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1 What's in the box

The following items are delivered with the DVM-HPHT system:

- DVM-HPHT module with sensor installed
- SME Electronics (Transmitter housing or DIN rail housing)
- Sensor cable
- USB stick with software tool installer
- Tools for removing and re-installing sensor in the DVM-HPHT module
- Spare O-rings and backup rings for sensor
- USB cables
- Torque wrench

Based on your selection you may have a SME-TRD (SME Transmitter with Display) or SME-DRM (SME DIN Rail Mount) as shown below

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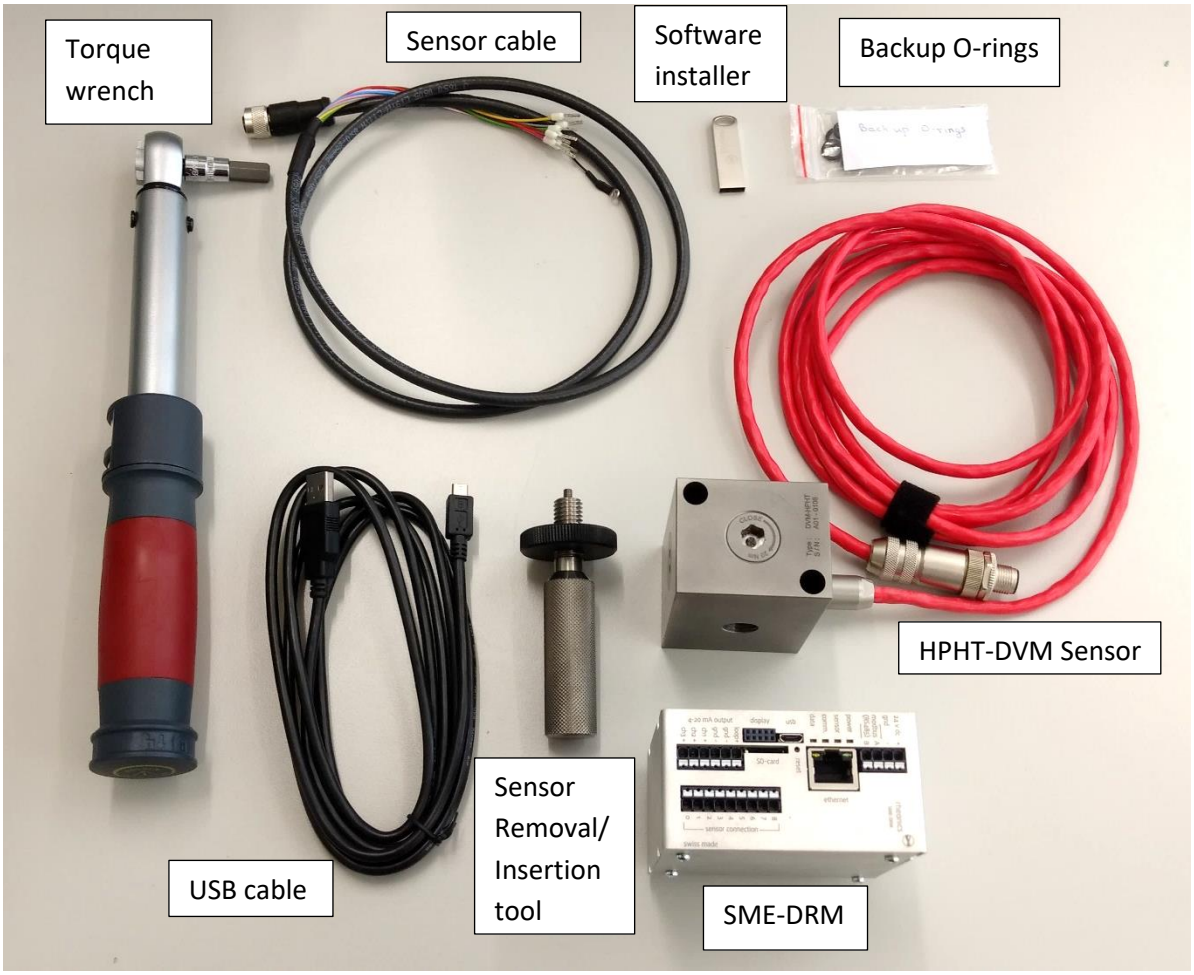

2 Setting up the system

The sensor measurement system consists of two components:

- HTHP DVM sensor and module
- SME Transmitter (Electronics unit)

The transmitter is shipped fully assembled. Gain access to the connections by unscrewing the cover and removing the display (if ordered with display) by pulling it out. The SME electronics module is now accessible for connecting the sensor, power, and communication cables.

3 Connecting and disconnecting wires to the terminal blocks on SME electronics

The wires are generally color coded, the ends should be crimped with 8mm diameter crimps. This connection is valid for sensor cable, power cable, Modbus cable, 4-20 mA cables.

