M400 Multi-Parameter Transmitter Series for pH/ORP, Oxygen, Dissolved Carbon Dioxide, Conductivity and Tunable Diode Laser Analyzer

Versatile and Intelligent for advanced process control

Technical Data

ISM®

Short description

The multi-parameter M400 transmitter series features Intelligent Sensor Management (ISM®) technology and covers pH/ORP, oxygen (for measurement of dissolved oxygen or in gas), dissolved carbon dioxide, conductivity or GPro® 500 TDL depending on the type you choose.

The high contrast black and white touchscreen together with four soft keys, allows you to operate the transmitter even in the harshest applications without compromising user ergonomics. The mixed-mode input functionality accepts any analog or ISM sensor of your choice. The online diagnostic information with harmonized menu display lets you know when it is time to do maintenance or calibration of sensors equipped with ISM technology. The HART or FOUNDATION fieldbus communication protocol provides easy integration of sensor diagnostics into process control systems.

Features

– Black and white 4" touchscreen as an intuitive user interface
– Soft-key operation
– ISM diagnostics, incl. iMonitor
– Communication protocol: 4 to 20 mA (with HART or FOUNDATION fieldbus)
– Aluminum die cast enclosure (coated)
– Multi-parameter measurement
– Mixed-mode 1-channel input (analog or ISM sensors accepted)
– Four 0/4 to 20 mA current outputs, galvanically isolated
– Analog 4 to 20 mA input signal (for pressure compensation)
– Graphic trending
– Four configurable relays
– One PID process controller
– 4-wire installation
– IP 66/NEMA 4X rating
– 10 languages: English, German, French, Italian, Spanish, Portuguese, Russian, Japanese, Korean and Chinese
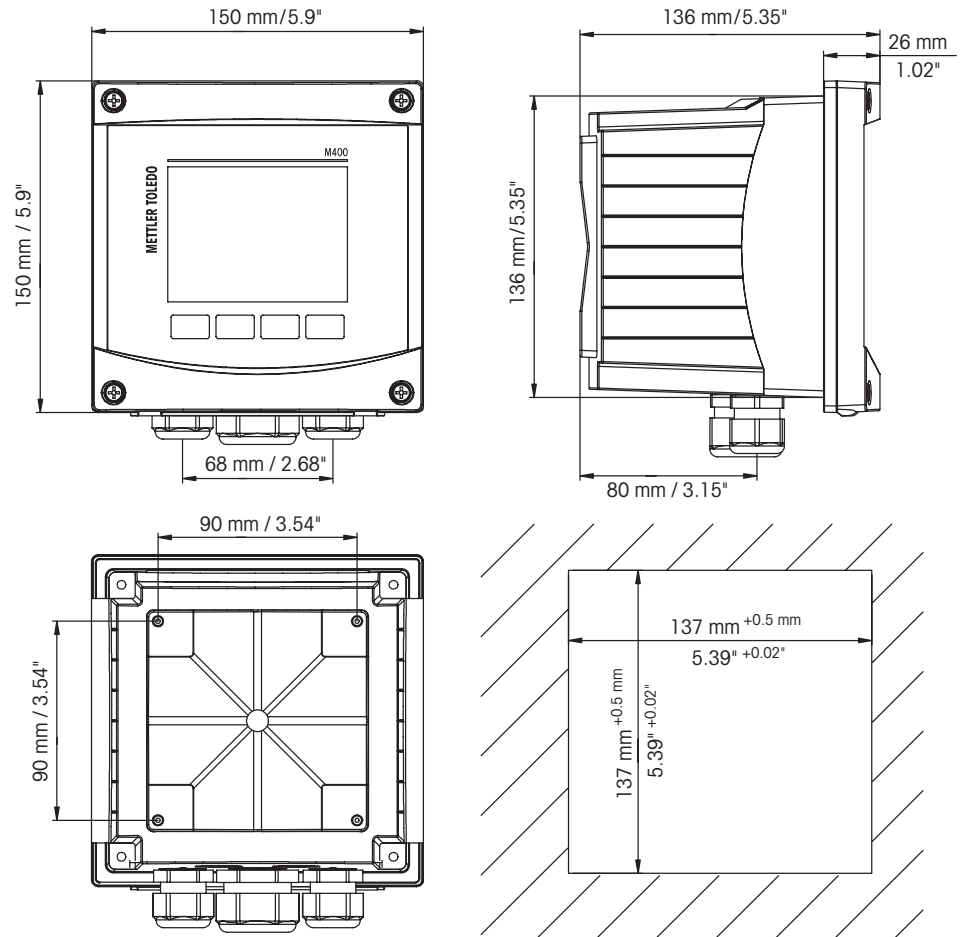
Contents

