VAISALA / TECHNOLOGY DESCRIPTION

Vaisala HUMICAP® Sensor for Measuring Moisture in Oil

Water is a common contaminant in industrial oils. Water contamination deteriorates the performance of the oil, be it used for lubrication, cooling, insulation or other purposes. High moisture content increases the risk of corrosion, overheating, machine malfunction and other problems and can ultimately lead to costly failure and unscheduled downtime. Monitoring the oil for moisture is a simple way of improving the reliability of industrial machinery and equipment. With time, substantial savings in maintenance costs can be achieved.

Free Water Formation – the Critical Point

Water can dissolve in oil. When the water content of the oil increases, it eventually reaches the saturation point of the oil. Once the fluid has reached its saturation point, any additional water introduced will separate out as free water by forming a distinct layer. Alternatively, the oil can form dispersion with water, which turns the oil cloudy. Since most oils are less dense than water, the water layer will usually settle below the oil with time.

Free water formation is critical in terms of problems related to water in oil. When water is no longer dissolved in the oil, corrosion and wearing of equipment increase rapidly. Therefore it is important to keep the moisture content safely below the saturation point.

The ability of oil to hold dissolved water depends on the type and age of the oil as well as its additives. Two major factors have an effect on the saturation point as the oil ages: temperature fluctuations and changes in the chemical make-up due to the formation of new substances as by-products of the chemical reactions.

Water Activity (a_w) – a Direct Measure of Oil Quality

The conventional measure for water content in oil is ppm (parts per million), which describes the absolute amount of water in the oil. Ppm measurement has, however, a major limitation. It does not account for any variations in the oil's saturation point. In other words, ppm measurement provides no indication of how close the moisture level is to the saturation point in a dynamic system with fluctuating saturation point. By measuring water activity instead of ppm, the risk of actually exceeding the saturation point can be avoided.

Unique Benefits of HUMICAP in Oil Moisture Measurements

- Fast. Online, real-time detection of moisture in oil without sampling
- Reliable. Tells the true margin to water saturation point in all changing conditions, taking into account e.g. temperature changes and aging of oil
- Highly stable. Excellent pressure and temperature tolerance
- Easy to install through ball valve – no need to shut down the process
- Enables predictive maintenance work. Trends can be quickly identified.

Water activity measurement indicates directly whether there is a risk of free water formation. With a relative scale from 0 (no water present) to 1 (the oil is saturated with water) it gives a reliable indication of how close the saturation point of water is.

In contrast to traditional measurement techniques, water activity measurement is independent of oil type. Regardless of the saturation point of the fluid, water activity measurement always provides a true indication for the risk of free water formation, even when the saturation point is increasing or decreasing. In its simplicity, water activity value is understandable at a glance. Trends can be quickly identified.

Vaisala HUMICAP® for Measuring Water Activity

The Vaisala transmitters used for measuring moisture in oil feature the HUMICAP® sensor, a capacitive thin-film polymer sensor especially developed for demanding moisture measurements in liquid hydrocarbons.

The HUMICAP sensor consists of four functional layers: glass substrate, lower electrode, water-active polymer layer, and porous upper electrode. The thin-film polymer either absorbs or releases water as the surrounding moisture level changes. Water molecules move to/from the polymer layer until there is moisture equilibrium between the polymer and the oil. The dielectric properties of the polymer depend on the moisture level. As the moisture level changes, the dielectric properties of the polymer film change, and so does the capacitance of the sensor. The instrument's electronics measure the capacitance of the sensor and convert it into water activity.

Oil molecules or additives do not penetrate the electrode. Thus the sensor output is independent of the oil type.

On-line Measurement

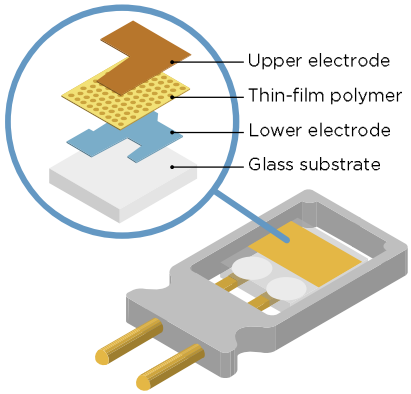
On-line water activity measurement ensures reliable performance of equipment at all times. Time-consuming sampling and laboratory analysis are no longer needed. This not only reduces the risk of human induced error but also provides cost savings in equipment and chemicals.

Typical Applications for Moisture in Oil Measurement

Moisture is an important factor determining the condition of both lubricating and transformer oils. With on-line information on the quality of the oil, preventive actions can be taken and the maintenance costs cut substantially.

HUMICAP in Brief

- A capacitive thin-film polymer sensor
- Water activity (a_w) measurement within range 0...1
- Accurate to +/- 0.02 (a_w)
- 15 years of experience in measuring moisture in oil



Structure of the HUMICAP sensor.

