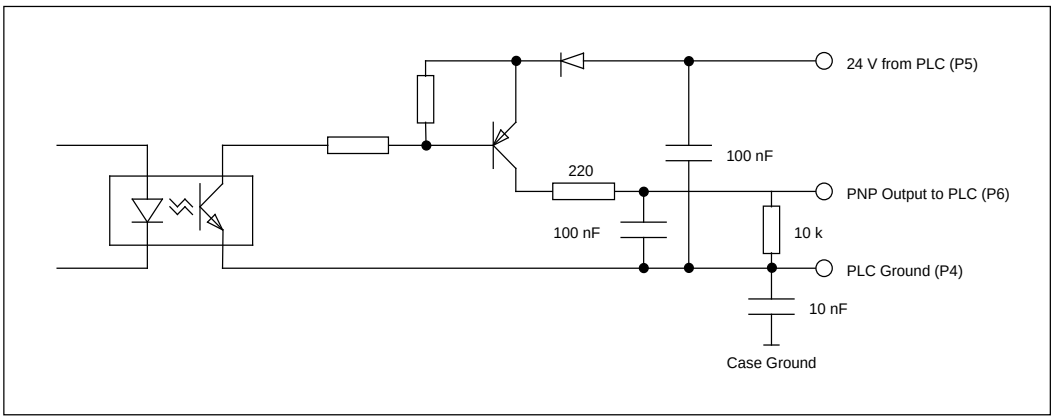
There is a pause of 1 second (irrespective of the pulse frequency selected) between the output of the two sizes of the ISO codes or between the NAS/SAE classes of two channels. The result is displayed again after 10 seconds (irrespective of the pulse frequency selected). Output is not synchronized with the measurement interval. This means that if output has started it is ended even if a new measured value is already present.

In the event of a flow or device error no pulses are outputted via the PLC interface. The same applies when measurement is stopped (Modes M3 and M4).

The measured result is outputted only once.



Examples



PLC Output Circuit of the TIM

9 DIN Measurement Bus Module

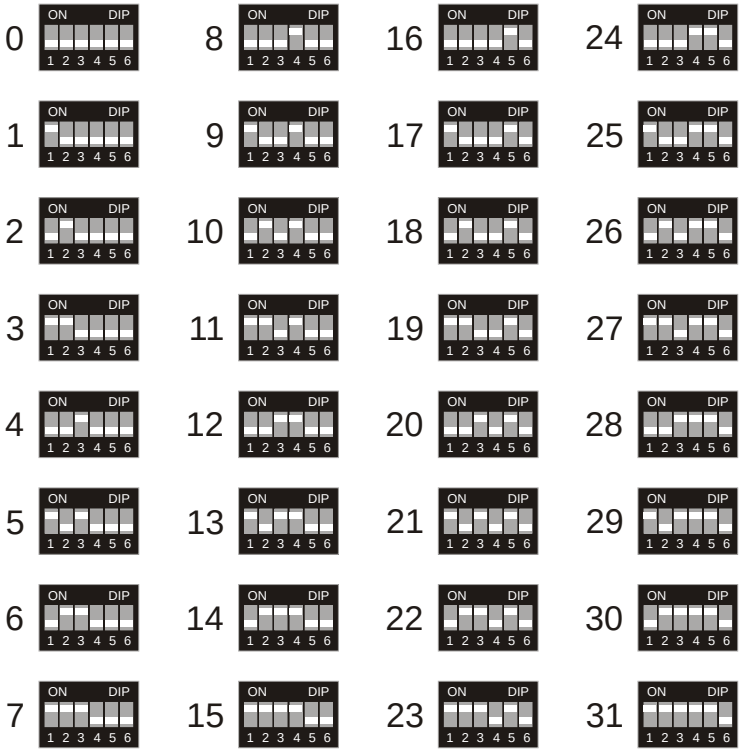
9.1 Interface

The interface and the protocol structure required for communication conform to the criteria listed in DIN 66348 part 2.
Generally speaking, the electrical properties correspond to those of an RS 485 interface, however there is a galvanic separation of the interface component and the rest of the circuit as stipulated in DIN 66348 part 2.
Data transfer via this interface is only possible via a 4-wire bus in full duplex mode.

9.2 Setting the Bus Address

Since several TIM's can be connected to the same BUS, each sensor has to be assigned an address of its own via which it is accessed. According to DIN 66348, the address range extends from 1 to 31. Each address can be assigned only once, consequently the maximum number of devices is 31.
When the DIP switch is set to "0" the BUS address stored in the TIM is used. The BUS address can be set within a range of 1 to 31 in Parameter Mode (for more information see *Parameter Mode*, in *Serial RS232 Display and Parameter Interface*) or via one of the optional digital interfaces.
The BUS address of the TIM is fixed in any other setting and cannot be changed in Parameter Mode or via any of the optional digital interfaces.

