

DVM

HPHT ULTRA HIGH ACCURACY SIMULTANEOUS DENSITY AND VISCOSITY MEASUREMENT

rheonics

inline process
density and viscosity
monitoring



- Single instrument for both density and viscosity measurement to extremely high accuracy
- Measure reservoir fluid density and viscosity at 30,000 psi and 400 °F
- Less than 0.7 cc fluid sample required for measurement
- No hardware or software changes to measure density and viscosity across complete range
- All Titanium Grade 5 wetted parts, built in high-accuracy fluid temperature measurement

Specifications

Fluid Measurements

Viscosity Range 0.2 to 300 cP

lower than 0.2 available

Viscosity Accuracy 0.1 cP below 1 cP

5% of reading (standard)

higher accuracy available

Density Range 0–15 g/cc

Density Accuracy 0.001 g/cc

higher accuracy available

Reproducibility Better than 1% of reading

Temperature Pt1000 (class AA)

Calibrated to NIST traceable viscosity and density standards.

Operational Environment

Process Fluid Temperature -40 up to 200 °C

Ambient Temperature -40 up to 200 °C

Pressure Range up to 30,000 psi

Mechanical

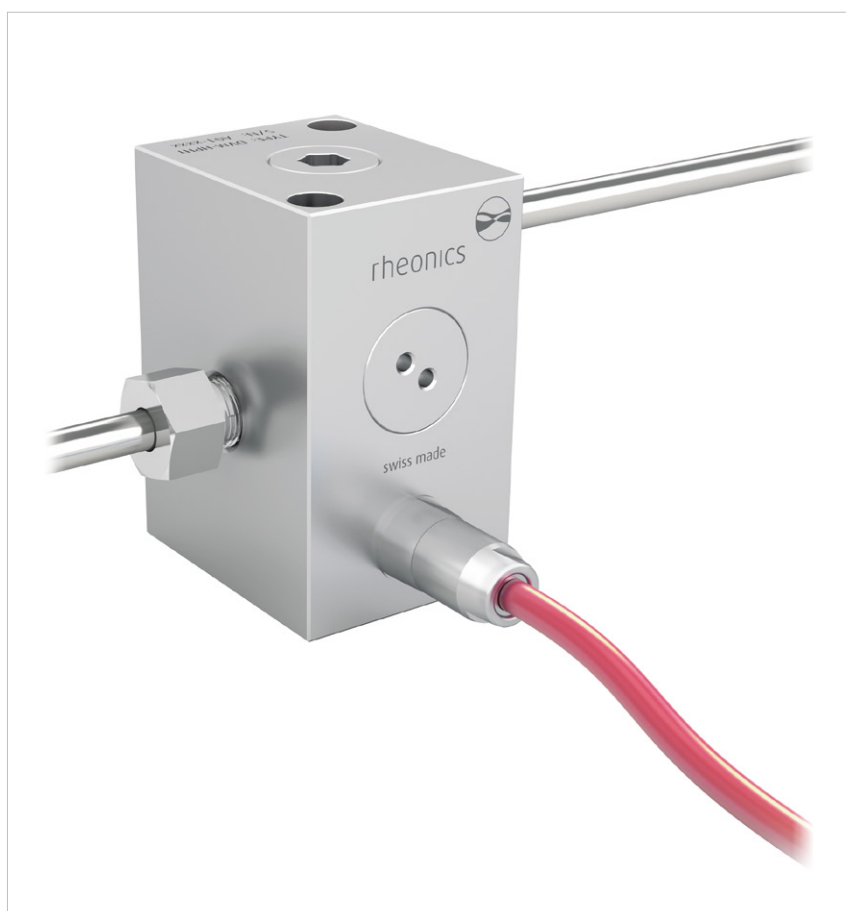
Material (Wetted parts) Titanium Grade 5

Dimensions 44 x 55 x 75.3 mm

Process Connection 1/4" HP (9/16-18 UNF)