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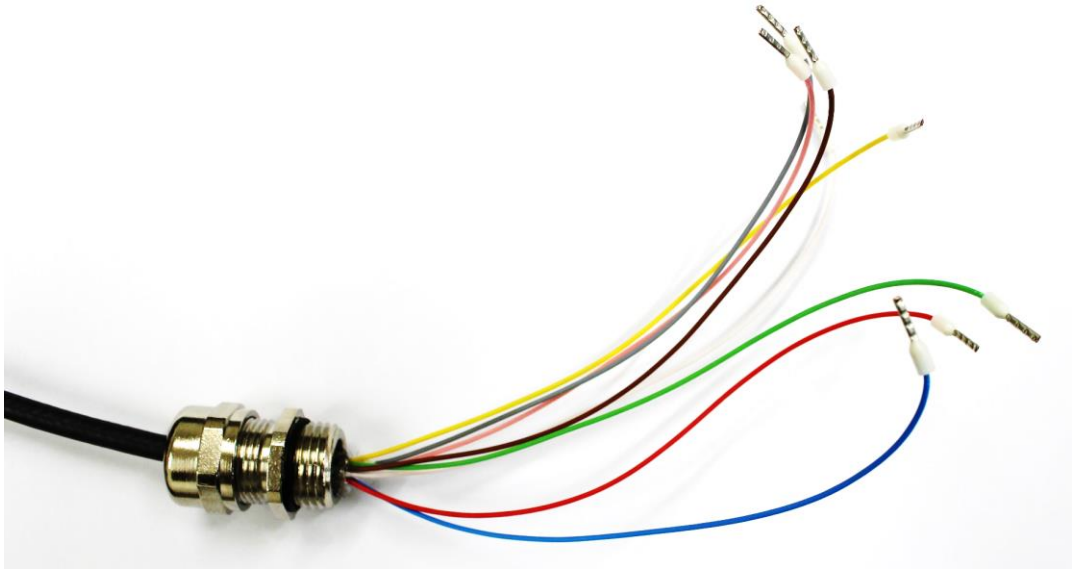
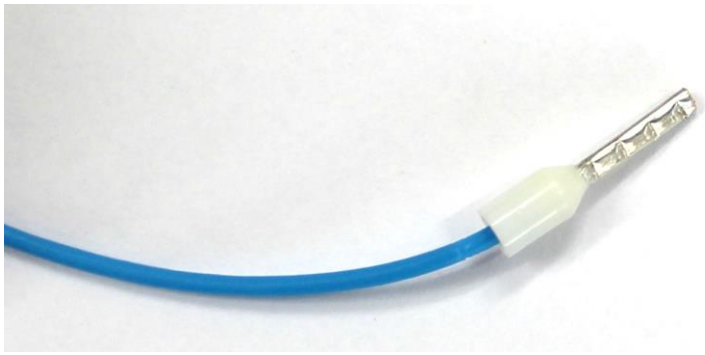
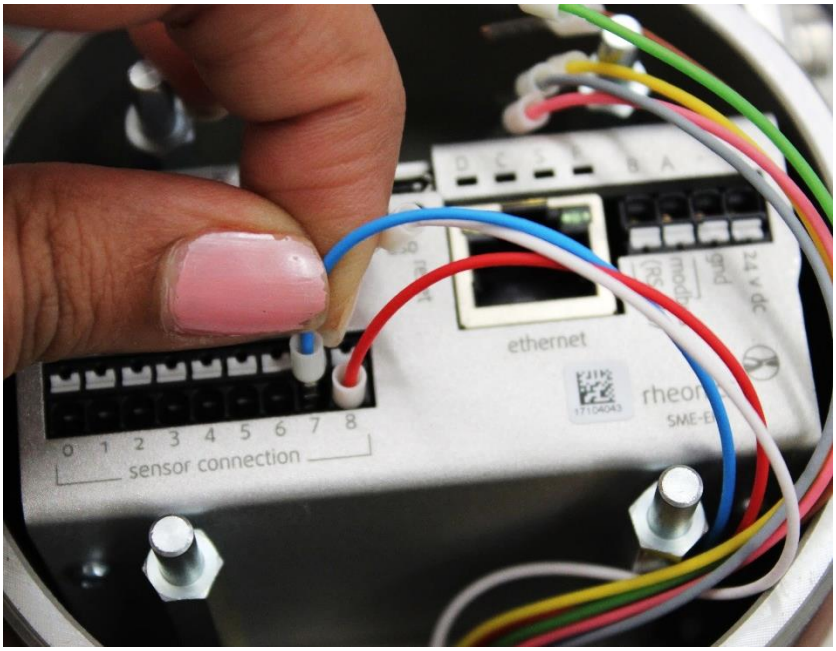




To connect the wires, insert the crimped end in the correct port on the terminal block till it clicks firmly in place and cannot be pulled out when tugging on the wires (do not tug on the wires with a lot of force as that may damage the terminal block).



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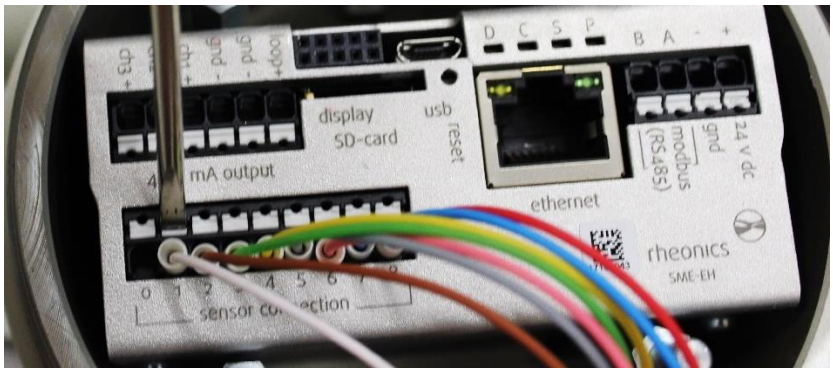
To disconnect the sensor wires, press the white tab for that specific port with a small flat screw driver as shown in picture below where the user is removing wire connected to port 1.