9.3 Setting the BUS Address Using DIP Switches



9.4 DIN Measurement Bus Commands (General)

All transmissions are ASCII-coded, there is no transmission of binary values. The transmission of strings is done as follows: first the number of characters is transmitted, then the string enclosed in quotation marks (**"**). Characters with a decimal value over 127 are transmitted in an escape sequence because the DIN-MESS bus transmits only 7-bit characters. The escape sequence is initiated by a '@' and then followed by the hexadecimal value (as ASCII) of the character.

e.g.: 'Pump 12' -----> 8 "Pump 12"
'Behälter 3' -----> 12 "Beh@84lter 3" ä → 132 decimal → 84 hex
(This example is included to demonstrate how accented characters are handled.)

The master in a DIN measurement bus system controls all communication:

- To send a command to the TIM it first transmits a receive request, and then the command string.
- To receive a response it first transmits a send request, then the TIM sends the answer string.
- A send request sent to the TIM with no answer string present at the TIM returns an error status, status and mode.

e.g.: '1024 00 22'*:*

Explanation:		
Error status:	1024	(Flow rate error)
Status:	00	(No new measurement value)
Mode:	22	(Measurement Mode M2,

Error status:

Name	***Binary value***	***Description***
COMAND_ERROR	64	Error in bus command string: semantic
TX_ERROR	512	Error in transmission log (DIN MESS bus)
Q_ERROR	1024	Flow rate error
ISENSOR_ERROR	4096	Error, supply current particle sensor

Status:

Name	***Binary value***	***Description***
COUNT_READY	1	A new measurement has been performed */

Mode:

Mode module 10 shows the number of the measurement program
1X → M1, 2X → M2, etc.

The units position provides an exact definition of the status:
The following applies to M1 (Measure), M2 (Measure + switch), M3 (Filter to):

x0 Measurement off
x1 Wait for correct flow rate
x2 Measurement currently in progress

M4 (Filter from to)
40 Measurement stopped
41 Waiting for a correct flow rate
42 Measurement running, testing lower limit
43 Delay in progress
44 Delay elapsed, waiting for a correct flow rate
45 Measurement running, testing upper limit

9.5 Commands

A command always consists of a command number and accompanying command parameters. Some commands force the TIM to respond to the next send request. The response is always preceded by the command number. If the response is longer than one data block, it is transmitted in several blocks.

Command '8': program parameter(s) of the TIM
Command '9': read parameter(s) of the TIM
Command '11': read particle counts (differential) on line
Command '12': read contamination classes on line
Command '13': stop measurement
Command '14': start measurement
Command '15': test parameters of the TIM
Command '16': reset error status
Command '17': read LED current
Command '18': read flow info
Command '19': Reset parameters to factory default setting:
Command '109': read TIM model and firmware version

9.5.1 Command '8': Program Parameter(s) of the TIM

The different parameters in the TIM (limit values, cycle times, name of measurement point, etc.) are set by this command. The command number is followed by the parameter number and the value of that parameter.
Example: Set parameter 21 to 0
TRANSMIT: '8 21 0' parameters 21 set to value 0.

NOTE *Not all TIM parameters are programmable*

9.5.2 Command '9': Read parameter(s) of the TIM

Example: Read out parameter 21

The command number is followed by the parameter number.

TRANSMIT:	'9 21'	reads parameter 21
RECEIVE:	'9 21 1'	parameter value: 1

NOTE: *all TIM parameters are readable*

9.5.3 Command '11': Read Particle Counts (Differential) On Line

This command transmits the values of the last measurement:

TIM H: 4...6µm, 6...14µm, 14...21µm, >21µm particles, flow rate, water content and temperature.

NOTE: water content and temperature values have to be discarded because the TIM 2030/TIM 2031 and TIM 2130/TIM 2131 don't have any of these sensors (two "0"s are transmitted for compatibility with the FCU protocol).

TRANSMIT: '11'
RECEIVE: '11 50453 4324 234 67 100 34.7 52.0'

Particle counts (5..15µm/2..5µm/4..6µm): 50453
Particle counts (15..25µm/5..15µm/6..14µm): 4324
Particle counts (25..50µm/15..25µm/14..21µm): 234
Particle counts (>50µm/>25µm/>21µm): 67
Flow rate: ..... 100 ml/min
Measurement value Analog input 1 (Water content): 34.7
Measurement value Analog input 2 (Temperature): 52.0

The water content (saturation) and temperature information is not available unless a SCHROEDER TestMate Water Sensor is connected to the analog input channels. (The measured values are determined at the end of a measurement interval of the particle count.)

9.5.4 Command '12': Read Contamination Classes (ISO/NAS/SAE) On Line

The values of the last measurement are transmitted:
Whether NAS/SAE or ISO classes are transmitted is selectable by parameter 21.
If ISO is selected, four ISO codes are transmitted even though >25µm (for TIM 2130/ TIM 2131) and >25µm, >50µm (for TIM 2030/TIM 2031) are not defined by ISO 4406.