Ingress Protection IP69

Electrical Connection Fixed cable



Electronics & Communication

Analog output 4–20 mA (3 channel)
{Viscosity, Density, Temp.}

Digital output Modbus RTU (RS-485)
Ethernet
USB

Wireless output Bluetooth LE 4.0

Display Multi-line LCD
(SME-TRD) (max. 55°C)

Operational temp. max. 55 °C
Power supply 24 V DC
SME-TR(D) IP65/66
SME-DRM IP40/50

Software Data acquisition and service control panel
iOS and Android app

Protected by US and International patents granted and pending

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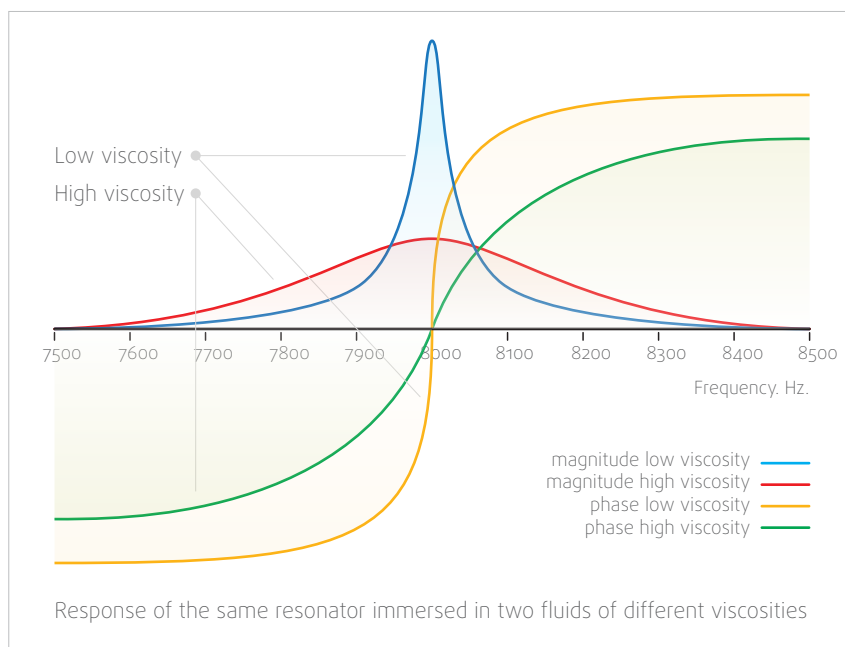
DVM-DS-1706



Operating principle

The rheonics DVM measures viscosity and density by means of a torsional tuning fork resonator with flattened tine ends, which is immersed in the fluid under test. The more viscous the fluid, the higher the mechanical damping of the resonator, and the denser the fluid, the lower its resonant frequency. From the damping and resonant frequency, the density and viscosity may be calculated by means of rheonics' proprietary algorithms. Thanks to rheonics' coupled torsional resonator design (US patent number 9518906), the transducer is perfectly balanced, while maintaining excellent mechanical isolation from the sensor's mounting.

Damping and resonant frequency are measured by the rheonics sensing and evaluation electronics (US patent number 8291750). Based on rheonics' proven gated phase-locked loop technology, the electronics unit offers stable and repeatable, high-accuracy readings over the full range of specified temperatures and fluid properties.