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For more information, visit www.vaisala.com or contact us at sales@vaisala.com

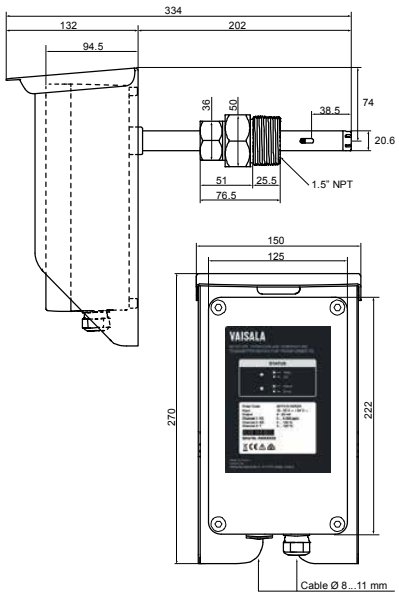
Vaisala Moisture, Hydrogen and Temperature Transmitter MHT410 for Online Transformer Condition Monitoring

The Vaisala MHT410 Moisture, Hydrogen and Temperature Transmitter provides reliable online monitoring of insulating oil in power transformers. With its unique probe design, the MHT410 delivers accurate measurement and trend data about the health of the transformer in real time.

- Information on transformer fault situations
- Enables timely, proactive maintenance decisions to minimize expensive service shutdowns and outages

Dimensions

Dimensions in mm



Features/Benefits

- Online monitoring of insulating oil transformer
- Measures directly from oil without a need of pumps, membranes etc.
- Moisture and hydrogen sensors are in direct contact with representative oil in the transformer
- Monitors health of the transformer in real time
- Information on transformer fault situations
- Unique probe design, robust and easy to install
- Compact size
- 5 year standard warranty
- Isolated inputs and outputs, EMC tolerant device with IP66 metal housing
- Adjustable probe installation depth fits in a variety of transformers

Technical Data

Measurement Performance

HYDROGEN MEASUREMENT	
Measurement range (in oil)	0 ...5000 ppm
Accuracy (in oil temp. range -20 ...+60 °C) (-4 ...+140 °F)"	±20% of reading or ±25 ppm(whichever is greater)
Repeatability	±10 % of reading or ±15 ppm (whichever is greater)
Min. detection limit	20 ppm
Typical long-term stability	3 % of reading / year
Cross sensitivity to other gases	< 2 % (CO_2, C_2H_2, C_2H_4, CO)
Response time	63%: 2.5 hours (when sensor is not in reference cycle), 90%: 17 hours
Warm-up time	2 hours, 12 hours for full specification
Sensor	Catalytic palladium-nickel alloy film solid-state sensor
MOISTURE IN OIL MEASUREMENT	
Measurement range (in oil)	0 ...100 %RS / a_w 0 ...1
Accuracy (in oil temp. range 0 ...+60 °C) (+32 ...+140 °F) (including non-linearity, hysteresis and repeatability)	
0 ...90 %RS (a_w 0 ...0.9)	±2 %RS (a_w ±0.02)
90 ...100 %RS (a_w 0.9 ...1.0)	±3 %RS (a_w ±0.03)
Sensor response time (90%, at +20 °C (+68 °F) in still oil)	10 min
Sensor	HUMICAP® 180L2
TEMPERATURE MEASUREMENT	
Measurement range	-40 ...+120 °C (-40 ...+248 °F)
Accuracy at +20 °C (+68 °F)	± 0.2 °C (0.36 °F)
Sensor	Pt1000 RTD Class F0.1 IEC 60751

Technical Data

Operating Environment

Oil type	Mineral oil
Operating humidity range	0 ... 100 %RH, condensing
Operating temperature range (electronics)	-40 ... +60 °C (-40 ... 140 °F)
Storage temperature range	-40 ... +60 °C (-40 ... 140 °F)
Pressure tolerance (probe, short-term)	Vacuum ... 10 bara
Pressure tolerance (probe, continuous)	Max. 4 bara
Integrated protection for short power outages	> 3 seconds
Electromagnetic compatibility:	
Complies with EMC standard EN61326-1, Industrial environment	
Complies with CISPR22 class B emission limits when DC powered	
Fulfills the requirements of IEC 61000-6-5 in the following tests:	
IEC 61000-4-2	IEC 61000-4-8
IEC 61000-4-3	IEC 61000-4-11
IEC 61000-4-4	IEC 61000-4-12
IEC 61000-4-5	IEC 61000-4-16
IEC 61000-4-6	IEC 61000-4-17

Connections and Outputs

Operating voltage*	15 ... 30 VDC, 24 VAC (±15%) (power supply input is galvanically isolated)
Power consumption	4 W, typical 12 W max.
Analog output (current)*	Three isolated 4 ... 20 mA, loop powering required
External load	Max. 500 Ohm
Error status indication in case of device error	3.5 mA default, user configurable for each channel
Accuracy of analog outputs at +20 °C	± 0.125 % full scale
Temperature dependence of the analog outputs	± 0.006 %/ °C full scale
Digital outputs*	Isolated RS-485 half-duplex, RS-485 (Service Port, non-isolated)
Protocols	MODBUS RTU, serial ASCII commands
Screw terminals	Wire size AWG 22-14
	Single wire (solid) 1.5 mm^2
	Stranded wire (flex.) 1.0 mm^2
	Recommended wire torque 0.4 Nm

*Max. isolation voltage 1.5 kV DC

Mechanics

Mechanical connection on transmitter	1.5" NPT (male)
Cable bushing (optional)	M20x1.5 for cable diameter 8 ... 11mm/0.31 ... 0.43"
Conduit fitting (optional)	1/2" NPT
Interface cable (optional, pre-assembled)	5 meters, 9.2 mm outer diameter
Housing material	AlSi 10 Mg
Housing classification	IP66
Transmitter weight without cables	4.1 kg

