Instruction Manual

M400/2XH

Cond Ind Transmitter

METTLER TOLEDO

Operation Manual
Transmitter M400/2XH Cond Ind

Printed in Switzerland

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1 Introduction

1.1 Intended Use

The M400/2XH Cond Ind is a 2-wire transmitter for analytical measurements with HART® communication capability. It is available as 1-channel version and compatible with analog inductive conductivity sensors.

The M400/2XH Cond Ind transmitter is designed for use in the process industries. Additionally, the M400/2XH Cond Ind transmitter is intrinsically safe certified and suitable for installations in hazardous areas.

METTLER TOLEDO accepts no liability for damages resulting from incorrect use or use other than that intended.

M400/2XH Cond Ind parameter fit guide

Parameter	M400/2XH Cond Ind
	Analog
Cond Ind (Inductive Conductivity) 1)	•

1) InPro™ 7250 ST, InPro 7250 PFA. InPro 7250 HT

Table 1: M400/2XH Cond Ind parameter fit guide

2 Safety Instructions

This manual includes safety information with the following designations and formats.

2.1 Definition of Equipment and Documentation Symbols and Designations

WARNING: POTENTIAL FOR PERSONAL INJURY.

CAUTION: possible instrument damage or malfunction.

NOTE: Important operating information.

On the transmitter or in this manual text indicates: Caution and/or other possible hazard including risk of electric shock (refer to accompanying documents)

The following is a list of general safety instructions and warnings. Failure to adhere to these instructions can result in damage to the equipment and/or personal injury to the operator.

- The M400 Transmitter should be installed and operated only by personnel familiar with the transmitter and who are qualified for such work.
- The M400 Transmitter must only be operated under the specified operating conditions. Refer to section 17 "Specifications" on Page 67.
- Repair of the M400 Transmitter must be performed by authorized, trained personnel only.
- With the exception of routine maintenance, cleaning procedures or fuse replacement, as described in this manual, the M400 Transmitter must not be tampered with or altered in any manner.
- METTLER TOLEDO accepts no responsibility for damage caused by unauthorized modifications to the transmitter.
- Follow all warnings, cautions, and instructions indicated on and supplied with this product.
- Install equipment as specified in this instruction manual. Follow appropriate local and national codes.
- Protective covers must be in place at all times during normal operation.
- If this equipment is used in a manner not specified by the manufacturer, the protection provided by it against hazards may be impaired.

WARNINGS:
Installation of cable connections and servicing of this product require access to shock hazard voltage levels. Main power and OC contacts wired to separate power source must be disconnected before servicing.

Switch or circuit breaker shall be in close proximity to the equipment and within easy reach of the OPERATOR; it shall be marked as the disconnecting device for the equipment. Main power must employ a switch or circuit breaker as the disconnecting device for the equipment. Electrical installation must be in accordance with the National Electrical Code and/or any other applicable national or local codes.

NOTE: PROCESS UPSETS
Because process and safety conditions may depend on consistent operation of this transmitter, provide appropriate means to maintain operation during sensor cleaning, replacement or sensor or instrument calibration.

NOTE: This is a 2-wire-product with two active 4–20 mA analog output.

2.2 Environmental protection

Waste electrical products should not be disposed of with household waste. Please recycle where facilities exist. Check with your Local Authority or retailer for recycling advice.

2.3 Ex Instructions for M400 Series Multi-Parameter Transmitters – ATEX/IECEx/UKCA

M400 series multi-parameter transmitters are produced by Mettler-Toledo GmbH.
It has passed the inspection of IECEx and conforms to following standards:

- **IEC 60079-0 : 2017**
  Edition: 7.0 Explosive atmospheres –
  Part 0: General requirements
- **IEC 60079-11 : 2011**
  Edition: 6.0 Explosive atmospheres –
  Part 11: Equipment protection by intrinsic safety "i"

Ex Marking:
- **Ex ib [ia Ga] IIC T4 Gb**
- **Ex ib [ia Da] IIIC T80 °C Db IP66**

Certificate No.:
- **IECEx NEP 18.0007X**
- **SEV 12 ATEX 0132X**
- **CML 22 UKEX 2209X**

1. Special Conditions of use (X-marking in the Certificate Number):
1. Avoid ignition hazard due to impact or friction, prevent mechanical sparks.
2. Avoid electrostatic discharge on enclosure surface, use wet cloth only for cleaning.
3. In hazardous area, IP66 cable glands (as supplied) must be mounted.

2. Pay particular attention to the following when using the transmitter:
1. Rated ambient temperature range:
   – for gas atmosphere: –20 ~ +60 °C
   – for dust atmosphere: –20 ~ +57 °C
2. No operation on the upgrade interface in hazardous area.
3. Users shall not arbitrarily replace the internal electrical components.
4. When installation, use and maintenance, IEC 60079-14 should be observed.
5. When installation in explosive dust atmosphere
   5.1 Cable gland or blanking plug to IEC 60079-0:2011 and IEC 60079-11:2017 with marking Ex ia IIIC IP66 should be adopted.
   5.2 The overlay switch of multi-parameter transmitter shall be protected from light.
   5.3 Avoid high risk of mechanical danger on the overlay switch.
6. Observe the warning: potential electrostatic charging hazard- see instructions, avoid ignition hazard due to impact or friction for Ga application.
7. For connection to intrinsically safe circuits, use the maximum values in the following table.

M400/2XH and M400G/2XH

Terminal	Function	Safety Parameters				
10, 11	Aout1	U_i = 30 V	I_i = 100 mA	P_i = 0.8 W	Li ≈ 0	C_i = 15 nF
12, 13	Aout2	U_i = 30 V	I_i = 100 mA	P_i = 0.8 W	Li ≈ 0	C_i = 15 nF
1, 2; 3, 4;	Digital Input	U_i = 30 V	I_i = 100 mA	P_i = 0.8 W	Li ≈ 0	C_i ≈ 0
6, 7; 8, 9;	OC Output	U_i = 30 V	I_i = 100 mA	P_i = 0.8 W	Li ≈ 0	C_i ≈ 0
P, Q	Analog Input	U_i = 30 V	I_i = 100 mA	P_i = 0.8 W	Li ≈ 0	C_i = 15 nF
N, O	RS485 Sensor	U_i = 30 V U_o = 5.88 V	I_i = 100 mA I_o = 54 mA	P_i = 0.8 W P_o = 80 mW	Li ≈ 0 L_o = 1 mH	C_i = 0.7 µF C_o = 1.9 µF
A, E, G	pH Sensor	U_o = 5.88 V	I_o = 1.3 mA	P_o = 1.9 mW	L_o = 5 mH	C_o = 2.1 µF
B, A, E, G	Conductivity Sensor	U_o = 5.88 V	I_o = 29 mA	P_o = 43 mW	L_o = 1 mH	C_o = 2.5 µF
K, J, I	Temperature Sensor	U_o = 5.88 V	I_o = 5.4 mA	P_o = 8 mW	L_o = 5 mH	C_o = 2 µF
H, B, D	Dissolved oxygen sensor	U_o = 5.88 V	I_o = 29 mA	P_o = 43 mW	L_o = 1 mH	C_o = 2.5 µF
L	One-wire Sensor	U_o = 5.88 V	I_o = 22 mA	P_o = 32 mW	L_o = 1 mH	C_o = 2.8 µF

M400/2XH Cond Ind

Terminal	Function	Safety Parameters				
10, 11	Aout1	U_i = 30 V	I_i = 100 mA	P_i = 0.8 W	Li ≈ 0	C_i = 15 nF
12, 13	Aout2	U_i = 30 V	I_i = 100 mA	P_i = 0.8 W	Li ≈ 0	C_i = 15 nF
1, 2; 3, 4;	Digital Input	U_i = 30 V	I_i = 100 mA	P_i = 0.8 W	Li ≈ 0	C_i ≈ 0
6, 7; 8, 9;	OC Output	U_i = 30 V	I_i = 100 mA	P_i = 0.8 W	Li ≈ 0	C_i ≈ 0
D, E, F, G, H	Inductive Conductivity Sensor	U_o = 5.36 V	I_o = 17.2 mA	P_o = 23 mW	L_o = 1 mH	C_o = 3.2 µF
K, J, I	Temperature Sensor	U_o = 5.88 V	I_o = 5.4 mA	P_o = 8 mW	L_o = 5 mH	C_o = 2 µF

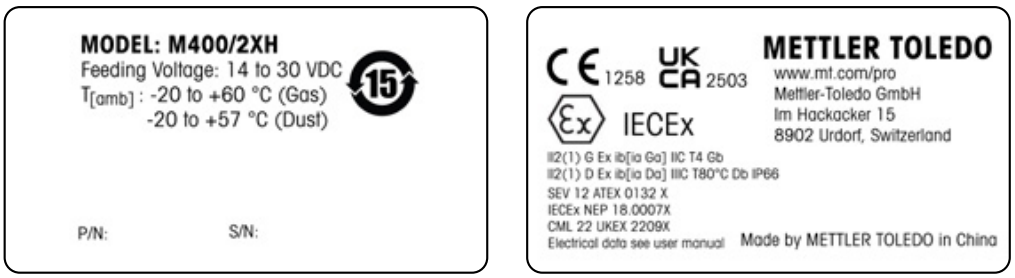


Fig. 1: Label Model M400/2XH Cond Ind

2.4 Ex Instructions for M400 Series Multi-Parameter Transmitters – FM Approval

2.4.1 Instructions of Use to Be Considered under FM Approval

M400 series multi-parameter transmitters are produced by Mettler-Toledo GmbH.
It has passed the inspection of NRTL cFMus and to following requirements:

The equipment is provided with an internal bond wiring and an internal flying lead wire for grounding purposes.

US marking	
Operating temperature range	–20 °C to +60 °C (–4 °F to +140 °F)
Environmental designation	Enclosure type 4X, IP 66
Intrinsically safe	• Class I, Division 1, Groups A, B, C, D T4 • Class II, Division 1, Groups E, F, G • Class III
Intrinsically safe	Class I, Zone 0, AEx ia IIC T4 Ga
Parameters	• Entity: Control drawing 12112601 and 12112602(4) • FISCO: Control drawing 12112603 and 12112602(4)
Nonincendive	• Class I, Division 2, Groups A, B, C, D T4A • Class I, Zone 2, Groups IIC T4
Certificate no.	FM16US0216X
Standards	• FM3810:2005 Approval Standard for Electrical Equipment for Measurement, Control and Laboratory Use • ANSI/IEC-60529:2004 Degrees of Protection Provided by Enclosures (IP Codes) • ANSI/ISA-61010-1:2004 Edition: 3.0 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements • ANSI/NEMA 250:1991 Enclosures for Electrical Equipment (1,000 Volts Maximum) • FM3600:2011 Approval Standard for Electrical Equipment for Use in Hazardous (Classified) Locations – General Requirements • FM3610:2015 Approval Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II & III, Division 1, Hazardous (Classified) Locations • FM3611:2004 Approval Standard for Nonincendive Electrical Equipment for Use in Class I & II, Division 2, and Class III, Division 1 & 2, Hazardous (Classified) Locations • ANSI/ISA-60079-0:2013 Edition: 6.0 Explosive Atmospheres – Part 0: General Requirements • ANSI/ISA-60079-11:2012 Edition: 6.0 Explosive Atmospheres – Part 11: Equipment Protection by Intrinsic Safety "i"

Canadian marking	
Operating temperature range	–20 °C to +60 °C (–4 °F to +140 °F)
Environmental designation	Enclosure type 4X, IP 66
Intrinsically safe	• Class I, Division 1, Groups A, B, C, D T4 • Class II, Division 1, Groups E, F, G • Class III
Intrinsically safe	Class I, Zone 0, Ex ia IIC T4 Ga
Parameters	• Entity: Control drawing 12112601 and 12112602(4) • FISCO: Control drawing 12112603 and 12112602(4)
Nonincendive	Class I, Division 2, Groups A, B, C, D T4A
Certificate no.	FM16CA0119X
Standards	• CAN/CSA-C22.2 No. 60529:2010 Degrees of Protection Provided by Enclosures (IP Codes) • CAN/CSA-C22.2 No. 61010-1:2004 Edition: 3.0 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements • CAN/CSA-C22.2 No. 94:1976 Special Purpose Enclosures – Industrial Products • CAN/CSA-C22.2 No. 213-M1987:2013 Non-Incendive Equipment for Use in Class I, Division 2 Hazardous Locations – Industrial Products • CAN/CSA-C22.2 No. 60079-0:2015 Edition: 2.0 Explosive Atmospheres – Part 0: General Requirements • CAN/CSA-C22.2 No. 60079-11:2014 Edition: 2.0 Explosive Atmospheres – Part 11: Equipment Protection by Intrinsic Safety "i"

2.4.1.1 General Notes

The Multi-parameter Transmitter M400/2(X)H, M400G/2XH, M400FF, M400PA and the M400/2XH Cond Ind are suitable for use in hazardous atmospheres of all combustible materials of explosion groups A, B, C, D, E, F and G for applications requiring Class I, II, III, Division 1 instruments and groups A, B, C and D for applications requiring Class I, Division 2 instruments (National Electrical Code® (ANSI/NFPA 70 (NEC®), Article 500; or Canadian Electrical (CE) Code® (CEC Part 1, CAN/CSA-C22.1), Appendix F when installed in Canada, or of explosion groups IIC, IIB or IIA for applications requiring Class I, Zone 0, AEx/Ex ia IIC T4, Ga instruments (National Electrical Code® (ANSI/NFPA 70 (NEC®), Article 500; or Canadian Electrical (CE) Code® (CEC Part 1, CAN/CSA-C22.1), Appendix F when installed in Canada).

If the Multi-parameter Transmitter M400/2(X)H, M400G/2XH, M400FF, M400PA, M400/2XH Cond Ind is installed and operated in hazardous areas, the general Ex installation regulations as well as these safety instructions must be observed.

The operating instructions as well as the installation regulations and standards that apply for explosion protection of electrical systems must always be observed.

The installation of explosion-endangered systems must always be carried out by qualified personnel.

For mounting instructions on specific valves refer to the mounting instructions supplied with the mounting kit. Mounting does not affect the suitability of the SVI FF positioner for use in a potentially hazardous environment.

The equipment is not intended to be used as personal protective equipment. To prevent injury, read the manual before use.

For language translation assistance contact your local representative or email process.service@mt.com.
Pour la langue de traduction aide, contactez votre représentant local ou envoyez un e-mail process.service@mt.com.

2.4.1.2 Cautionary Notes, Warnings and Markings

Hazardous location notes:

1. For guidance on US installations, see ANSI/ISA-RP12.06.01, Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations.
2. Installations in the US shall comply with the relevant requirements of the National Electrical Code® (ANSI/NFPA 70 (NEC®)).
3. Installations in Canada shall comply with the relevant requirements of the Canadian Electrical (CE) Code® (CEC Part 1, CAN/CSA-C22.1).
4. Wiring methods must conform to all local and national codes governing the installation, and wiring must be rated for at least +10 ºC above the highest expected ambient temperature.
5. Where the protection type allows and depends on wiring glands, the glands must be certified for the type of protection requiredand area classification identified on the equipment or system nameplate.
6. The internal grounding terminal shall be used as the primary equipment grounding means and the external grounding terminal is only for a supplemental (secondary) bonding connection where local authorities permit or require such a connection.
7. A dust-tight conduit seal shall be used when installed in Class II conductive and non-conductive dust environments and Class III combustible flyings environments.
8. Approved seals against ingress of water or dust are required and the NPT or metric thread fittings must be sealed with tape or thread sealant in order to meet the highest level of ingress protection.
9. When the equipment is supplied with plastic dust plugs in the conduit/cable gland entries; it is the end-user's responsibility to provide cable glands, adaptors and/or blanking plugs suitable for the environment in which the equipment is installed. When installed in a hazardous (classified) location, the cable glands, adaptors and/or blanking plugs shall additionally be suitable for the hazardous (classified) location, the product certification, and acceptable to the local authority having jurisdiction for the installation.
10. The end-user must consult the manufacturer for repair disclaimers, and only certified parts, such as entry plugs, mounting and cover lock screws and gaskets, supplied by the manufacturer are permitted. No substitutions with non-manufacturer supplied parts are permitted.
11. Tighten cover screws to 1.8 Nm (15.8 lb·in.). Overtorquing may cause enclosure breakage.
12. The minimum tightening torque for M4 (No. 6) binding screw protective conductor terminals is 1.2 Nm (10.6 lb·in.) or greater, as specified.
13. Care must be taken during installation to avoid impacts or friction that could create an ignition source.
14. Use copper, copper-clad aluminum or aluminum conductors only.

