

High Precision Resistometric Sensor/Transmitter for Monitoring Cathodic Protection Performance at Buried or Underground Structures.

FEATURES

- High 18 bits measuring resolution achieves 1nm metal release sensitivity for a 0.5 mm thick exposed element.
- 2 Channel PSD detector for high error signal attenuation.
- Reads ER sensors from 0.7 mohm to 10 mohm.
- Temperature output from sensor body can be used to detect seasonal changes in exposed environment.
- Very low temperature drift for measurement electronic. 0.002% of FS from -10°C to 70°C.
- Very low supply current. 3.6mA at 24 VDC supply voltage.
- Galvanically isolated sensor from supply and comm.
- RS485 comm output for easy integration with data loggers, radios or PLCs. Modbus RTU output if required.
- Sensor with encapsulated electronics can be used in water.
- Long cable runs without compromising sensor signal.
- Energy flows in and out of the device are restricted for use in hazardous areas.
- Dedicated wire for connecting the sensor to CP ground structure.

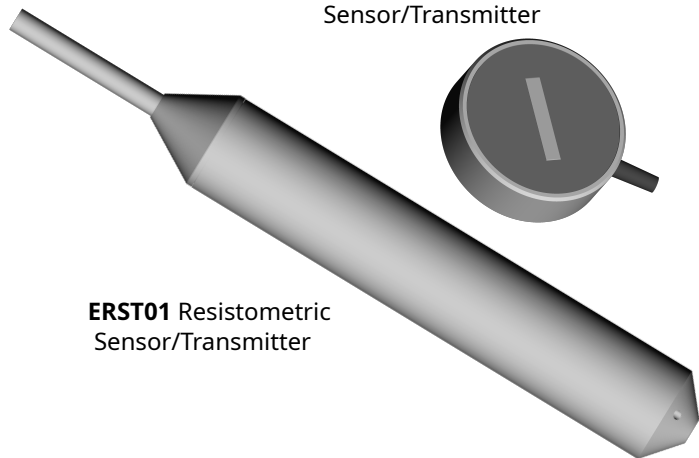
APPLICATIONS

- Cathodic Protection Performance Monitoring
- Corrosion in Soil Monitoring
- Atmospheric Corrosion Monitoring
- Laboratory Corrosion Testing
- General Corrosion Testing/Monitoring
- Soil Bed Testing

ERST02 Resistometric Sensor/Transmitter



ERST01 Resistometric Sensor/Transmitter



DESCRIPTION

The **ERST01/02** sensor/transmitters are specifically designed to detect metal release (caused by corrosion) in soils and aquatic media at low pressure and temperatures not exceeding 60°C.

The **ERST01/02** sensor/transmitter arrangement is based on the resistometric technique outlined in the copper sensor data sheet **DS FMRS06**. The three channel **FMRT01 PSD** detector for the **FMRT01** transmitter has been reduced to 2 channels without the temperature gradient detector for the two sensing elements in the sensor. The temperature measurement represents the body temperature of the encapsulant and not the temperature of the sensors reference element.

The **ERST01/02** sensor/transmitter uses cylindrical and strip shaped metal elements as reference and sensing resistors.

An internal flat reference element is used for both devices to compensate for the temperature dependent resistance of the element material. The wall thickness for the exposed cylinder is 0.5 mm or 0.25 mm (0.02" or 0.01") and the wall thickness for the strip type sensor is 1 mm, 0.5 mm and 0.25 mm (0.04", 0.02" and 0.01").

The **TCR** (Temperature Coefficient of Resistance) of the two elements (reference and exposed) is within or better than +/- 2 **RRU** for a 1°C change in element material temperature at 18 bits of resolution. 18 bits of resolution result in 262144 **RRU** (Resistance Ratio Units). The loss of half the wall thickness for the exposed cylinder or strip sensing element is a full scale reading of 262144 **RRU** or 254 000 nm for a 0.5mm thick cylinder or strip wall (1 **RRU** = ~ 1nm). Sensors are proximity signal corrected. A basic **AI** algorithm based on linear regression further improves precision and accuracy for the collected ratio-metric measurement samples.