Other

Self-diagnostics indication	Status LEDs, analog output, MODBUS
Integrated data logging capabilities	Non-volatile memory up to 44 years storage with default logging
Individual functional test reports	Calibration test reports for moisture, hydrogen and temperature Probe leak test report (20 bara)
Factory warranty	5 years

Display with Relays (External Option 242003)

Pre-configured range for hydrogen	0...5000 ppm
Pre-configured alarm relays (user re-configurable)	Relay 1 trigger limit 200 ppm (hi) Relay 2 trigger limit 1500 ppm (hihi)
Input	4...20 mA, loop-powered
Accuracy	0.05 % of span (-10...+60 °C)
Relays	2 x solid state (SSR) max. 250 VAC, 150 mA
Display	4-digit red LED, 14.5 mm
Dimensions	100 x 100 x 57 mm (WHD)
Case Protection	IP65
Case material and color	ABS-plastic, grey
Cable glands	2 x M16x1.5

Spare Parts and Accessories

USB cable for PC connection	219690
External din rail power 100 ... 240 Vac to 24 Vdc	242422
5 meter shielded PUR cable	CBL210392-5MSP
10 meter shielded PUR cable	CBL210392-10MSP
Cable gland	214728SP
Detachable screw terminal block	236620SP
Loop-powered external display, Nokeval 302 (with alarm relays)	242003
MI70 connection cable	219980
Conduit fitting	214780SP
1.5" NPT ball valve with welding fitting	BALLVALVE-3SET

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Vaisala takes pride in professional and comprehensive specifications that are based on scientific test methods and known standards. The accuracy specification takes into account repeatability, non-linearity, and hysteresis, and is given for the full measurement range, unless otherwise stated. This means our customers get truly reliable information with no gaps, helping them make the right decisions.

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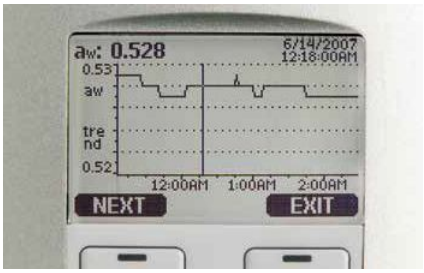
MMT330 Moisture and Temperature Transmitter Series for Oil

The MMT330 transmitter family offers reliable performance for the demanding measurement of moisture in oil.



The display shows measurement trends, real-time data, and measurement history.

Features/Benefits

- Continuous online measurement of moisture in oil
- Ball-valve installation – no need to shut down the process or drain the oil
- Proven Vaisala HUMICAP® sensor, used for over 15 years in oil applications
- Easy field calibration and maintenance – compatible with Vaisala HUMICAP® Hand-Held Moisture Meter for Oil MM70
- NIST traceable calibration (certificate included)
- Analog outputs, RS232/485, WLAN/LAN
- MODBUS protocol support (RTU/TCP)
- Approved for installation in MAN Diesel & Turbo Two-Stroke Diesel Engines lubrication systems

The Vaisala HUMICAP® Moisture and Temperature Transmitter Series for Oil MMT330 enables the fast and reliable detection of moisture in oil. MMT330 series transmitters can be used in online moisture monitoring and as control devices, allowing separators and oil driers to be started only when needed.

Proper monitoring saves both oil and the environment. With the MMT330 series it is easy and economical to monitor the changes of moisture in oil.

Reliable Vaisala HUMICAP® Technology

The MMT330 series incorporates the latest-generation Vaisala HUMICAP® sensor, which is the result of over 15 years of field experience. It was developed for demanding moisture measurement in liquid hydrocarbons.

The sensor's excellent chemical tolerance provides accurate and reliable measurement over a wide measurement range.

For Diverse Applications and Demanding Conditions

With a wide variety of probes, the transmitter can be used in lubrication systems, hydraulic systems, and transformers.

Indicates the Margin to Water Saturation

The MMT330 measures moisture in oil in terms of the water activity (aw) and temperature (T). Water activity indicates directly whether there is a risk of free-water formation. The measurement is independent of oil type and age.

Water Content as ppm Conversion

In addition to water activity, the MMT330 can output ppm, the average mass concentration of water in oil. Vaisala has this conversion readily available for mineral transformer oil.

For other oils, the oil-specific conversion coefficients can be programmed into the transmitter if the water solubility of the oil is known.

Graphical Display of Measurement Data and Trends for Convenient Operation

The MMT330 features a large numerical and graphical display with a multilingual menu and keypad. It allows users to easily monitor operational data, measurement trends, and access measurement history for the past 12 months.

The optional data logger, with real-time clock, makes it possible to generate over four years of measurement history and zoom in on any desired time or time frame.

The display alarm allows any measured parameter to be tracked, with freely configurable low and high limits.

Versatile Outputs and Data Collection

The MMT330 can support up to three analog outputs; an isolated galvanic power supply and relay outputs are also available.

For serial interface the USB connection, RS232, and RS485 can be used.

MMT330 is also capable of applying the MODBUS communication protocol and, together with an appropriate connection option, provides either MODBUS RTU (RS485) or MODBUS TCP/IP (Ethernet) communication.

The data logger, with real-time clock and battery backup, guarantees reliable logging of measurement data for over four years. The recorded data can be viewed on the local display or transferred to a PC with Microsoft Windows® software. The transmitter can also be connected to a network with an optional (W)LAN interface, which enables a (wireless) Ethernet connection. A USB service cable makes it easy to connect the MMT330 to a PC via the service port.