Application

PVT and coreflood studies

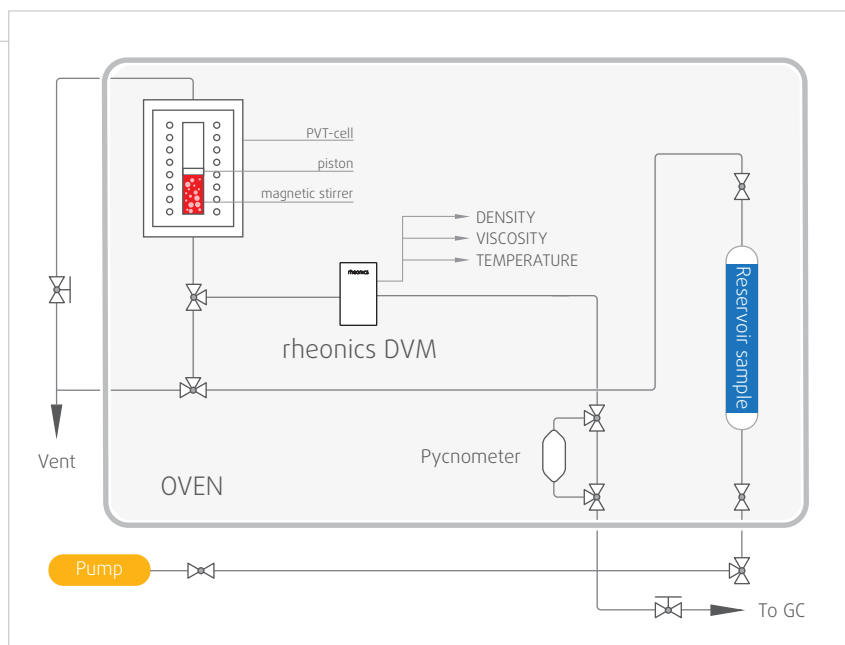
- Highly accurate and reliable density measurement at pressure to 30,000 psi and temperature to 400 °F
- Complete DVM sensor unit rated for up to 200 °C temperature for installation in PVT oven or bath
- Fully automated inline high pressure and high temperature density meter and viscometer
- Live oil viscosity (dynamic and kinematic) and density measurement in combination with high pressure sample cylinders and high pressure pump
- Improve crude oil separation and recovery from wells by understanding behavior of reservoir fluid through multistage separators under operation pressure and temperatures of each stage
- Stable and repeatable measurements of fluid property of foamed systems under extreme conditions
- Gas viscosity at HPHT for flow modeling in porous media

Real-time scale deposition evaluation

- Evaluate the performance of scale and wax inhibitors at high pressure and high temperature

Oil fields fluids

- Viscosity measurement of completion fluids at high pressure and high temperature
- Inline real-time on location accurate measurement of fracturing fluid viscosity and density
- Long term HPHT viscosity monitoring of drilling mud to assess heat stress and thermal stability
- Continuous measurement - eliminate manual sampling

