Conductivity/Resistivity Systems
When Optimal Performance Is Essential

Electrolytic conductivity is a widely used analytical parameter for water purity analysis, monitoring of reverse osmosis, cleaning procedures, control of chemical processes, and in industrial wastewater.

Three commonly used techniques
Electrolytic conductivity is a measure of the total ionic content of a solution. There are three main methodologies to measure conductivity:
- 2-electrode sensors are for measurements in high purity water and relatively low conductivity ranges
- 4-electrode sensors are for mid to high ranges. They are more resistant to fouling than 2-electrode designs
- Inductive sensors cover mid to very high conductivity ranges, and are particularly resistant to fouling.

METTLER TOLEDO offers all three methodologies.

2-electrode sensor design
An AC voltage is applied across the two electrodes, and the resistance between them is measured. The built-in temperature sensor provides fast accurate measurement. The cell geometry and the high solution resistance allow for very accurate and precise conductivity determination.
Sensors are used for: water conditioning and purification stages where they are capable of detecting minute levels of impurities in ultrapure water.

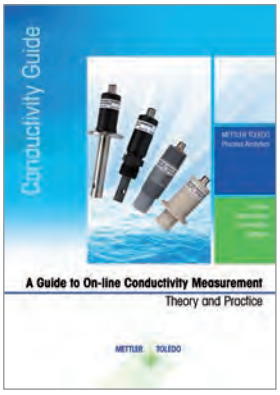
4-electrode sensor design
An AC voltage is applied across the two outside electrodes. The principle is to measure the voltage drop across the two inner electrodes. This eliminates polarization errors. Since this technique measures potential drop the measurement remains accurate.
It permits easier in-line cleaning and it can be installed in smaller piping than inductive sensors.
Sensors are used for: concentration measurement of acids, alkalis, and salt process streams.

Inductive sensor design
The inductive or "electrodeless" conductivity sensor consists of two toroidal coils encapsulated in an inert polymer body. When placed in a conductive solution, a current loop is generated proportional to the conductivity of the solution.
They are ideal for very high conductivity measurements as found in chemical processes, and aggressive applications where contacting electrodes may not be suitable.

Continuous conductivity monitoring according to USP <645>
USP guideline <645> sets a standard for the quality assessment of USP waters based on measurement of the electrolytic conductivity. There is a 3-stage test in which stage 1 allows on-line, non-temperature compensated conductivity measurement. There are specific requirements for the sensors and transmitters (see table below).

Application guide for conductivity sensors

Where to use	Ingold sensors InPro 7000-VP	InPro 7001-VP	InPro 7002-TC-VP	InPro 7005-VP	InPro 7108-25-VP	InPro 7108-TC-VP	InPro 7108-VP/CPVC	InPro 7108-VP/PEEK	InPro 7100/InPro 7100i	InPro 7250HT PEEK & PFA	InPro 7250ST PEEK
Pure and ultrapure water	•	•									
Sanitary			•								
Water purification				•					•		
SIP					•	•					
Industrial wastewater							•			•	•
Medium/high conductivity								•	•	•	
Aggressive chemicals									•	•	
Chemical applications									•	•	•
Pharmaceutical water									•		
High conductivity										•	
Chemical concentration										•	



Find out more in our comprehensive conductivity theory guide at **www.mt.com/conductivity**

Specification	USP <645>
Conductivity sensor and cell constant accuracy	Verify cell constant within ±2 % using a reference solution
Conductivity meter calibration	NIST traceable 0.1 % precision resistors in place of sensor
Instrument resolution	0.1 µS/cm
Instrument accuracy at 1.3 µS/cm	0.1 µS/cm
Temperature compensation	Must be read uncompensated
Instrument dynamic range	10^2

METTLER TOLEDO instruments meet USP <645> water conductivity requirements.


InPro 7250 HT


InPro 7108-VP/PEEK


InPro 7005-VP


InPro 7002-TC-VP


InPro 7100i

InPro 7000-VP
2-Electrode Design

InPro 7000-VP


InPro 7005-VP


InPro 7002-VP


InPro 7001-VP

The InPro 7000-VP series are 2-electrode conductivity sensors designed for high accuracy measurements in very low to medium conductivity water. The sensors are available in a wide selection of process connections to meet every application need. Series includes hygienic and sterilizable designs.