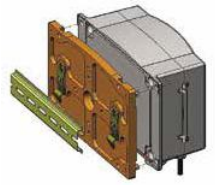
The Vaisala HUMICAP® Hand-Held Moisture for Oil Meter MM70 is designed for field-checking MMT330 transmitters.

Easy Installation

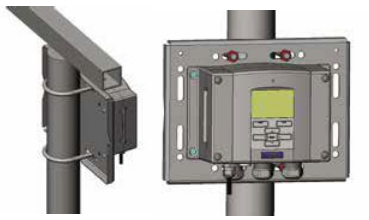
MMT330 transmitters have several options for transmitter mounting. They are delivered installation-ready, pre-configured with all settings.

Mounting Options

Mounting with Wall Mounting Kit



Mounting with DIN Rail Installation Kit



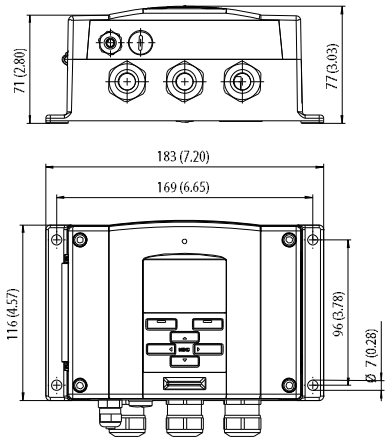
Pole Installation with Installation Kit for Pole or Pipeline

Mounting Rain Shield with Installation Kit

HUMICAP® is a registered trademark of Vaisala.

Dimensions

Dimensions in mm (inches)



TYPE APPROVED PRODUCT
CERTIFICATE NO.: A-13529

The MMT332 probe is installed using a flange. It is designed for high-pressure applications.

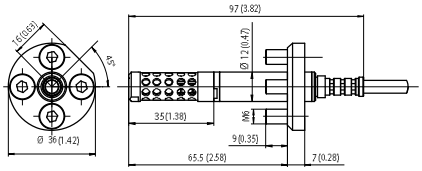
Installation Options

MMT332 for High Pressure Installations

Pressure range	0 ... 250 bar / 0 ... 3625 psia
Probe diameter	12 mm / 0.5"
Installation	
Flange	36 mm / 1.4"
Temperature	
Measurement range	-40 ... +180 °C (-40 ... 356 °F)

Dimensions

Dimensions in mm (inches)



The MMT337 probe, with optional Swagelok® connector, is ideal for tight spaces with a thread connection. The small probe is designed for integration into small diameter lines.

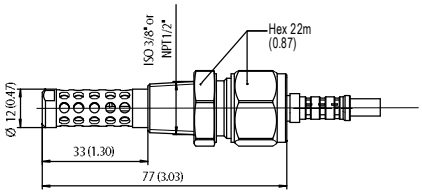
Installation Options

MMT337 with Small-Sized Probe

Pressure range	0 ... 10 bar / 0 ... 145 psia
Probe diameter	12 mm / 0.5"
Installation	
Fitting body	R 3/8" ISO
Fitting body	1/2" ISO
Fitting body	NPT 1/2"
Temperature	
Measurement range	-40 ... +180 °C (-40 ... 356 °F)

Dimensions

Dimensions in mm (inches)



The MMT338 is ideal for installation into pressurized processes where the probe needs to be able to be removed while the process is running. The probe depth is adjustable.

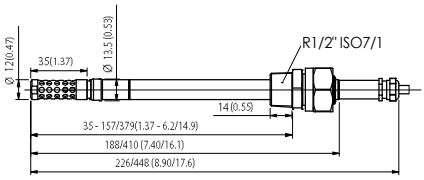
Installation Options

MMT338 with Probe for Pipeline Installations

Pressure range with ball-valve	
	0 ... 40 bar / 0 ... 580 psia
	up to 120 °C (248 °F) and 40 bar
Adjustable length	35 ... 157/379 mm / 1.37 ... 6.2 /14.9"
Installation	
Fitting body	R1/2" ISO
Fitting body	NPT 1/2"
Ball-valve set	BALLVALVE-1
Sampling cell	DMT242SC2
Temperature	
Measurement range	-40 ... +180 °C (-40 ... 356 °F)

Dimensions

Dimensions in mm (inches)



Technical Data

Measured Values

WATER ACTIVITY

Measurement range a_w	0 ... 1
Accuracy (including non-linearity, hysteresis and repeatability)	
0 ... 0.9	±0.02
0.9 ... 1.0	±0.03
Response time (90%) at +20 °C in still oil (with stainless steel filter)	10 min.
Sensor	HUMICAP® 180$_L$2

Performance

TEMPERATURE

Measurement range	
MMT332	-40 ... +180 °C (-40 ... +356 °F)
MMT337	-40 ... +180 °C (-40 ... +356 °F)
MMT338	-40 ... +180 °C (-40 ... +356 °F)
Accuracy at +20 °C (+68 °F)	± 0.2 °C (0.36 °F)

Operating Environment

Operating temperature	
for probes	same as measurement ranges
for transmitter body	-40 ... +60 °C (-40 ... +140 °F)
with display	0 ... +60 °C (+32 ... +140 °F)
Pressure range for probes	see probe specifications
Electromagnetic compatibility	Complies with EMC standard EN61326-1, Industrial environment Note: Transmitter with display test impedance of 40 ohm is used in IEC61000-4-5 (Surge immunity)