METTLER TOLEDO

½ DIN versions

The ½ DIN versions are suitable for panel, wall and pipe mounting. For accessories refer to "Accessories" on page 11 .

150 mm/5.9"

150 mm / 5.9"

M400

METTLER TOLEDO

68 mm / 2.68"

136 mm/5.35"

136 mm/5.35"

26 mm
1.02"

80 mm / 3.15"

90 mm / 3.54"

90 mm / 3.54"

137 mm $^{+0.5\ mm}$
5.39" $^{+0.02"}$

137 mm $^{+0.5\ mm}$
5.39" $^{+0.02"}$

pH / ORP (incl. pH / pNa)

Measurement parameters	pH, mV and temperature
pH display range	-2.00 to $+16.00$ pH
pH resolution	Auto / 0.001 / 0.01 / 0.1 / 1 (can be selected)
pH accuracy [1]	Analog: ± 0.02 pH
mV range	-1500 to $+1500$ mV
mV resolution	Auto / 0.001 / 0.01 / 0.1 / 1 mV (can be selected)
mV accuracy [1]	Analog: ± 1 mV
Temperature input [2]	Pt 1000 / Pt 100 / NTC 22k
Temperature measuring range	-30 to $+140\,°C$ (-22 to $+284\,°F$)
Temperature resolution	Auto / 0.001 / 0.01 / 0.1 / 1 (can be selected)
Temperature accuracy [1]	Analog: $\pm 0.25\,°C$ ($\pm 0.45\,°F$)
Temperature compensation	Automatic / Manual
Max. sensor cable length	• Analog: 10 to 20 m (33 to 65 ft) depending on sensor
	• ISM: 80 m (260 ft)
Calibration	1-point, 2-point or process

1) ISM input signal causes no additional error.
2) Not required on ISM sensors

Amperometric oxygen

Measurement parameters	Dissolved oxygen (DO): Saturation or concentration and temperature
	Oxygen in gas: Concentration and temperature
Measuring current range	Analog: 0 to -7000 nA
Oxygen display ranges	• Dissolved Oxygen Saturation: 0 to 500 % air, 0 to 200 % O_2-sat
	Concentration: 0 ppb (µg / L) to 50.00 ppm (mg / L)
	• In gas Saturation: 0 to 100 vol-% O_2
	Concentration: 0 to 9999 ppb O_2 gas
Oxygen accuracy [1]	• Dissolved Oxygen: Saturation ± 0.5 % of the measured value or ± 0.5 %, depending on which is larger.
	• Concentration at high values: ± 0.5 % of the measured value or ± 0.050 ppm / ± 0.050 mg / L, depending on which is larger.
	• Concentration at low values: ± 0.5 % of the measured value or ± 0.001 ppm / ± 0.001 mg / L, depending on which is larger
	• In gas: ± 0.5 % of the measured value or ± 5 ppb, depending on which is larger for ppm O_2 gas.
	• ± 0.5 % of the measured value or ± 0.01 %, depending on which is larger for vol-% O_2.
DO resolution	Auto / 0.001 / 0.01 / 0.1 / 1 (can be selected)
Polarization voltage	• O_2 High: Cal / Meas: -675 mV (Configurable)
	• O_2 Low: Cal: -675 mV, Meas: -500 mV (Configurable)
Temperature input	Pt 1000 / Pt 100 / NTC 22k
Temperature compensation	Automatic
Temperature measuring range	-10 to $+80\,°C$ ($+14$ to $+176\,°F$)
Temperature resolution	Auto / 0.001 / 0.01 / 0.1 / 1 °C (°F) (can be selected)
Temperature accuracy [1]	$\pm 0.25\,°C$ ($\pm 0.45\,°F$)
Max. sensor cable length	• Analog: 20 m (65 ft)
	• ISM: 80 m (260 ft)
Calibration	1-point (slope and offset) or process (slope and offset)

1) ISM input signal causes no additional error.