While pressing on the white part, pull out the cable connection with the other hand as shown in the picture below.

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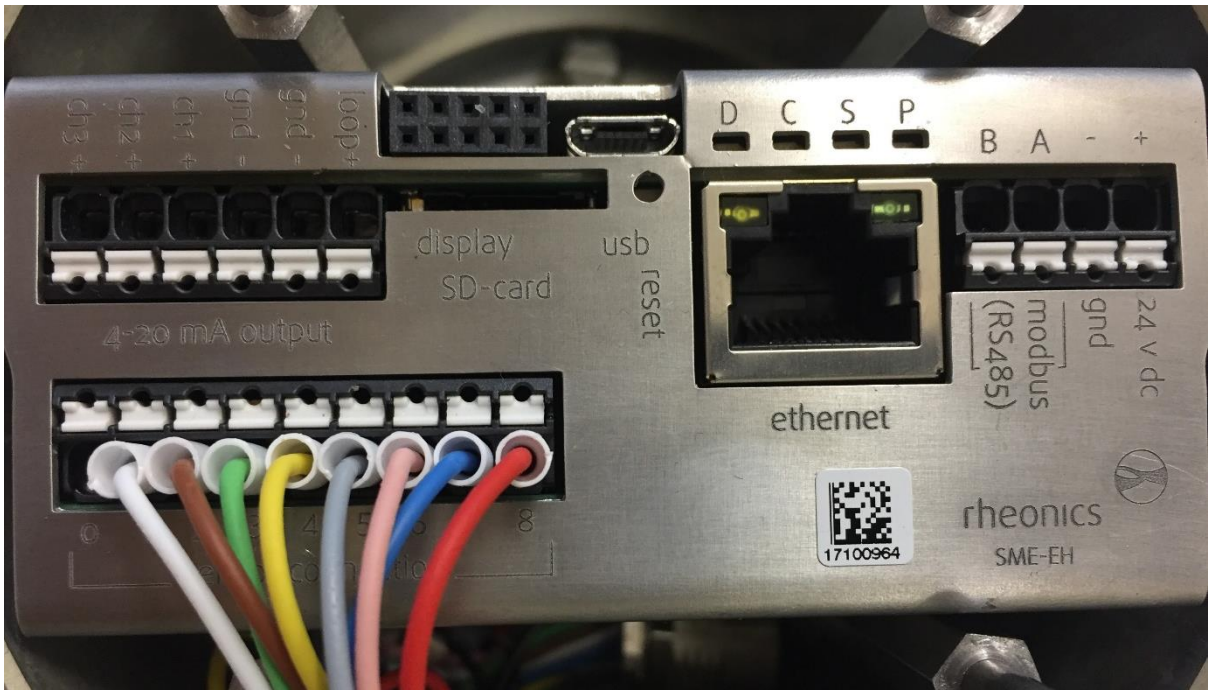
4 Connecting sensor to transmitter electronics

The sensor is connected to the transmitter electronics by a sensor cable. Follow the color code table below to connect the correct wires from the sensor cable to the sensor connection terminal strip on the transmitter. The leads are delivered with crimped ends; cable can be shortened if needed, but sleeves should be crimped on the stripped ends.



Wire Color	Sensor connection terminal #
Red	8
Blue	7
Pink (Rose)	6
Grey	5
Yello	4
Green	3
Brown	2
White	1
---not connected---	0

5 Powering the Transmitter

Connect a 24V DC supply to the power input terminals on the transmitter.

Power input terminals are labeled with 24 V DC + and – GND.

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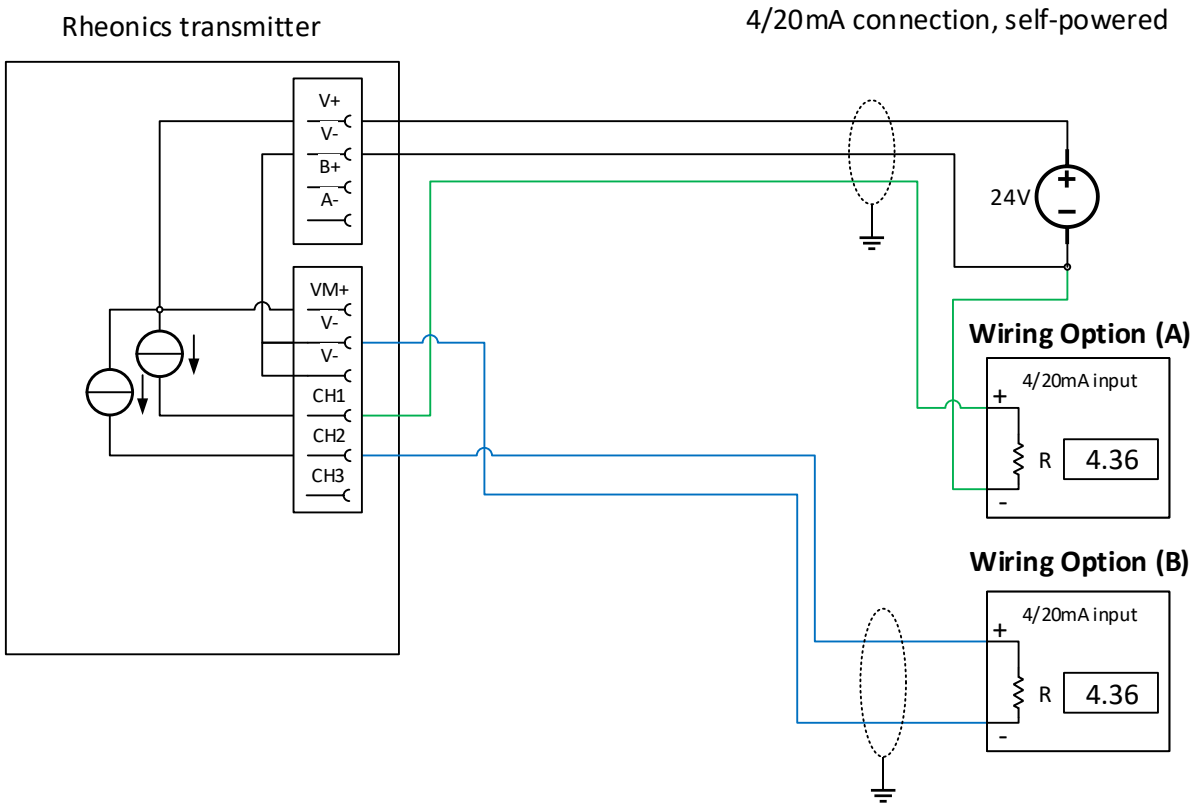
It is important to avoid ground loops in the setup / plant where the SMET is used. Ground loops can lead to excessive currents on the ground / return wire of the SMETs 24V power supply which can damage the unit.