Ordering Information

InPro 7000-VP Series 2-Electrode Sensors	Order Number
InPro 7000-VP	52 001 995
InPro 7005-VP	52 001 996
InPro 7001/120-VP 3.1	52 001 997
InPro 7001/225-VP 3.1	52 001 998
InPro 7002/1.5" TC-VP 3.1	52 001 999
InPro 7002/2" TC-VP 3.1	52 002 000
InPro 7002-VAR-VP 3.1	52 002 857

Cables	Order Number
1.5 m (4.9 ft)	58 080 201
3.0 m (9.8 ft)	58 080 202
4.5 m (14.8 ft)	58 080 203
7.5 m (24.6 ft)	58 080 204
15.0 m (49.2 ft)	58 080 205
25.0 m (82.0 ft)	58 080 206
30.0 m (98.4 ft)	58 080 207
Adapter (VP to old patch cord, 1 m/3.3 ft)	58 080 101

Features Overview

– Watertight VarioPin connector (IP 68) for easy connection and excellent signal transmission
– MaxCert certification package includes NIST/ASTM traceable cell constant, 3.1 materials certificate, and FDA compliant materials documentation

Typical Applications

– Water conditioning and preparation in the chemical, pharmaceutical and food and beverage industries

www.mt.com/InPro7000

Specifications

	InPro 7000-VP	InPro 7005-VP	InPro 7001-VP	InPro 7002-VP
Measurement principle	2-electrode sensor	2-electrode sensor	2-electrode sensor	2-electrode sensor
Electrode material	Titanium	Titanium	SS 316L	SS 316L
Body material	PVDF	PTFE-coated. SS 316/1.4401	SS 316L	SS 316L
RTD	Built-in Pt1000	Built-in Pt1000	Built-in Pt1000	Built-in Pt1000
Insertion length	29mm (1.15")	34mm (1.35")	120/225mm (4.71/8.86")	85/104mm (3.35/4.09")
Max. sensor length	153.20mm (6.03")	75mm (2.95")	194/299mm (7.64/11.77")	156/175mm (6.14/6.88")
Process connection	¾" NPT 1" NPT conduit	¾" NPT	Pg 13.5	Tri-Clamp 1.5" Tri-Clamp 2" Tuchenhagen-VARIVENT DN 40–DN125
Measuring range	See separate table below			
Cell constant nominal	0.1 cm^{-1}	0.1 cm^{-1}	0.1 cm^{-1}	0.1 cm^{-1}
Cell constant accuracy	±1.0%	±1.0%	±1.0%	±1.0%
Working Conditions				
Max. pressure at 25 °C (77 °F)	34 bar (493 psig)	17 bar (246 psig)	17 bar (246 psig)	31 bar (449.5 psig)
Max. pressure at 95 °C (203 °F)	7 bar (100 psig)	7 bar (100 psig)	7 bar (100 psig)	10 bar (145 psig)
Measuring temperature range	–10…100 °C (14…212 °F)	–10…100 °C (14…212 °F)	–10…100 °C (14…212 °F)	–10…120 °C (14…248 °F)
Temperature range (sterilization)	N/A	N/A	Sterilizable –10…131 °C (14…268 °F)	Sterilizable –10…155 °C (14…311 °F)
Temperature accuracy at 25 °C (77 °F)	±0.25 °C (±0.5 °F)	±0.25 °C (±0.5 °F)	±0.25 °C (±0.5 °F)	±0.25 °C (±0.5 °F)
Design				
Temperature compensation	Pt1000 IEC class A	Pt1000 IEC class A	Pt1000 IEC class A	Pt1000 IEC class A
Cable connection	Vario Pin (IP68)	Vario Pin (IP68)[a]	Vario Pin (IP68)	Vario Pin (IP68)
Wetted parts:				
– Metals	Titanium (Grade 2)	Titanium (Grade 2)	SS 316L	SS 316L
– Plastics	PVDF (FDA)	PTFE-coated. SS 316/1.4401		
– O-rings	Viton® (FDA)	Viton® (FDA)	Viton® (FDA)	Viton® (FDA)
– Insulation	PEEK (FDA)	PEEK (FDA)	PEEK (FDA)	PEEK (FDA)
– Surface roughness of wetted metal parts[b]	N/A	N/A	Polished N4 (R_a <0.2 µm) (R_a <8 µin)	Electropolished N4 (R_a <0.2 µm) (R_a <8 µin)
Certificates and Approvals				
Cell constant	•	•	•	•
CE certificate	•	•	•	•
Material certificate EN 10204 3.1	–	–	•	•
Material confirmation EN 10204 2.1	•	•	•	•
Surface roughness	–	–	•	•
ATEX (II 1/2G Ex ia)	•	•	•	•