Inputs and Outputs

Operating voltage	10 ... 35 VDC, 24 VAC ± 20%
with optional power supply module	100 ... 240 VAC 50/60 Hz
Power consumption @ 20 °C (U_{in} 24VDC)	
RS232	max. 25 mA
U_{out} 2 x 0...1V / 0...5V / 0...10V	max. 25 mA
I_{out} 2 x 0...20 mA	max. 60 mA
display and backlight	+ 20 mA
Analog outputs (2 standard, 3rd optional)	
current output	0 ... 20 mA, 4 ... 20 mA
voltage output	0 ... 1 V, 0 ... 5 V, 0 ... 10 V
Accuracy of analog outputs at 20 °C	± 0.05% full scale
Temperature dependence of the analog outputs	± 0.005%/°C full scale
External loads	
current outputs	R_L < 500 ohm
0 ... 1V output	R_L > 2 kohm
0 ... 5V and 0 ... 10V outputs	R_L > 10 kohm
Max. wire size	0.5 mm^2 (AWG 20) stranded wires recommended
Digital outputs	RS232, RS485 (optional)
Protocols	ASCII commands, MODBUS RTU
Service connection	RS232, USB
Relay outputs	0.5 A, 250 VAC, SPDT, potential-free (optional)
Ethernet interface (optional)	
Supported standards	10BASE-T, 100BASE-TX
Connector	8P8C (RJ45)
IPv4 address assignment	DHCP (automatic), static
Protocols	Telnet, MODBUS TCP/IP
WLAN interface (optional)	
Supported standards	802.11b
Antenna connector type	RP-SMA
IPv4 address assignment	DHCP (automatic), static
Protocols	Telnet, MODBUS TCP/IP
Security	WEP 64/128, WPA
Authentication / Encryption	
Open / no encryption	
Open / WEP	
WPA Pre-shared key / TKIP	
WPA Pre-shared key / CCMP (a.k.a. WPA2)	
Optional data logger with real-time clock	
Logged parameters	max. four with trend/min/max values
Logging interval	10 sec. (fixed)
Max. logging period	4 years, 5 months
Logged points	13.7 million points per parameter
Battery lifetime	min. 5 years
Display	LCD with backlight, graphical trend display of any parameter
Menu languages	English, Chinese, Finnish, French, German, Japanese, Russian, Spanish, Swedish

Mechanics

Cable bushing	M20x1.5 for cable diameter 8 ... 11mm/0.31 ... 0.43"
Conduit fitting	1/2" NPT
Interface cable connector (optional)	M12 series 8-pin (male)
option 1	female plug with 5 m (16.4 ft.) black cable
option 2	female plug with screw terminals
USB-RJ45 Serial Connection Cable (incl. Mi70 Link software)	219685
Probe cable diameter	5.5 mm
Standard probe cable lengths	2 m, 5 m or 10 m (Additional cable lengths available, please see order forms for details)
Housing material	G-AlSi 10 Mg (DIN 1725)
Housing classification	IP 66 IP65 (NEMA4X) with local display
Weight	
depending on selected probe, cable and modules	1.0 - 3.0 kgs
Sensor protection	Stainless steel grid standard filter/ Stainless steel grid filter for high flow rates (>1 m/s)

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MMT310 Series Moisture and Temperature Transmitters for Oil

Two probe options: MMT318 and MMT317. Optional rain shield is also available.

Features/Benefits

- Continuous measurement of moisture in oil
- Proven Vaisala HUMICAP® sensor, over 15 years in oil applications
- Measurements in lubrication, hydraulic and transformer oils
- Excellent pressure and temperature tolerance
- Measuring water activity - ppm calculation for transformer oil
- Small size, easy to integrate
- NIST traceable calibration (certificate included)
- Applications: e.g. monitoring of transformer oil and of lubrication systems in marine and paper industry

The Vaisala HUMICAP® Moisture and Temperature Transmitter Series for Oil MMT310 is a fast and reliable on-line detector for moisture in oil.

Reliable Vaisala HUMICAP® Technology

The MMT310 series incorporates the latest generation of the Vaisala HUMICAP® sensor, developed for demanding moisture measurement in liquid hydrocarbons. The sensor's excellent chemical tolerance provides accurate and reliable measurement over the wide measurement range.

Measuring Water Activity

The MMT310 measures moisture in oil in terms of the water activity (a_w) and temperature (T). Water activity indicates directly whether there is a risk of free-water formation. The measurement is independent of oil type, age, and temperature.

Water Content as PPM Calculation for Transformer Oils

PPM units are traditionally used in transformer applications. They indicate the average mass concentration of water in oil. The ppm calculation for mineral oil based transformer oil is optional in the MMT310 series.

Diverse Applications and Demanding Conditions

The MMT310 can be used in lubrication and hydraulic systems as well as in transformers. It can be used for on-line moisture monitoring and as a control function, allowing separators and oil purifiers to be started only when necessary.

Installation Options

The MMT318 has two adjustable probe lengths. The transmitter can be ordered with a ball-valve set that enables the insertion and removal of the moisture probe for calibration, without the need to empty the oil system.

The MMT317 has a small pressure-tight probe with optional Swagelok fittings.