Optical oxygen

Measurement parameters	Dissolved Oxygen (DO): Saturation or concentration and temperature Oxygen in gas: Concentration and temperature
Oxygen display ranges	• Dissolved Oxygen Saturation: 0 to 500 % air, 0 to 200 % O_2-sat Concentration: 0 ppb (ug/L) to 50.00 ppm (mg/L) • In gas Saturation: 0 to 100 vol-% O_2 Concentration: 0 to 9999 ppb O_2 gas
Oxygen accuracy	± 1 digit
Oxygen resolution	Auto/0.001/0.01/0.1/1 (can be selected)
Temperature compensation	Automatic
Temperature measuring range	−30 to +150 °C (−22 to +302 °F)
Temperature resolution	Auto/0.001/0.01/0.1/1 °C (°F) (can be selected)
Temperature accuracy	± 1 digit
Max. sensor cable length	80 m (260 ft)
Calibration	1-point (depending on sensor model) 2-point or process, process scaling

Dissolved carbon dioxide

Measurement parameters	Dissolved carbon dioxide and temperature
CO_2 display range	0 to 5000 mg/L 0 to 200 % sat 0 to 1500 mm Hg 0 to 2000 mbar 0 to 2000 hPa
CO_2 accuracy	± 1 digit
CO_2 resolution	Auto/0.001/0.01/0.1/1 (can be selected)
mV range	−1500 to +1500 mV
mV resolution	Auto/0.01/0.1/1 mV (can be selected)
mV accuracy	± 1 digit
Total pressure range	0 to 4000 mbar
Temperature measuring range	−30 to +150 °C (−22 to +302 °F)
Temperature resolution	Auto/0.001/0.01/0.1/1 °C (°F) (can be selected)
Temperature accuracy	± 1 digit
Max. sensor cable length	80 m (260 ft)
Calibration	1-point (offset), 2-point (slope and offset) or process (offset)

CO_2 hi (thermal conductivity)

Measurement parameters	Dissolved carbon dioxide and temperature
CO_2 display ranges	0 to 10 bar p (CO_2)/0 to 145 psi p (CO_2) 0 to 15 g/L 0 to 7 V/V CO_2
Accuracy in fluids [1]	± 1 % of reading (within ± 5 % of calibration temperature) ± 2 % of reading over temperature range 0 to 50 °C (32 to 122 °F)
Calibration	1-point or process

1) Complete loop of sensor and transmitter

GPro 500 TDL

Measurement parameters	O_2, O_2 and temperature, CO (ppm), CO (%), H_2O, CO_2 (%)
Gas display ranges	0 to 100 %

Gas accuracy, resolution, repeatability and low detection limit	Depending on sensor model
Linearity	Better than 1 %
Drift	Negligible ($<$ 2 % of measurement range between maintenance intervals)
Sampling rate	1 second
Response time (t_{90})	Depending on sensor model
Process pressure ranges	Depending on sensor model
Process temperature ranges	0 to 250 °C (32 to 482 °F) optional (for probe installation)
	0 to 600 °C (32 to 1112 °F) with additional thermal barrier
	0 to 150 °C (32 to 302 °F) (white cell)
Max. sensor cable length	40 m (130 ft) (FM version)
Calibration	1-point (offset) or process (slope or offset)