TRANSMIT: '12' (Parameter 21=0)
RECEIVE: '12 6 7 7 6 100 34.7 52.0'

Explanation:

NAS/SAE class (channel 0): 6
NAS/SAE class (channel 1): 7
NAS/SAE class (channel 2): 7
NAS/SAE class (channel 3): 6
Flow rate: ..... 100 ml/min

Measurement value Analog input 1 (Water content): 34.7
Measurement value Analog input 2 (Temperature): 52.0

TRANSMIT : '12' (Parameter 21 = 1)
RECEIVE : '12 21 18 15 12 100 34.7 52.0'

Explanation:

ISO class (channel 0): 21
ISO class (channel 1): 18
ISO class (channel 2): 15
ISO class (channel 3): 12
Flow rate: ..... 100 ml/min

Measurement value Analog input 1 (Water content): 34.7
Measurement value Analog input 2 (Temperature): 52.0

9.5.5 Command '13': Stop Measurement

This command stops a running measurement.
TRANSMIT: '13'

9.5.6 Command '14': Start Measurement

This command starts a pre-selected measurement mode (M1...M4).
TRANSMIT: '14'

9.5.7 Command '17': Read LED Current

This command transmits the present LED current (digital value between 0 and 1023).

TRANSMIT: '17'
RECEIVE: '17 156' -> LED current 156 digits

9.5.8 Command '19': Reset parameters to factory default setting:

This command causes the settings of the TIM which can be changed by the user to be reset to the factory default settings (see *8.4 Parameter List*)
TRANSMIT: '19'

9.5.9 Command ‘109’: Read TIM Model and Firmware Version

The TIM responds with 3 strings, indicating the TIM model, the TIM series and the firmware version of the EPROM.

TRANSMIT : '109'

RECEIVE : ‘109 6 “TIM2130” 6 “TIM 2000 “ 5 ”V4.00”

Explanation:

Number of places (characters + spaces) in string: 7

Device type: ..... TIM 2130

Number of places (characters + spaces) in string: 7

Device family: ..... TIM 2000

Number of places (characters + spaces) in string: 5
Firmware version: V4.00

10 RS 232 Module

This module uses the same data transmission protocol as the DIN-Measurement BUS module described in section “DIN Measurement Bus Module“.

The RS 232 module enables the in-line monitor to be connected directly to a standard RS 232 computer interface (COM port) without having to use an interface converter.

However the RS 232 module does not enable several devices to be networked.

In addition, the RS232 interface exhibits lower noise immunity as compared to the RS 485 interface.

Attention! This serial RS 232 interface cannot be used to enter settings via a terminal program. The RS 232 display interface is to be used for this purpose. For more information see section „Serial RS232 Display and Parameter Interface“.

11 Ethernet Module

The Ethernet module is designed for 10Base-T standardized cable types and complies with the criteria detailed in IEEE 802.3 (e.g. bit rate: 10 Mbps, transmission medium: twisted-pair (UTP/STP) cable).
Data transfer takes place via the TCP/IP communication protocol.

11.1 Entering the IP Address

Before entering an IP address, contact your systems administrator first. The assignment of IP addresses is subject to in-house rules and international regulations.

The IP address of each unit can be individual set in order to identify the unit in the network.
Use only IP addresses which have been assigned by your systems administrator. Not doing this may cause serious network outages and other problems.

Entering the IP address is done during configuration via the RS232 display and parameter interface (see 7.3.4.5 for more information). This module uses the same data transfer protocol as that described in the section on the DIN measurement bus module.

When accessing the unit via your Ethernet LAN only the IP address is decisive, the bus address is ignored.

11.2 Units Featuring an Ethernet Module Provide the Following 2 Functions:

11.2.1 Transmission of Commands

The commands available here are the same as those described in 9.5 for the DIN measurement bus module. However, transfer of the ASCII-coded commands takes place via the TCP/IP protocol. For information on how the commands are interpreted and their responses, see 9.4.

Version 3.xx and higher of CoCoS, the Schroeder Contamination Control Software, also enables communication with the measurement unit via an Ethernet LAN.

11.2.2 Web Server

The Ethernet module enables a readout of the current measurement data (cumulative particle counts, ISO code/classes) and other unit data (device type, firmware, serial number) using a web browser (e.g. Internet Explorer).
The forms are stored on the web server in HTML format and can be viewed in the browser by entering the proper IP address (see section 11.1) in the URL box.
Example:

The following HTML page pops up:

The HTML page is refreshed every 15 seconds, thus it always shows the latest measurement results.
However, the values for the temperature (Temperature [°C]) and saturation (Saturation [%]) are not outputted unless a Schroeder TestMate Water Sensor is connected to the TIM.

Being equipped with an Ethernet module, the device takes on the tasks of a server. When a link is established with the device this function is locked for other clients during this time, meaning the server only communicates with one client at a time. However, while the device is being accessed the web server can be simultaneously accessed as described in section 11.2.1 above (e.g. via the Ethernet LAN using CoCoS version X.XX or higher).