15. The recommended tightening torque for field wiring terminals is 0.8 Nm (7 lb·in.) or greater, as specified.
16. The Nonincendive version of the Multi-parameter Transmitter M400/2H must be connected to limited output NEC Class 2 circuits, as outlined in the National Electrical Code® (ANSI/NFPA 70 (NEC®)), only. If the devices are connected to a redundant power supply (two separate power supplies), both must meet this requirement.
17. The Class I, Zone 2 certifications are based on Division evaluations and the marking acceptance of Article 505 of the National Electrical Code® (ANSI/NFPA 70 (NEC®)).
18. The Multi-parameter Transmitter M400/2(X)H, M400G/2XH, M400FF, M400PA, M400/2XH Cond Ind assessed were certified by FM Approvals under a Type 3 Certification System as identified in ISO Guide 67.
19. Tampering and replacement with non-factory components may adversely affect the safe use of the system.
20. Insertion or withdrawal of removable electrical connectors is to be accomplished only when the area is known to be free of flammable vapors.
21. The Multi-parameter Transmitter M400/2(X)H, M400G/2XH, M400FF, M400PA, M400/2XH Cond Ind is not intended for servicing or maintenance operation. Malfunctioning units operating out of manufacturer's specification should be discarded and replaced with a new operational unit.
22. Substitution of components may impair intrinsic safety.
23. Do not open when an explosive atmosphere is present.
24. Explosion hazard, do not disconnect while circuit is live unless area is known to be non-hazardous.
25. Explosion hazard, substitution of components may impair suitability for Class I, Division 2.

The Transmitter M400/2XH Cond Ind intrinsically safe apparatus, entity version, bears the following label marking:

Fig. 2: Label Model M400/2XH Cond Ind

2.4.1.3 Control Drawings

Refer to section 17.5 "Control Drawings" on Page 70.

3 Function and Design

3.1 Function

The M400/2XH Cond Ind is a 2-wire transmitter for analytical measurements with HART® communication capability. The M400/2XH Cond Ind It is available as 1-channel version and compatible with analog inductive conductivity sensors.

M400/2XH Cond Ind parameter fit guide

Parameter	M400/2XH Cond Ind
	Analog
Cond Ind (Inductive Conductivity) [1]	•

1) InPro 7250 ST, InPro 7250 PFA. InPro 7250 HT

Table 2: M400/2XH Cond Ind parameter fit guide

3.2 Design

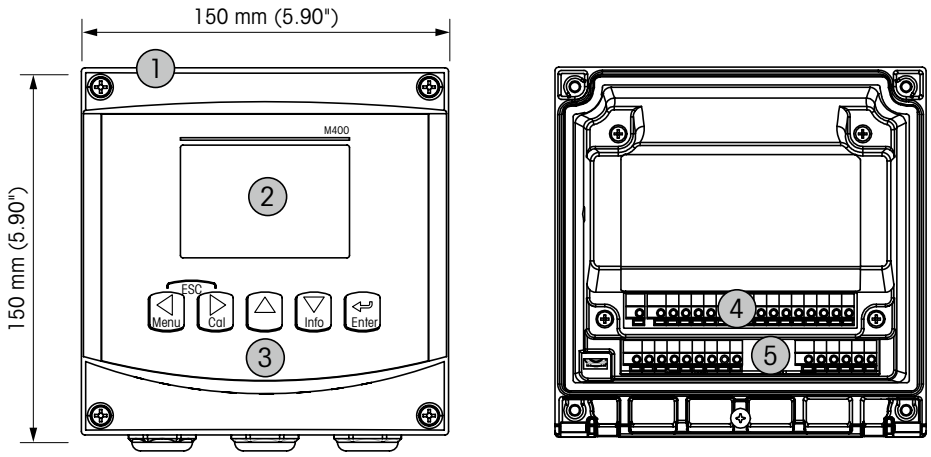


Fig. 3: Design (Overview) M400 transmitter

1 Hard polycarbonate housing ½ DIN
2 Four-line LC display
3 Five tactile-feedback navigation keys
4 TB1 – Input and output analog signal
5 TB2 – Sensor signal

3.3 Navigation Keys

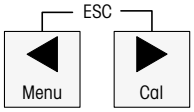
Navigation key	Description
	• Enter Menu mode. • Navigate backwards within a changeable data entry field.
	• Enter Calibration mode. • Navigate forward within a changeable data entry field.
	Return to Measurement mode. Press the ◄ and ► key simultaneously (escape). NOTE: In order to back up only one menu page, move the cursor under the UP Arrow character (↑) at the bottom right of the display screen and press [ENTER].
	• Increase a digit. • Navigate within a selection of values or options of a data entry field.
	• Enter Info mode. • Decrease a digit. • Navigate within a selection of values or options of a data entry field.
	Confirm action or selection.

Table 3: Navigation key

3.4 Displays

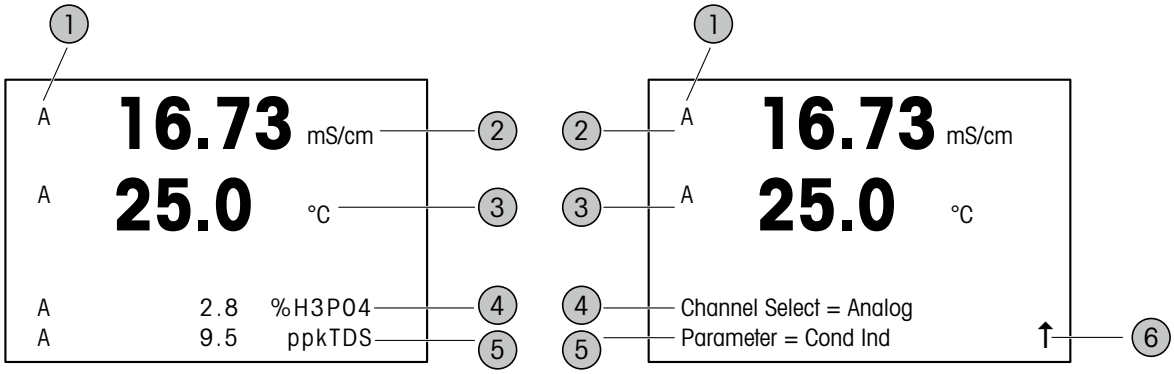


Fig. 4: Left: Measurement mode (example), Right: Edit mode (example)

1 Channel information
A: Analog sensor is connected.
H: Transmitter is in Hold mode.
2 1st line (a), standard configuration
3 2nd line (b), standard configuration
4 3rd line (c), Measurement mode: The screen depends on configuration.
Edit mode: Navigation through the menu or editing parameters
5 4th line (d): Measurement mode: The screen depends on configuration.
Edit mode: Navigation through the menu or editing parameters
6 If a ↑ is displayed, you can use the ▶ or the ◀ key to navigate to it. If you click [ENTER] you will navigate backwards through the menu (go back one screen).

You can configure the information shown on the display for each line. By default in the measurement mode no values are shown in the third and in the fourth line of the display. Refer to Chapter 9.2.1 "Channel Setup" on Page 35.

Display	Description
Hold mode	During calibration, clean, Digital In with Analog Output / OC the transmitter changes in Hold mode. After calibration or clean is completed the flashing "H" still remains for further 20 seconds. The "H" is not displayed any longer when Digital In is deactivated.
⚠	Idicates that an alarm or error is occurred. The symbol is displayed as long as the cause for the alarm or error persists.

Table 4: Hold mode and alarm symbol

"Save changes" dialog	Description
Yes & Exit	Save changes and exit to Measurement mode.
Yes & ↑	Save changes and go back one screen. Use this option if you want to continue configuring without re-entering the Edit mode.
No & Exit	Do not save changes and exit to Measurement mode.

Table 5: "Save changes" dialog

3.5 Menu Structure

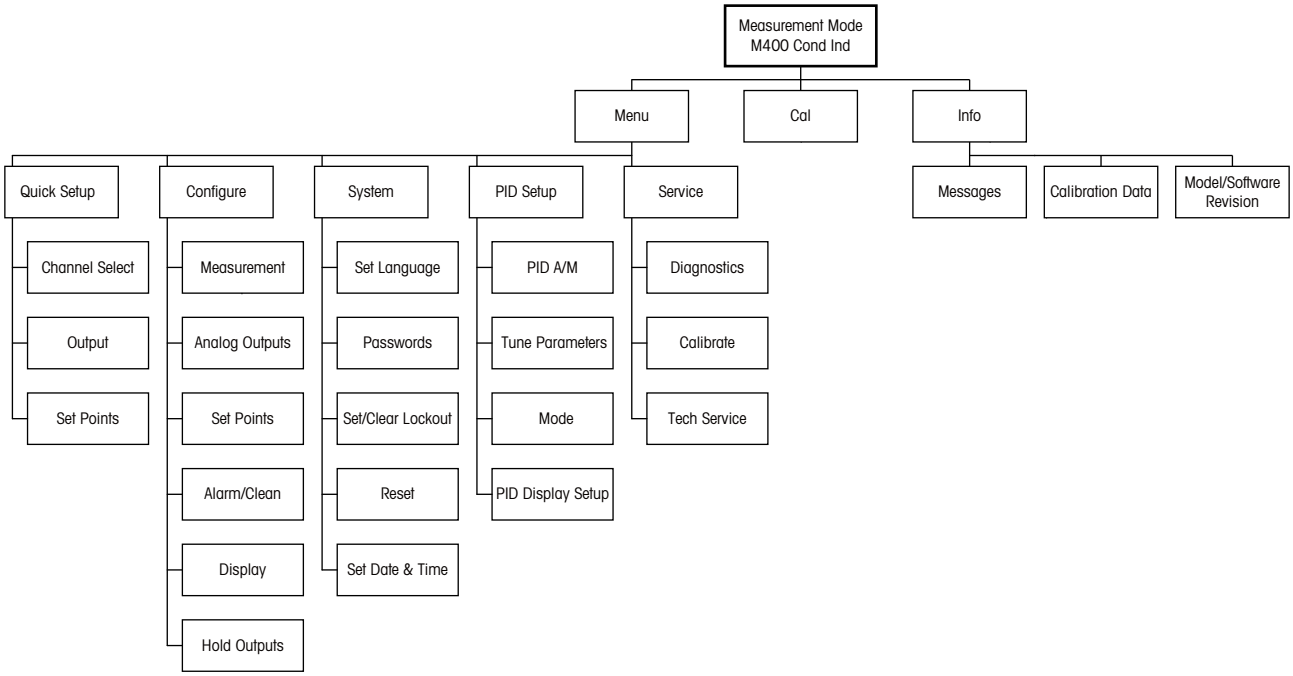


Fig. 5: Menu structure M400 Cond Ind

4 Mounting

4.1 Unpacking and Inspection of Equipment

Inspect the shipping container. If it is damaged, contact the shipper immediately for instructions. Do not discard the box.

If there is no apparent damage, unpack the container. Be sure all items shown on the packing list are present.

If items are missing, notify METTLER TOLEDO immediately.

4.2 Dimensions

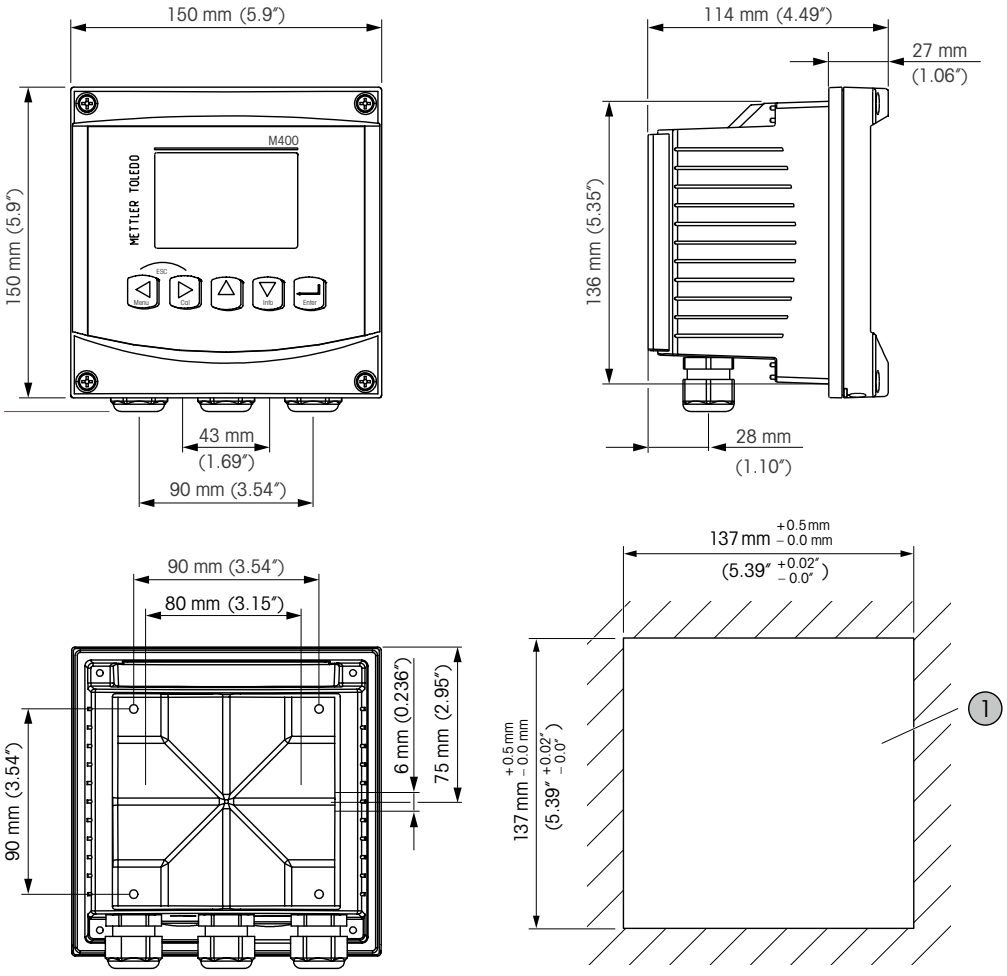


Fig. 6: Dimensions M400 transmitter

1 Panel-cutout for wall mounting

4.3 Mounting Procedure

The M400/2XH Cond Ind is available in ½ DIN case size and provide an integral IP66/NEMA4X housing. The M400/2XH Cond Ind can be mounted as follows:

- Panel mounting
- Wall mounting
- Pipe mounting.

Optional hardware accessories are available that allow for panel, wall or pipe mounting. Refer to Chapter 16 "Accessories and Spare Parts" on Page 66.

Assembly

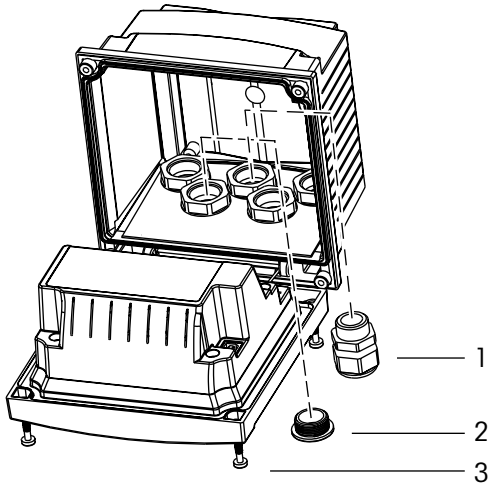


Fig. 7: Assembly

1 Cable glands M20 x 1.5 (3 pieces)
2 Blind plug
3 Screws (4 pieces)

General

- Orient the transmitter so that the cable glands face downwards.
- Lines have to be suitable for wet conditions.
- In order to provide IP66 enclosure ratings, all cable glands must be in place. Each cable gland must be filled using a cable.
- Not used cable glands must be closed by suitable blind plugs.
- Tighten the screws of the front panel with a tightening torque of 1.5 Nm to 2 Nm.

4.4 Panal Mounting

For the panal mouting kit refer to Chapter 16 "Accessories and Spare Parts" on Page 66.

To insure a good seal, the panel or door must be flat and have a smooth finish. Textured or rough surfaces are not recommended and may limit the effectiveness of the gasket seal provided.

1. Make cutout in panel. Refer to Chapter 4.2 "Dimensions" on Page 21.
   – Be sure surface surrounding cutout is clean, smooth and free of burrs.
2. Slide face gasket around transmitter from the back of the unit.
3. Place transmitter into cutout hole. Be sure there are no gaps between the transmitter and panel surface.
4. Place the two mounting brackets on either side of the transmitter as shown.
5. While holding transmitter firmly into the cutout hole, push the mounting brackets toward the backside of panel.
6. Once secure, use a screwdriver to tighten the brackets against the panel. In order to provide IP66/NEMA4X environmental enclosure rating, the two clamps provided shall be securely tightened to create an adequate seal between the panel enclosure and transmitter.
   – Face gasket will compress between transmitter and panel.

4.5 Wall Mounting

For the wall mouting kit refer to Chapter 16 "Accessories and Spare Parts" on Page 66.

1. Mount wall mounting kit to the housing. Do not exceed maximum screw-in depth.
2. Mount wall mounting kit with the housing to the wall. Attach to wall using appropriate mounting hardware for wall surface. Be sure it is level and securely fastened and the installation adheres to any and all clearance dimensions required for transmitter service and maintenance. Orient the transmitter so that the cable grips are facing downward.

4.6 Pipe Mounting

The transmitter may only be mounted on a pipe by using the optional pipe mount kit. Refer to Chapter 16 "Accessories and Spare Parts" on Page 66.