An optional rain shield is available for outdoor installations.

Several Outputs, One Connector

The MMT310 series has two analog outputs and an RS232 serial output. The output signals and the supply power travel in the same cable, the only cable connected to the unit.

Technical Data

Measured Values

WATER ACTIVITY	
Measurement range a_w	0 ... 1
Accuracy (including non-linearity, hysteresis, and repeatability)	
0 ... 0.9	±0.02
0.9 ... 1.0	±0.03
Response time (90 %) at +20 °C in still oil (with stainless steel filter)	10 min.
Sensor	Vaisala HUMICAP® 180L2
TEMPERATURE	
Measurement range	-40 ... +180 °C (-40 ... +356 °F)
Typical accuracy at +20 °C (68 °F)	±0.2 °C (±0.36 °F)
Sensor	Pt100 RTD Class F0.1 IEC 60751

Electrical Connections

Two analog outputs, selectable and scalable	0 ... 20 mA or 4 ... 20 mA 0 … 5 V or 0 … 10 V 1 … 5 V available through scaling
Typical accuracy of analog output at +20 °C	±0.05 % full scale
Typical temperature dependence of analog output	0.005 %/°C (0.003 %/°F) full scale
Serial output	RS232C
Connections	8-pole connector with RS232C, current/voltage outputs (two channels) and U_{in}
Operating voltage	10 ... 35 VDC
Minimum operating voltage	
RS232C output	10 VDC
Analog output	15 VDC
Pressures above 10 bara (145 psia)	24 VDC
Power consumption	
RS232C	12 mA
U_{out} 10 V (10 kOhm) channel 1 & channel 2	12 mA
I_{out} 20 mA (load 511 Ohm) channel 1 & channel 2	50 mA
External load	R_L < 500 Ohm
Startup time after power-up	3 s

Accessories

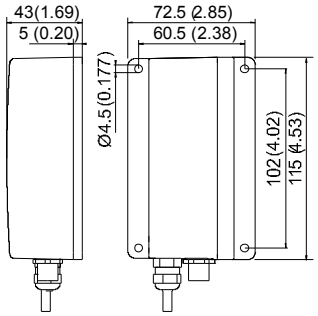
Rain shield	ASM211103
USB cable	238607
Stainless steel filter	HM47453SP
Stainless steel filter (high flow rate)	220752SP

General

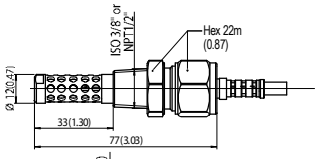
Operating temperature range for electronics	-40 ... +60 °C (-40 ... +140 °F)
Storage temperature	-55 ... +80 °C (-67 ... +176 °F)
Pressure range for MMT318 with ball-valve up to 120 °C	0 ... 40 bar
Pressure range for MMT317	0 ... 10 bar
Material	
transmitter housing	G-AlSi 10 Mg
transmitter base	PPS
Housing classification	IP66
Cable feed through alternatives	8-pole connector with 5 m cable, female 8-pin connector screw joint for cable diameter 4 ... 8 mm
Sensor protection	stainless steel grid standard filter stainless steel grid filter for high flow rates (>1 m/s)
Probe cable length	
MMT317	2 m, 5 m, or 10 m
MMT318	2 m, 5 m, or 10 m
Weight (depending on selected probe and cable)	
example: MMT317 with 2 m cable	476 g
Probe installation MMT317	
Swagelok®	NPT 1/2", ISO 3/8" or ISO 1/2"
Probe installation MMT318	
Fitting bodies	ISO 1/2", NPT 1/2"
Ball-Valve Set	BALLVALVE-1
Complies with EMC standard EN61326-1, Industrial environment	

Dimensions

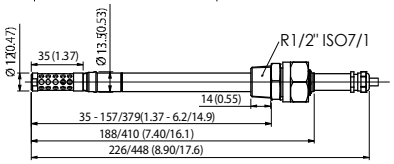
Dimensions in mm (inches)



Transmitter body



MMT317 probe



MMT318 probe

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MMT162 Compact Moisture in Oil and Temperature Transmitter for OEM Applications

The MMT162 enables on-line moisture monitoring in oils even in the most demanding applications.

Features/Benefits

- Continuous measurement of moisture in oil
- Measures in lubrication, hydraulic and transformer oils
- Excellent pressure and temperature tolerance
- Proven Vaisala HUMICAP® Sensor, 15 years in oil applications
- Measures water activity - ppm-calculation available for transformer oil
- Small size, easy to integrate
- Digital output RS-485 with MODBUS
- NIST traceable calibration (certificate included)

The Vaisala HUMICAP® Moisture and Temperature Transmitter for Oil MMT162 is an excellent economical solution for reliable on-line detection of moisture in oil.

Reliable Vaisala HUMICAP® Technology

The MMT162 incorporates the latest generation of the Vaisala HUMICAP® Sensor. The sensor is developed for demanding moisture measurement in liquid hydrocarbons and has been successfully used in oil applications for over a decade. The sensor's excellent chemical tolerance provides accurate and reliable measurement over the measurement range.

Water Activity Measurement

The MMT162 measures moisture in oil in terms of the water activity (aw) and temperature (T). Water activity directly indicates whether there is a risk of free water formation. The measurement is independent of oil type, age and temperature. The ppm calculation for mineral oil based transformer oil is optional in the MMT162.