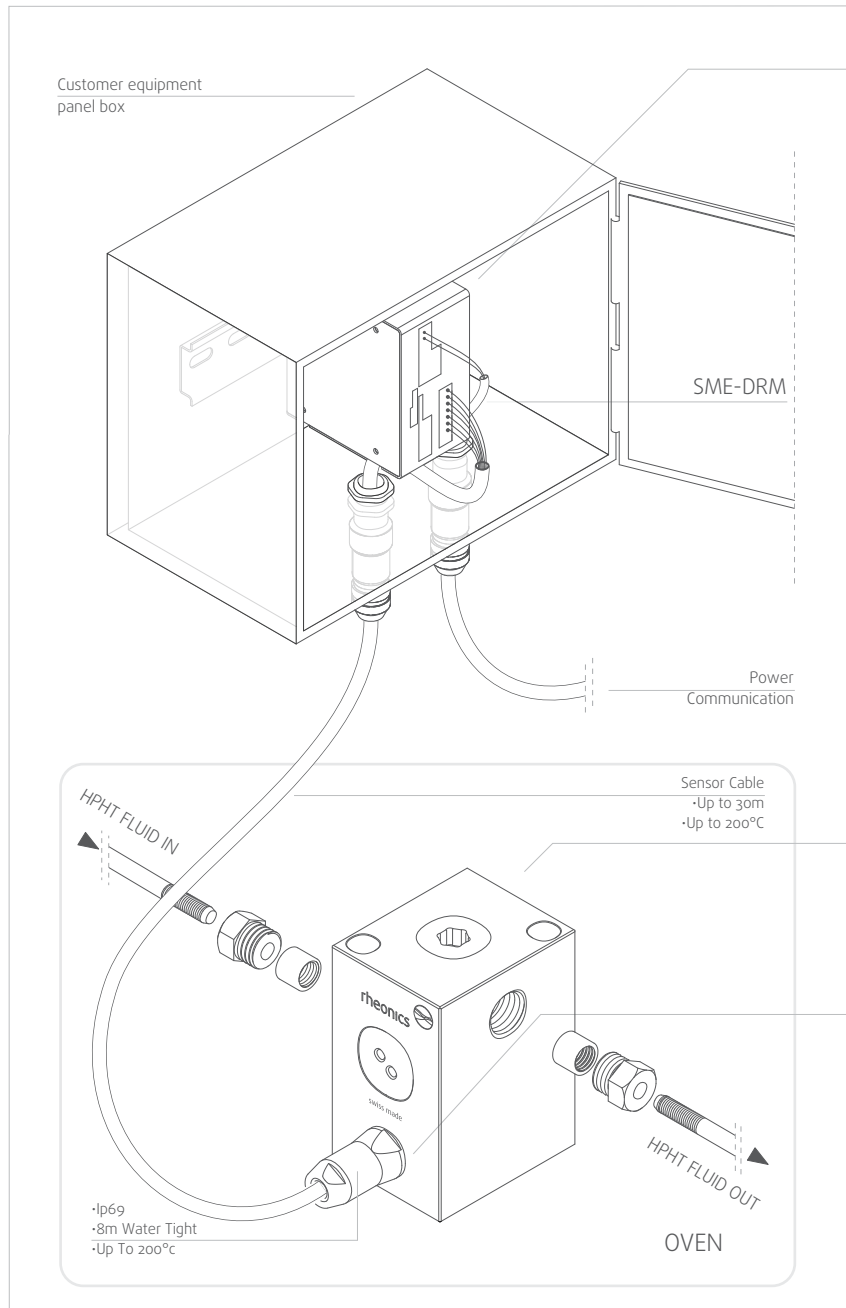


Other applications:

- Jet fuel, aerosols, adhesives, automotive fluids, coatings, colloids, dispersions
- High pressure diesel injector development
- Lubricant viscosity profile under operational high pressure and high temperature conditions
- Gas mixture specific gravity measurement under HPHT conditions
- Simulation of deepwater conditions. Pipeline and umbilical restart tests
- Stability tests of emulsions for non-newtonian and newtonian fluids