Integrating the sensor signal conditioner and communication into the sensor head eliminates the problems with long sensor cable runs and reduces the cable cost significantly for long cable runs. For buried **Cathodic Protected** structures the exposed sensor cylinder can be connected through a dedicated wire to the protected structure (the wire can also be incorporated into the supply/comm cable). The **ERST01/02** sensor elements are **galvanically isolated** from supply and communication. For buried applications the sensor can now be wired back to a shelter (if available) to avoid theft and vandalism. Tank bottom monitoring is now possible without compromises.

The **ERST01/02** sensor/transmitter can be directly read with a rugged **Tablet PC** without an additional power supply. It can also be connected to the **LSHR01** data logger (see also data sheet **DS-LSHR01**). To avoid battery changes, the data logger contains a rechargeable Sodium-ion battery for 6500 data samples. Data are usually collected by collecting the logger and replacing it with a fresh one. The logger can then be read and recharged back at the base. The **LSHR01** data logger contains an energy harvester which allows the use of small solar panels.

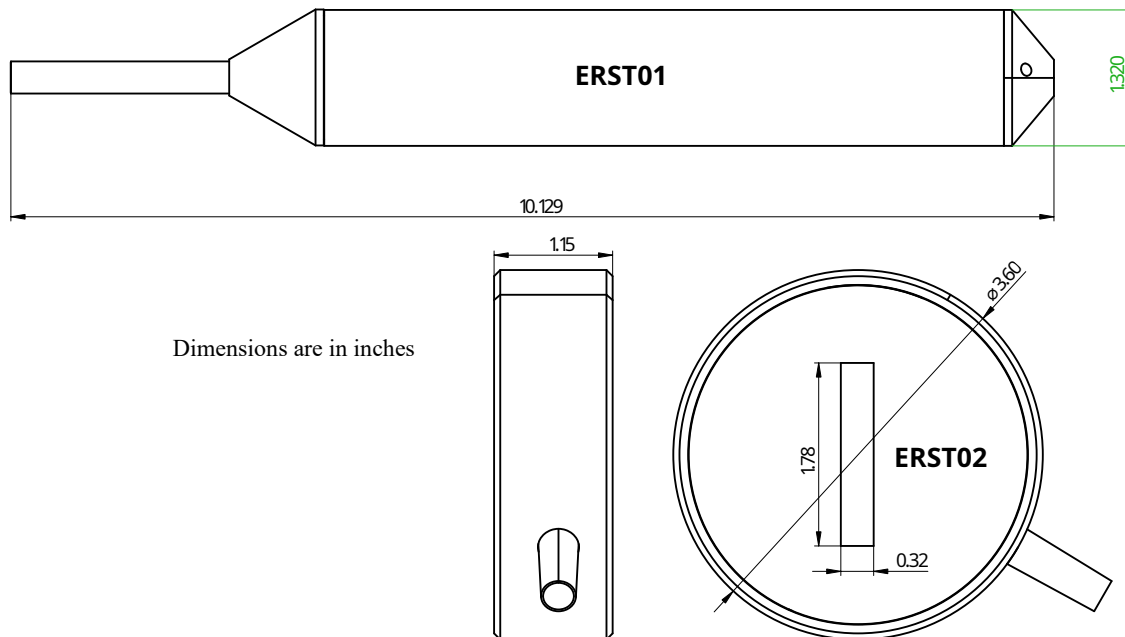
Cell phone radios and other wireless gear can be directly connected to the **ERST01/02** or via the **LSHR01** data logger. The Tablet PC can also be used for online or wireless communication.

The **ERST01/02's** best in class precision, repeatability, communication flexibility and the use of long cable runs more than compensate for the higher cost compared to plain **ER probes** connected to manual readers or data loggers and takes resistometric metal release monitoring to the next level.