To prevent this, we strongly recommend that the SMET is powered by a separate 24V power supply with galvanic separation. Otherwise, the SMET might be permanently damaged.

6 Connecting 4-20 mA outputs



Load impedance: 0 to 720 Ohms
Output range: 4-20mA, (3.5mA error)
Galvanic isolation: none

Wiring Option (A)

- Connect positive terminal of current input module to desired channel terminal of SME device
- Connective negative terminal of current input module to negative power supply terminal used for SME device

Wiring Option (B)

- Connect positive terminal of current input module to desired channel terminal of SME device
- Connective negative terminal of current input module to V- terminal of SME device

Notes

- The 4/20mA outputs are not galvanically isolated. It is not recommended to route the 4/20mA to off-site locations if the corresponding 4/20mA input does not provide galvanic isolation.

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7 Connecting Modbus RTU (RS-485) outputs

7.1 General

All SME devices implement a MODBUS RTU compliant RTU slave. The default configuration of the MODBUS RTU slave is 38400 and ODD parity. Connection is by RS485-2W where the interface is not electrical isolated.

7.2 Wiring

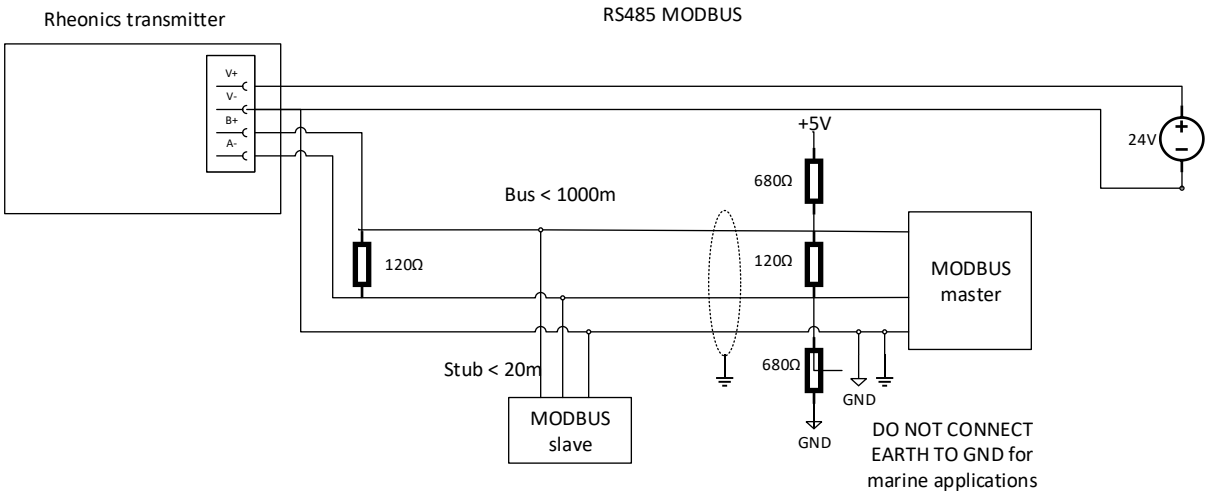
Wiring is RS485-2W. The device does not have internal biasing resistors and termination resistors and proper setup of the RS485 network has to be ensured.

Termination: Termination should be only at the end and beginning of the bus to avoid reflections. Requirements on termination differ not only on the baud-rate used but also on the slew-rate of device internal drivers. As a general rule, if there are devices on the RS485 bus that allow fast transmission speeds, and cable lengths exceed a few meters, then termination is required.

Biasing: Biasing of the RS485 BUS is required. If biasing is omitted, communication may work unreliably or not at all. See figure below for Pull-Up/Pull-Down resistors.

Connections: Connection stubs on the RS485 bus should be kept to the minimum.

Common: RS485 does allow common mode voltages of +12V / -7V. It is therefore recommended to use a common wire to ensure common mode voltage is within safe limits for all receivers. In case of problems it might be necessary to introduce RS485 isolators into the network. The common terminal for the SME device is the 0V terminal (GND) for the power supply.