Several Outputs - One Connector

The MMT162 has two analog outputs that can be scaled and the measurement ranges changed. Additionally, the transmitter has an RS-485 serial output. The signals and the unit power travel in the same cable.

An optional LED-cable enables a visual alarm.

Compact, Rugged and Intelligent

Due to its compact size, the MMT162 is quickly and easily installed in tight spaces. Units are delivered fully assembled, however, you can re-configure them to suit your needs.

MM70

In combination with an MM70 indicator, the MMT162 provides an ideal tool for on site calibration. The MI70 indicator can be used as a display, communication, and data-logging device for the MMT162.

Technical Data

Measured Values

WATER ACTIVITY	
Measurement range	0 ... 1 aw
Accuracy (including non-linearity, hysteresis and repeatability)	
0 ... 0.9	± 0.02
0.9 ... 1.0	± 0.03
Response time	
in oil flow (typical)	<1 min (dry-wet)
MOISTURE	
Calculated moisture content in ppm for mineral transformer oil	
TEMPERATURE	
Accuracy at +20 °C (+68 °F)	± 0.2 °C (0.36 °F)

Operating Environment

Operating temperature	-40 ... +60 °C (-40 ... +140 °F)
Oil temperature	-40 ... +80 °C (-40 ... +176 °F)
Pressure range	
metal version	up to 200 bar
plastic version	up to 40 bar
Oil flow	some flow recommended

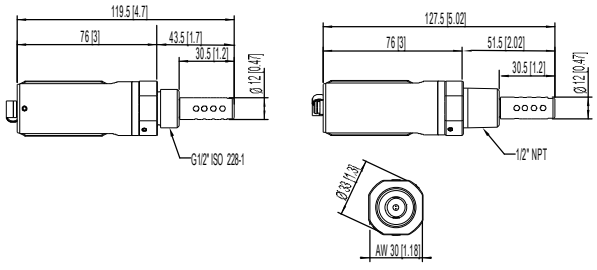
Outputs

Analog outputs (two channels)	
current output	0 ... 20 mA, 4 ... 20 mA
voltage output	0 ... 5 V, 0 ... 10 V
Alarm level indication by analog signal	user selectable
Digital outputs	RS-485, non-isolated, Vaisala protocol, MODBUS RTU protocol

Pin	I	II
1	Vsupply	Vsupply
2	Ch 1	RS-485 - / B
3	GND	GND
4	Ch 2	RS-485 + / A

Dimensions

Dimensions in mm (inches)



General

Sensor	HUMICAP®
Cable connections (2 ports)	M8, 4 pin
Minimum operating voltage with	
RS-485 output	14 ... 28 VDC
voltage output	16 ... 28 VDC
current output	22 ... 28 VDC
Supply current	
normal measurement	20 mA + load current
External load for	
voltage output	min. 10 kOhm
current output	max. 500 Ohm
Housing material	
metal	AISI 316L
plastic	PPS + 40% GF
Mechanical connections with bonded seal ring (washer)	
metal version	G 1/2" ISO or NPT 1/2''
plastic version	G 1/2'' ISO
Housing classification	IP65 (NEMA 4)
Storage temperature range	-40 ... +80 °C (-40 ... +176 °F)
Weight	
with plastic housing	65 g (2.3 oz)
with metal housing	200 g (7 oz)
Complies with EMC standard EN61326-1, Electrical equipment for measurement control and laboratory use - EMC requirements; Industrial environment	

Options and Accessories

Stainless steel filter (standard)	225356SP
Stainless steel filter for high flow (>1 m/s)	221494SP
Connection cable for MM70 hand-held meter	219980
USB serial interface cable	219690
Sealing ring set (U-seal) ISO G1/2, 3 pcs	221525SP
Sealing ring set (copper) ISO G1/2, 3 pcs	221524SP
ISO 1/2" plug	218773
NPT 1/2" plug	222507
Sampling cell	DMT242SC
Sampling cell w. Swagelok connectors	DMT242SC2
Connection cable	
2 m (6.5 ft), M8 snap-on	211598
0.32 m (1 ft) Shielded, M8 threaded	HMP50Z032
3.0 m (9.8 ft), Shielded, M8 threaded	HMP50Z300SP
5.0 m (16.4 ft), Shielded, M8 threaded	HMP50Z500SP
10 m (32.8 ft), Shielded, M8 threaded	HMP50Z1000SP
3 m, connector 90° angle	221739
5 m, connector 90° angle	221740
M8 threaded, Ch1 signal + Ch2 LED	MP300LEDCBL

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MM70 Hand-Held Moisture and Temperature Meter for Spot-Checking in Oil

The MM70 is an ideal tool for the preventive maintenance of oil-filled systems. The water activity measurement indicates the margin to free water formation, which causes severe problems in lubrication systems.

Features/Benefits

- Measurement independent of oil type, age and temperature
- In-line process checking through ball valve, no need to drain the oil
- Rugged and reliable construction
- Excellent pressure and temperature tolerance
- Data can be logged and transferred to a PC
- Proven Vaisala HUMICAP® Sensor, over 15 years in oil applications.
- Compatible with Vaisala's fixed oil moisture instruments
- No reference oil needed for recalibration
- NIST traceable calibration (certificate included)

The Vaisala HUMICAP® Hand-held Moisture Meter for Oil MM70 enables reliable detection of moisture in oil.