- Small form factor for direct installation in flow lines



Mechanical & Electrical



Electronics (select between)



SME-TRD



SME-TR

- Explosion-proof IP66 enclosures
- Onsite and remote installation of electronics head
- Available with and without rugged display for field use



SME-DRM

- 35mm DIN rail mount
- Extra-small form factor for easy installation
- Ethernet connection
- External adapters for wifi

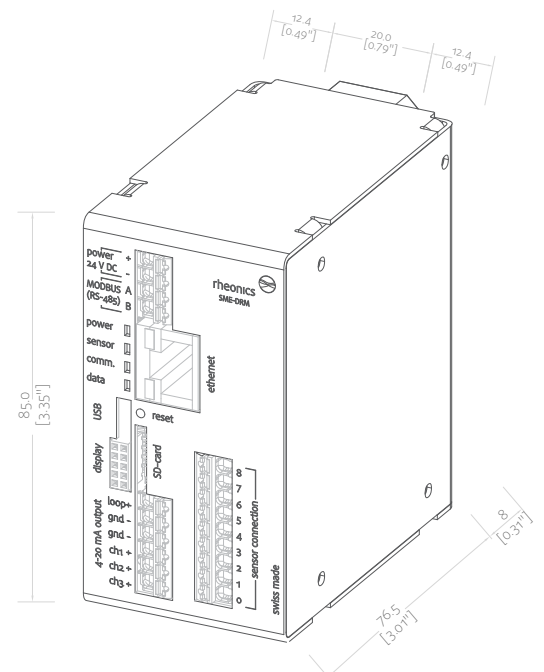
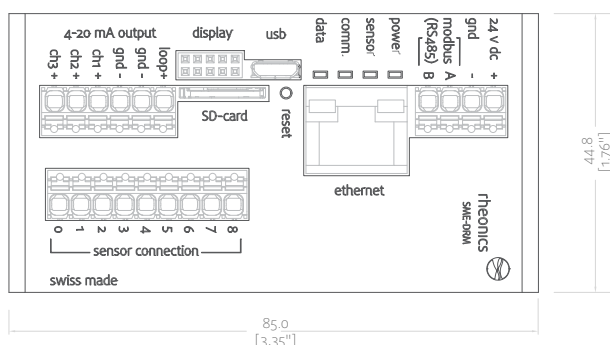
Mechanical