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7.3 Configuration

The SME device allows the configuration of the Modbus address using the RCP software. Please refer to the RCP manual for instructions.

Factory default settings of Modbus parameters:

address=0 or 1

baudrate=38400

parity=odd

The system is capable of supporting:

- parity settings of odd, even and none
- baudrates of 9600, 19200 and 38400

7.4 Input Registers

The table uses PDU addressing; addresses start at zero. Depending on the PLC used it might be required to add 1 to the addresses in the table below

Table 1: Modbus input registers.

Address (Dec)	Length of registers	Type	Description
Parameter 1			
40	2	Float	Parameter 1 value as float
42	1	Int16	Parameter 1 value scaled by 100 as signed integer
43	1	Uint16	Parameter 1 status (See datatypes)
Parameter 2			
48	2	Float	Parameter 2 value as float
50	1	Int16	Parameter 2 value scaled by 100 as signed integer
51	1	Uint16	Parameter 2 status (See datatypes)
Parameter 3			
58	2	Float	Parameter 3 value as float
60	1	Int16	Parameter 3 value scaled by 100 as signed integer
61	1	Uint16	Parameter 3 status (See datatypes)
Parameter 4			
64	2	Float	Parameter 4 value as float
66	1	Int16	Parameter 4 value scaled by 100 as signed integer
67	1	Uint16	Parameter 4 status (See datatypes)
Parameter 5			
72	2	Float	Parameter 5 value as float
74	1	Int16	Parameter 5 value scaled by 100 as signed integer

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75	1	Uint16	Parameter 5 status (See datatypes)
Parameter 6			
80	2	Float	Parameter 6 value as float
82	1	Int16	Parameter 6 value scaled by 100 as signed integer
83	1	Uint16	Parameter 6 status (See datatypes)
Parameter 7			
88	2	Float	Parameter 7 value as float
90	1	Int16	Parameter 7 value scaled by 100 as signed integer
91	1	Uint16	Parameter 7 status (See datatypes)
Parameter 8			
96	2	Float	Parameter 8 value as float
98	1	Int16	Parameter 8 value scaled by 100 as signed integer
99	1	Uint16	Parameter 8 status (See datatypes)

7.5 Data-Types

Float: IEEE754 floating point. This data type spans two registers which should be read together. Depending on the endianness of the host it might be necessary to swap high/low byte and/or the respective registers.

Int16: Signed 16 bit integer (register)

Uint16: Unsigned 16 bit integer

Parameter status: The parameter status is a bitmask of individual status bits. As a general rule Bit 0 checking should be implemented where a set bit corresponds to an error/warning condition. In case of a critical error the parameter value is also set to NAN (not a number – See IEE754)

Bit 0: General error – Check other bits for more detailed configuration

Bit 1: Internal configuration error – Restart. If error persists call Rheonics for support

Bit 2: Hardware error, e.g. broken temperature sensor. Call Rheonics for support and arrange RMA

Bit 3: Dependency error: a parameter is calculated from other parameters and one of the source parameter has an error. Check all other parameters for errors.

Bit 4: Device is starting up and no results are ready.

Bit 5: Internal error – Restart. If error persists call Rheonics for support.

Bit 8: Parameter result is not stable. Check measurement conditions (flow, vibration, etc.)

Bit 15: Parameter exceeds sensor upper limit. No results available.

Bit 14: Parameter below sensor lower limit. No results available.

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Bit 13: Parameter value above upper warning range. Measurements might not be accurate and sensor performance might be reduced.

Bit 12: Parameter value below lower warning range. Measurements might not be accurate and sensor performance might be reduced.

Here is an image of a fully connected transmitter.

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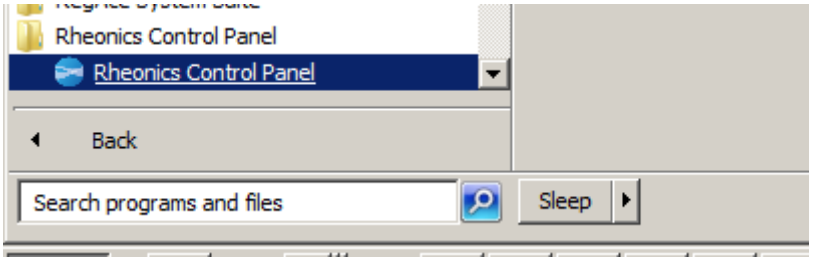
8 Operating the system