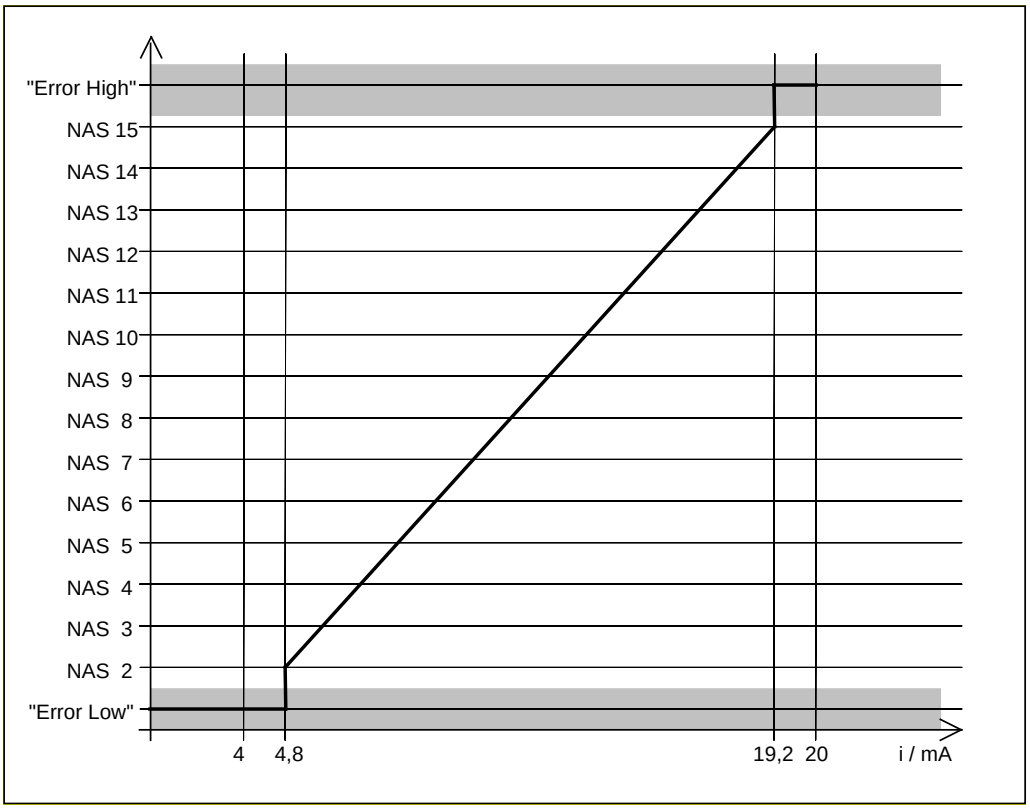
12 Analog Module - Output Signals

The measurement results are outputted as a current between 4mA and 20mA as follows:
(load $\leq 500\ \Omega$):
When NAS max. or SAE max. is selected under "i" in Parameter Mode:

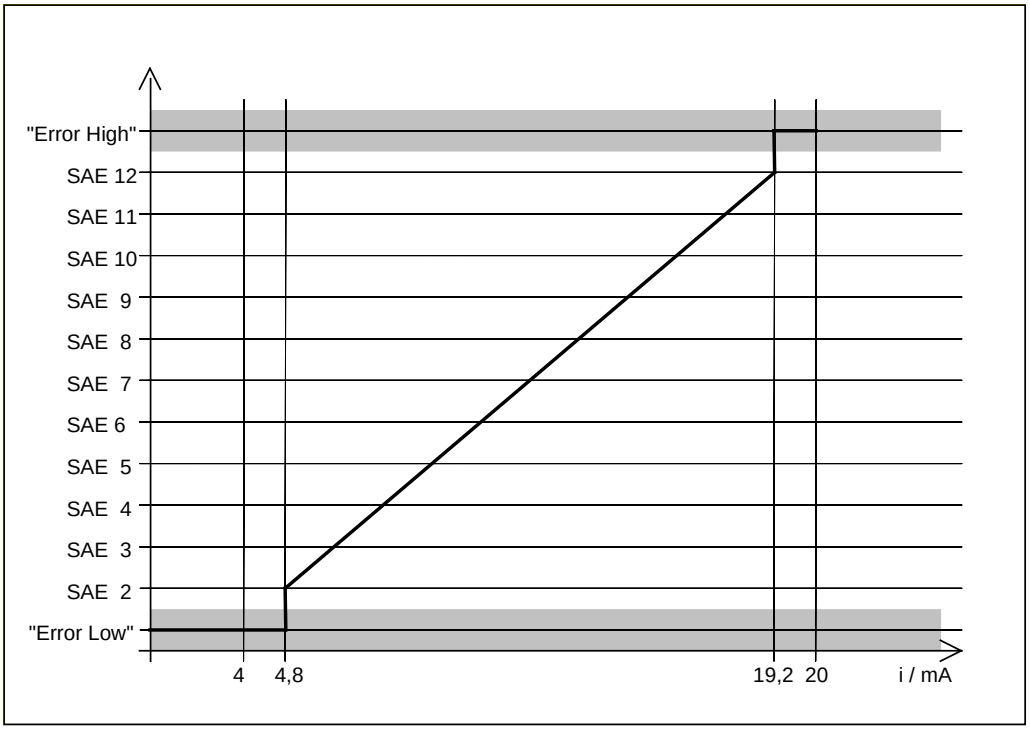
	Current 4-20mA
Measurement range from NAS/SAE =2	4.8 mA
Measurement range to NAS=15/SAE=12	19.2 mA
"Error Low"	4 mA
"Error High"	20 mA

"**Error Low**" means: The device is not ready for performing measurements (e.g. on account of a defective sensor, or because of excessively high air or water content).