In-Line Process Checking Through Ball Valve

The probe can be inserted directly into the process pipe through a ball valve without draining the oil in the system.

Water Activity Measurement

The MM70 measures moisture in oil in terms of the water activity (aw) and temperature (T). Water activity directly indicates whether there is a risk of free water formation. The measurement is independent of oil type, age and temperature.

PPM Calculation Included

The MM70 has an embedded model for expressing moisture as ppm in mineral transformer oil. The customer can enter up to three other oil models into the meter's memory.

Numerical and Graphical Display

The MM70 features a multilingual, menu-based user interface and a backlit LCD display. The measurement parameters can be numerically and graphically displayed and logged into the meter's memory at the same time. An analog output option is also available.

Connection to PC

The optional MI70 Link Windows® software in combination with a USB connection cable is used to transfer logged data and real time measurement data from the MM70 to a PC.

Proven Vaisala HUMICAP® Technology

The MM70 incorporates the latest generation of the Vaisala HUMICAP® Sensor, developed for demanding moisture measurements in liquid hydrocarbons. The sensor's excellent chemical tolerance provides accurate and reliable measurement over the measurement range.

Speedy Service - Once a Year

The meter can be recalibrated by sending the probe to Vaisala Service, or customers can calibrate the instrument themselves using a standard relative humidity calibration.

Multi-Probe Operation

One or two probes can be connected simultaneously. Maintenance teams can use additional Vaisala dew point or relative humidity probes for other tasks. For example, a dew point probe is ideal for checking the moisture inside washed and dried oil tanks.

Technical Data

Performance

WATER ACTIVITY

Measurement range a_w	0 ... 1
Accuracy (including nonlinearity, hysteresis and repeatability)	
When calibrated against salt solutions (ASTM E104-85):	
0 ... 0.9	±0.02
0.9 ... 1.0	±0.03
Maximum achievable accuracy when calibrated against high-quality, certified humidity standards:	
0 ... 0.9	±0.01
0.9 ... 1.0	±0.02
Response time (90%) at +20 °C (+68 °F) in still oil (with stainless steel filter)	10 min.
Sensor	Vaisala HUMICAP® 180L2
Recommended recalibration interval	1 year

TEMPERATURE

Measurement range	-40 ... +100 °C (-40 ... +212 °F)
Typical accuracy at +20 °C	±0.2 °C (±0.36 °F)
Typical temperature dependence of electronics	±0.005 °C/°C (±0.005 °F/°F)
Sensor	Pt100 RTD Class F0.1 IEC 60751
Typical long-term stability	better than 0.01 aw / year

Operating Environment

PROBE

Operating temperature range for electronics	-40 ... +60 °C (-40 ... +140 °F)
Operating pressure range	max. 20 bar
during installation through ball valve	max. 10 bar
Oil flow range	max. 1 m/s

INDICATOR

Operating temperature range	-10 ... +40 °C (+14 ... +104 °F)
Operating humidity range	non-condensing

ELECTROMAGNETIC COMPATIBILITY

Complies with EMC standard EN61326-1, Electrical equipment for measurement, control and laboratory use - EMC requirements; Portable equipment.

Inputs and Outputs

Power supply	Rechargeable NiMH battery pack with AC-adapter or 4xAA-size alkalines, type IEC LR6
Battery operation time	
continuous use	48 h typical at +20 °C (+68 °F)
data logging use	up to a month, depending on logging interval
Menu languages	English, Chinese, Spanish, French, German, Japanese, Russian, Swedish, Finnish
Display	LCD with backlight, graphic trend display of any parameter, character height up to 16 mm
Analog output	0 ... 1 VDC
Output resolution	0.6 mV
PC interface	MI70 Link software with USB or serial port cable
Data logging capacity	2700 points
Alarm	Audible alarm function

Mechanics

PROBE

Housing classification	IP65 (NEMA 4)
Housing material	ABS/PC blend
Probe material	Stainless steel (AISI316L)
Cable length between probe and indicator	1.9 m, 10 m extension available
Weight	506 g

INDICATOR

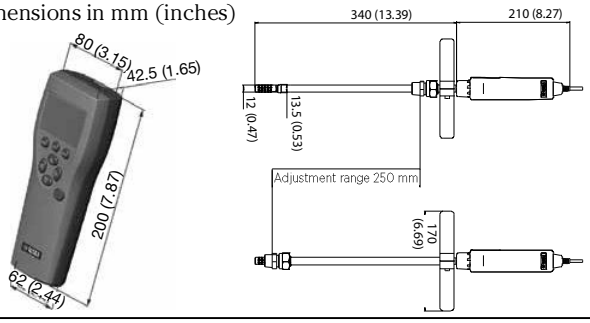
Housing classification	IP54
Weight	400 g
Probe inputs	1 or 2

Options and Accessories

Carrying case	MI70CASE2
Ball valve set (incl. fitting body & blanking plug)	HMP228BVS
Probe cable extension, 10 m	213107SP
Transmitter connection cables for	
MMT162	219980
MMT310	DRW216050
MMT330	211339
MI70 Link software with USB cable	219687
MI70 Link software with serial port cable	MI70LINK
Analog output cable	27168ZZ
Sensor protection	HM47453SP
Dew point measurement probes	DMP74A/B
Relative humidity measurement probes	HMP75, HMP76, HMP77

Dimensions

Dimensions in mm (inches)



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