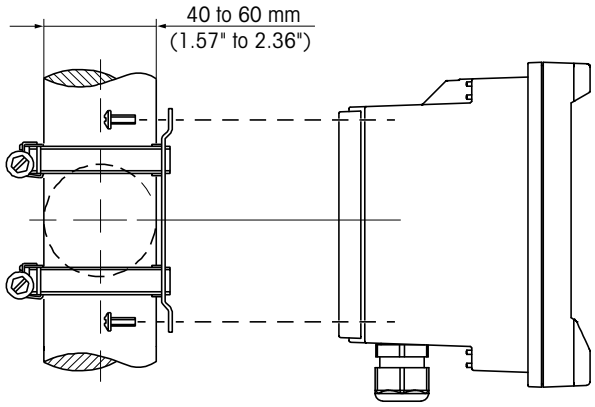


Fig. 8: Pipe mounting

1. Tighten the fixing screws with a tightening torque of 2 to 3 Nm.

5 Wiring

5.1 Electrical Connection of the Transmitter

⚠ Power off transmitter during wiring.

Connect wires firmly to the connection terminals.

For power requirements and ratings and size power wiring refer to Chapter 17.2.1 "General Electrical Specifications" on Page 68.

All connections to the transmitter are made on the rear panel.

1. Switch off supply voltage.
2. Connect mains supply (14 to 30 V DC) to the terminals AO1+ / HART and AO1– / HART or to the terminals AO2+ and AO–. Notice polarity.
3. Connect digital input signal, digital output signals (OC) and analog output signal to terminal block TB1. Refer to Chapter 5.2 "Overview of Terminal Blocks in Transmitter" on Page 25.
4. Connect sensor to terminal block TB2. Refer to Chapter 5.3 "Connection of Terminal Block TB2: Sensor Connection" on Page 27.

5.2 Overview of Terminal Blocks in Transmitter

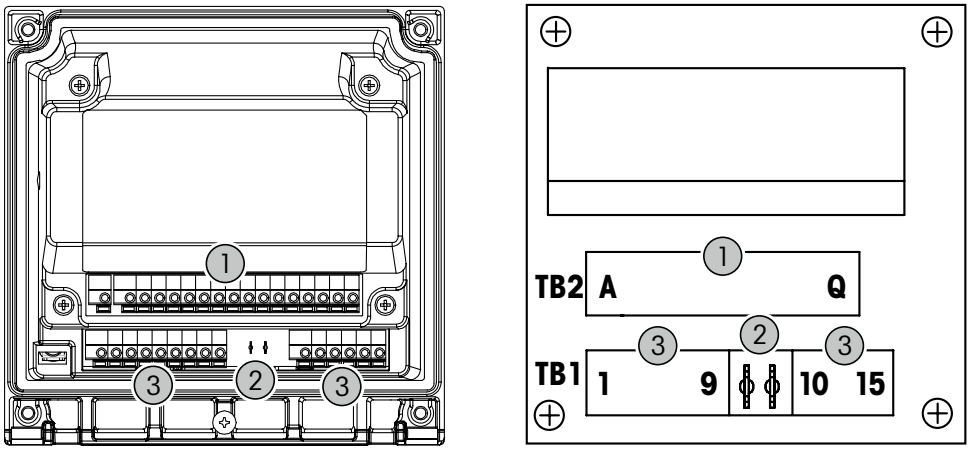


Fig. 9: Overvew of terminal blocks in transmitter

1 TB1: Terminal block 1 –
Power connection, HART signal, digital input signal, digital output signals (OCs) and analog output signals
2 Connection of HART modem
3 TB2: Terminal block 2 – Sensor signal

Terminal		Description	
TB1	1	DI1+	Digital input 1
	2	DI1–	
	3	DI2+	Not active for M400/2XH Cond Ind transmitter
	4	DI2–	
	5	Not used	–
	6	OC1+	Digital output 1 (open collector)
	7	OC1–	
	8	OC2+	Digital output 2 (open collector)
	9	OC2–	
	10	AO1+, HART+	• Power connection 14 to 30 V DC. Notice polarity. • Analog output signal 1 • HART signal
	11	AO1–, HART–	
	12	AO2+	• Power connection 14 to 30 V DC. Notice polarity. • Analog output signal 2
	13	AO2–	
	14	Not used	–
	15	⏚	Ground
TB2	A – Q	–	Sensor input. Refer to Chapter 5.3 "Connection of Terminal Block TB2: Sensor Connection" on Page 27.

Table 6: Terminal block (TB) definition M400

5.3 Connection of Terminal Block TB2: Sensor Connection

5.3.1 Analog Inductive Conductivity Sensors

The analog inductive conductivity sensor is connected to terminal block TB2.

Terminal		Function	Color	
			InPro 7250 ST / InPro 7250 PFA	InPro 7250 HT
TB2	A	Not used	–	–
	B	Not used	–	–
	C	Not used	–	–
	D	Send High	Blue	Black or Transparent
	E	Send Low	Brown	Violet
	F	Shield (GND)	Green-Yellow	Green-Yellow
	G	Receive Low	Red	Yellow
	H	Receive High	Black or Transparent	Red
	I	RTD	White	White
	J	RTD sense	Grey	Grey
	K	RTD	Green	Green
	L – Q	Not used	–	–

Table 7: Analog inductive conductivity sensors

5.4 HART Communication

You configure the M400 transmitter either via a configuration tool, an asset-management-tool or via a HART handheld terminal.

The DD and the DTM files can be downloaded via Internet "www.mt.com/M400". The DD is also on the supplied CD-ROM.

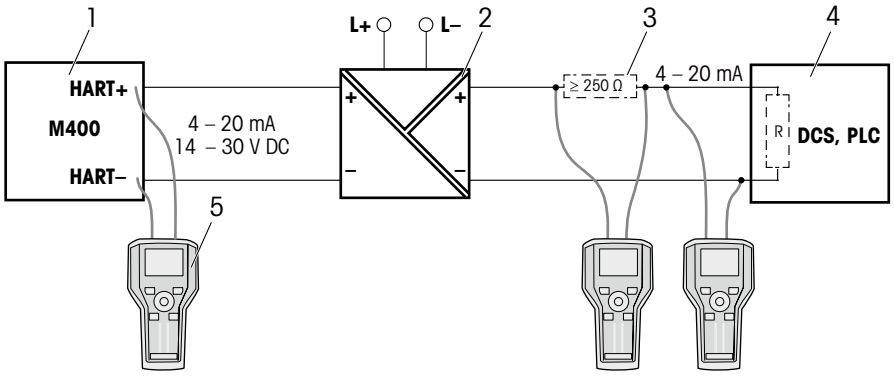


Fig. 10: HART® connection with HART handheld terminal

1 M400 transmitter
2 Repeater power supply, preferably HART transparent
3 Load resistor, is not required if one is installed in the repeater power supply
4 DCS (Distributed control system) or PLC (Programmable logic controller)
5 HART handheld terminal e.g. 475 FieldCommunicator from Emerson

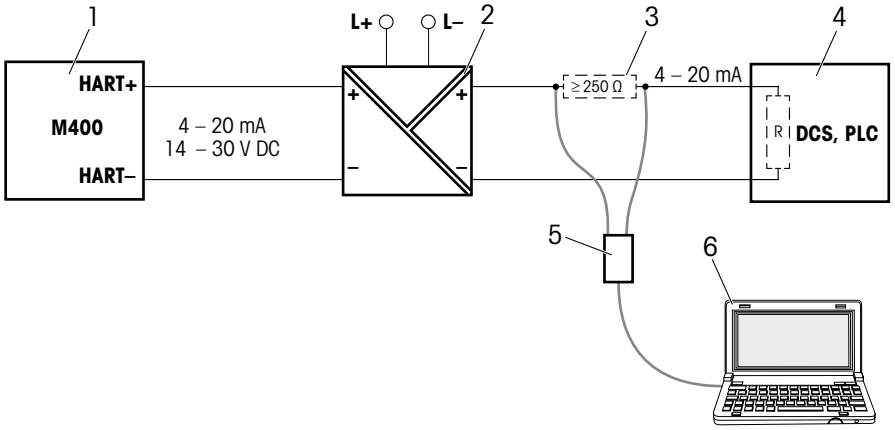


Fig. 11: HART® connection with HART modem and configuration tool

1 M400 transmitter
2 Repeater power supply, preferably HART transparent
3 Load resistor, is not required if one is installed in the repeater power supply
4 DCS (Distributed control system) or PLC (Programmable logic controller)
5 HART modem
6 PC with configuration tool, e.g. PACTWare™ from Pepperl+Fuchs
PACTWare™ is on supplied CD-ROM or available as freeware.

6 Placing Transmitter In, or Out of Service

6.1 Placing Transmitter in Service

After connecting the transmitter to power supply circuit, it will be active as soon as the circuit is powered.

6.2 Placing Transmitter Out of Service

First disconnect the unit from the main power source, then disconnect all remaining electrical connections. Remove the unit from the wall/panel. Use the installation instruction in this manual as reference for dis-assembling mounting hardware.

All transmitter settings stored in memory are non volatile.

7 Quick Setup

(PATH: Menu/Quick Setup)

Select Quick Setup and press the [ENTER] key. Enter the security code if necessary. Refer to Chapter 10.2 "Passwords" on Page 48.

NOTE: Please do not use Quick Setup menu after configuration of the transmitter, because some of the parameters i.e. analog output configuration will may be reseted.

Parameter	Description
Channel Select	Select for the connected sensor type "Analog".
Parameter	Select the measured value. For analog inductive conductivity only the parameter "Cond Ind" is available.
Sensor	Select the connected sensor type. • InPro7250 • InPro7250-PFA • Other: Enter for this option the values "Transfer Ratio" and "Frequency".
Cell constants (Ap: M and A / As: M and A)	Enter the cell constants given on the sensor label or certificate.
a and b	Set the first and second parameter. The options depend on the connected sensor. • a: First parameter shown in the first line on the display. • b: Second parameter shown in the second line on the display.
Analog Outputs	Only the option "Yes" is possible. The analog output is activated.

Table 8: Quick Setup

The following parameters are shown when the option "a" was selected.

Parameter	Description
Aout1 min, Aout1 max	Set the analog output for the first parameter (a). • Aout1 min: Defines the value for the 4 mA output value. Example: 4 mA at 0.000 mS/cm • Aout1 max: Defines the value for the 20 mA output value. Example: 20 mA at 100.0 mS/cm
a Set Point	Activate or deactivate the "a Set Point" for the first parameter. • Yes: Set Point is activated. • No: Set Point is deactivated.

Parameter	Description
SP1 Type	Set the Set Point type for the first parameter. The Set Point is assigned to the digital output (OC) by the "SP1 Use OC #" parameter. • Off: The Set Point is deactivated. • Between: The Set Point switches, if the measured value is between the low and high Set Point. • Outside: The Set Point switches, if the measured value is either lower than the low Set Point or higher than the high Set Point . • Low: The Set Point switches, if the measured value is lower than the Set Point . • High: The Set Point switches, if the measured value is higher than the Set Point. Set the other required parameters. The parameters are dependent on the selected option.
SP1 use OC #	Prerequisite: The Set Point 1 is activated. Assign the Set Point for the first parameter to the digital output (OC). #2 has to be selected.

Table 9: Quick Setup – Aout1, SP1

The following parameters are shown when the option "b" was selected.

Parameter	Description
Aout2 min, Aout2 max	Set the analog output for the second parameter (b). • Aout1 min: Defines the value for the 4 mA output value. Example: 4 mA at 0.000 °C • Aout1 max: Defines the value for the 20 mA output value. Example: 20 mA at 100.0 °C
b Set Point	Activate or deactivate the "b Set Point" for the second parameter. • Yes: Set Point is activated. • No: Set Point is deactivated.
SP2 Type	Set the Set Point type for the second parameter. The Set Point is assigned to the digital output (OC) by the "SP2 Use OC #" parameter. • Off: The Set Point is deactivated. • Between: The Set Point switches, if the measured value is between the low and high Set Point. • Outside: The Set Point switches, if the measured value is either lower than the low Set Point or higher than the high Set Point . • Low: The Set Point switches, if the measured value is lower than the Set Point . • High: The Set Point switches, if the measured value is higher than the Set Point. Set the other required parameters. The parameters are dependent on the selected option.
SP2 use OC #	Prerequisite: The Set Point 2 is activated. Assign the Set Point for the second parameter to the digital output (OC). #2 has to be selected.

Table 10: Quick Setup – Aout2, SP2

8 Sensor Calibration

(PATH: Cal)

The calibration key ▶ allows the user one-touch access to sensor calibration and verification features.

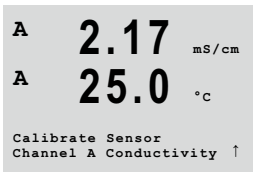
NOTE: During Calibration on Channel A, a flashing "H" (Hold) in the upper left corner of the Display indicates a calibration is in process with a Hold condition active. (The hold output needs to be activated.) Refer to Chapter 3.4 "Displays" on Page 19.

NOTE: When performing calibration on a conductivity sensor, results will vary depending on the methods, calibration apparatus and/or quality of reference standards used to perform the calibration.

NOTE: For measuring tasks the temperature compensation for the application as defined at the menu Resistivity will be considered and not the temperature compensation selected thru the calibration procedure. Refer to Chapter 9.2.3 "Resistivity – Conductivity Temperature Compensation" on Page 37 (Menu/Configure/Measurement/Resitivity).

For inductive conductivity sensors the "Process", "1 Point" and "Zero Point" calibration methods are available. The process calibration and the 1 Point calibration are always performed as a slope calibration. At the Zero Point calibration the system assumes that the conductivity of the reference system is "0".

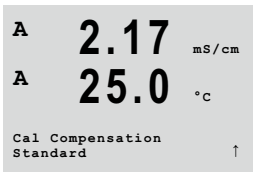
8.1 Process Sensor Calibration Mode



While in Measurement mode press the [CAL (▶)] key. If the display prompts you to enter the Calibration security code, press the ▲ or ▼ key to set the calibration security mode. Press the [ENTER] key to confirm the calibration security code.

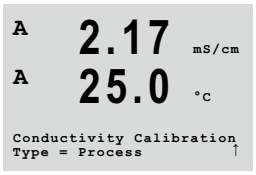
Select the type of calibration, here "Conductivity". Press the ▲ or ▼ key to select the type. The following options are available: Conductivity, Resistivity, Temperature, Edit and Verify.

Press the [Enter] key.



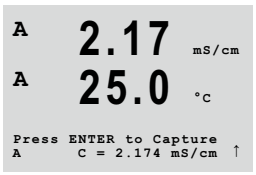
Select compensation method, e.g. "Standard". Refer to Table "Compenation Mode" on Page 37.

Press the [Enter] key.



Select calibration type, here "Process". The process calibration is always performed as a slope calibration.

Press the [Enter] key.



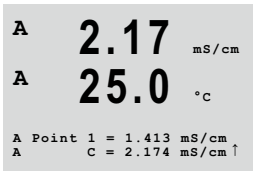
Result: The display shows the message "Press ENTER to Capture" is shown.

Take a sample.

Press the [Enter] key to store the current measuring value.

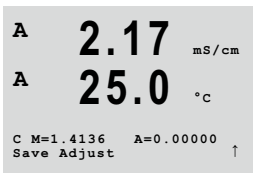
Result: During the ongoing calibration process, the letter "A" is blinking in the display.

After determining the conductivity value of the sample, press the [CAL (▶)] key again to proceed with the calibration.



Enter the conductivity value of the sample.

Press the [ENTER] key to start the calculation of calibration results.



Result: After the calibration the display shows the Multiplier or slope calibration factor "M" and the Adder or offset calibration factor "A".

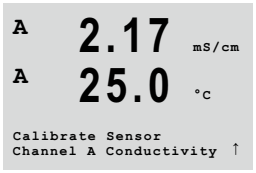
Select ADJUST or ABORT to finish calibration.
Adjust: Calibration values are stored in the transmitter and used for the measurement. Additionally, the calibration values are stored in the calibration data.
Abort: Calibration values are discarded.

Result: The display shows the message "RE-INSTALL SENSOR and Press [ENTER]".

Press the [ENTER] key to return to the measuring mode.

8.2 1 Point Sensor Calibration

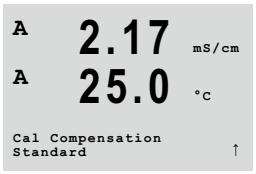
(Display reflects typical Conductivity Sensor calibration)



While in Measurement mode press the [CAL (▶)] key. If the display prompts you to enter the Calibration security code, press the ▲ or ▼ key to set the calibration security mode. Press the [ENTER] key to confirm the calibration security code.

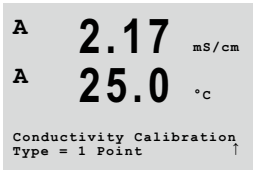
Select the type of calibration, here "Conductivity". Press the ▲ or ▼ key to select the type. The following options are available: Conductivity, Resistivity, Temperature, Edit and Verify.

Press the [Enter] key.



Select compensation method, e.g. "Standard". Refer to Table "Compenation Mode" on Page 37.

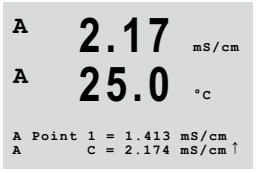
Press the [Enter] key.



Select calibration type, here "1 Point". The ! Point calibration is always performed as a slope calibration.