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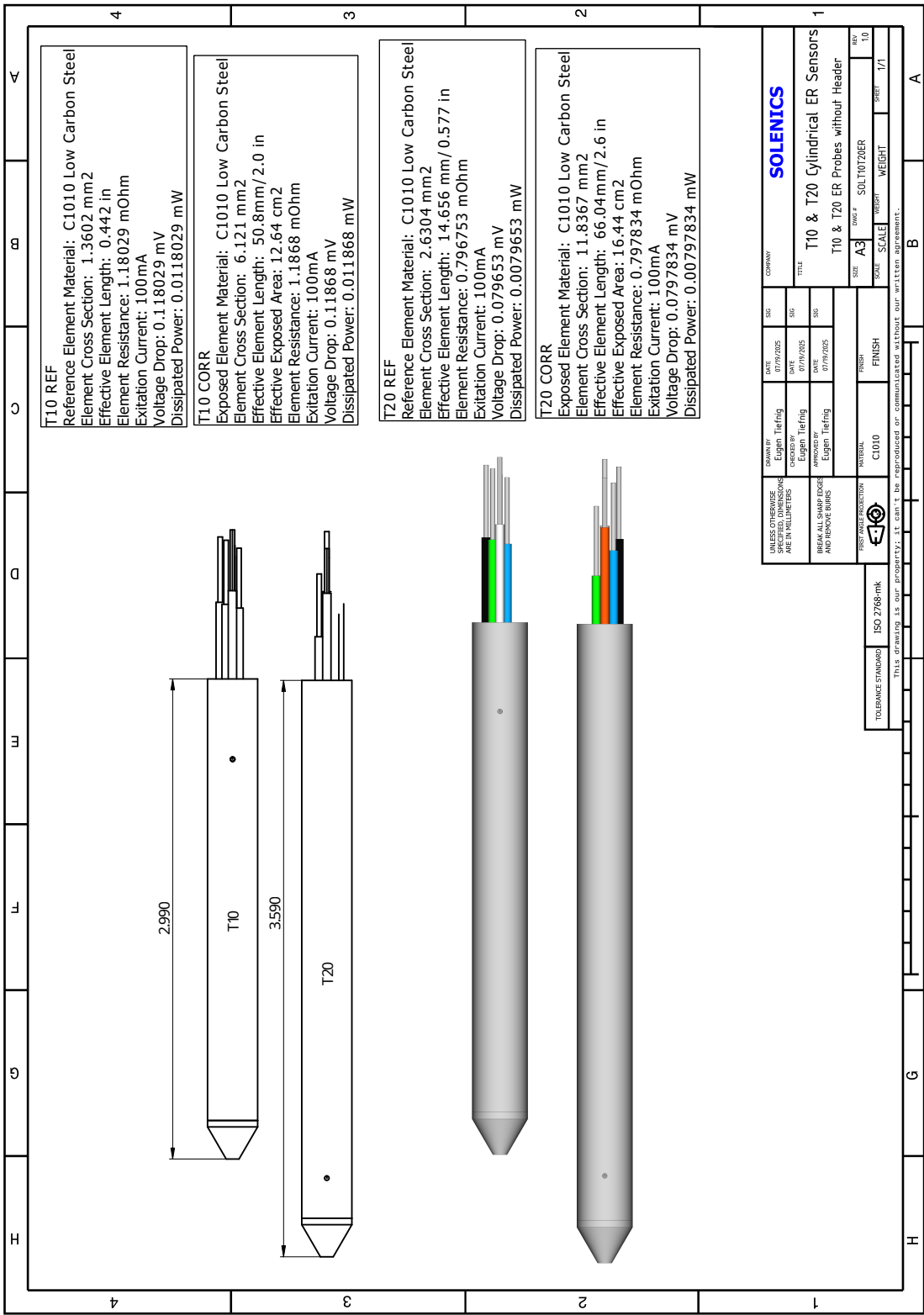
ERST01/02 Sensor/Transmitter Specifications