- Titanium Grade 5
- Complete unit including cable and connector on DVM rated for up to 200 °C insertion in fluid bath

Process connection

- 1/4" HP (9/16-18 UNF) (standard)
- Custom connections and adapter

Dimensions





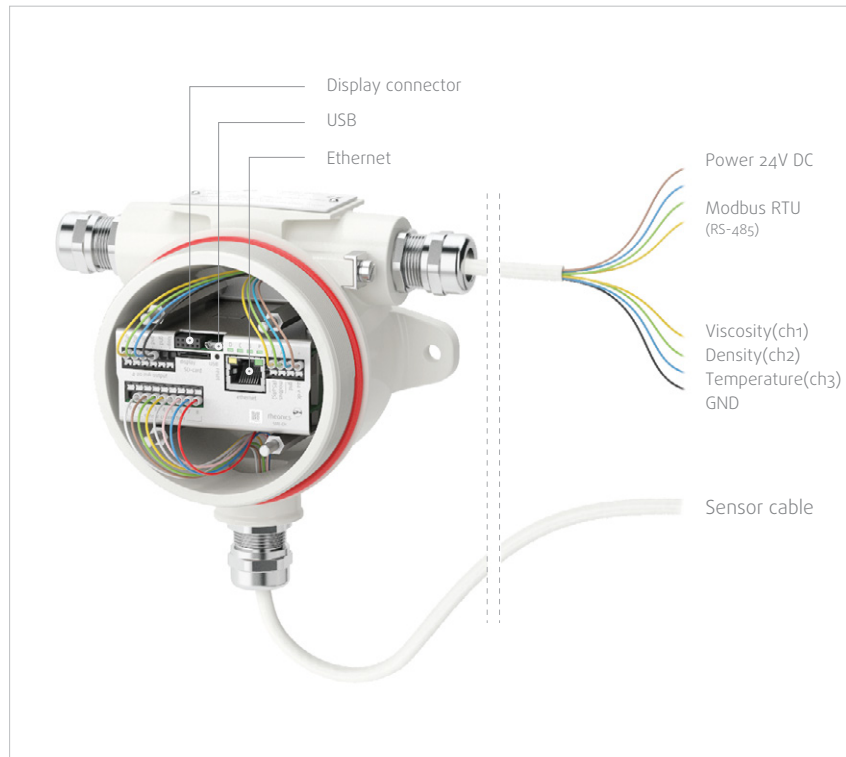
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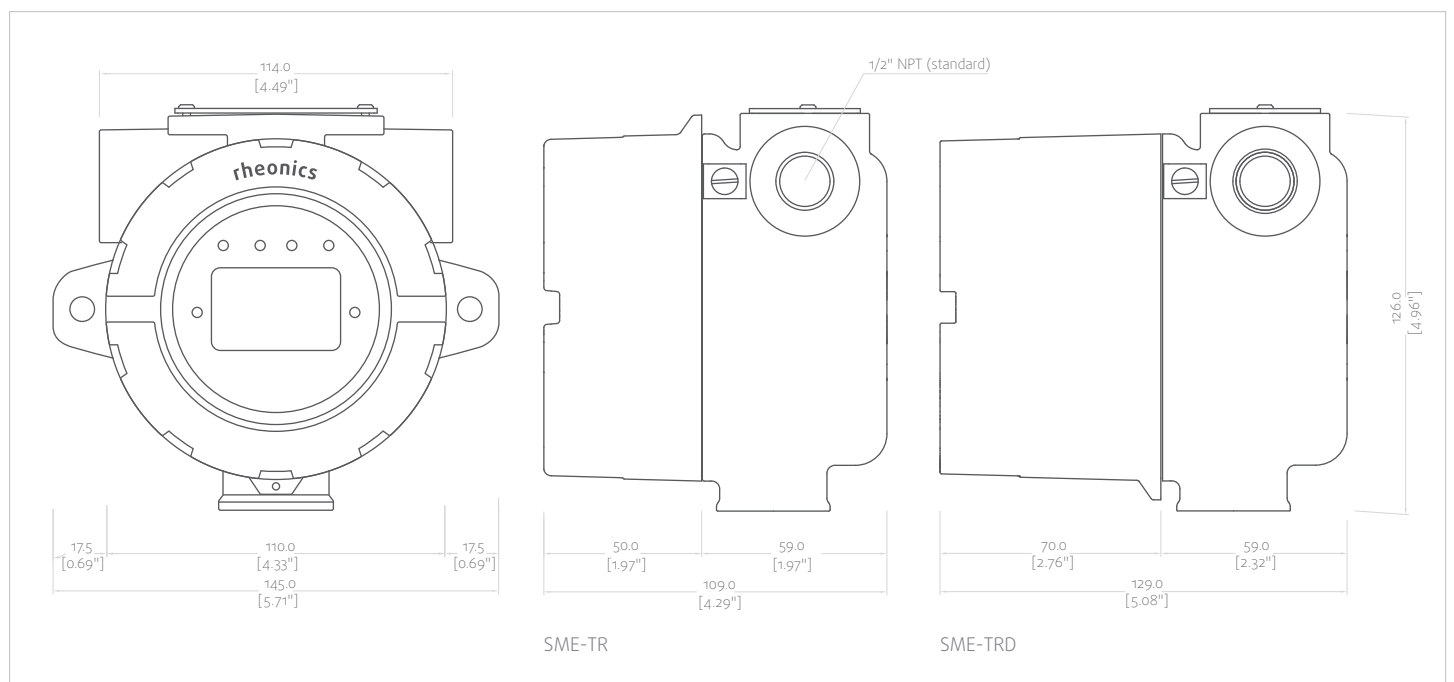
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Electronics installation