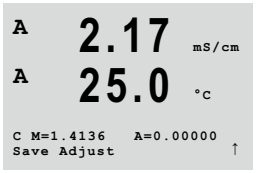
Place the sensor into the reference solution.

Press the [Enter] key.



Enter the value for Point 1 including a decimal point and units. The value in the second text line is the value being measured by the transmitter and sensor in the units selected by the user.

Press [ENTER] when this value is stable to perform the calibration.



Result: After the calibration the display shows the Multiplier or slope calibration factor "M" and the Adder or offset calibration factor "A".

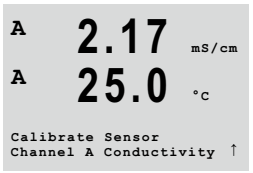
Select ADJUST or ABORT to finish calibration.
Adjust: Calibration values are stored in the transmitter and used for the measurement. Additionally, the calibration values are stored in the calibration data. Abort: Calibration values are discarded.

Result: The display shows the message "RE-INSTALL SENSOR and Press [ENTER]".

Press the [ENTER] key to return to the measuring mode.

8.3 Zero Point Sensor Calibration

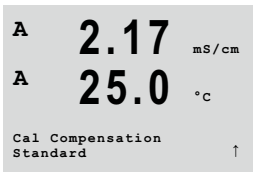
(Display reflects typical Conductivity Sensor calibration)



While in Measurement mode press the [CAL (▶)] key. If the display prompts you to enter the Calibration security code, press the ▲ or ▼ key to set the calibration security mode. Press the [ENTER] key to confirm the calibration security code.

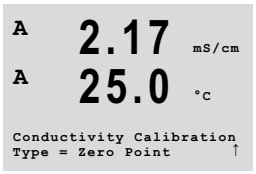
Select the type of calibration, here "Conductivity". Press the ▲ or ▼ key to select the type. The following options are available: Conductivity, Resistivity, Temperature, Edit and Verify.

Press the [Enter] key.



Select compensation method, e.g. "Standard". Refer to Table "Compenation Mode" on Page 37.

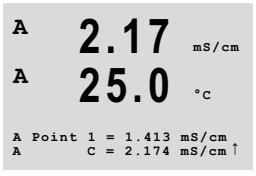
Press the [Enter] key.



Select calibration type, here "Zero Point". The system assumes that the conductivity of the reference system is "0".

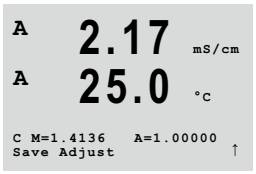
Place the sensor into the reference solution.

Press the [Enter] key.



Result: The display shows in the first line "0.0".The value in the second text line is the value being measured by the transmitter and sensor in the units selected by the user.

Press [ENTER] when this value is stable to perform the calibration.



Result: After the calibration the display shows the Multiplier or slope calibration factor "M" and the Adder or offset calibration factor "A".

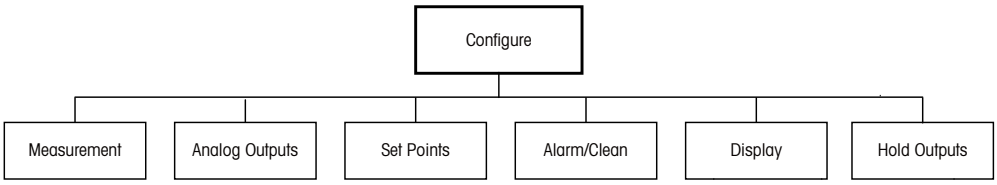
Select ADJUST or ABORT to finish calibration.
Adjust: Calibration values are stored in the transmitter and used for the measurement. Additionally, the calibration values are stored in the calibration data.
Abort: Calibration values are discarded.

Result: The display shows the message "RE-INSTALL SENSOR and Press [ENTER]".

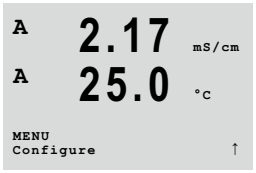
Press the [ENTER] key to return to the measuring mode.

9 Configuration

(PATH: Menu/Configure)



9.1 Enter Configuration Mode

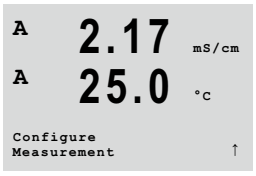


While in Measurement mode, press the [MENU (◀)] key.

Press the ▲ or ▼ key to navigate to the "Configure" menu. Press the [ENTER] key.

9.2 Measurement

(PATH: Menu/Configure/Measurement)

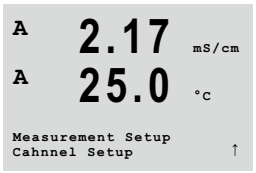


Enter configuration mode. Refer to Chapter 9.1 "Enter Configuration Mode" on Page 35.

Press the ▲ or ▼ key to navigate to the "Measurement" menu. Press the [ENTER] key.
The following sub menus can now be selected: Channel Setup, Resistivity, Concentration Table and Set Averaging.

9.2.1 Channel Setup

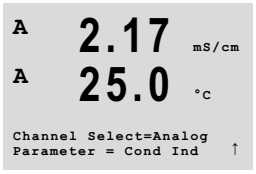
(PATH: Menu/Configure/Measurement/Channel Setup)



Enter configuration mode. Refer to Chapter 9.1 "Enter Configuration Mode" on Page 35.

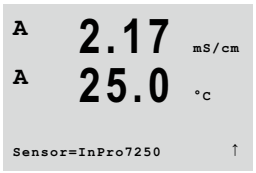
Press the ▲ or ▼ key to navigate to the "Measurement" menu. Press the [ENTER] key.

Select the "Channel Setup" menu. Press the [ENTER] key.

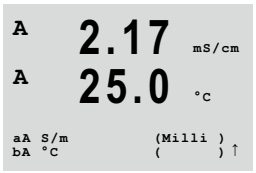


Result: The display shows "Channel Select = Analog" and "Parameter = Cond Ind".

Press the [ENTER] key.

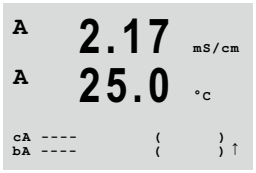


Select for "Sensor one of the following option:
InPro 7250: InPro 7250 and InPro 7250 HT
InPro 7250-PFA: For InPro 7250-PFA:
Other: For all other inductive conductivity sensors.



Configure the 1st and 2nd line of the display a and b. Press the ▶ or ◀ key to toogle between the measurements / units and the multipliers. Press the ▲ or ▼ key to select the options.

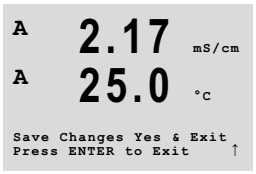
Press the [ENTER] key.



Configure the 3rd and 4th line of the display c and d. Press the ▶ or ◀ key to toogle between the measurements / units and the multipliers. Press the ▲ or ▼ key to select the options.

Press the [ENTER] key.

Result: The save changes dialog is displayed.



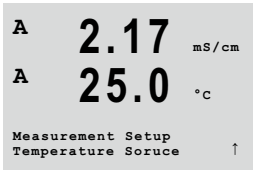
Select one of the options. Selecting "No" will discard the entered values and return to the measurement display screen, selecting "Yes" will save changes made.

9.2.2 Temperature Source

(PATH: Menu/Configure/Measurement/Temperature Source)

Enter configuration mode. Refer to Chapter 9.1 "Enter Configuration Mode" on Page 35.

Press the ▲ or ▼ key to navigate to the "Measurement" menu. Press the [ENTER] key.

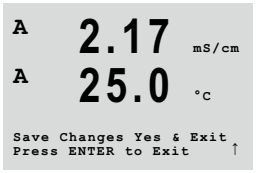


Select the "Temperature Source" menu. Press the [ENTER] key.

Select one of the following options:

Auto: The transmitter automatically recognizes the temperature source.
Use NTC22K: Input will be taken from the sensor attached.
Use Pt1000: Temperature input will be taken from the sensor attached
Use Pt1 00: Input will be taken from the sensor attached.
Fixed = 25 °C: Allows a specific temperature value to be entered.

Press the [ENTER] key.



Result: The save changes dialog is displayed.

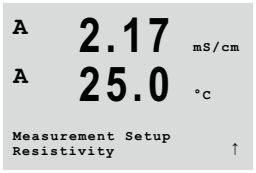
Select one of the options. Selecting "No" will discard the entered values and return to the measurement display screen, selecting "Yes" will save changes made.

9.2.3 Resistivity – Conductivity Temperature Compensation

(PATH: Menu/Configure/Measurement/Resistivity)

Enter configuration mode. Refer to Chapter 9.1 "Enter Configuration Mode" on Page 35.

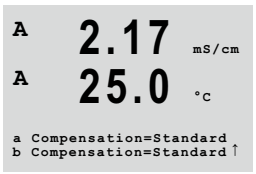
Press the ▲ or ▼ key to navigate to the "Measurement" menu. Press the [ENTER] key.



Select the "Resistivity" menu. Press the [ENTER] key.

Temperature compensation should be matched to the characteristics of the application. The transmitter considers this value for the temperature compensation by calculating and displaying the result for the measured conductivity.

NOTE: For calibration purposes the temperature compensation as defined at the menu "Cal/Compensation" for the samples will be considered.



The first two measurement lines are displayed on the screen. This chapter described the procedure for the first measurement line. By using the key ▶ the second line will be chosen. To select the 3rd and 4th line press [ENTER]. The procedure itself works at every measurement line in the same way.

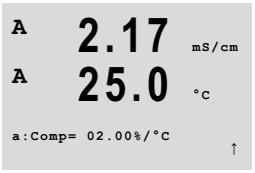
Select one of the following Compensation Modes and press the [ENTER] key.

Compenation Mode

Compensation Mode	Description
Standard	The **Standard** compensation mode includes compensation for non-linear high purity effects and conventional neutral salt impurities. This mode conforms to ASTM standards D1125 and D5391.
Linear 25 °C	The **Linear 25 °C** compensation mode adjusts the reading by a coefficient expressed as %/°C, deviation from 25 °C. Use this mode only if the solution has a well-characterized linear temperature coefficient. The coefficient is set with the **Comp** parameter. (Default: 2.0 %/°C)
Linear 20 °C	The **Linear 20 °C** compensation mode adjusts the reading by a coefficient expressed as %/°C, deviation from 20 °C. Use this mode only if the solution has a well-characterized linear temperature coefficient. The coefficient is set with the **Comp** parameter. (Default: 2.0 %/°C)
Light 84	The **Light 84** compensation mode matches the high purity water research results of Dr. T.S. Light published in 1984. Use this mode only if your institution has standardized on that work.
Std 75 °C	The **Std 75 °C** compensation mode is the Standard compensation algorithm referenced to 75 °C.
Glycol .5 (Gylcol 0.5)	The **Glycol .5** compensation mode matches the temperature characteristics of 50 % ethylene glycol in water. Compensated measurements using this solution may go above 18 Mohm-cm.

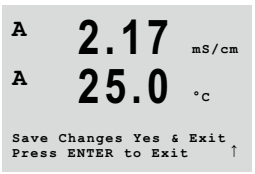
Compensation Mode	Description
Glycol 1	The **Glycol 1** compensation mode matches the temperature characteristics of 100 % ethylene glycol. Compensated measurements may go well above 18 Mohm-cm.
Cation	The **Cation** compensation mode is used in power industry applications measuring the sample after a cation exchanger. This mode takes into account the effects of temperature on the dissociation of pure water in the presence of acids.
Alcohol	The **Alcohol** compensation mode provides for the temperature characteristics of a 75 % solution of isopropyl alcohol in pure water. Compensated measurements using this solution may go above 18 Mohm-cm.
Ammonia	The **Ammonia** compensation mode is used in power industry applications for specific conductivity measured on samples using ammonia and/or ETA (ethanolamine) water treatment. This mode takes into account the effects of temperature on the dissociation of pure water in the presence of these bases.
None	The **None** compensation mode does not make any compensation of the measured conductivity value.

Table 11: Resitivity – Compensation mode



If compensation mode "Lin 25 °C" or "Lin 20 °C" has been chosen, the factor for the adjustment of the reading "Comp" can be modified.

Press the [ENTER] key.



Result: The save changes dialog is displayed.

Select one of the options. Selecting "No" will discard the entered values and return to the measurement display screen, selecting "Yes" will save changes made.

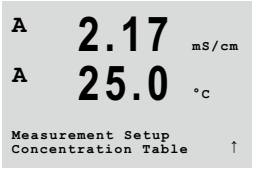
9.2.4 Concentration Table

(PATH: Menu/Configure/Measurement/Concentration Table)

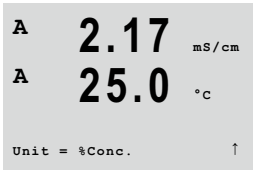
To specify customers-specific solutions, up to 9 concentration values can be edited in a matrix together with up to 9 temperatures. To do so the desired values are edited under the concentration table menu. Furthermore the conductivity values for the according temperature and concentration values are edited.

Enter configuration mode. Refer to Chapter 9.1 "Enter Configuration Mode" on Page 35.

Press the ▲ or ▼ key to navigate to the "Measurement" menu. Press the [ENTER] key.



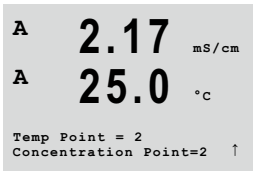
Select the "Concentration Table" menu. Press the [ENTER] key.



Define the desired **unit**.

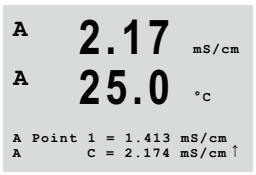
Press the [ENTER] key.

NOTE: Select the same unit as used in the display. Refer to Chapter 9.2.1 "Channel Setup" on Page 35.



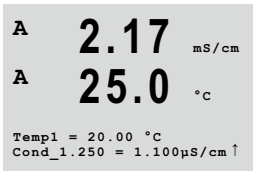
Enter the amount of desired temperature points (**Temp Point**) and **Concentration Points**.

Press the [ENTER] key.



Enter the values for the different concentrations (**ConcentrationX**).

Press the [ENTER] key.



Enter the value of the 1st temperature (**Temp1**) and the value for the conductivity which belongs to the first concentration at this temperature.

Press the [ENTER] key.

Enter the value for the conductivity which belongs to the second concentration at the first temperature and press [ENTER] etc.

After entering all conductivity values, that belong to the different concentrations at the first temperature point, enter in the same way the value of the 2nd temperature point (**Temp2**) and the conductivity value which belongs at the second temperature to the first concentration. Press [ENTER] and go on in the same way for the next concentration points as described for the first temperature point.

Enter in this way the values at every temperature point. After entering the last value, pressing [ENTER] again will bring up the Save Changes dialog. Selecting No will discard the entered values and return to the measurement display screen, selecting Yes will save changes made.

NOTE: The values for the temperature have to increase from Temp1 to Temp2 to Temp3 etc.. The values for the concentration have to increase from Concentration1 to Concentration2 to Concentration3 etc.

NOTE: The conductivity values at the different temperatures have to increase or decrease from Concentration1 to Concentration2 to Concentration3 etc.. Maxima and/or minima are not permitted. If the conductivity values at Temp1 are increasing with the different concentrations, they have to increase also at the other temperatures. If the conductivity values at Temp1 are decreasing with the different concentrations, they have to decrease also at the other temperatures.

9.2.5 Set Averaging

(PATH: Menu/Configure/Measurement/Set Averaging)

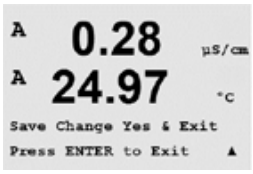
Enter configuration mode. Refer to Chapter 9.1 "Enter Configuration Mode" on Page 35.

Press the ▲ or ▼ key to navigate to the "Measurement" menu. Press the [ENTER] key.

Select the "Set Averaging" menu. Press the [ENTER] key.

The averaging method (noise filter) for each measurement line can now be selected.
The options are Special (Default), None, Low, Medium and High:

None = no averaging or filtering
Low = equivalent to a 3 point moving average
Medium = equivalent to a 6 point moving average
High = equivalent to a 10 point moving average
Special = averaging depending on signal change (normally High averaging but Low averaging for large changes in input signal)



Pressing the [ENTER] key again will bring up the Save Changes dialog. Selecting No will discard the entered values and return to the measurement display screen, selecting Yes will save changes made.

9.3 Analog Outputs

(PATH: Menu/Configure/Analog Outputs)

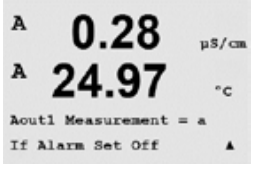
With the "Analog Outputs" menu you configure the 2 analog outputs.

Enter Configuration mode. Refer to Chapter 9.1 "Enter Configuration Mode" on Page 35.

Navigate to the "Analog Outputs" menu by using the ▲ or ▼ key.

Press the [ENTER] key.

Once analog outputs have been selected, use the ◀ and ▶ key to navigate between configurable parameters. Once a parameter is selected, its setting can be selected per the following table.