a The VP is at the end of an approx. 0.5m (1.64ft) long fixed cable. **b** Except at active electrode areas.

Measuring Ranges 2-Electrode Design Sensors

Sensors	Transmitters					
	M300	M400 4-W	M400 2-W	M700	M800 1-channel	System Accuracy (±)
InPro 7000-VP/7005-VP	0.02–2000	0.02–2000	0.02–2000	0.02–10000	0.02–2000	3%
InPro 7001-VP	0.02–500	0.02–500	0.02–500	0.02–500	0.02–500	3%
InPro 7002-VP	0.02–2000	0.02–2000	0.02–2000	0.02–2000	0.02–2000	3%

all values in µS/cm

Suitable Housings **p.**
InTrac 781 121

InPro 7100-VP
4-Electrode Design

InPro 7108-25-VP

InPro 7108-VP/PEEK

InPro 7108-TC-VP

InPro 7108-VP/CPVC

InPro 7108-VAR

The InPro 7100-VP series conductivity sensors utilize 4-electrode technology to expand the range of contacting conductivity for the measurement of medium to high conductivity solutions. The rugged sensor design withstands the most rigorous CIP/SIP procedures in food and pharmaceutical industries. Series includes process connections for industrial processing as well as hygienic 25 mm port and Tri-Clamp fittings.

Ordering Information

InPro 7100-VP Series 4-Electrode Sensors	Order Number
InPro 7108-VP/CPVC	52 002 001
InPro 7108-VP/PEEK	52 002 002
InPro 7108-VP/PEEK/HA-C22	52 002 003
InPro 7108-VP-25/40-VP	52 002 004
InPro 7108-VP-25/40/HA-C22-VP	52 002 005
InPro 7108-VP-25/65-VP	52 002 006
InPro 7108-VP-25/65/HA-C22-VP	52 002 007
InPro 7108-VP/1.5" TC-VP	52 002 008
InPro 7108/2" TC-VP	52 002 009
InPro 7108-VAR-VP 3.1	52 002 790

Cables	Order Number
1.5 m (4.9 ft)	58 080 201
3.0 m (9.8 ft)	58 080 202
4.5 m (14.8 ft)	58 080 203
7.5 m (24.6 ft)	58 080 204
15.0 m (49.2 ft)	58 080 205
25.0 m (82.0 ft)	58 080 206
30.0 m (98.4 ft)	58 080 207
Adapter (VP to old patch cord, 1 m/3.3 ft)	58 080 101

Features Overview
- No polarization effects
- Withstands over 200 sterilization cycles (where applicable)
- Smooth flat surfaces resist fouling
- Watertight VarioPin connector (IP 68) for easy connection and excellent signal transmission
- MaxCert certification package includes NIST/ASTM traceable cell constant, 3.1 materials certificate, and FDA compliant materials documentation
- WideRange™ technology for wide measuring range and compact, cost-efficient installation

Typical Applications
- Chemical concentration measurement/control
- Detection of phase separation
- Control of CIP processes
- Wastewater monitoring