Industrial high-contrast LCD
Bluetooth LE 4.0
Status LED

Dimensions



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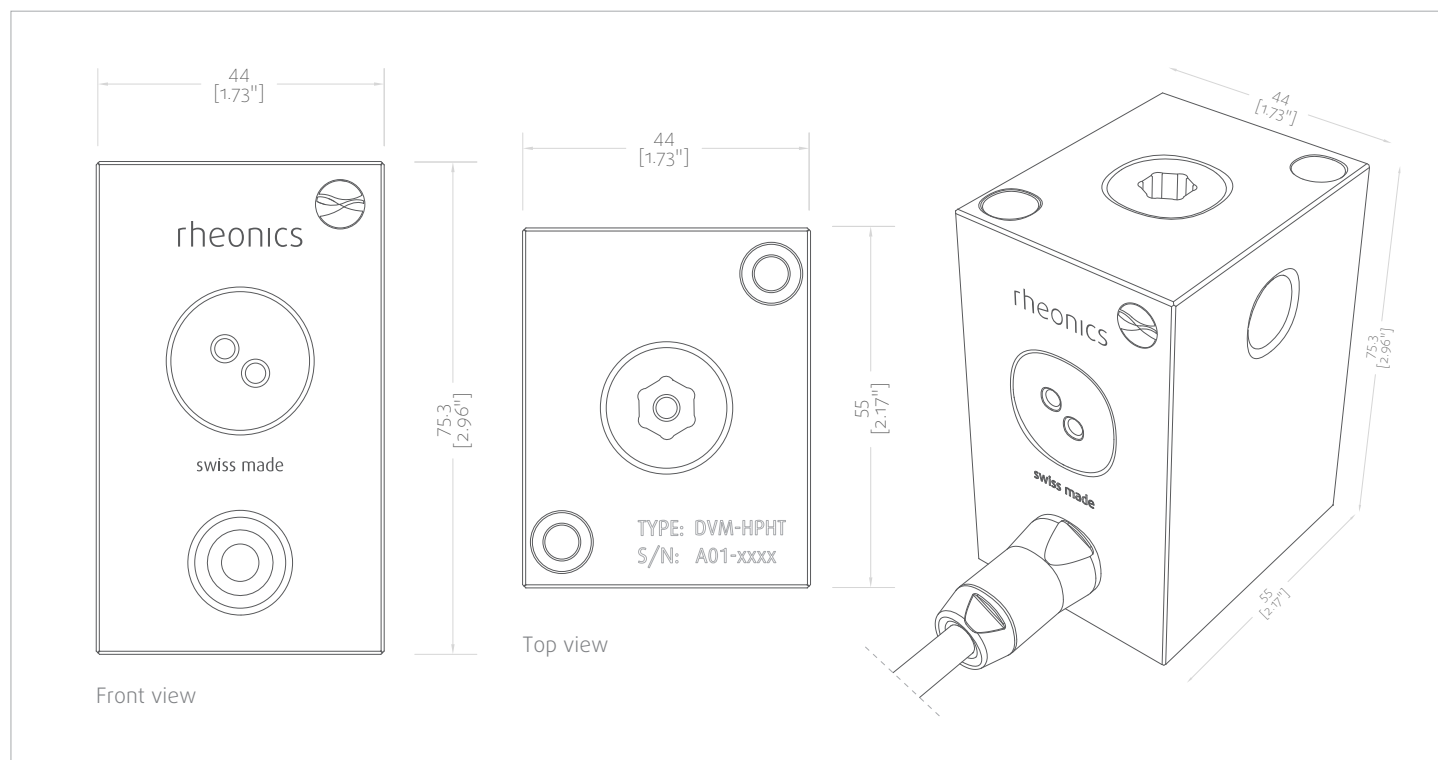
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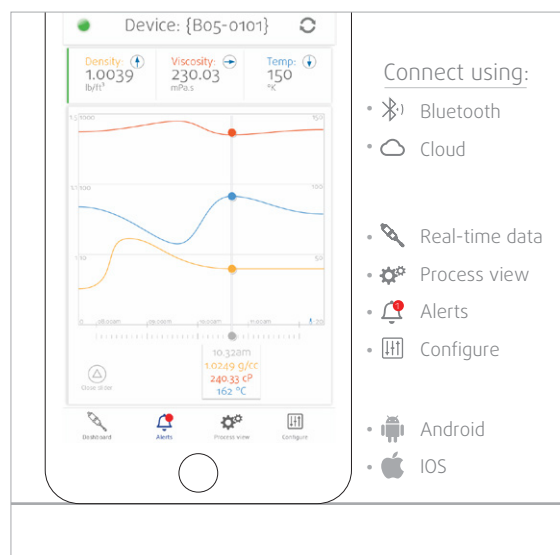


DVP dimensions

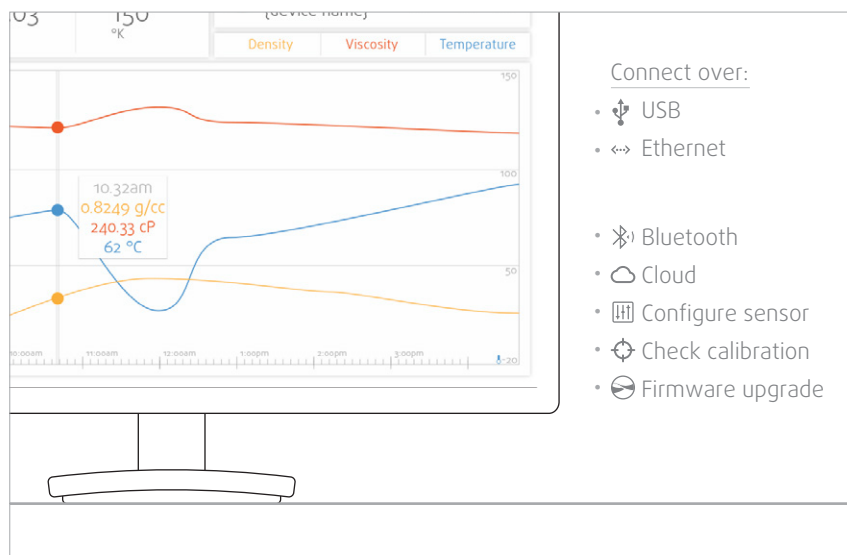


Software

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PC Data Acquisition & Analysis