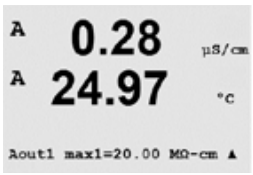
When an alarm value is selected the analog output will go to this value if any of these alarm conditions occurs. Refer to Chapter 9.5.1 "Alarm" on Page 43.

With the "Aout1 Measurement = a" parameter the analog output 1 is assigned to the measured value "a". With the "Aout2 Measurement = b" parameter the analog output 2 is assigned to the measured value "b".

With the "If Alarm Set" parameter the current is set to 3.6 mA or 22.0 mA (default) in case of an alarm.

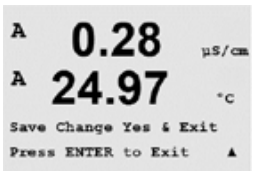
The "AoutX Type" parameter is "Normal". The "AoutX Range" parameter is "4–20 mA".

Enter the minimum and maximum value of Aout.



If Auto-Range was selected then Aout max1 can be configured. Aout max1 is the maximum value for the first range on auto-range. The maximum value for the second range on auto-range was set in the previous menu. If Logarithmic Range was selected, it will also prompt for the number of decades as "Aout1 # of Decades =2".

The value for the Hold mode can be configured to hold the last value or can be set to a fixed value.



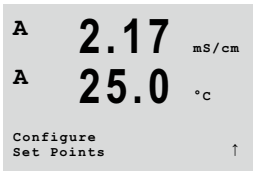
Pressing the [ENTER] key again will bring up the Save Changes dialog. Selecting No will discard the entered values and return to the measurement display screen, selecting Yes will save changes made.

9.4 Set Points

(PATH: Menu/Configure/Set Points)

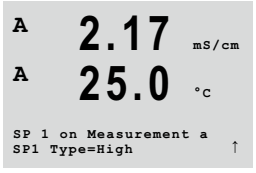
With the "Set Pointss" menu you can configure up to 6 setpoints.

Enter Configuration mode. Refer to Chapter 9.1 "Enter Configuration Mode" on Page 35.



Navigate to the "Set Points" menu by using the ▲ or ▼ key.

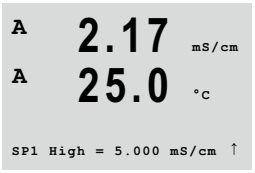
Press the [ENTER] key.



Up to 6 setpoints can be configured on any of the measurements (a thru d). The possible Setpoint types are Off, High, Low, Outside (<->) and Between (>-<).

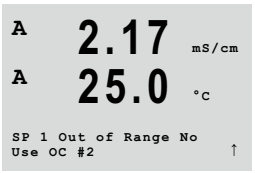
An "Outside" setpoint will cause an alarm condition whenever the measurement goes above its high limit or below its low limit. A "Between" setpoint will cause an alarm condition to occur whenever the measurement is between its high and low limits.

Enter the desired value(s) for the setpoint and the press [ENTER] key.



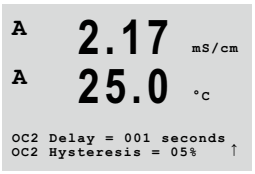
Depending on the defined setpoint type, this screen provides the option to adjust the values for the setpoint(s).

Press the [ENTER] key.



Out of Range
Once configured, the selected OC will be activated if a sensor Out of Range condition is detected on the assigned input channel. Select the setpoint and "Yes" or "No". Select the desired OC that will activate when the setpoint alarm condition is reached.

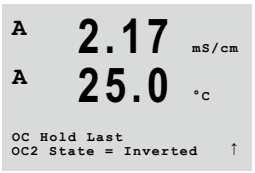
Press the [ENTER] key.



Delay
Enter the delay time in seconds. A time delay requires the setpoint to be exceeded continuously for the specified length of time before activating the OC. If the condition disappears before the delay period is over, the OC will not be activated.

Hysteresis
Enter value for the hysteresis. A hysteresis value requires the measurement to return within the setpoint value by a specified hysteresis before the OC is deactivated.

For a high setpoint, the measurement must decrease more than the indicated hysteresis below the setpoint value before the OC is deactivated. With a low setpoint, the measurement must rise at least this hysteresis above the setpoint value before the OC is deactivated. For example, with a high setpoint of 100 and hysteresis of 10, when this value is exceeded, the measurement must fall below 90 before the OC is deactivated.
Press the [ENTER] key.



Hold
Enter the OC Hold Status of "Last", "On" or "Off". This is the state the OC will go to during a hold status.

State
OC contacts are in normal state until the associated setpoint is exceeded, then the OC is activated and the contact states change.

Select "Inverted" to reverse the normal operating state of the OC (i.e. normally high voltage state is in a low voltage state until the setpoint is exceeded). "Inverted" OC operation is functional vice versa. All OCs can be configured.

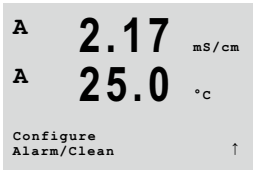
Pressing the [ENTER] key again will bring up the Save Changes dialog. Selecting No will discard the entered values and return to the measurement display screen, selecting Yes will save changes made.

9.5 Alarm/Clean

(PATH: Menu/Configure/Alarm/Clean)

This menu allows the configuration of alarm and clean functionality.

Enter Configuration mode. Refer to Chapter 9.1 "Enter Configuration Mode" on Page 35.

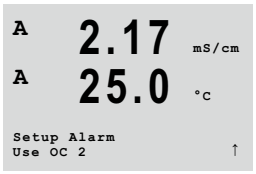


Navigate to the "Alarm / Clean" menu by using the ▲ or ▼ key.

Press the [ENTER] key.

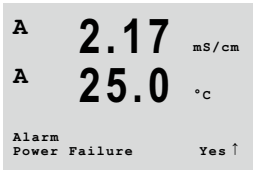
Select the option "Setup Alarm" to configure the alarm functionality. Select the option "Setup Clean" to configure the clean functionality.

9.5.1 Alarm



To select "Setup Alarm", press the ▲ or ▼ key so that "Alarm" is flashing.

Using the ◄ and ► keys, navigate to "Use OC #". Using the ▲ or ▼ keys, select a OC to be used for the alarm and press [ENTER].



Select the alarm event by using the ▲ or ▼ key. Assign for each alarm event the option "Yes" or "No".

The following alarm events are available:

Alarm event (criteria)	Condition for the alarm
Power Failure	There is a power failure or power cycling
Software Failure	The software watchdog performs a reset
Cond Ind Defect	If the sensor is faulty e.g. through broken wires or a short cut

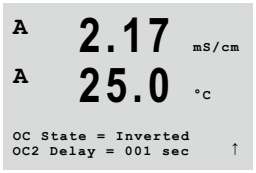
Table 12: Alarm events

If any of these alarm events are set to "Yes" and the conditions for an alarm are given, the flashing symbol ⚠ will be shown in the display. The selected OC will be activated.

An alarm message will be recorded. Refer to Chapter 13.1 "Messages" on Page 61 (PATH: Info/Messages).

Furthermore an alarm can be indicated by the current output if this has been parameterized. Refer to Chapter 9.3 "Analog Outputs" on Page 40.

For the alarm events "Power Failure" and "Software Failure" the alarm indicator will be turned off when the alarm message is cleared. It will reappear if the power is constantly cycling or if the watchdog is repeatedly resetting the system.

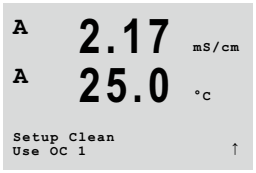


Each alarm OC can be configured in either a Normal or Inverted state. In addition, a Delay for the activation can be set. Refer also to Chapter 9.4 "Set Points" on Page 41.

Pressing the [ENTER] key again will bring up the Save Changes dialog. Selecting No will discard the entered values, selecting Yes will make the entered values the current ones.

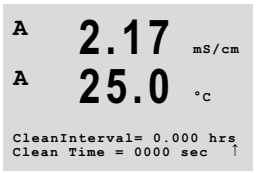
Note: There are additional alarms, which will be indicated in the display. Refer to Chapter 15 "Troubleshooting" on Page 64.

9.5.2 Clean



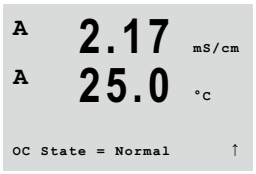
Configure the OC to be used for the cleaning cycle.

The default value is OC 1.



The cleaning interval can be set from 0.000 to 999.9 hours. Setting it to 0 turns the clean cycle off. The cleaning time can be 0 to 9999 seconds and must be smaller than the cleaning interval.

Select the desired OC state: Normal or Inverted.



Pressing the [ENTER] key again will bring up the Save Changes dialog. Selecting No will discard the entered values and return to the measurement display screen, selecting Yes will save changes made.

9.6 Display

(PATH: Menu/Configure/Display)

This menu allows for the configuration of the values to be displayed and also the configuration of the display itself.

Enter Configuration mode. Refer to Chapter 9.1 "Enter Configuration Mode" on Page 35.

Navigate to the "Display" menu by using the ▲ or ▼ key.

Press the [ENTER] key.

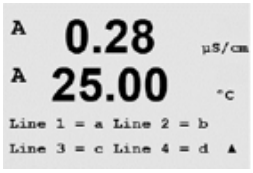
9.6.1 Measurement

(PATH: Menu/Configure/Display/Measurement)

The display has 4 lines. Line 1 on top and Line 4 on the bottom.

Select the values (Measurement a, b, c or d) to be displayed on each line of the display.

The selection of the values for a, b, c, d needs to be done under Configuration/measurement/Channel Setup.



Select the "Error Display" mode. If this is set to "On" when an alarm or warning has occurred, the message "Failure – Press ENTER" will be displayed on Line 4 when an alarm occurs in the normal measurement mode.

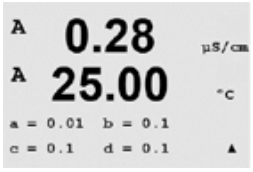
Pressing the [ENTER] key again will bring up the Save Changes dialog. Selecting No will discard the entered values, selecting Yes will make the entered values the current ones.

9.6.2 Resolution

(PATH: Menu/Configure/Display/Resolution)

This menu allows the setting of the resolution of each displayed value.

The accuracy of the measurement is not effected by this setting.



Possible settings are 1, 0.1, 0.01, 0.001 or Auto.

Pressing the [ENTER] key will bring up the Save Changes dialog.

9.6.3 Backlight

(PATH: Menu/Configure/Display/Backlight)

This Menu allows the setting of the back light options of the display.

Possible settings are On, On 50% or Auto Off 50%. If Auto Off 50% is selected then the backlight will go to 50% after 4 minutes with no keypad activity. The backlight will automatically come back on if a key is pressed.

Pressing the [ENTER] key will bring up the Save Changes dialog.

9.6.4 Name

(PATH: Menu/Configure/Display/Name)

This menu allows for the configuration of an alpha-numeric name which is displayed in the first 9 characters on lines 3 and 4 of the display. The default is nothing (blank).

If a name is entered on line 3 and/or 4 a measurement can be still displayed on the same line.

Use the ◄ and ► keys to navigate between digits to be altered. Using the ▲ and ▼ keys to change the character to be displayed. Once all digits of both display channels have been entered, press [ENTER] to bring up the Save Changes dialog.

The resulting display in the measurement mode appears on lines 3 and 4 ahead of the measurements.

9.7 Hold Analog Outputs

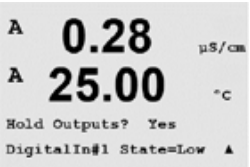
(PATH: Menu/Configure/Hold Outputs)

Enter Configuration mode. Refer to Chapter 9.1 "Enter Configuration Mode" on Page 35.

Navigate to the "Hold Outputs" menu by using the ▲ or ▼ key.

Press the [ENTER] key.

The **"Hold outputs"** function applies during the calibration process. If set "Hold outputs" to Yes, during calibration process the analog output, the output OC will be at hold state. The hold state depends on the setting. For the possible hold settings, see the list below. The following options are possible:



Hold Outputs? Yes/No

The **"DigitalIn"** function applies all the time. As soon as a signal is active on the digital input the transmitter goes to hold mode and the values on the analog output, the output OC will be at hold state.

DigitalIn1 State = Off/Low/High

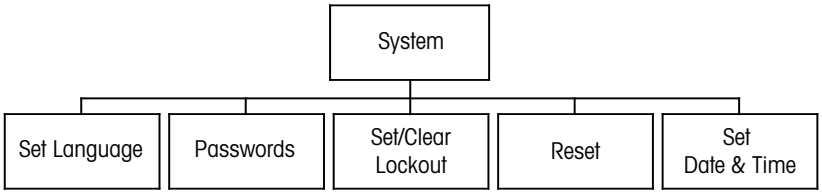
NOTE: DigitalIn1 is to hold channel A (conventional sensor)

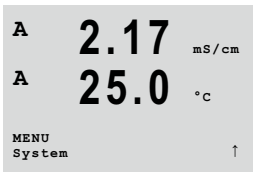
Possible Hold states:

Output OC:	On/Off	(Configuration/Set point)
Analog Output:	Last/Fixed	(Configuration/Analog output)
PID OC	Last/Off	(PID setup/Mode)

10 System

(PATH: Menu/System)

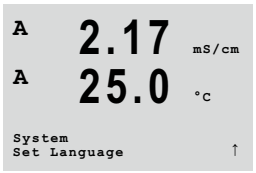




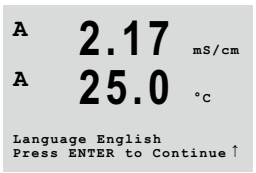
While in measurement mode press the ◀ key. Press the ▲ or ▼ key to navigate to the "System" menu and press [ENTER]. The available system configuration options are detailed below.

10.1 Set Language

(PATH: Menu/System/Set Language)



This menu allows the configuration of the display language.

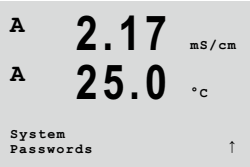


The following selections are possible:
English, French, German, Italian, Spanish, Portuguese, Russian or Japanese (Katakana).

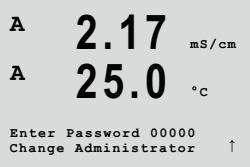
Pressing the [ENTER] key will bring up the Save Changes dialog.

10.2 Passwords

(PATH: Menu/System/Passwords)



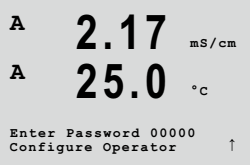
This menu allows for the configuration of operator and administrator passwords, as well as setting up a list of allowed menus for the operator. The administrator has rights to access all menus. All default passwords for new transmitters are "00000".



The passwords menu is protected: Enter the administrator password to enter the menu.

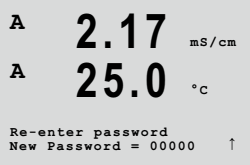
10.2.1 Changing Passwords

Enter the "Password" menu. Refer to Chapter 10.2 "Passwords" on Page 48.



Select the option "Change Administrator" or "Change Operator".

Set the new password.

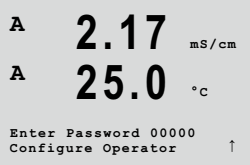


Press the [ENTER] key to confirm the new password.

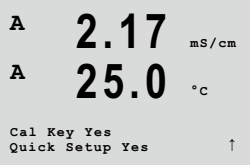
Pressing the [ENTER] key again will bring up the Save Changes dialog.

10.2.2 Configuring Menu Access for Operator

Enter the "Password" menu. Refer to Chapter 10.2 "Passwords" on Page 48.



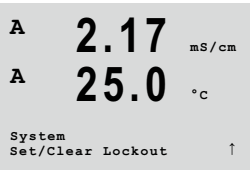
Select "Configure Operator" to configure the access list for the operator. It is possible to assign/deny rights to the following menus: Cal Key, Quick Setup, Configuration, System, PID Setup and Service.



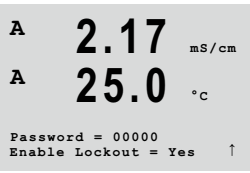
Choose either "Yes" or "No" to give/deny access to the above menus and press [ENTER] to advance to the next items. Pressing the [ENTER] key after configuring all menus will bring up the Save Changes dialog. Selecting No will discard the entered values, selecting Yes will make the entered values the current ones.

10.3 Set/Clear Lockout

(PATH: Menu/System/Set/Clear Lockout)



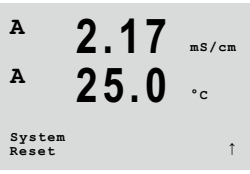
This menu enables/disables the lockout functionality of the transmitter. The user will be asked for a password before being allowed into any menus if the lockout functionality is enabled.



The lockout-menu is protected: Enter the administrator or operator password and select YES to enable or NO to disable the lockout functionality. Pressing the [ENTER] key after the selection will bring up the Save Changes dialog. Selecting No will discard the entered value, selecting Yes will make the entered value the current one.

10.4 Reset

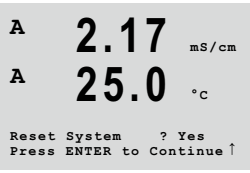
(PATH: Menu/System/Reset)



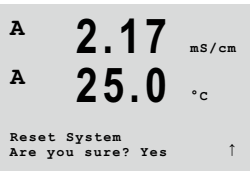
This menu allows access to the following options:

Reset System, Reset Meter Cal, Reset Analog Cal.