Enclosure	Cylindrical/Disk encapsulated in PU with integrated sensor	For other enclosure or encapsulant options please contact SOLENICS
Connectors/Cables	No connectors for encapsulated version	For custom connections and cables please contact Solenics
Measurement Method	Ratio-metric Electrical Resistance	Modified Wheatstone Bridge
Signal Conditioning	PSD	Phase Sensitive Demodulation
Resolution	18 bits	262144 points FS
Sensor Resistance Range	0.7 mohm to 10 mohm	Transmitter can be adapted to other resistance ranges.
Channels	2	
Power Supply	6 to 24 VDC	
Current Consumption	3.6 mA at 24 VDC	
Communication	RS485 Solenics or Modbus RTU	For other Comm options please contact SOLENICS
Output Values	2	
Value 1	Sensor Ratio 0 to 262144 RRU	RRU = Resistance Ratio Units
Value2	Body Temperature -40 to 80 °C.	PU Body Temperature
Sensor Material	C1010 Low Carbon Steel	For other materials please contact SOLENICS
Sensitivity to thickness loss	1nm for 0.5 mm wt 0.5 nm for 0.25 mm wt	
Precision	+/- 5 RRU for 0.7 mohm SR better for higher resistances	Depends also on the rate of temperature change in the exposed environment.
Transmitter Temperature Drift	0.002% of FS from -10 to 70 °C	
Permanent Operating Temperature Range	-20 to 70 °C	
Excitation Output	28 Hz Sinusoidal	
Max Excitation Current	100mA	
Max Excitation Output Amplitude	40 mVpp	Terminal voltage for a disconnected sensor



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ERST01 Cylindrical T10 T20 Sensor Element Data



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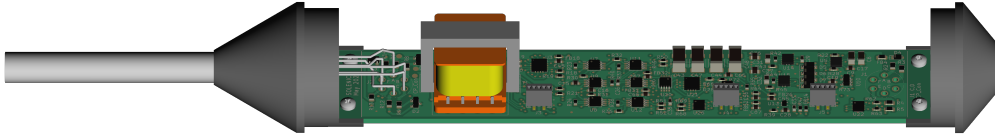
Element	Material	Cross Section	Length	Area	Resistance	Current	Voltage Drop	Power Dissipation
F10 REF	C1010 Low Carbon Steel	1.6744 mm ²	41.148 mm	3.51419 mOhm	100mA	0.351419 mV	0.0351419 mW	
F20 CORR	C1010 Low Carbon Steel	3.3548 mm ²	41.148 mm	1.75395 mOhm	100mA	0.175395 mV	0.0175395 mW	
F40 CORR	C1010 Low Carbon Steel	6.7097 mm ²	41.148 mm	0.876964 mOhm	100mA	0.0876964 mV	0.00876964 mW	

TOLERANCE STANDARD ISO 2768-mk
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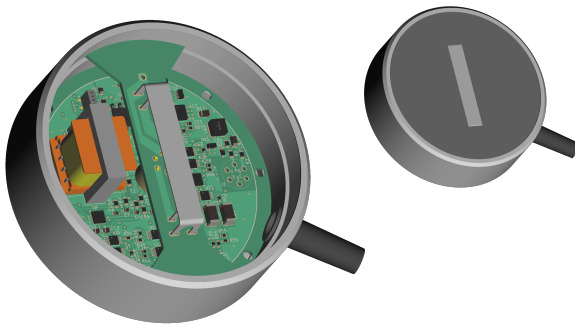
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Sensor/Transmitter Types (Encapsulated and with Connectors to Sensors)