"**Error High**" means: flow error



The NAS class is computed on the basis of the current measured i as follows:
"NAS value" = 1 + (i – 4.8 mA) x 13 / 14.4
NAS class = NAS value rounded up to the next whole number



The SAE class is computed on the basis of the current measured i as follows:
"SAE value" = 1 + (i – 4.8 mA) x 11 / 14.4
SAE class = SAE value rounded up to the next whole number

When particles is selected under "i" in Parameter Mode:

	Duration	Current 4-20mA
”Identifier” for particle channel 1	300 ms 300 ms	19.2 mA 4.8 mA
Log (particle count channel 1)	3000 ms	4.8mA-19.2mA
”Identifier” for particle channel 2	300 ms 300 ms 300 ms 300 ms	19.2 mA 4.8 mA 19.2 mA 4.8 mA
Log (particle count channel 2)	3000 ms	4.8mA-19.2mA
...	...	...
"Error Low"	0%	4mA
"Error high"	100%	20mA

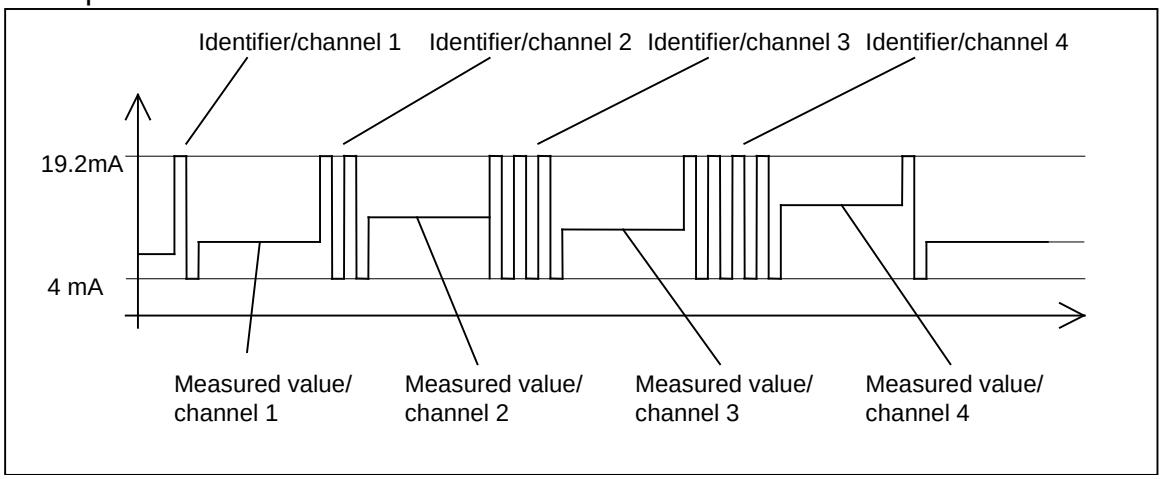
After an "identifier" for the particle channel, the particle count of the respective channels is outputted as a current between 4.8 mA and 19.2 mA.

The current is computed as follows: $\mathbf{I(n) = I_{min} + \log(n) \times (I_{max} - I_{min}) / (\log(n_{max}) - \log(n_{min}))}$

Whereby:

n = particle count
n_{min} = minimum particle count (1)
n_{max} = maximum particle count (20,480,000)
I_{min} = minimum current (4.8mA)
I_{max} = maximum current (19.2mA)
Log = logarithm base 10

This results in: **I(n) = 4.8mA+ log(n) x 1.9695mA**
If the particle count is larger than 20,480,000, 19.2 mA is outputted, if the particle count = 0, 4.8mA is outputted.
The particle count is then computed on the basis of the current as follows:
$n(I) = 10^{(I-4.8mA)/1.9695mA}$
Example:



13 Error Messages and Troubleshooting

Error message	Cause(s)	Remedy
F 225	The flow rate through the TIM is outside of the permissible range set. F = fault 225 = flow rate equals ca. 225 ml/min.	Reduce the flow rate leading to the TIM.
F 0	The TIM doesn't detect a flow in the particle measurement cell. F = fault 0 = flow rate equals ca. 0 ml/min.	Check to see whether enough pressure is being applied at the sensor input. If necessary, increase the pressure. If this message/fault remains, this means that the working section (measurement section) is probably clogged. -> Ship the unit in to Schroeder for repair.
999999	Malfunction of the particle measurement cell by virtue of • component defect or • excessively high water or air content in the oil	Make sure that no oil with a high water or air content is fed to the TIM. If this message/fault remains, this probably means that the particle measurement cell is defective. -> Ship the unit in to Schroeder for repair.