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Ordering

Ordering code example

| DVM | V1 | STD | D1 | DCAL1 | E1 | C1,C2 | T1 | P1 | X1 |
|-----|-----------------|----------------|---------------|----------------|-------------|---------------|-------------|----------|--------------------|
| | Viscosity range | V. Calibration | Density range | D. Calibration | Electronics | Communication | Temperature | Pressure | Process Connection |

| Order code | Name | Short description |
|------------------------------------|--|--|
| Viscosity range (select all) | | |
| V1 | 0.2 - 300 cP | Standard calibrated range |
| V2 | custom | Customer specified calibration range (0.02 to 500 cP) |
| Viscosity Calibration (select all) | | |
| STD | Standard calibration | |
| CUS | Customer specific calibrations - specify viscosity range, accuracy required and operational conditions | |
| Density range (select all) | | |
| D1 | 0 - 1.5 g/cc | Standard range |
| D2 | custom | Customer specified range (max. 3 g/cc) |
| Density Calibration (select all) | | |
| DCAL1 | 0.001 g/cc | Standard calibration accuracy |
| DCAL2 | 0.0001 g/cc or better | Customer specific calibrations - specify density range, accuracy required and operational conditions |
| Electronics (select one) | | |
| E1 | SME-TRD | Explosion proof transmitter housing with display |
| E2 | SME-TR | Explosion proof transmitter housing with solid cover |
| E3 | SME-DRM | 35mm DIN rail mount housing |
| Communication (select all) | | |
| C1 | 4-20 mA | 3 channels of 4-20 mA analog signal |
| C2 | Modbus RTU (RS-485) | Modbus RTU over RS-485 |
| C3 | USB | USB 2.0 compliant service and data acquisition port |
| C4 | Ethernet | Ethernet TCP/IP with RJ45 connector |
| C5 | Bluetooth LE 4.0 | Bluetooth module for short range communication, only available with display module |
| Temperature (select one) | | |
| T1 | 125 °C | Sensor rated for operation in process fluids up to 125 °C (250 °F) |
| T2 | 150 °C | Sensor rated for operation in process fluids up to 150 °C (300 °F) |
| T3 | 175 °C | Sensor rated for operation in process fluids up to 200 °C (400 °F) |
| T4 | 200 °C | Sensor rated for operation in process fluids above 200 °C (400 °F) |
| Pressure (select one) | | |
| P1 | 700bar (10,000 psi) | Sensor rated for process fluids pressure up to 700bar (10,000 psi) |
| P2 | 1000bar (15,000 psi) | Sensor rated for process fluids pressure up to 1000bar (15,000 psi) |
| P3 | 1400bar (20,000 psi) | Sensor rated for process fluids pressure up to 1400bar (20,000 psi) |
| P4 | 2100bar (30,000 psi) | Sensor rated for process fluids pressure up to 2100bar (30,000 psi) |
| Process Connection (select one) | | |
| X1 | 1/4" HP (9/16-18 UNF) | Standard |
| X2 | custom | Custom fluid connection |

| | | |
|------------------------------|-------------------|---|
| Accessories | | |
| Torque wrench | 20 N.m adjustable | Torque wrench to tighten the sensing element with correct torque (20 N.m) |
| Cable gland | 1/2" NPT | 1/2"NPT Standard and explosion-proof cable glands |
| Transmitter mounting bracket | | Mounting bracket for SME-TR and SME-TRD transmitter housings |


Contact Information

rheonics GmbH

Technoparkstr. 2
8406 Winterthur
Switzerland
+41 52 511 32 00

rheonics Inc.

3 Sugar Creek Center Blvd, Ste 100
Sugar Land, TX 77478
United States of America
+1 713 364 5427

www.rheonics.com
info@rheonics.com
 rheonics



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†subject to change without notice

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