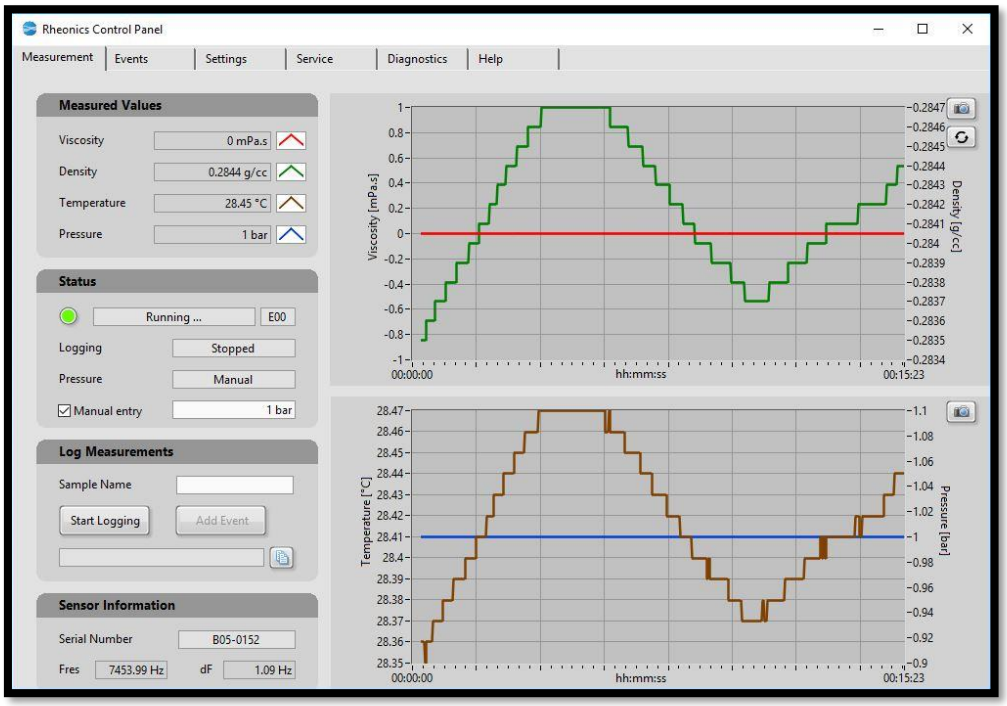
After installing the software and setting up the port, the system may now be started. The installation of the Rheonics Control Panel (RCP) Software and its settings are described in the RCP manual.

THE ELECTRONIC BOX MUST BE ATTACHED TO THE COMPUTER WITH THE USB CABLE AND POWERED UP IN ORDER FOR THE SYSTEM TO OPERATE

1. Connect the sensor to the Transmitter (instructions in section 2)
2. Connect power to Transmitter (instructions in section 3)
3. Connect the micro USB cable to the Transmitter electronics. Connect the other end to a free USB port on the computer.
4. Now that the proper operating mode has been established, run the Rheonics Control Panel software. The Rheonics Control Panel application is opened from the Start menu.



When the software is running, you will see a screen similar to the following:



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For help about the Rheonics Control Panel (RCP) and its settings see:
Help -> RCP – Rheonics Control Panel Software manual

9 Handling the Sensor

The DVM-HPHT is a stable, robust sensor system that operates over a wide range of temperatures and pressures. All wetted parts of the sensor system are made of Titanium Grade 5, which resists attack by a wide variety of highly corrosive fluids.

In order to get optimum performance from the system, some simple guidelines must be followed.

9.1 Cleaning the sensor

The DVM-HPHT is based on a resonant sensor that operates in the range of approximately 7-8 kHz. The sensor measures viscosity in a thin layer of fluid surrounding the resonant element. Any high-viscosity fluids or tenacious solids that adhere to the resonator will distort its readings.

The resonant element contains small permanent magnets. If the fluid in which the resonator is immersed contains suspended magnetic particles, these may likewise cling to the sensor and distort its readings.

In any measurement scenario in which the sensor could become coated with tenacious fluids, solids, or magnetic particles, it is recommended that the sensor be removed and mechanically cleaned.

Adherent films can be removed by using appropriate solvents and/or wiping with solvent-saturated cloth or paper. Under no circumstances should abrasives be used to clean the resonator, as these will change the geometry and destroy its calibration.

Magnetic particles may be removed by pressing scotch tape, masking tape, or similar pressure-sensitive adhesive against the sensor's surface. When pulled away from the sensor, it will remove any particles adhering by magnetic forces. Examine the sensor with a magnifying lens to satisfy yourself that its surface is clean of particles.

Note: Do not use ultrasonic cleaners.