www.mt.com/InPro7100

Specifications

	InPro 7108–VP/CPVC	InPro 7108–VP/PEEK	InPro 7108–25-VP	InPro 7108–TC–VP InPro 7108–VAR–VP
Measuring principle	4-electrode sensor	4-electrode sensor	4-electrode sensor	4-electrode sensor
Electrode material	316L	Sterilizable 316L or HA-C22	Sterilizable 316L or HA-C22	Sterilizable 316L
Body material	CPVC	PEEK	PEEK	PEEK
RTD	Built-in Pt1000	Built-in Pt1000	Built-in Pt1000	Built-in Pt1000
Insertion length	28mm (1.10")	28mm (1.10")	40/65mm (1.57/2.56")	25mm (0.98")
Max. sensor length	151mm (5.96")	126.7mm (4.99")	123/148mm (4.86/5.84")	105mm (4.14")
Process connection	1" NPT 1" NPT conduit	1" NPT	DN25	Tri-Clamp 1.5" Tri-Clamp 2" Tuchenhagen-Varivent DN 40–DN125
Measuring range	See separate table on page 75			
Cell constant nominal	0.25 cm^{-1}	0.25 cm^{-1}	0.25 cm^{-1}	0.25 cm^{-1}
Working Conditions				
Max. pressure at 25 °C (77 °F)	7bar (100psig)	17bar (246psig)	17bar (246psig)	17bar (246psig)
Max. pressure at 95 °C (203 °F)	– –	7bar (100psig)	7bar (100psig)	7bar (100psig)
Measuring temperature range	–10…80 °C (14…176 °F)	–10…140 °C [a] (14…284 °F)	–10…140 °C [a] (14…284 °F)	–10…140 °C [a] (14…284 °F)
Temperature range (sterilization)	N/A	Sterilizable –10…140 °C [a] (14…284 °F)	Sterilizable –10…140 °C [a] (14…284 °F)	Sterilizable –10…140 °C [a] (14…284 °F)
Temperature accuracy at 25 °C (77 °F)	±0.25 °C ±0.5 °F	±0.25 °C ±0.5 °F	±0.25 °C ±0.5 °F	±0.25 °C ±0.5 °F
Design				
Temperature compensation	Pt1000 IEC class A	Pt1000 IEC class A	Pt1000 IEC class A	Pt1000 IEC class A
Cable connection	Vario Pin (IP68)	Vario Pin (IP68)	Vario Pin (IP68)	Vario Pin (IP68)
Wetted parts:				
– Metals	316L	316L or HA-C22	316L or HA-C22	316L
– Plastics	CPVC	PEEK (FDA)	PEEK (FDA)	PEEK (FDA)
– O-rings	N/A	N/A	EPDM (FDA)	N/A
Certificates and Approvals				
Cell constant	•	•	•	•
CE certificate	•	•	•	•
Material certificates EN 10204 3.1	•	•	•	•
Material confirmation 2.1	•	•	•	•
ATEX (II 1/2G Ex ia)	•	•	•	•

a Short term 150 °C (302 °F)

InPro 7100 (i)

Convenient Sensors for All Your Processes

InPro 7100 InPro 7100 i

The InPro 7100 is particularly suited for applications in the Chemical Industry, Pharmaceutical Industry, Food & Beverage and Pulp & Paper. The fast response time allows quick detection of process changes, leading to better process control. The PEEK shaft material offers high resistivity against aggressive solutions and is particularly suitable in process with frequent CIP/SIP cycles. The InPro 7100 is compatible with a variety of static (InDip® or InFit® series) and retractable (InTrac® series) housings giving the user a wide choice of installation options.

Specifications

Performance	
Cell constant nominal	0.31 cm^{-1}
System accuracy	±5 % or better
Operation range	0 to 20 bar at 135 °C (0 to 290 psi at 275 °F) 0 to 10 bar at 150 °C (0 to 145 psi at 302 °F)
Temperature range (sterilization)	Sterilizable –20 to 150 °C (–4 to 302 °F)
Temperature accuracy at 25 °C (77 °F)	±0.1 °C (±0.1 °F)
Construction	
Measuring principle	4-electrode sensor
Electrode material	SS 316 L/1.4435 Hastelloy C22
Body material	PEEK
RTD	Built-in Pt 1000
Sensor diameter	12 mm
Sensor length	120 mm (4.72"), 225 mm (8.85"), 425 mm (16.73")
Process connection	Pg 13.5, (with InFit series: Tri-Clamp 1.5", Tri-Clamp 2", Cap nut DN 25
Design	
Temperature compensation	Pt 1000 IEC class A
Cable connection	InPro 7100: Vario Pin (IP 68); InPro 7100 i: AK9
Wetted parts:	– Metals: SS 316 L/1.4435 or Hastelloy C22 – Plastics: PEEK (FDA; USP Class VI)
Certificates and Approvals	Cell constant, ATEX, Material certificate 2.1 and 3.1, CE