Dissolved ozone

Measurement parameters	Concentration and temperature
Display range for current	Analog: 0 to $-$7000 nA
Ozone measuring range	0 to 5000 ppb (µg/L) O_3
Ozone accuracy	$\pm$ 1 % (or 0.4 ppb) up to 2000 ppb
	$\pm$ 2.5 % (or 50 $-$ 125 ppb) from 2000 to 5000 ppb
Resolution	$\pm$ 1 digit
Temperature compensation	Automatic
Temperature measuring range	5 to + 50 °C (+ 41 to + 122 °F)
Temperature resolution	Auto / 0.001 / 0.01 / 0.1 / 1 (can be selected)
Temperature accuracy [1]	Analog: $\pm$ 0.25 °C ($\pm$ 0.45 °F)
Max. sensor cable length	80 m
Calibration	1-point (offset) or process (slope and offset)

Conductivity 2-e / 4-e

Measurement parameters	Conductivity / resistivity and temperature
Conductivity ranges	See sensor specification
Chemical concentration curves (used with 4-e sensors)	NaCl: 0 $-$ 26 % @ 0 °C to 0 $-$ 28 % @ +100 °C
	NaOH: 0 $-$ 12 % @ 0 °C to 0 $-$ 16 % @ + 40 °C to 0 $-$ 6 % @ +100 °C
	HCl: 0 $-$ 18 % @ $-$ 20 °C to 0 $-$ 18 % @ 0 °C to 0 $-$ 5 % @ +50 °C
	HNO_3: 0 $-$ 30 % @ $-$ 20 °C to 0 $-$ 30 % @ 0 °C to 0 $-$ 8 % @ +50 °C
	H_2SO_4: 0 $-$ 26 % @ $-$ 12 °C to 0 $-$ 26 % @ + 5 °C to 0 $-$ 9 % @ +100 °C
	H_3PO_4: 0 $-$ 35 % @ + 5 °C to + 80 °C
TDS ranges	NaCl, $CaCO_3$
Cond / Res accuracy [1]	Analog: $\pm$ 0.5 % of reading or 0.25 Ω, whichever is greater
Cond / Res repeatability [1]	Analog: $\pm$ 0.25 % of reading or 0.25 Ω, whichever is greater
Cond / Res resolution	Auto / 0.001 / 0.01 / 0.1 / 1 (can be selected)
Temperature input	Pt 1000
Temperature measuring range	$-$ 40 to + 200 °C ($-$ 40 to + 392 °F)
Temperature resolution	Auto / 0.001 / 0.01 / 0.1 / 1 (can be selected)
Temperature accuracy	Analog: $\pm$ 0.25 °C ($\pm$ 0.45 °F) within
	$-$ 30 to + 150 °C ($-$ 22 to + 302 °F);
	$\pm$ 0.50 °C ($\pm$ 0.90 °F) outside
Max. sensor cable length	• Analog: 2-e sensors: 61 m (200 ft); 4-e sensors: 15 m (50 ft)
	• ISM: 2-e sensors: 90 m (300 ft); 4-e sensors: 80 m (260 ft)
Calibration	1-point, 2-point or process

1)   ISM input signal causes no additional error.

Electrical specifications

Supply voltage	• 80 to 255 VAC, 50 to 60 Hz, 10 VA	
	• 20 to 30 VDC, 10 VA	
Connection terminal	Detachable screw terminals, appropriate for wire cross section 0.2 to 1.5 mm² (AWG 16–24)	
Mains fuse	2.0 A slow blow, type FC	
Analog output [1]	4 × 0/4 to 20 mA, 22 mA alarm, galvanically isolated from input and from earth/ground	
Measurement error through analog outputs	< ±0.05 mA over 1 to 22 mA range	
Analog output configuration	Linear, bi-linear, logarithmic, auto range	
Load	Max. 500 Ω	
PID process controller	1 × PID with pulse length, pulse frequency or analog control output signal	
Cycle time analog output	Ca. 1 s	
Hold input/Alarm contact	Yes/Yes	
Alarm output delay	0 to 999 s, selectable	
Relays	• 2 SPDT, mechanical, 250 VAC or 30 VDC, 3 A	
	• 2 SPST, Reed, 250 VAC or 250 VDC, 0.5 A, 10 W	
Digital input	2	
	With switching limits 0.00 VDC to 1.00 VDC inactive, 2.30 VDC to 30.00 VDC active; galvanically isolated up to 60 V from output, analog input and ground/earth	
Analog input [2]	1 × 0/4 to 20 mA	
User interface	• TFT touch-screen 4"	
	• Black and white	
	• Resolution: ¼ VGA (320 pixel × 240 pixel)	
Keypad	• 4 tactile feedback keys	
Languages	10 (English, German, French, Italian, Spanish, Portuguese, Russian, Japanese, Korean and Chinese)	
Interfaces	• 1 USB Host: Printer connection, data logging, loading configuration from USB stick and saving configuration to USB stick	
	• 1 USB Device: Software update interface	