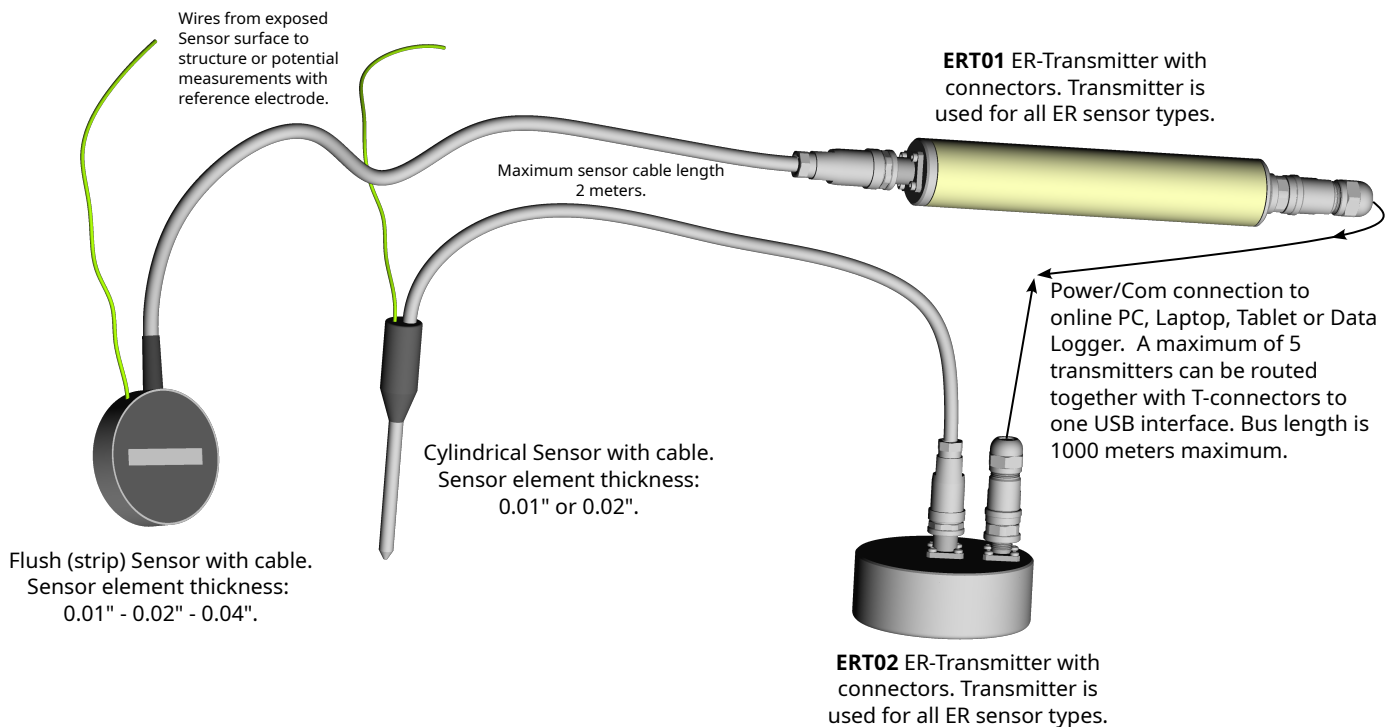
Power/Com cable length can be up to 1000 meters and is permanently attached for encapsulated versions.



ERST01 Resistometric Sensor/Transmitter with cylindrical sensing elements.
Internal view without power/com cable