Features Overview

– Wide measurement range (0.02 – 500 mS/cm, depending on the transmitter)
– High resistance against aggressive chemicals
– Compatible with a variety of our static and retractable housing
– WideRange technology

ISM Features

– Digital connector
– Plug and Measure functionality

Typical Applications

– Chemical concentration control
– Control of CIP processes
– Control of digesting and bleaching (Pulp & Paper)
– Detection of phase separation (Food & Beverages)
– Buffer preparation (Pharma)

www.mt.com/InPro7100

Ordering Information

InPro 7100

Sensor	Order Number
InPro 7100/12/120/4435	52 003 571
InPro 7100/12/120/C22_	52 003 572
InPro 7100/12/425/4435	52 003 793
InPro 7100/12/425/C22_	52 003 794

InPro 7100 i

Sensor	Order Number
InPro 7100i/12/120/4435	52 003 791
InPro 7100i/12/120/C22_	52 003 792
InPro 7100i/12/225/4435	30 095 803
InPro 7100i/12/425/4435	52 003 880
InPro 7100i/12/425/C22_	52 003 881

Patch Cables

1.5 m (5 ft)	58 080 201
3.0 m (10 ft)	58 080 202
4.6 m (15 ft)	58 080 203
7.6 m (25 ft)	58 080 204
15.2 m (50 ft)	58 080 205
22.9 m (75 ft)	58 080 206
30.5 m (100 ft)	58 080 207

AK9 Coax Cables with K8S Connector for ISM sensors

Cable Socket	Termination	Cable Length	Order Number
AK9	Tinned ends	1 m (3.3 ft)	59 902 167
AK9	Tinned ends	3 m (9.8 ft)	59 902 193
AK9	Tinned ends	5 m (16.4 ft)	59 902 213
AK9	Tinned ends	10 m (32.8 ft)	59 902 230
AK9	Tinned ends	20 m (65.6 ft)	52 300 204

For accessories, cables and cable lengths refer to page 132.

Measuring Ranges 4-Electrode Design Sensors

Sensors	Transmitters							
4-electrode sensors	**M100**	**M200**	**M300**	**M400 4-W**	**M400 2-W**	**M700**	**M800**	**System Accuracy (±)**
InPro 7108	–	–	0.02 – 650	0.02 – 650	0.02 – 650	0.02 – 500	0.02 – 650*	5 %
InPro 7100	–	–	0.02 – 400	0.02 – 400	0.02 – 400	0.02 – 400	0.02 – 400*	5 %
InPro 7100 i	0.02 – 500	0.02 – 500	0.02 – 500	0.02 – 500	0.02 – 500	–	0.02 – 500	5 %

All values in mS/cm

* M800 1-channel only

Suitable Housings **p.**
InTrac 781 121

InPro 7250
Inductive Conductivity Sensors

PEEK PFA

The InPro 7250 Series conductivity sensors are inductive sensors designed to handle aggressive chemical solutions or dirty water applications. These "electrodeless" sensors have no electrodes in contact with the sample and are not affected by coatings that foul traditional contacting conductivity sensors. Able to measure medium to very high conductivity levels, applications range from measurement of industrial wastewater to acid, caustic, and salt stream concentration in industrial processing.

Specifications

High Temperature (HT)	**PEEK**	**PFA**
Measurement range	0–2,000 mS/cm	0–2,000 mS/cm
Temperature range	–20 to 180 °C (–4 to 356 °F)	–20 °C to 125 °C (–4 to 257 °F)
Pressure range at 25 °C (77 °F)	0–20 bar (0–290 psi)	0–16 bar (0–232 psi)
Sensor material	PEEK, glass filled	PFA, not glass filled
Seal material	Viton®	PTFE
Temperature sensor	Pt 1000	Pt 1000
Cell factor	2.175	2.30
Process connection	G ¾"	G ¾"
Cable length	3 m, 5 m, 10 m (9.8 ft, 16.4 ft, 32.8 ft)	3 m, 5 m, 10 m (9.8 ft, 16.4 ft, 32.8 ft)
Certificates and Approvals ATEX:	•	•
FM:	•	•
CE:	•	•