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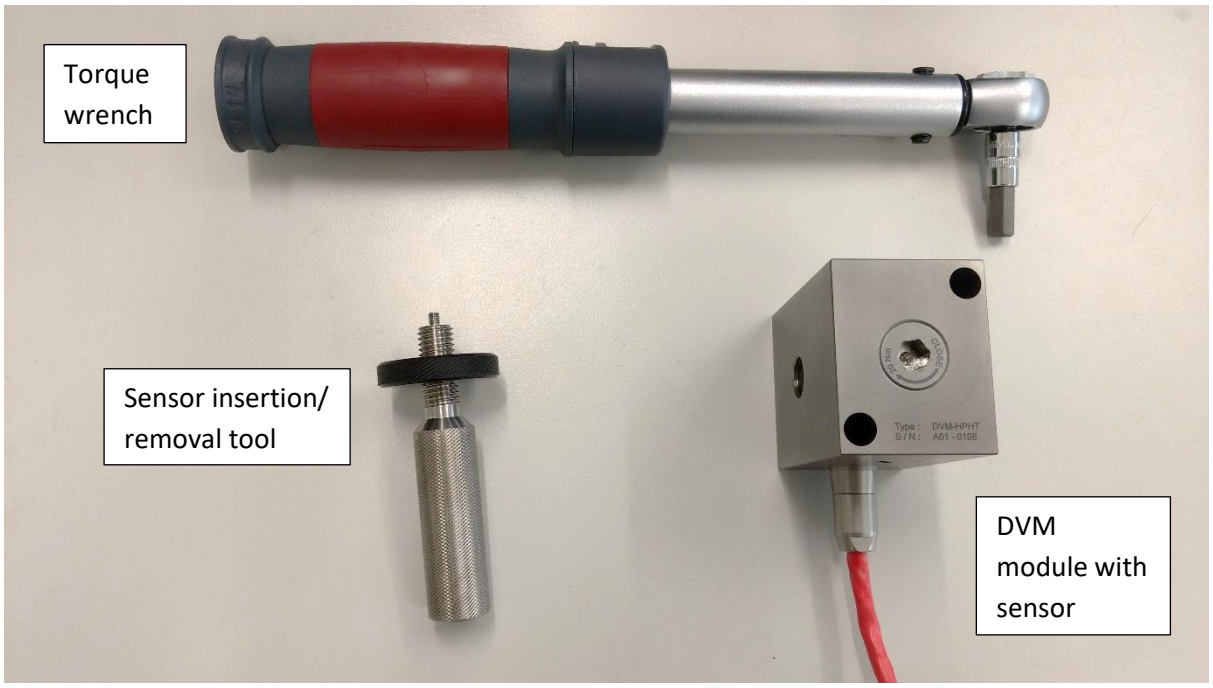
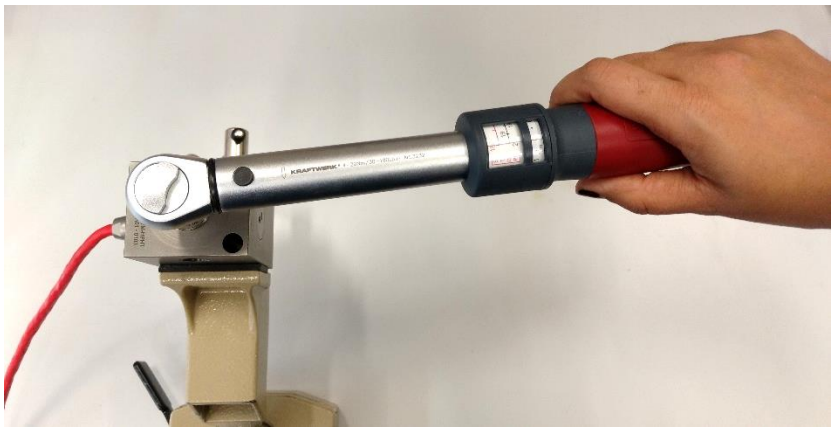
Tools for removing and inserting the sensor are shown below:



9.2 To remove the sensor:

- Using the provided torque wrench, remove the sensor retaining screw. This will require approximately 20 N.m of torque. It may be necessary to hold the DVM-HPHT in a bench vise to apply the necessary torque. Use soft jaw covers in the vise to avoid marring the DVM-2000.



This will reveal the back of the sensor base, with its M4 threaded removal/insertion hole:

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- Holding the black ring of the sensor removal tool, screw in the M4 threaded rod:

- Holding the black screw grip, screw the threaded rod into the hole in the back of sensor as far as it will go, finger tight:

- Holding the back of the threaded rod, screw the black ring clockwise against the upper surface of the module, until it has backed the sensor out of the module:

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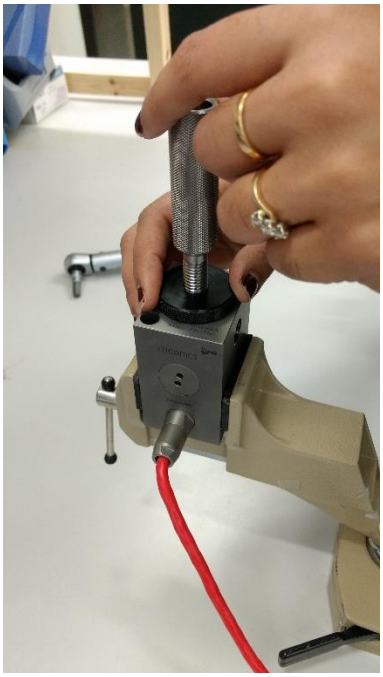

9.3 To re-insert the sensor:

- Put a VERY LIGHT film of lubricant on the O-ring around the base of the sensor. Applying a light film of lubricant to the O-ring rather than the bore of the module will tend to push the lubricant AWAY from, rather than into the bore, minimizing any chance of contamination of the fluid under test by the O-ring lubricant. In any event, very little lubricant is required. Suitable lubricants include silicone grease, light mineral oil, petroleum jelly, or simply a bit of the fluid whose properties will be measured.

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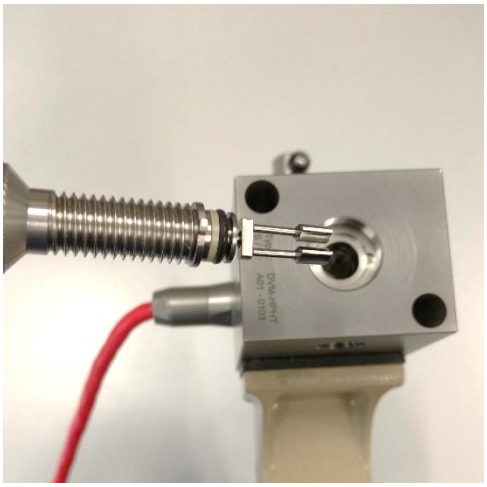
- Screw the insertion tool (without the black ring) finger tight into the M4 thread on the base of the sensor.