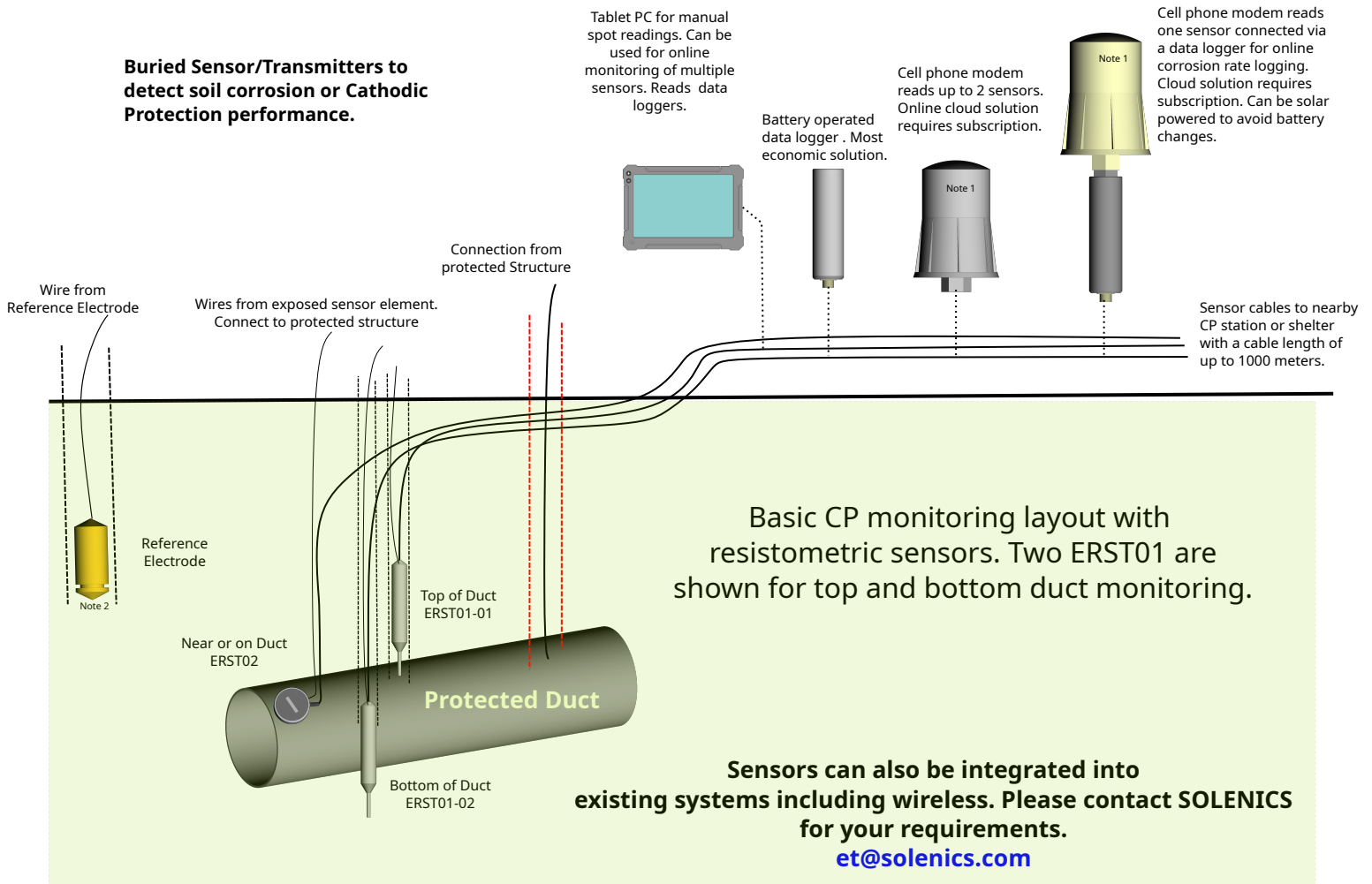


ERST02 Resistometric Sensor/Transmitter with metal strip (flush) sensing elements.
Internal view without power/com cable



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Buried Sensor/Transmitters to detect soil corrosion or Cathodic Protection performance.