Standard Temperature (ST)	**PEEK**
Measurement range	0–2,000 mS/cm
Temperature range	–20 to 100 °C (–4 to 212 °F)
Pressure range at 25 °C (77 °F)	0–8 bar (0–116 psi)
Sensor material	PEEK, glass filled
Seal material	Viton®
Temperature sensor	Pt 1000
Cell factor	2.175
Process connection	G ¾"
Cable length	3 m, 5 m, 10 m (9.8 ft, 16.4 ft, 32.8 ft)
Certificates and Approvals CE:	•

Features Overview

- Inductive design ideal for dirty applications or process chemical concentration measurement
- No polarization effects
- High temperature model suitable for boiler blowdown applications
- Chemically resistant PEEK body for very aggressive chemicals
- PFA version available for harsh environments
- Robust design for maintenance-free operation
- Available bushings and flanges simplify installation

www.mt.com/InPro7250

Ordering Information

Sensors	Order Number
InPro 7250 ST/Pt1000/3 m (9.8 ft)	52 002 736
InPro 7250 ST/Pt1000/5 m (16.4 ft)	52 002 737
InPro 7250 ST/Pt1000/10 m (32.8 ft)	52 002 738
InPro 7250 HT/Pt1000/3 m (9.8 ft)	52 002 739
InPro 7250 HT/Pt1000/5 m (16.4 ft)	52 002 740
InPro 7250 HT/Pt1000/10 m (32.8 ft)	52 002 741
InPro 7250 PFA/Pt1000/3 m (9.8 ft)	52 005 423
InPro 7250 PFA/Pt1000/5 m (16.4 ft)	52 005 424
InPro 7250 PFA/Pt1000/10 m (32.8 ft)	52 005 425

Other sensor cable lengths are available. Please contact METTLER TOLEDO for details.

Process Connections and Accessories	Order Number
– Flanges	
Flange DN 50/PN16	52 403 565
Flange ANSI 2"	52 403 567
Flange ANSI 3"	52 403 569
Flange DN50/PN16, PVDF, only for PFA version	52 403 946
Flange ANSI 2", incl. Sealing Plate PTFE	52 403 947
– Bushings	
Bushing R 1½"	52 403 446
Bushing R 1½", PVDF	52 403 447
Bushing R 2"	52 403 448
Bushing R 2", PVDF	52 403 449
Bushing 1½" NPT	52 403 450
Bushing 1½" NPT, PVDF	52 403 451
Bushing 2" NPT	52 403 452
Bushing 2" NPT, PVDF	52 403 453
– Sanitary Adapters	
Dairy adapter DN50	52 403 583
Aseptic adapter DN50	52 403 584
– InDip 550 Ind – Sensor holder spare part set	
InDip 550 ind PVC	52 403 579
InDip 550 ind PVDF	52 403 580
– Accessories	
Flat gasket (Viton®)	52 403 432
O-ring (Viton®)	52 750 171
Locknut (stainless steel)	52 403 433

Transmitter M700(x), Module Cond Ind 7700 (x)	Designation	Order Number
Transmitter base, ss (no modules)	M700S	52 121 174
Transmitter base, ss, Ex, VPW*, 100…230 VAC	M700XS/VPW	52 121 175
Transmitter base, ss, Ex, 24 VAC/DC	M700XS/24 V	52 121 176
Transmitter base, coated (no modules)	M700C	52 121 171
Transmitter base, coated, Ex, VPW*, 100…230 VAC	M700XC/VPW	52 121 172
Transmitter base, coated, Ex, 24 VAC/DC	M700XC/24 V	52 121 173

* VPW = VariPoWer

Conductivity (Inductive) Measurement Module	Designation	Order Number
Conductivity (inductive) measurement module	Cond Ind 7700	52 121 186
Conductivity (inductive) measurement module, Ex	Cond Ind 7700 X	52 121 187

Transmitter M400 (4-Wire Transmitter)	Designation	Order Number
M400, Type 1 Cond Ind	–	52 121 495

Transmitter M400 (2-Wire Transmitter)	Designation	Order Number
M400 2XH Cond Ind	–	30 256 307