1) For M400 Type 1, Type 2, Type 3 only.   2) For M400 Type 2, Type 3 and M400 4-wire FF only.

FOUNDATION fieldbus specifications

Supply voltage for FF block	9 to 32 V DC
Current	22 mA
Max. current in case of fault (FDE)	< 28 mA
Physical interface	According to IEC 61158-2
Transfer rate	31.25 kbit / s
Profile	FF_H1 (Foundation fieldbus)
Communication protocol	FF-816
ITK version	6.1.0
Manufacturer ID	(DEV_TYPE) 0x465255
FF Type	(DEV_REV) 1
FF communication model	• 1 Resource Block
	• 2 Transducer Blocks
	• 4 Analog Input Blocks
	• 1 Analog Output Block
	• 2 Discrete Input Blocks
	• 2 Discrete Output Blocks

Environmental specifications
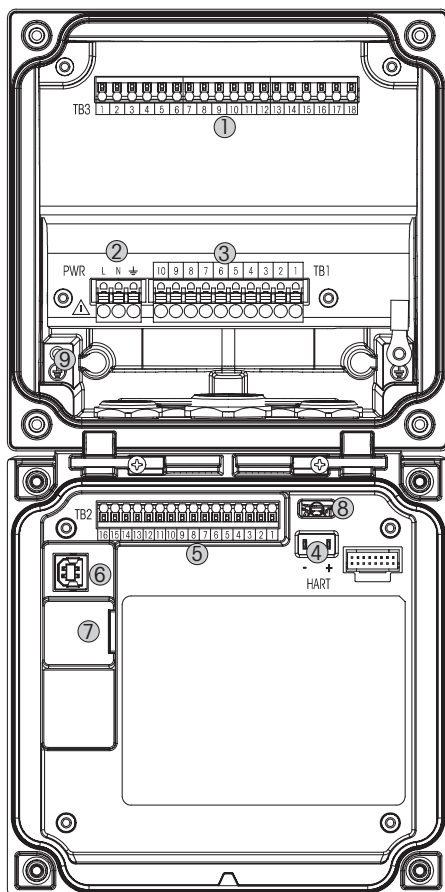
Storage temperature	−40 to +70 °C (−40 to +158 °F)
Ambient temperature operating range	−20 to +50 °C (−4 to +122 °F)
Relative humidity	0 to 95 % non-condensing
Altitude	Max. 2000 m
EMC	Compliant with EN 61326-1:2013 (Industrial environment) Emission: Class A, Immunity: Class A
CE mark	The measuring system is in conformity with the statutory requirements of the EC Directives. METTLER TOLEDO confirms successful testing of the device by affixing to it the CE mark.
Ex Approvals[1]	• cCSAus Class I, Division 2, Groups A, B, C, D T4 Class I, Zone 2, AEx nA nC IIC T4 Gc • ATEX II 3G Ex nA nC IIC T4 Gc

1) for M400 Type 1, Type 2, Type 3 only.