14 Technical Specification

14.1 Fluids

Mineral-Oil-Based Hydraulic Fluids

Temperature range:	0°C ... 70°C (32°F ... 176°F)

14.2 Particle Detection

Material:	solids
Particle size channels:	**TIM H**: 4µm$_{(c)}$ / 6µm$_{(c)}$ / 14µm$_{(c)}$ / 21 µm$_{(c)}$

Measurement range (calibrated):

TIM H:
SAE 2 ... 12
ISO 13/11/10...23/21/18

Indication range:

TIM H:
SAE 2 ... 15
ISO 12/10/9...25/23/21

Accuracy:	±1/2 class (ISO, NAS, SAE)
Calibration:	to ISO 4402 (TIM 203X, TIM 213X) or ISO 11943 (TIM H)
Measurement interval:	programmable from 20s ... 120s

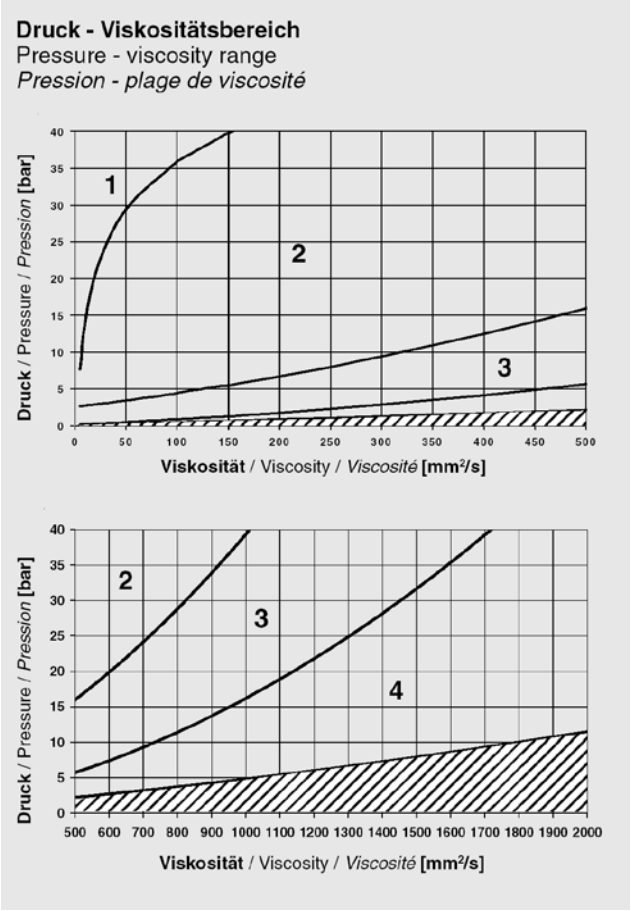
14.2.1 Recalibration:

Every 2-3 years providing your in-house QA system does not prescribe otherwise.

14.3 Hydraulic Data

Max. inlet pressure	350 bars / 5000 psi
Operating pressure:	0,5 ... 40 bars / 7 ... 580 psi
Viscosity range:	1 - 200 mm^2/s
Total flow rate:	10 to 200 ml/min
Threaded connector:	G1/4, ISO 228
Max. outlet pressure:	dependent on inlet pressure pressure in the measurement cell: max. 40 bar / 580 psi

Pressure / viscosity range, depending on the individual version:



14.4 Ambient Conditions

Protection type:	IP65, EN 6052
Ambient temperature:	0°C ... +55°C / 32°F ... 131°F

14.5 Electrical Data

Supply voltage:	24 V DC, ± -25%
Power consumption:	max. 300 mA

Outputs:

Standard	3 relays (ready, warning, alarm) (max. 2A , 24 VDC / 50 VAC; 30 W / 50 VA) + RS 232 for external display + PLC signal
Optional	Analog signal (4-20 mA) load ≤ 500 Ω or DIN measurement bus or RS 232 or RS 485 or Ethernet-Interface
Conductor cross-section	supply terminals: max. 2.5 mm^2 signal terminal: max. 0.5 mm^2

Inputs:

Standard	2x Analog signal (4..20 mA), Ri = 240 Ω, Current source

15 Model/Type code

TIM-H-1-2

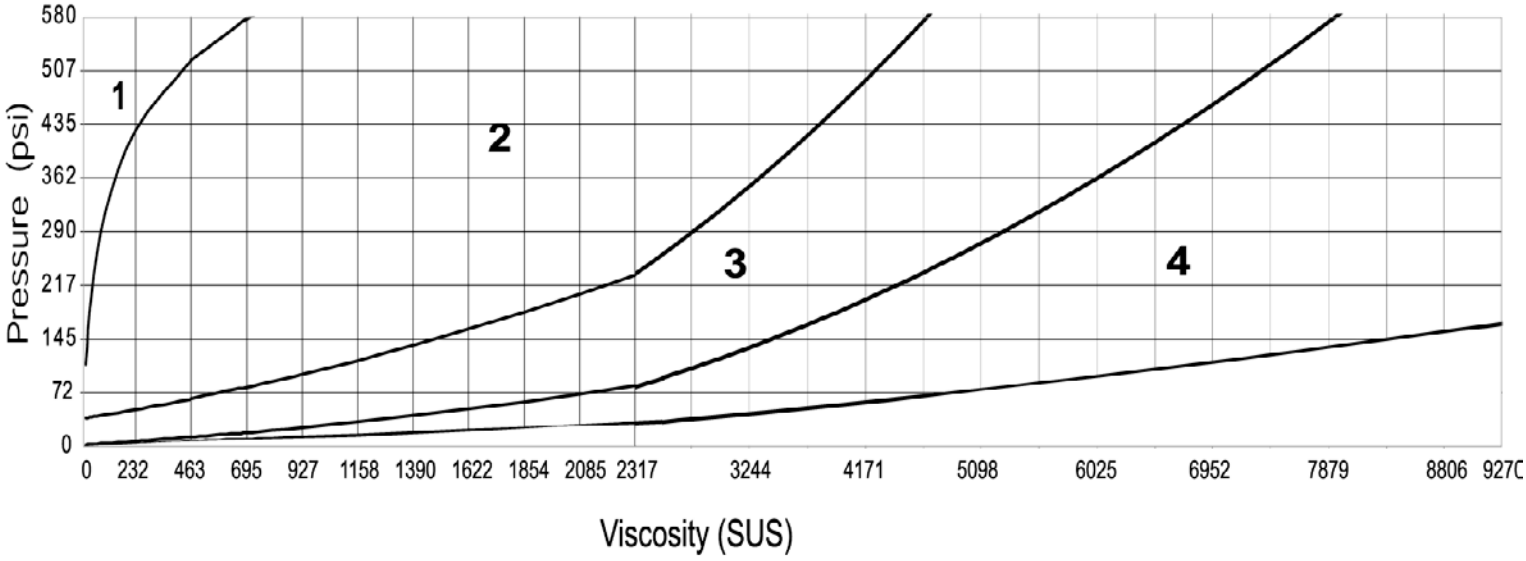
Type
- Testmate In-Line Monitor **TIM**

Fluids
- For standard mineral oils **H**
- For phosphate esters **E**

Pressure / Viscosity range
- Refer to chart below for value **1**
- **2**
- **3**
- **4**

Outputs
- Analog (4-20mA) **1**
- RS-232 **2**
- DIN measurement bus **3**

Pressure – Viscosity Range



16 ISO 4406, SAE AS 4059 and NAS 1638: Tables

ISO 4406 table:

	Particle count / 100 ml	
Code	Over	up to (and including)
0	0	1
1	1	2
2	2	4
3	4	8
4	8	16
5	16	32
6	32	64
7	64	130
8	130	250
9	250	500
10	500	1,000
11	1,000	2,000
12	2,000	4,000
13	4,000	8,000
14	8,000	16,000
15	16,000	32,000
16	32,000	64,000
17	64,000	130,000
18	130,000	250,000
19	250,000	500,000
20	500,000	1,000,000
21	1,000,000	2,000,000
22	2,000,000	4,000,000
23	4,000,000	8,000,000
24	8,000,000	16000000
25	16000000	32,000,000
26	32,000,000	64,000,000
27	64,000,000	130,000,000
28	130,000,000	250,000,000

SAE AS 4059 table:

		Maximum particle count / 100 ml					
Size ISO 11171		> 4 µm(c)	> 6 µm(c)	> 14 µm(c)	> 21 µm(c)	> 38 µm(c)	> 70 µm(c)
Size Code		A	B	C	D	E	F
CLASS	000	195	76	14	3	1	0
	00	390	152	27	5	1	0
	0	780	304	54	10	2	0
	1	1,560	609	109	20	4	1
	2	3,120	1,220	217	39	7	1
	3	6,250	2,430	432	76	13	2
	4	12,500	4,860	864	152	26	4
	5	25,000	9,730	1,730	306	53	8
	6	50,000	19,500	3,460	612	106	16
	7	100,000	38,900	6,920	1,220	212	32
	8	200,000	77,900	13,900	2,450	424	64
	9	400,000	156,000	27,700	4,900	848	128
	10	800,000	311,000	55,400	9,800	1,700	256
	11	1,600,000	623,000	111,000	19,600	3,390	512
	12	3,200,000	1,250,000	222,000	39,200	6,780	1,020

NAS 1638 table:

	Maximum particle count / 100 ml					
Class	2..5 µm	5..15 µm	15..25 µm	25..50 µm	50..100 µm	> 100 µm
00	625	125	22	4	1	0
0	1,250	250	44	8	2	0
1	2,500	500	88	16	3	1
2	5,000	1,000	178	32	6	1
3	10,000	2,000	356	64	11	2
4	20,000	4,000	712	128	22	4
5	40,000	8,000	1,425	253	45	8
6	80,000	16,000	2,850	506	90	16
7	160,000	32,000	5,700	1,012	180	32
8	320,000	64,000	11,400	2,025	360	64
9	640,000	128,000	22,800	4,050	720	128
10	1,280,000	256,000	45,600	8,100	1,440	256
11	2,560,000	512,000	91,200	16,200	2,880	512
12	5,120,000	1,024,000	182,400	32,400	5,760	1,024
13	10,240,000	2,048,000	364,800	64,800	11,520	2,048
14	20,480,000	4,096,000	729,000	129,600	23,040	4,096

17 Parameter List

All parameters are either strings or integers. Multiply by a factor of ten as needed.