Exerting gentle pressure, rocking and turning the sensor slightly, push, while turn, the sensor into bore in the module. Make sure that the locating tabs are sitting IN the locating notches in the module:

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- Unscrew the insertion tool from the sensor and make sure that the sensor locating tabs are correctly oriented and sitting flush against the bottom of the locating notches in the module:

- Re-install the sensor retaining screw, screwing it down until it contacts the sensor. Now, using the torque wrench with Allen key extension, tighten the sensor retaining screw to a torque of 20 N.m (15 lb.ft). It may be necessary to hold the DVM-HPHT in a bench vise to apply the necessary torque. Use soft jaw covers in the vise to avoid marring the DVM-2000.

Sensor installation is now complete.

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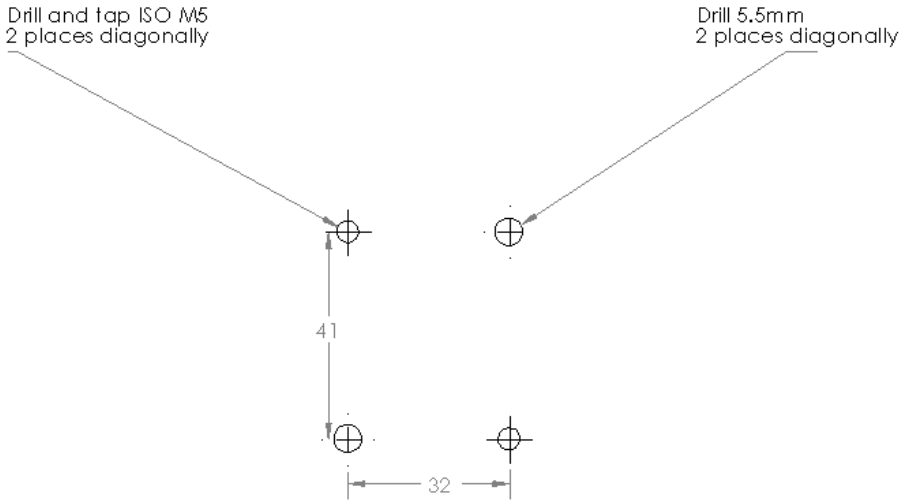
9.4 Mounting the DVM-HPHT

The DVM-HPHT module has four mounting holes. Two are through-holes for M5 socket head screws; the other two are tapped with ISO M5 threads. The whole pattern for a mounting plate is:



Either the through holes or the tapped holes can be used, depending on the requirements of the test setup.

The DVM-HPHT should be mounted with the sensor retaining screw on the top. This ensures that small bubbles trapped in the module's chamber will collect around the base of the sensor where they will not influence the measurements.

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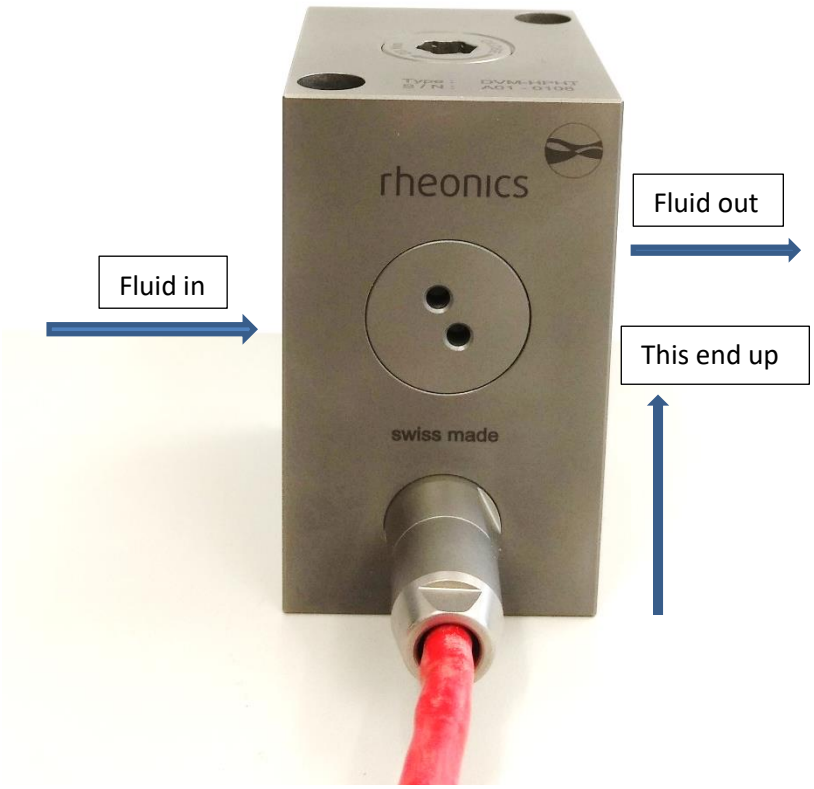

Fluid flow through the DVM-HPHT should follow the arrow marked on the cable-exit side. This makes sure that fluid enters at the ends of the resonator tines, and leave near the base, sweeping any bubbles toward the inactive (base) end of the sensor.

Please note that it is difficult to get accurate measurement with plain water stationary in the DVM-HPHT measurement chamber. Even degassed water tends to have air dissolved in it, which eventually forms micro bubbles on the surface of the sensor, disturbing its geometry. This is not a problem at higher pressures, which tend to re-dissolve any gases present. Hydrocarbons, glycols, and other fluids with low surface tension are less prone to bubble formation.

The DVM-HPHT will operate even with flow rates up to 1 l/min. Flow may be in either direction, subject to the above caution about the effects of bubbles.

Both fluid connectors are standard High Pressure Engineering ¼" high pressure connectors. DO NOT exceed a pressure 2000 bars.

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10 Notes/Errata:

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