Mechanical specifications

Dimensions	Housing − Height × Width × Depth	136 × 136 × 116 mm (5.35 × 5.35 × 4.57")
	Front bezel − Height x Width	150 × 150 mm (5.91 × 5.91")
	Max. depth − panel mounted	116 mm (4.57") (excludes plug-in connectors)
Weight	1.50 kg (3.3 lb)	
Material	Aluminum die cast	
Enclosure rating	IP 66 / NEMA 4X	

Terminal block (TB) definitions

1 TB3 − Terminal block for sensor connection
2 Terminals for supply voltage
3 TB1 − Terminal block for relay outputs
4 HART, for M400 Type 1, Type 2, Type 3 only
5 TB2 − Terminal block for analog output and digital input signals
6 USB Device − Software update interface
7 USB Host − Printer connection, data logging, loading and saving configuration
8 **Warning!** Do not dis-connect the internal ground wire between the front and back module.
9 **Warning!** Ensure to tightly secure an earth wire to the internal PE (Protective Earth) screw terminal. The cross-section of the PE wire must be above 18 AWG (0.8 mm).

TB1 terminal definition – All transmitter versions

Terminal	Description	Contact rating
1	NO 1	250 VAC or 30 VDC, 3 A
2	COM 1	
3	NC 1	
4	NO 2	250 VAC or 30 VDC, 3 A
5	COM 2	
6	NC 2	
7	NO 3	250 VAC or 30 VDC, 0.5 A, 10 W
8	COM 3	
9	NO 4	250 VAC or 30 VDC, 0.5 A, 10 W
10	COM 4	

TB2 terminal definition

Type 1, 2, 3

Terminal	Description
1	AO 1 + / HART +
2	AO 1 − / HART −
3	AO 2 +
4	AO 2 −
5	AO 3 +
6	AO 3 −
7	AO 4 +
8	AO 4 −
9	DI 1 +
10	DI 1 − / DI 2 −
11	DI 2 +
12	AI +
13	AI −
14 to 16	Not used

FF version

Terminal	Description
1	FF+
2	FF-
3	FF+
4	FF−
5	Not used
6	Not used
7	Not used
8	Not used
9	DI1+
10	DI1− / DI2−
11	DI2+
12	AI+
13	AI−
14 to 16	Not used

TB3 terminal definition – Analog sensors

Conductivity 2-e / 4-e

Terminal	Function	Color
1	Cnd inner 1 [1]	White
2	Cnd outer 1 [1]	White / blue
3	Cnd outer 1	–
4	Not used	–
5	Cnd outer 2	–
6	Cnd inner 2 [2]	Blue
7	Cnd outer 2 (GND) [2]	Black
8	Not used	–
9	RTD ret / GND	Bare shield
10	RTD sense	Red
11	RTD	Green
12 to 18	Not used	–

1) For third party Conductivity 2-e sensors a jumper between 1 and 2 may be required.
2) For third party Conductivity 2-e sensors a jumper between 6 and 7 may be required.

TB3 terminal definition – Analog sensors (continued)

pH/ORP, dissolved carbon dioxide

Terminal	pH/dissolved carbon dioxide (InPro® 5000)		Redox (ORP)	
	Function	Color [1]	Function	Color
1	Glass	Transparent	Platinum	Transparent
2	Not used	–	–	–
3	Not used	–	–	–
4	Not used	–	–	–
5	Reference	Red	Reference	Red
6	Reference [2]	–	Reference [2]	–
7	Solution GND [2]	Blue [3]	Solution GND [2]	–
8	Not used	–	–	–
9	RTD ret/GND	White	–	–
10	RTD sense	–	–	–
11	RTD	Green	–	–
12	Not used	–	–	–
13	Shield (GND)	Green/yellow	Shield (GND)	Green/yellow
14 to 18	Not used	–	–	–

1)   Grey wire not used.
2)   Install jumper between 6 and 7 for ORP sensors and pH electrodes without SG.
3)   Blue wire for electrode with SG.