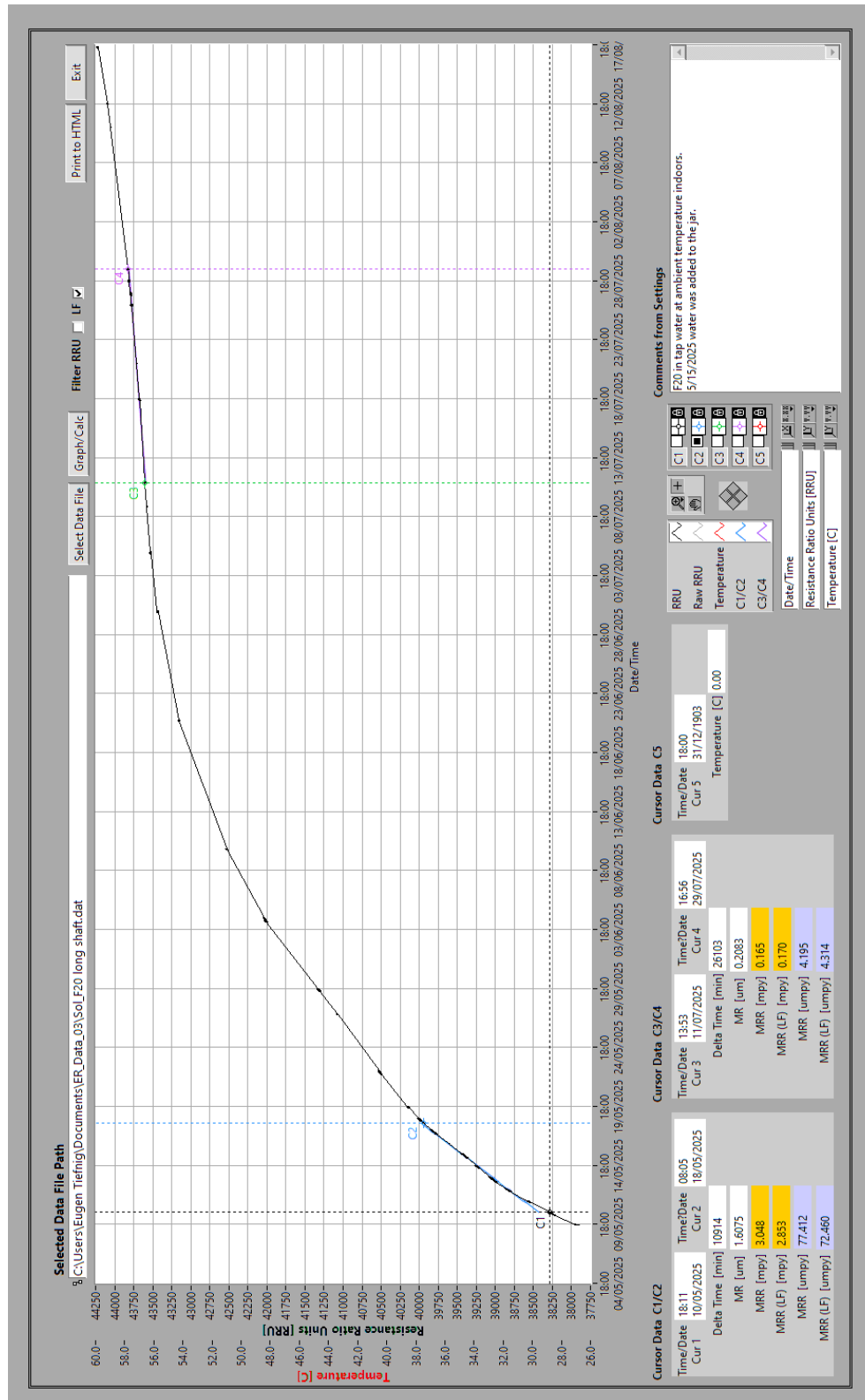


ERST01/02 Transmitter Serial Interface Modbus RTU Mapping for 32 bit Floating Point numbers

Serial Interface IO Mapping				Protocol: RS485						
				Comm Protocol: Modbus RTU (Master)						
				PLC Address:						
				Baud Rate: 1200						
				Start Bit: 1						
				Stop Bit: 1						
Project:				Parity: None						
End User:				PLC Data Type: Holding Register						
Doc No:										
Rev. No / Date:										
Serial Device Type:										
Remote IO Device Address	IO Card Slot Number	Ch. No.	Field Tag Name	Description	Remote Register Address	PLC to DCS Register Address	Access Type	Data Type	Remark	
1		CH1	ER 0001	ER Corrosion Sensor	40001	40001	Read	IEEE Floating Point	32 Bit Floating Point Number (DCBA)	
2		CH2	ER 0002	ER Corrosion Sensor	40001	40003	Read	IEEE Floating Point	32 Bit Floating Point Number (DCBA)	

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Metal release test in tap water showing exponential decay of corrosion rate over time.



MR = Metal Release (Thickness Loss)

MRR = Metal Release Rate (Thickness Loss per Year)

MRR (LF) = Metal Release Rate with Slope Determined by Linear Regression.

um = [micro meter]

umpy = [micro meter per year]

mpy = [mils per year]

Test Conditions:

Instrument: ERST02

Sensor: Flush 20 (0.5 mm thick).

Exposed Material: C1010 (low carbon steel).