No.	*String*	*Read Only*	*Designation*	*Default*	*Min.*	*Max.*
0..3		Yes	internal use			
4		Yes	Testmate In-Line Monitor model: 2 → TIM H / TIM E	2	0	2
5	Yes	Yes	Serial no.	Yyyyyy		
6	Yes	Yes	Sensor no.	XxxAyyyyyy		
7	Yes	Yes	Calibration date	01.01.1999		
8		No	Measuring interval	60	20	120
9	Yes	No	Measuring point (max. 20 characters)	SI		
10		Yes	internal use			
11		Yes	internal use			
12		No	Lower limit M2, relay 1, channel 9 / 10	80	0	999
13		no	Upper limit M2, relay 1, channel 9 / 10	120	0	999
14		no	Limit switch function for relay 1 (in M2) 0 → no function 1 → within range 2 → outside range 3 → exceed 4 → fall below	4	0	4
15		no	Measuring channel for relay 1 (in M2) 0 → NAS/SAE Ch. 0 (4..6µm) 1 → NAS/SAE Ch. 1 (6..14µm) 2 → NAS/SAE Ch. 2 (14..21µm) 3 → NAS/SAE Ch. 3 (> 21µm) 4 → ISO Ch. 0 (>4µm) 5 → ISO Ch. 1 (>6µm) 6 → ISO Ch. 2 (>14µm) 7 → NAS/SAE class (largest value of NAS/SAE channels 0 .. 3) 8 → ISO code 9 → Flow info 10 → LED current	8	0	9
16		no	Lower limit M2, relay 2, channel 9 / 10	40	0	999
17		no	Upper limit M2, relay 2, channel 9 / 10	75	0	999

No.	*String*	*Read Only*	*Designation*	*Default*	*Min.*	*Max.*
18		no	Limit switch function relay 2 (in M2) 0 → no function 1 → within range 2 → outside range 3 → exceed 4 → fall below	4	0	4
19		no	Measuring channel for relay 2 (in M2) 0 → NAS/SAE Ch. 0 (4..6µm) 1 → NAS/SAE Ch. 1 (6..14µm) 2 → NAS/SAE Ch. 2 (14..21µm) 3 → NAS/SAE Ch. 3 (> 21µm) 4 → ISO Ch. 0 (>4µm) 5 → ISO Ch. 1 (>6µm) 6 → ISO Ch. 2 (>14µm) 7 → NAS/SAE class (largest value of NAS/SAE channels 0 .. 3) 8 → ISO code 9 → Flow info 10 → LED current	8	0	9
21		No	Unit for Command 12 0→ NAS/SAE 1 → ISO	1	0	1
22		No	Lower limit in M3 Channel 0 (NAS/SAE / ISO)	18		
23		No	Lower limit in M3 Channel 1 (NAS/SAE / ISO)	15		
24		No	Lower limit in M3 Channel 2 (NAS/SAE / ISO)	12		
25		No	Lower limit in M4 Channel 0 (NAS/SAE / ISO)	18		
26		No	Lower limit in M4 Channel 1 (NAS/SAE / ISO)	15		
27		No	Lower limit in M4 Channel 2 (NAS/SAE / ISO)	12		
28		No	Upper limit in M4 Channel 0 (NAS/SAE / ISO)	22		
29		No	Upper limit in M4 Channel 1 (NAS/SAE / ISO)	19		
30		No	Upper limit in M4 Channel 2 (NAS/SAE / ISO)	16		
31		No	Test cycle time in M4 (in minutes)	60	0	1440
33		No	Address for DIN MESS BUS	1	1	31
35		Yes	Number of bad parameter (see command '15')			
40		No	Unit of limit value in M3 0 → NAS/SAE , 1 → ISO	1	0	1
41		No	Unit of limit value in M4 0 → NAS/SAE , 1 → ISO	1	0	1
43		No	Pump pre-running time in seconds Relay 1 switched off (Pump Protection)	0	0	200
44.. 79		Yes	internal use			
80		no	Measuring mode M1..M4 → 0..3	1	0	3
81	Yes	No	Header for RS232 Display Output			

No.	*String*	*Read Only*	*Designation*	*Default*	*Min.*	*Max.*
82		No	Unit for RS232 Display Output 0→ NAS/SAE 1 → ISO	1	0	1
83		No	Unit for PLC Output 1→ NAS/SAE 2 → ISO	2	1	2
84		No	Lower limit 1 M2, relay 1, channels 0-8	16	0	999
85		No	Lower limit 2 M2, relay 1, channels 0-8	13	0	999
86		No	Lower limit 3 M2, relay 1, channels 0-8	10	0	999
87		No	Upper limit 1 M2, relay 1, channels 0-8	18	0	999
88		No	Upper limit 2 M2, relay 1, channels 0-8	15	0	999
89		No	Upper limit 3 M2, relay 1, channels 0-8	12	0	999
90		No	Lower limit 1 M2, relay 2, channels 0-8	16	0	999
91		No	Lower limit 2 M2, relay 2, channels 0-8	13	0	999
92		No	Lower limit 3 M2, relay 2, channels 0-8	10	0	999
93		No	Upper limit 1 M2, relay 2, channels 0-8	18	0	999
94		No	Upper limit 2 M2, relay 2, channels 0-8	15	0	999
95		No	Upper limit 3 M2, relay 2, channels 0-8	12	0	999