10.4.1 Reset System

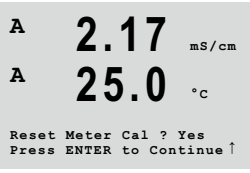


This menu allows the reset of the meter to the factory default settings (setpoints off, analog outputs off, etc.). The meter calibration and the analog output calibration are not affected.

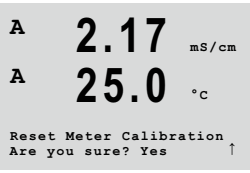


Pressing the [ENTER] key after the selection will bring up a confirmation screen. Selecting No will return the user to the measurement mode with no changes. Selecting Yes will reset the meter.

10.4.2 Reset Meter Calibration

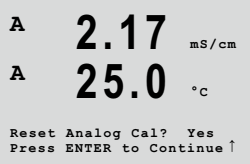


This menu allows the reset of the meter's calibration factors to the last factory calibration values.

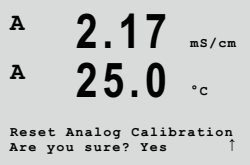


Pressing the [ENTER] key after the selection will bring up a confirmation screen. Selecting No will return the user to the measurement mode with no changes. Selecting Yes will reset the meter calibration factors.

10.4.3 Reset Analog Calibration

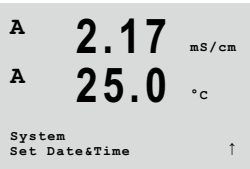


This menu allows reset of the analog output calibration factors to the last factory calibration values.



Pressing the [ENTER] key after the selection will bring up a confirmation screen. Selecting No will return the user to the measurement mode with no changes. Selecting Yes will reset the analog output calibration.

10.5 Set Date & Time

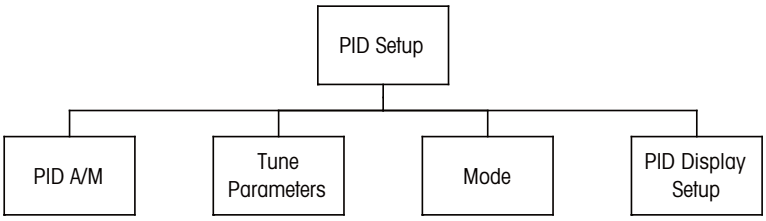


Please enter the actual date and time. The following options are possible.
This function is automatically activated at every power-up.

Date (YY-MM-DD):
Time (HH:MM:SS):

11 PID Setup

(PATH: Menu/PID Setup)



PID control is proportional, integral and derivative control action that can provide smooth regulation of a process. Before configuring the transmitter, the following process characteristics must be identified.

Identify the control direction of the process (Conductivity):

– Dilution – direct acting where increasing measurement produces increasing control output such as controlling the feed of low conductivity diluting water to rinse tanks, cooling towers or boilers

– Concentrating – reverse acting where increasing measurement produces decreasing control output, such as controlling chemical feed to attain a desired concentration

Identify the **control output type** based on the control device to be used:

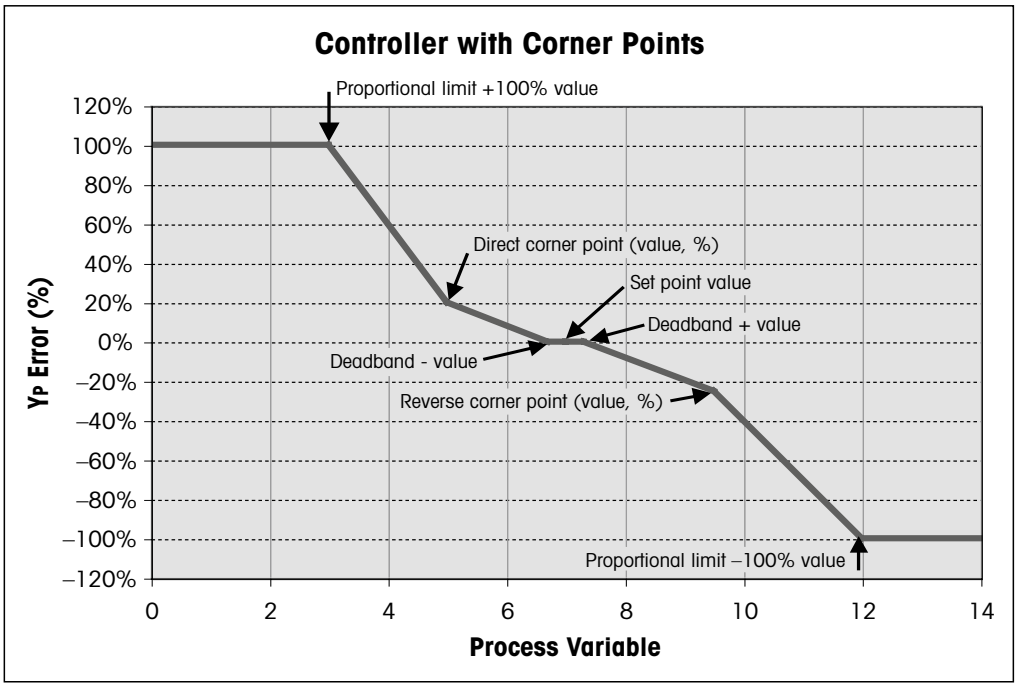
– Pulse frequency – used with pulse input metering pump

– Pulse length – used with solenoid valve

– Analog – used with current input device such as electric drive unit, analog input metering pump or current-to-pneumatic (I/P) converter for pneumatic control valve

Default control settings provide linear control. Therefore, when configuring PID for these parameters ignore settings of deadband and corner points in the tuning parameter section below.

Improved control can be obtained if the non-linearity is accommodated with an opposing non-linearity in the controller. A titration curve made on a process sample provides the best information. There is often a very high process gain or sensitivity near the setpoint and decreasing gain further away from the setpoint. To counteract this, the instrument allows for adjustable non-linear control with settings of a deadband around the setpoint, corner points further out and proportional limits at the ends of control as shown in the figure below.

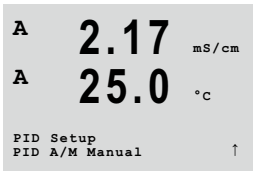


11.1 Enter PID Setup

While in measurement mode press the ◀ key. Press the ▲ or ▼ key to navigate to the PID Set-up-menu and press [ENTER].

11.2 PID Auto/Manual

(PATH: MENU/PID Setup/PID A/M)

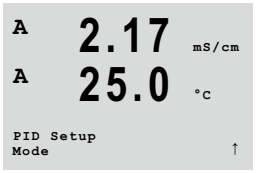


This menu allows selection of automatic or manual operation. Select Auto or Manual operation.

Pressing the [ENTER] key will bring up the Save Changes dialog.

11.3 Mode

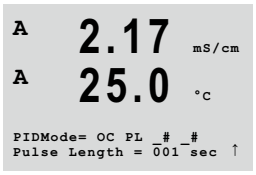
(PATH: MENU/PID Setup/Mode)



This menu contains the selection of control modes using OCs.

Press [ENTER].

11.3.1 PID Mode

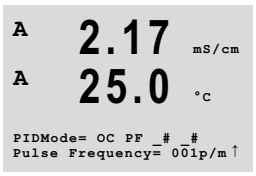


This menu assigns a OC or analog output for PID control action as well as details of their operation. Based on the control device being used, select one of the following three paragraphs for use with solenoid valve, pulse input metering pump or analog control.

Pulse Length – If using a solenoid valve, select "OC" and "PL", pulse length.
Choose the first OC position as #1 (recommended) and/or the second OC position as #2 (recommended) as well as the pulse length (PL) according to the table below. A longer pulse length will reduce wear on the solenoid valve. The % "on" time in the cycle is proportional to the control output.

NOTE: All OCs #1, #2 can be used for the controlling function.

	1st OC	2nd OC	Pulse OC
Conductivity	Controlling concentrating reagent feed	Controlling dilution water	Short (PL) provides more uniform feed. Suggested start point = 30 sec.



Pulse Frequency – If using a pulse input metering pump, select "OC" and "PF", pulse frequency. Choose the first OC position as #1 and/or the second OC position as #2 according to the table below. Set the pulse frequency to the maximum frequency allowed for the particular pump being used, typically 60 to 100 pulses/minute. Control action will produce this frequency at 100% output.

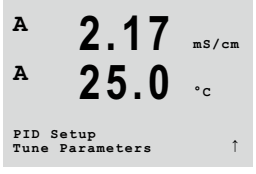
NOTE: All OCs #1, #2 can be used for the controlling function.

CAUTION: Setting the pulse frequency too high may cause the pump to overheat.

	1st OC	2nd OC	Pulse Frequency (PF)
Conductivity	Controlling concentrating chemical feed	Controlling dilution water	Max allowed for the pump used (typically 60–100 pulses/minute)

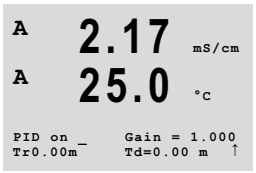
11.4 Tune Parameters

(PATH: MENU/PID Setup/Tune Parameters)



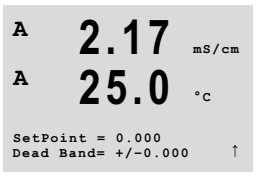
This menu assigns control to a measurement and sets the setpoint, tuning parameters and nonlinear functions of the controller through a series of screens.

11.4.1 PID Assignment & Tuning



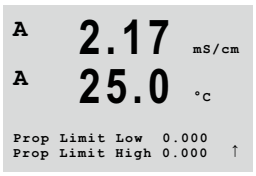
Assign the measurement, a, b, c, or d to be controlled after "PID on_". Set the Gain (unitless), integral or reset time Tr (minutes) and rate or derivative time Td (minutes) needed for control. Press [ENTER]. Gain, reset and rate are later adjusted by trial and error based on process response. Always begin with Td at zero.

11.4.2 Setpoint & Deadband



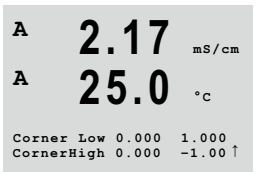
Enter the desired setpoint value and the deadband around the setpoint, where no proportional control action will take place. Be sure to include the units multiplier u or m for conductivity. Press [ENTER].

11.4.3 Proportional Limits



Enter the low and high proportional limits -the range over which control action is required. Be sure to include the units multiplier u or m for conductivity. Press [ENTER].

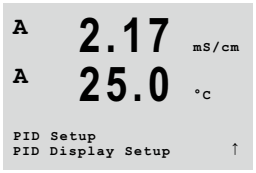
11.4.4 Corner Points



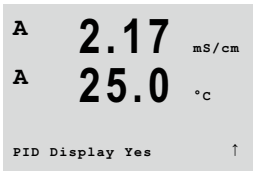
Enter the low and high corner points in conductivity, pH, dissolved oxygen units and the respective output values from −1 to +1, shown in the figure as −100 to +100%. Press [ENTER].

11.5 PID Display

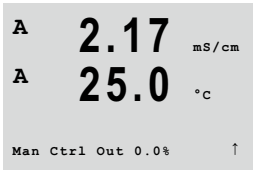
(PATH: Menu/PID Setup/PID Display Setup)



This screen enables display of PID control status in the normal measurement mode.



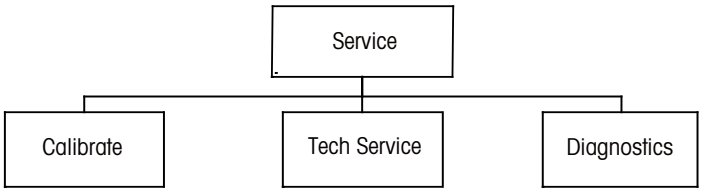
When PID Display is selected, the status (Man or Auto) and control output (%) will be displayed on the bottom line. In addition, for the display to be enabled, a measurement must be assigned under Tune Parameters and a OC or analog output must be assigned under Mode.

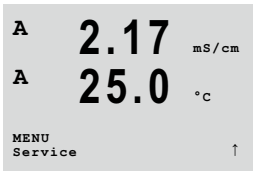


In manual, the control output may be adjusted with the up and down arrow keys. (The "Info" key function is not available in manual.)

12 Service

(PATH: Menu/Service)

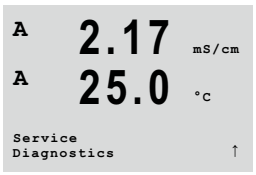




While in measurement mode press the ◀ key. Press the ▲ or ▼ key to navigate to the "Service" menu and press [ENTER]. The available system configuration options are detailed below.

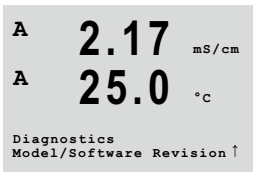
12.1 Diagnostics

(PATH: Menu/Service/Diagnostics)

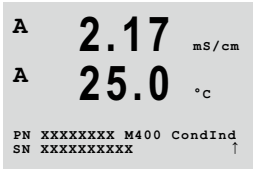


This menu is a valuable tool for troubleshooting and provides diagnostic functionality for the following items: Model/Software Revision, Digital Input, Display, Keypad, Memory, Set OC, Read OC, Set Analog Outputs, Read Analog Outputs.

12.1.1 Model/Software Revision

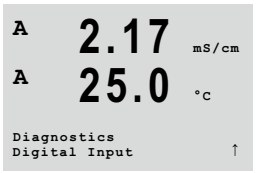


Essential information for every Service call is the model and software revision number. This menu shows the part number, model and the serial number of the transmitter. By using the ▼ key it is possible to navigate forward through this menu and get additional information like the current version of firmware implemented on the transmitter: (Master V_XXXX and Comm V_XXXX.

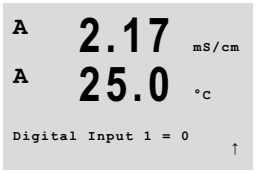


Press [ENTER] to exit from this display.

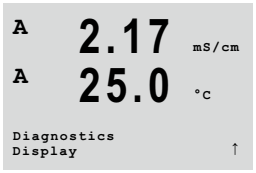
12.1.2 Digital Input



The digital input menu shows the state of the digital input. Press [ENTER] to exit from this display.

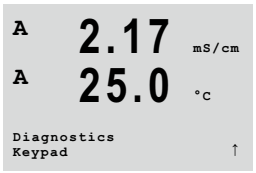


12.1.3 Display

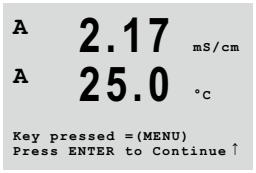


All pixels of the display will be lit for 15 seconds to allow troubleshooting of the display. After 15 seconds the transmitter will return to the normal measuring mode or press [ENTER] to exit sooner.

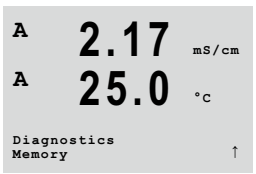
12.1.4 Keypad



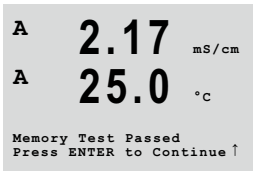
For keypad diagnostics, the display will indicate which key is pressed. Pressing [ENTER] will return the transmitter to the normal measuring mode.



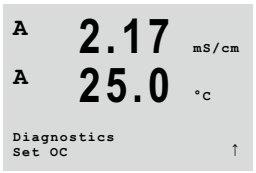
12.1.5 Memory



If Memory is selected then the transmitter will perform a RAM and ROM memory test. Test patterns will be written to and read from all RAM memory locations. The ROM checksum will be recalculated and compared to the value stored in the ROM.

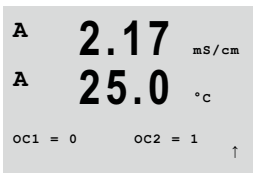


12.1.6 Set OC



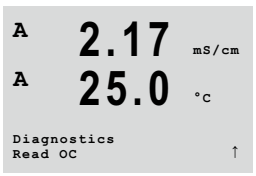
The Set OC diagnostic menu allows to open or close each OC manually.

0 = open the OC
1 = close the OC



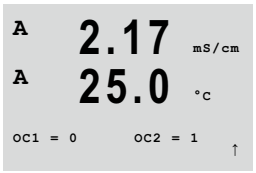
Press [ENTER] to return to Measurement mode.

12.1.7 Read OC

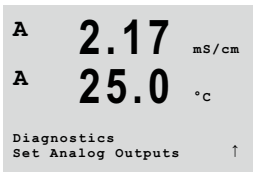


The Read OC diagnostic menu shows the state of each OC as defined below.
Press [ENTER] again to exit from this display.

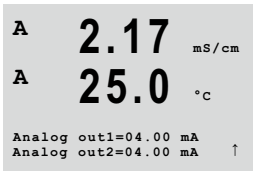
0 = Normal
1 = Inverted.