Amperometric oxygen and Ozone

Terminal	Function	Oxygen				Ozone
		InPro 6800	InPro 6900	InPro 6950	Hi Performance Oxygen	InPro 6510
		Color	Color	Color	Color	Color
1	Not used	–	–	–	–	–
2	Anode	Red	Red	Red	Red	Red
3	Anode	– [1]	– [1]	–	– [1]	– [1]
4	Reference	– [1]	– [1]	Blue	– [1]	– [1]
5	Not used	–	–	–	–	–
6	Not used	–	–	–	–	–
7	Guard	–	Grey	–	–	–
8	Cathode	Transparent	Transparent	Transparent	Grey	Grey
9	NTC ret (GND)	Green	Green	Green	Green	Green
10	Not used	–	–	–	–	–
11	NTC	White	White	White	White	White
12	Not used	–	–	–	–	–
13	Shield (GND)	Green/yellow	Green/yellow			Green/yellow
14 to 18	Not used	–	–	–	–	–

1) Install jumper between 3 and 4.

TB3 terminal definition – ISM sensors

pH/ORP, amperometric oxygen, dissolved ozone, conductivity 4-e, dissolved CO$_2$ low

Terminal	Function	Color
1 to 11	Not used	–
12	1-wire	Transparent (cable core)
13	GND	Red (shield)
14	RS485-B	–
15	RS485-A	–
16	5V	–
17	GND 24V	–
18	24V	–

UniCond® 2-e, UniCond 4-e

Terminal	Function	Color
1 to 12	Not used	–
13	GND	White
14	RS485-B	Black
15	RS485-A	Red
16	5V	Blue
17 to 18	Not used	–

Optical oxygen, dissolved CO$_2$ hi (InPro 5500 i), GPro 500 TDL

Terminal	Function	Optical Oxygen, CO$_2$ hi (InPro 5500 i) VP8 cables wire color	5-pin cables wire color	GPro 500 TDL Color
1 to 12	Not used	–		
13	GND	Green/Yellow	Green/Yellow	Brown
14	RS485-B	Brown	Blue	Yellow
15	RS485-A	Pink	White	Green
16	5V	–	–	–
17	GND (24V)	Blue	Black	Blue
18	24V	Grey	Brown	Red

Transmitter

Transmitter	Order no.
M400 Type 1	30 374 111
M400 Type 2	30 374 112
M400 Type 3	30 374 113
M400 4-wire FF	30 374 121

1) Included: 1 piece M 25 × 1.5 cable gland, 4 pieces M 20 × 1.5 cable glands.

M400 parameter fit guide

	M400 Type 1		M400 Type 2 / M400 4-wire FF		M400 Type 3	
	Analog	ISM	Analog	ISM	Analog	ISM
pH/ORP	●	●	●	●	●	●
pH/pNa	–	●	–	●	–	●
UniCond 2-e/4-e	–	●	–	●	–	●
Conductivity 2-e	●	–	●	–	●	–
Conductivity 4-e	●	●	●	●	●	●
Amp. dissolved oxygen ppm/ppb/trace	–	–	●/●[1]/–	●/●[1]/–	●/●/●	●/●/●
Opt. dissolved oxygen ppm/ppb	–	–	–/–	●/●[2]	–/–	●/●
Amp. O_2 gas ppm/ppb/trace	–	–	–/–/–	–/–/–	●/●/●	●/●/●
Opt. O_2 gas ppm	–	–	–	–	–	●
Dissolved ozone	–	–	●	●	●	●
Dissolved carbon dioxide	–	–	●	●	●	●
CO_2 hi	–	–	–	–	–	●
GPro 500 TDL	–	–	–	–	–	●

1) M400 4-wire FF supports Ingold Amp. DO ppb sensors
2) Thornton high performance dissolved oxygen and pure water optical sensors only

Accessories

Description	Order no.
Pipe mounting kit for ½ DIN for pipe diameter 40 to 60 mm (1.57 to 2.36")	30 300 480
Panel mounting kit for ½ DIN	30 300 481
Wall mounting kit for ½ DIN	30 300 482
Protective hood for ½ DIN	30 073 328

For addresses of METTLER TOLEDO
Market Organizations please go to:
www.mt.com/pro-MOs

www.mt.com/pro