Medium: Tap water in glass jar indoors no stirring.

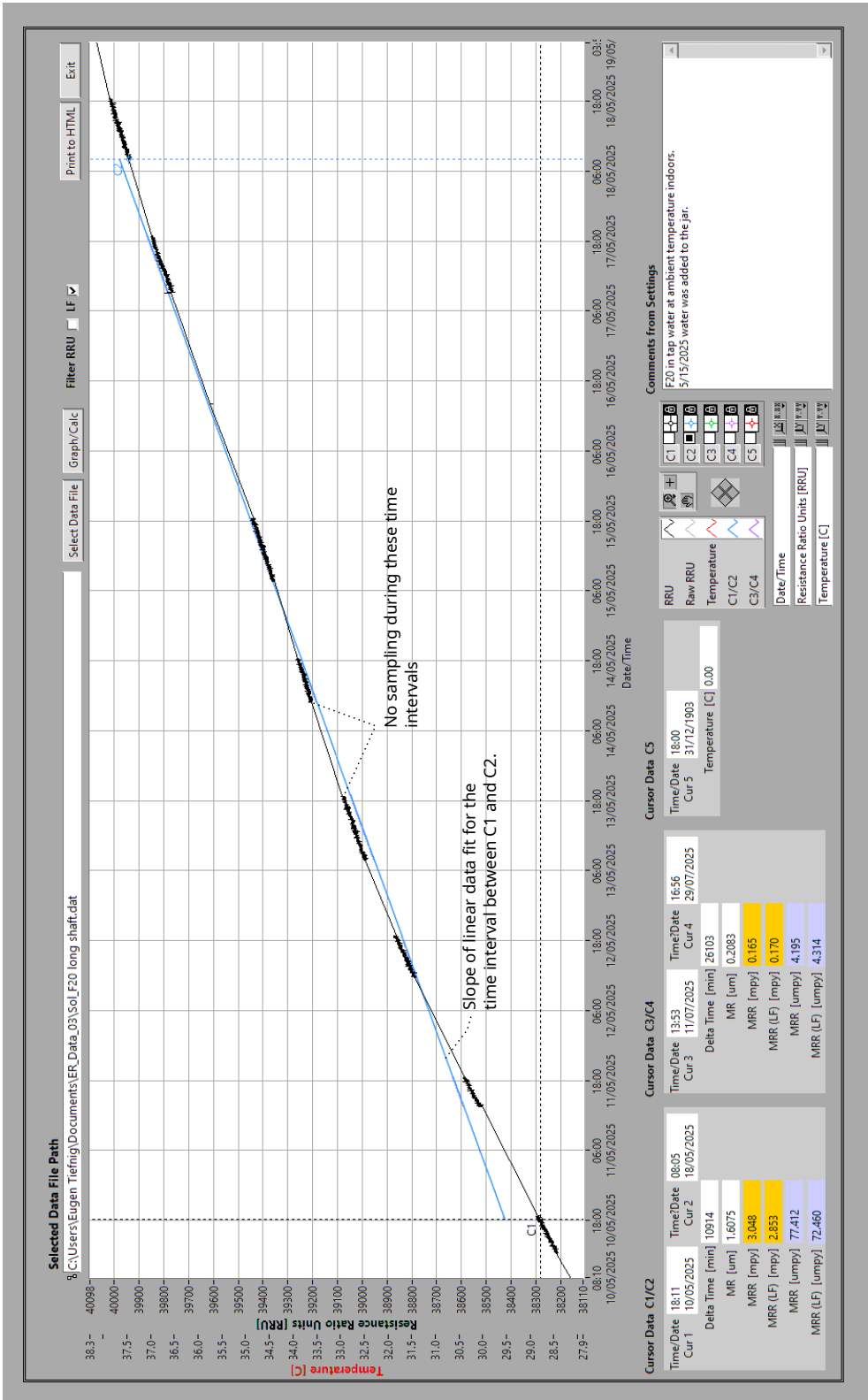
Temperature: min 26 °C max 35 °C.

Sampling: Discontinuous.

Duration: 90 days.

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