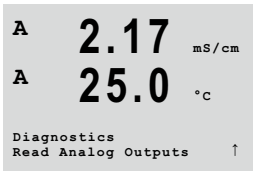
12.1.8 Set Analog Outputs



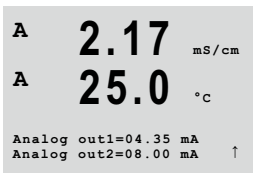
This menu enables the user to set all analog outputs to any mA value within the 0–22 mA range.
Press [ENTER] to exit from this display.



12.1.9 Read Analog Outputs



This menu shows the mA value of the analog outputs.



Press [ENTER] to exit from this display.

12.2 Calibrate

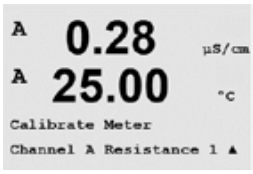
(PATH: Menu/Service/Calibrate)

Enter Service menu. Refer to Chapter 12 "Service" on Page 56.

Select Calibrate, and press [ENTER].

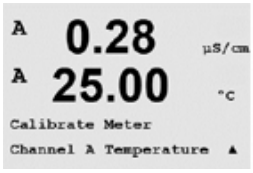
This menu has the options to calibrate the transmitter and the analog outputs and also allows the unlocking of calibration functionality.

12.2.1 Calibrate Meter



The M400 transmitter is factory calibrated within specifications. It is not necessary to perform meter re-calibration unless extreme conditions cause an out of spec operation shown by Calibration Verification. Periodic verification/re-calibration may also be necessary to meet Q.A. requirements. Meter calibration can be selected as-temperature or resistance.

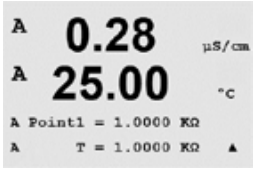
12.2.1.1 Temperature



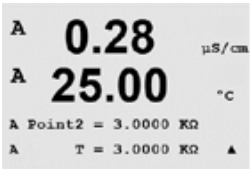
Temperature is performed as a three point calibration. The table above shows the resistance values of these three points.

Navigate to the Calibrate Meter screen and choose Temperature calibration for Channel A.

Press [ENTER] to begin temperature calibration process

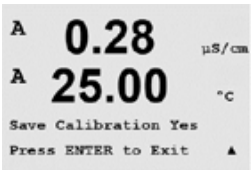


The first text line will ask for the Point 1 temperature resistance value (this will correspond to temperature 1 value shown on the calibration module accessory). The second text line will show the measured resistance value. When the value stabilizes, press [ENTER] to perform calibration.

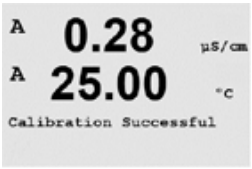


The transmitter screen will then prompt the user to enter the value for Point 2, and T2 will display the measured resistance value. When this value stabilizes, press [ENTER] to calibrate this range.

Repeat these steps for Point 3.



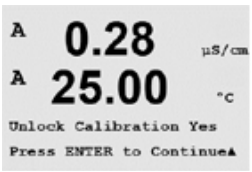
Press [ENTER] to bring up a confirmation screen. Select Yes to save the calibration values and the successful calibration is confirmed on the display.



The transmitter will return to the measurement mode in approximately 5 seconds.

12.2.2 Calibrate Unlock

Select this Menu to configure the CAL Menu.



Selecting Yes means that meter and analog output calibration menus will be selectable under the CAL Menu. Selecting No means that only the sensor calibration is available under the CAL Menu. Press [ENTER] after the selection to display a confirmation screen.

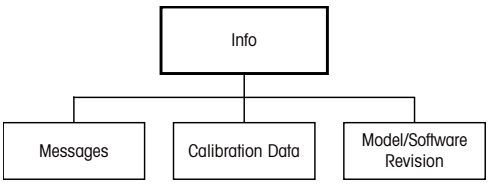
12.3 Tech Service

(PATH: Menu/Tech Service)

NOTE: This menu is for METTLER TOLEDO service personnel use only.

13 Info

(PATH: Info)



Pressing the ▼ key will display the Info menu with the options Messages, Calibration Data and Model/Software Revision.

13.1 Messages

(PATH: Info/Messages)

The most recent message is displayed. The up and down arrow keys allow scrolling through the last four messages that have occurred.

Clear Messages clears all the messages. Messages are added to the message list when the condition that generates the message first occurs. If all messages are cleared and a message condition still exists and started before the clear then it will not appear in the list. For this message to re-occur in the list the condition must go away and then reappear.

Press [ENTER] to exit from this display.

13.2 Calibration Data

(PATH: Info/Calibration Data)

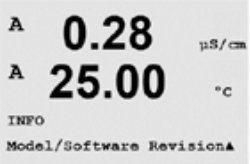
Selecting Calibration Data displays the calibration constants for each sensor.

P = calibration constants for the primary measurement
S = calibration constants for the secondary measurement

Press [ENTER] to exit from this display.

13.3 Model/Software Revision

(PATH: Info/Model/Software Revision)



Selecting Model/Software Revision will display the part number, model and the serial number of the transmitter.

By using the ▼ key it is possible to navigate forward through this menu and get additional information like the current version of firmware implemented on the transmitter (Master V_XXXX and Comm V_XXXX).

The displayed information is important for any Service call. Press [ENTER] to exit from this display.

14 Maintenance

14.1 Front Panel Cleaning

Clean the front panel with a damp soft cloth (water only, no solvents). Gently wipe the surface and dry with a soft cloth.

15 Troubleshooting

If the equipment is used in a manner not specified by METTLER TOLEDO the protection provided by the equipment may be impaired. Review the table below for possible causes of common problems:

Problem	Possible cause
Display is blank.	• No power to M400. • LC display contrast set incorrectly. • Hardware failure.
Incorrect measurement readings.	• Sensor improperly installed. • Incorrect units multiplier entered. • Temperature compensation incorrectly set or disabled. • Sensor or transmitter needs calibration. • Sensor or patch cord defective or exceeds recommended maximum length. • Hardware failure.
Measurement readings not stable.	• Sensor or cables installed too close to equipment that generates high level of electrical noise. • Recommended cable length exceeded. • Averaging set too low. • Sensor or patch cord defective.
Displayed ⚠ is flashing.	• Setpoint is in alarm condition (setpoint exceeded). • Alarm has been selected and occurred. Refer to Chapter 9.5.1 "Alarm" on Page 43.
Cannot change menu settings.	• User locked out for security reasons.

Table 13: Troubleshooting

15.1 Error Messages for Inductive Conductivity Sensors – Warning and Alarm List

Alarms [1)]	Description
Watchdog time-out	SW/System fault
Send side open	Wires for sending coil are broken or defective
Send side short circ.	Short circuit caused by sensor or cable for the sending coil
Receive side open	Wires for receiving coil are broken or defective

1) According to the parameterization of the transmitter. Refer to Chapter 9.5.1 "Alarm" on Page 43 (PATH: Menu/Configure/Alarm/Clean/Setup Alarm).

Table 14: Error messages for inductive conductivy sensors

15.2 Warning- and Alarm Indication on the Display

15.2.1 Warning Indication

If there are conditions, which generate a warning, the message will be recorded and can be selected through the menu Messages. Refer to Chapter 13.1 "Messages" on Page 61 (PATH: Info/Messages).

According to the configuration of the transmitter the hint "Failure – Press ENTER" will be shown at line 4 of the display, if a warning or alarm has occurred. Refer to Chapter 9.6 "Display" on Page 44 (PATH: Menu/Configure/Display/Measurement).

15.2.2 Alarm Indication

Alarms will be shown in the display by a flashing symbol ⚠ and recorded through the menu point Messages. Refer to Chapter 13.1 "Messages" on Page 61 (PATH: Info/Messages).

Furthermore the detection of some alarms can be activated or deactivated for an indication on the display. Refer to Chapter 9.5.2 "Clean" on Page 44 (PATH: Menu/Configure/Alarm/Clean). If one of these alarms occurs and the detection has been activated, the flashing symbol ⚠ will be shown on the display and the message will be recorded through the menu Messages. Refer to Chapter 13.1 "Messages" on Page 61 (PATH: Info/Messages).

Alarms which are caused by a violation of the limitation of a setpoint or the range will also be shown by a flashing symbol ⚠ and recorded through the menu Messages. Refer to Chapter 9.4 "Set Points" on Page 41 (PATH: Menu/Configure/Setpoint). Refer to Chapter 13.1 "Messages" on Page 61 (PATH: Info/Messages).

According to the configuration of the transmitter the hint "Failure – Press ENTER" will be shown at line 4 of the display, if a warning or alarm has occurred. Refer to Chapter 9.6 "Display" on Page 44 (PATH: Menu/Configure/Display/Measurement).

16 Accessories and Spare Parts

Please contact your local METTLER TOLEDO sales office or representative for details for additional accessories and spare parts.

Description	Order no.
Pipe Mount Kit for ½ DIN models	30 300 480
Panel Mount Kit for ½ DIN models	52 500 213
Wall Mount Kit for ½ DIN models	30 300 482
Protective Hood for ½ DIN models	30 073 328

Table 15: Accessories

17 Specifications

17.1 General Specifications

Inductive Conductivity

Measurement parameters	Conductivity and temperature
Display range	0 to 2,000 mS/cm
Chemical concentration curves	• NaCl: 0 – 26 % @ 0 °C to 0 – 28 % @ +100 °C • NaOH-1: 0 – 13 % @ 0 °C to 0 – 24 % @ +100 °C • NaOH-3: 15 – 50 % @ 0 °C to 35 – 50 % @ +100 °C • HCl-1: 0 – 18 % @ – 20 °C to +50 °C • HCl-2: 22 – 39 % @ – 20 °C to +50 °C • HNO_3-1: 0 – 30 % @ – 20 °C to +50 °C • HNO_3-2: 35 – 96 % @ – 20 °C to +50 °C • H_2SO_4-1: 0 – 26 % @ – 12 °C to 0 – 37 % @ +100 °C • H_2SO_4-2: 28 – 88 % @ 0 °C to 39 – 88 % @ +95 °C • H_2SO_4-3: 94 – 99 % @ – 12 °C to 89 – 99 % @ +95 °C • H_3PO_4: 0 – 35 % @ + 5 °C to +80 °C User-defined concentration table (5 x 5 matrix)
TDS ranges	NaCl, $CaCO_3$
Conductivity accuracy	± 1.0 % of reading or ± 0.005 mS/cm
Conductivity repeatability	± 1.0 % of reading or ± 0.005 mS/cm
Conductivity resolution	Auto/0.001/0.01/0.1/1 (can be selected)
Temperature input	Pt1000/Pt100/NTC22K
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	• ± 0.25 K (± 0.45 °F) within – 30 to + 150 °C (– 22 to + 302 °F) • ± 0.50 K (± 0.90 °F) outside
Temperature repeatability	± 0.13 K (± 0.23 °F)
Max. sensor cable length	10 m (32.8 ft)
Calibration	1-point, Zero point or Process

17.2 Electrical Specifications

17.2.1 General Electrical Specifications

Display	Backlit LCD, 4 lines
Running capacity	Ca. 4 days
Keypad	5 tactile feedback keys
Languages	8 (English, German, French, Italian, Spanish, Portuguese, Russian and Japanese)
Connection terminals	Spring cage terminals, appropriate for wire cross section 0.2 to 1.5 mm^2 (AWG 16 – 24)
Analog input	4 to 20 mA (for pressure compensation)

17.2.2 4 to 20 mA (with HART®)

Supply voltage	14 to 30 V DC
Number of outputs (analog)	2
Current outputs	Loop current 4 to 20 mA, galvanically isolated up to 60 V from input and from earth / ground, protected against wrong polarity, feeding voltage14 to 30 V DC
Measurement error through analog outputs	< ± 0.05 mA over 1 to 20 mA range
Analog output configuration	Linear
PID process controller	Pulse length, pulse frequency
Hold input /Alarm contact	Yes/Yes (alarm delay 0 to 999 s)
Digital outputs	2 open collector (OC), 30 V DC, 100 mA, 0.9 W
Digital input	1, galvanically isolated up to 60 V from output, analog input and ground/ earth with switching limits 0.00 V DC to 1.00 V DC inactive 2.30 V DC to 30.00 V DC active
Alarm output delay	0 to 999 s

17.3 Mechanical Specifications

Dimensions	Housing – Height x Width x Depth	144 x 144 x 116 mm (5.7 x 5.7 x 4.6 inch)
	Front bezel – Height x Width	150 x 150 mm (5.9 x 5.9 inch)
	Max. depth – panel mounted	87 mm (excludes plug-in connectors)
Weight		1.50 kg (3.3 lb)
Material		Aluminum die cast
Enclosure rating		IP 66/NEMA4X

17.4 Environmental Specifications

Storage temperature	−40 to +70 °C (−40 to +158 °F)
Ambient temperature operating range	−20 to +60 °C (−4 to +140 °F)
Relative humidity	0 to 95 % non-condensing
EMC	According to EN 61326-1 (general requirements) Emission: Class B, Immunity: Class A
Approvals and certificates	• ATEX/IECEx/UKCA Zone 1 Ex ib [ia Ga] IIC T4 Gb • ATEX/IECEx/UKCA Zone 21 Ex ib [ia Da] IIIC T80 °C Db IP66 • cFMus Class I, Division 1, Groups A, B, C, D T4 • cFMus Class II, Division 1, Groups E, F, G • cFMus Class III • cFMus Class I, Zone 0, AEx ia IIC T4 Ga • NEPSI EX Zone
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.

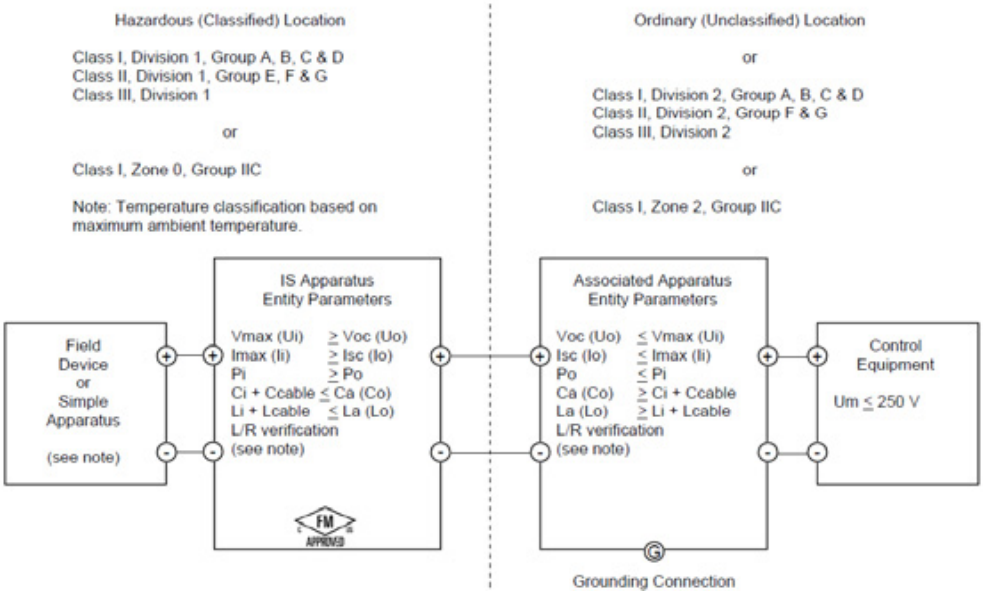
17.5 Control Drawings

17.5.1 Installation, Maintenance and Inspection

1. Intrinsically Safe Apparatus can be a source of ignition if internal spacings are shorted or connections opened.
2. Although intrinsically safe circuits are inherently low energy, they may still present a shock hazard because of the operating voltage.
3. Refer to manufacturer's written instructions before working on associated apparatus.
4. Inspection should be performed periodically to ensure that intrinsic safety has not been compromised. Inspections should include reviewing for unauthorized modifications, corrosion, accidental damage, change of flammable materials, and the effects of aging.
5. User replaceable parts of an intrinsically safe system should not be replaced with other than the manufacturer's direct equivalent.
6. Maintenance work may be performed on energized apparatus in hazardous areas subject to the conditions as follows:
   - Disconnection of, and removal or replacement of, items of electrical apparatus and cabling if such action will not result in shorting of different intrinsically safe circuits.
   - Adjustment of any control that is necessary for the calibration of the electrical apparatus or system.
   - Only test instruments specified in the written instructions should be used.
   - Performance of other maintenance activities specifically permitted by the relevant control drawing and instruction manual.
7. Maintenance of Associated Apparatus and parts of intrinsically safe circuits located in unclassified areas should be restricted to that described in a way such that electrical apparatus or parts of circuits remain interconnected with parts of intrinsically safe systems located in hazardous areas. Safety barrier ground connections should not be removed without first disconnecting the hazardous-area circuits.
8. Other maintenance work on Associated Apparatus or parts of an intrinsically safe circuit mounted in an unclassified area should be performed only if the electrical apparatus or part of a circuit is disconnected from the part of the circuit located in a hazardous area.
9. The location classification and the suitability of the intrinsically safe system for that classification should be verified. This includes verifying that the class, group, and temperature ratings of both the Intrinsically Safe Apparatus and the Associated Apparatus agree with the actual classification of the location.

10. Prior to energizing, an intrinsically safe system should be inspected to ensure the following:
    - Installation is in compliance with the documentation;
    - Intrinsically safe circuits are properly separated from non-intrinsically safe circuits;
    - Cable shields are grounded in accordance with the installation documentation;
    - Modifications have been authorized;
    - Cables and wiring are not damaged;
    - Bonding and grounding connections are tight;
    - Bonding and grounding hardware is not corroded;
    - Resistance of any grounding conductor, including termination resistance from shunt-type-Associated Apparatus to the grounding electrode does not exceed one ohm;
    - Protection has not been defeated by bypassing; and
    - Check for signs of corrosion on the equipment and connections.
11. All deficiencies should be corrected.

17.5.2 Control Installation Drawing General Installation

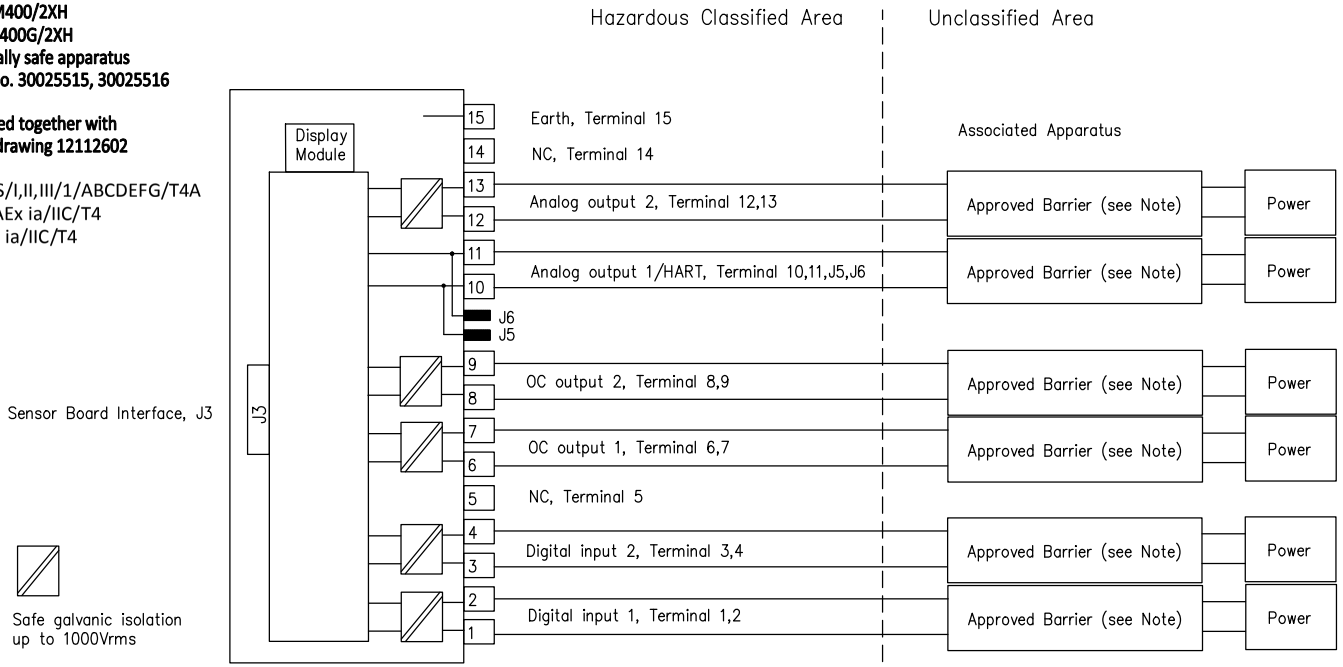


12112601 A

M400 series Multi-parameter Transmitter
Type M400/2XH
M400G/2XH
intrinsically safe apparatus
Model No. 30025515, 30025516

to be used together with
control drawing 12112602

C/US IS/I,II,III/1/ABCDEFG/T4A
USI/0/AEx ia/IIC/T4
CI/0/Ex ia/IIC/T4
Entity



	In type of protection intrinsic safety Ex ia IIC, only for connection to intrinsically safe circuits with the following maximum values				
	Ui(V)	Ii(mA)	Pi(W)	Li(mH)	Ci(nF)
Analog output 2, Terminal 12,13	30	100	0.8	0	15
Analog output 1/HART, Terminal 10,11,J5,J6	30	100	0.8	0	15
OC output 2, Terminal 8,9	30	100	0.8	0	0
OC output 1, Terminal 6,7	30	100	0.8	0	0
Digital input 2, Terminal 3,4	30	100	0.8	0	0
Digital input 1, Terminal 1,2	30	100	0.8	0	0
Earth, Terminal 15	For equipotential bonding				
Sensor Board Interface, J3	Only for connection to the sensor board belonging to M400 system				

WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY

Notes
1. Control equipment connected to the associated apparatus must not use or generate more than 250V.
2. At the time of installation, mark the selected type of protection on the equipment marking.
3. "X" following the code of explosion-proof certification indicates:
1) Avoid ignition hazard due to impact or friction, prevent mechanical sparks.
2) Avoid electrostatic discharge on enclosure surface, use wet cloth only for cleaning.
4. Check out the maxim values for IS (intrisically safe) in this page for use.

Mark	Num.	C.F. No.	Sign	Date					
Designer			Standardization		Pattern			Weight	Scale
Check			Approval		S				1:1
Technics			Date		1 Pages		Page 1		

Mettler-Toledo

Control Drawing, Main, M400

12112601 A

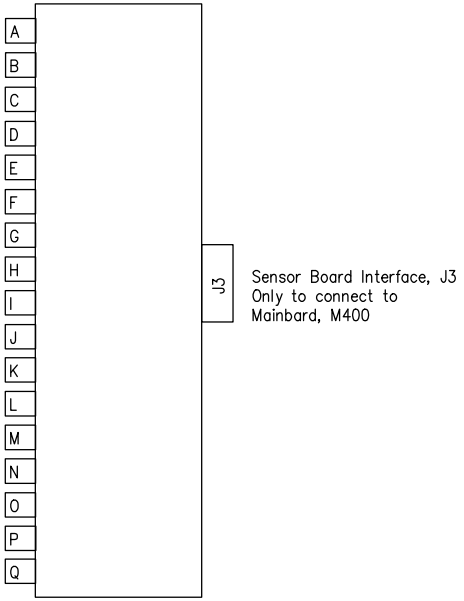
30 396 563 D

12112602 A

Hazardous Classified Area
Sensor Board
belonging to
M400 Multi-parameter Transmitters
control drawing 12112601 or 12112603

Sensor Interface	In type of protection intrinsic safety, only for connection to M400, with the following maximum values				
	U(V)	I(mA)	P(mW)	L(mH)	C(uF)
pH measuring loop, Terminal A,E,G	Uo=5.88	Io=1.3	Po=1.9	Lo=5	Co=2.1
Conductivity measuring loop, Terminal A,B,E,G	Uo=5.88	Io=29	Po=43	Lo=1	Co=2.5
DO measuring loop, Terminal B,C,D,H	Uo=5.88	Io=29	Po=43	Lo=1	Co=2.5
Temperature measuring loop, Terminal I,J,K	Uo=5.88	Io=5.4	Po=8	Lo=5	Co=2
One-wire measuring loop, Terminal L,M	Uo=5.88	Io=22	Po=32	Lo=1	Co=2.8
485 measuring loop, Terminal N,O	Uo=5.88 Ui=30V	Io=54 Ii=100	Po=80 Pi=0.8	Lo=1 Li=0	Co=1.9 Ci=0.7
Analog input measuring loop, Terminal P,Q	Ui=30	Ii=100	Pi=800	Li=0	Ci=0.015

The measuring circuits are galvanically connected.



WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY
WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR THE SUITABILITY FOR ZONE 2

Notes
IECEx, ATEX, FM, CSA
1. When installed in M400, Intrinsically Safe Equipment connecting to A~Q must be approved or be a Simple Apparatus.
2. A Simple Apparatus is defined as a device that does not generates more than 1.5V, 0.1A or 25mW.
3. Check out the maxim values for IS (intrisically safe) in this page for use.

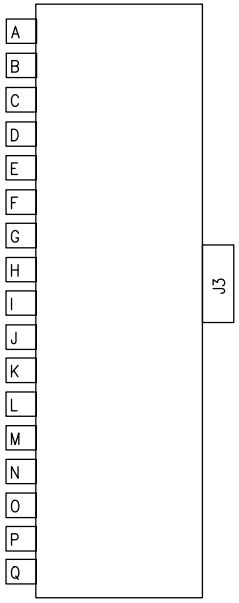
Mark	Num.	C.F. No.	Sign	Date					
Designer			Standardization		Pattern		Weight	Scale	Mettler-Toledo Instruments (Shanghai) Co. Ltd.
Check			Approval		S			1:1	Control Drawing, Sensor, M400
Technics			Date		1 Pages	Page 1			12112602 A

12112604 A

Hazardous Classified Area
Sensor Board
belonging to
M400 Multi-parameter Transmitters
control drawing 12112601 OR 12112603

Sensor Interface	In type of protection intrinsic safety, only for connection to M400, with the following maximum values					Sensor Types Refereced in FM COC 3021227 SIM *1/*2/*3 is a sensor series of universal input parameters.
	U(V)	I(mA)	P(mW)	L(mH)	C(uF)	
Conductivity measuring loop, Terminal D,E,F,G,H	Uo=5.36	Io=17.2	Po=23	Lo=1	Co=3.2	InPRO725X*1/*2/*3 Inductive conductivity sensor
Temperature measuring loop, Terminal I,J,K	Uo=5.88	Io=4.9	Po=6.6	Lo=5	Co=2	Temperature sensor is an assitant sensor, which is always intergrated with sensor types of all, such as pH, conductivtiy, or dissolved oxygen.

The measuring circuits are galvanically connected.



Sensor Board Interface, J3
Only to connect to
Mainbard, M400

WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY
WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR THE SUITABILITY FOR ZONE 2

Notes
IECEx, ATEX, FM, CSA
1. When installed in M400, Intrinsically Safe Equipment connecting to A~Q must be approved or be a Simple Apparatus.
2. A Simple Apparatus is defined as a device that does not generates more than 1.5V, 0.1A or 25mW.
3. Check out the maxim values for IS (intrisically safe) in this page for use.

Mark	Num.	C.F. No.	Sign	Date					
Designer			Standardization		Pattern			Weight	Scale
Check			Approval		S				1:1
Technics			Date		1 Pages		Page 1		

Mettler-Toledo Instruments (Shanghai) Co. Ltd.

Control Drawing, Sensor, Cond Ind M400

12112604 A

30 396 563 D

17.5.3 Notes

1. The intrinsic safety entity concept allows the interconnection of FM Approved intrinsically safe devices with entity parameters not specifically examined in combination as a system when: Voc (Uo) or Vt ≤ Vmax, Isc (Io) or It ≤ Imax, Ca (Co) ≥ Ci + Ccable, La (Lo) ≥ Li + Lcable, Po ≤ Pi
2. The intrinsic safety fieldbus intrinsically safe concept allows the interconnection of FM Approved intrinsically safe devices with fieldbus intrinsically safe concept parameters not specifically examined in combination as a system when: Voc (Uo) or Vt < Vmax, Isc (Io) or It ≤ Imax, Po ≤ Pi
3. The configuration of associated apparatus must be FM Approved under the entity concept.
4. Associated Apparatus manufacturer's installation drawing must be followed when installing this equipment.
5. The configuration of field device sensor must be FM Approved under the entity concept.
6. The installation must be in accordance with the National Electrical Code. (ANSI/NFPA 70 (NEC.)), Articles 504 and 505, and ANSI/ISA-RP12.06.01, or the Canadian Electrical (CE) Code. (CEC Part 1, CAN/CSA-C22.1), Appendix F, and ANSI/ISARP12.06.01 when installed in Canada.
7. A dust-tight conduit seal must be used when installed in Class II and Class III environments.
8. Control equipment connected to the associated apparatus must not use or generate more than the maximum unclassified location voltage, Um, or 250 VAC/DC.
9. Resistance between intrinsically safe ground and earth ground must be less than one ohm.
10. For Class I, Zone 0 and Division 1 locations, installation of the Multi-parameter Transmitter M400/2(X)H, M400G/2XH, M400FF, M400PA, M400 Cond Ind should be in accordance with ANSI/ISA RP12.06.01 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the National Electrical Code. (ANSI/ NRPA 70), or Canadian Electrical (CE) Code. (CEC Part 1, CAN/CSA-C22.1) when installed in Canada.
11. The Multi-parameter Transmitter M400/2(X)H, M400G/2XH, M400FF, M400PA, M400 Cond Ind are FM Approved for Class I, Zone 0 and Division 1 applications. If connecting [AEx ib] or [Ex ib] associated apparatus to the Multiparameter Transmitter M400/2(X)H, M400G/2XH, M400FF, M400PA, M400 Cond Ind the above system is only suitable for Class I, Zone 1, and is not suitable for Class I, Zone 0, or Division 1 hazardous (classified) locations.
12. For Division 2 installations, the associated apparatus is not required to be FM Approved under entity concept if the Multi-parameter Transmitter M400/2(X)H, M400G/2XH, M400 Cond Ind is installed in accordance with the National Electrical Code. (ANSI/NFPA 70), Articles 504 and 505 or Canadian Electrical (CE) Code., CAN/CSA-C22.1, Part 1, Appendix F, for Division 2 wiring methods excluding nonincendive field wiring.
13. Li may be greater than La and the cable length restrictions due to cable inductance (Lcable) can be ignored if both the following conditions are met: La/Ra (or Lo/Ro) > Li/Ri; La/Ra (or Lo/Ro) > Lcable/Rcable
14. If the electrical parameters of the cable used are unknown, the following values may be used: Capacitance - 197 pF/m (60 pF/ft.); Inductance - 0.66 µH/m (0.20 µH/ft.)
15. Simple apparatus is defined as a device that does not generate more than 1.5 V, 0.1 A, or 25 mW.
16. No revision to the control installation drawing without prior authorization by FM Approvals.

18 Default Table

18.1 Common Parameters

Parameter	Sub parameter	Value	Unit
Alarm	OC	2	
	Delay	1	
	Hysteresis	Always 0	
	State	Inverted	
	Power failure	No	
	Software failure	No	
	Cond Ind Defect	No	
Clean	OC	1	
	Hold mode	Hold	
	Interval	0	
	Clean time	0	
	Delay	0	
	Hysteresis	Always 0	
Hold outputs	–	Yes	
DigitalIn	–	Off	
Lockout	–	No	
Language	–	English	
Passwords	Administrator	00000	
	Operator	00000	
All OCs	Delay	10	sec
	Hysteresis	5	For measurement unit °C, °F the same unit. For other measurement unit, is %.
	State	Normal	
	Hold mode	Last value	
	Alarm	22.0mA	
	Hold mode	Last value	
	Aout 1 Damping	1 sec	
PID	PID A/M	Manual	
	PID display	Yes	
	PID on	None	
	PID mode	OC PL	
	PID PL	1	sec
	PID PF	1	p/m
	PID OC x,y	None,None	
	PID hold mode	OC Off	

Table 16: Default table, common parameters

18.2 PID Defaul Value

Parameter	Gain	Tr	Td	Set Point	Deadband	Corner(s)	Proportional Limit(s)
Conductivity	1	0	0	0	0	0, 0	0, 0

Table 17: PID Default table

18.3 Inductive Conductivity Parameters

Parameter	Sub parameter	Value	Unit
Channel A	a	Conductivity	ms/cm
	b	Temperature	°C
	c	----	
	d	----	
Temperature soure		Pt1000	
Compension		Standard	
Cal constants	Conductivity	M=2.175, A=0.0	
	Temperature	M=1.0, A=0.0	
Resolution	Conductivity	0.01	ms/cm
	Temperature	0.1	°C
Analog outputs	1	a	
	2	b	
Conductivity	Value 4 mA	0	ms/cm
	Value 20 mA	100	ms/cm
Temperature	Value 4 mA	0	°C
	Value 20 mA	100	°C
Set point 1 (SP1)	Measurement	a	
	Type	Off	
	OC		
Set point 2 (SP2)	Measurement	b	
	Type	Off	
	OC		
Alarm	Cond Ind Defect	No	

Table 18: Inductive conductivity parameters

19 Warranty

METTLER TOLEDO warrants this product to be free from significant deviations in material and workmanship for a period of one year from the date of purchase. If repair is necessary and not the result of abuse or misuse within the warranty period, please return by freight pre-paid and amendment will be made without any charge. METTLER TOLEDO's Customer Service Dept. will determine if the product problem is due to deviations or customer abuse. Out-of-warranty products will be repaired on an exchange basis at cost.

The above warranty is the only warranty made by METTLER TOLEDO and is lieu of all other warranties, expressed or implied, including, without limitation, implied warranties of merchantability and fitness for a particular purpose. METTLER TOLEDO shall not be liable for any loss, claim, expense or damage caused by, contributed to or arising out of the acts or omissions of the Buyer or Third Parties, whether negligent or otherwise. In no event shall METTLER TOLEDO's liability for any cause of action whatsoever exceed the cost of the item giving rise to the claim, whether based in contract, warranty, indemnity, or tort (including negligence).

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