9 Specifications

This chapter provides detailed specifications for UT-ONE S12A thermometer readout accuracy, operating conditions and other parameters.

Batemika is dedicated to constant improvement of our products and associated measurement procedures. We reserve the right to changes without prior notice.

9.1 General specifications

Specification	Value
Number of main channels	12
Thermometer probes	platinum resistance thermometers, thermistors, thermocouples
Temperature range	-200 °C to 1800 °C max, limited by the probe range
Type of sampling	consecutive
Sampling period	2 to 240 seconds per enabled channel (continuous mode)
	1 to 5 seconds per reading (single reading mode)
	up to 470 samples/second (digitizing mode)
Measurement current	1 mA / 0.707 mA for PRTs, 20 µA / 14.1 µA for thermistors
Keep-warm current	automatically adjusted for all PRT and thermistor channels
Measurement current accuracy	0.5%
Keep-warm current accuracy	2%
Channel matching	PRTs: <0.5 ppm typical, ±1 ppm maximum
	Thermistors: <1 ppm typical, ±3 ppm maximum
	Thermocouples: <0.2 µV typical, ±0.4 µV maximum
Parasitic emf suppression	full current reversal (PRT and thermistor channels only)
Communication interfaces	USB (GPIB+RS232 optional)
Power supply	USB bus
Power consumption	0.3 W typical, 1 W maximum (with GPIB option)
Weight	2.4 kg
External dimensions (WxHxD)	380 x 90 x 155 mm
Warm up time	no warm up time required to achieve specified accuracy

9.2 Main channels

Accuracy specification is applicable to readout unit only and does not include the thermometer probe accuracy. Note that thermometer probe will practically determine the temperature range and in may be the dominant contributor in the complete measurement uncertainty.

Specifications for PRT and thermistor ranges are specified for normal measurement current setting (1 mA and 20 μA). Using the reduced measurement current setting will result in deterioration of effective resolution by approximately 40%.

Effective resolution is given as the standard deviation of 1000 readings of stable input resistance or emf under optimal conditions. Effective resolution is specified for the 2 second acquisition rate. Increasing the acquisition rate will improve the effective resolution according to the square root rule (for example increasing the acquisition rate to 18 seconds will improve the effective resolution by a factor of 3). Effective resolution (expressed in μΩ or μV) is constant over particular measurement range.

Specifications for thermocouple ranges do not include cold junction compensation error. If internal temperature probe is used for cold junction compensation, refer to its specification and add "CJC accuracy" value to the thermocouple measurement uncertainty. CJC accuracy includes both probe accuracy and error due to temperature gradients.

Short-term drift is defined as the maximum drift of the measured value within the 48 hours from last recalibration. Ambient temperature during this period must be within ±3 °C from the calibration ambient temperature.

Long-term drift is defined as the maximum drift of the measured value within 12 months from last recalibration. UT-ONE must be used during this period within specified operational environmental specifications.

Temperature coefficient is factory-adjusted for each measurement range. Accuracy specification provides residual temperature coefficient after the correction is applied internally by UT-ONE algorithms. Accuracy specification is valid after the instrument has reached stable temperature, as indicated by internal thermometers TJ and TI.

Parasitic emf is a small voltage caused by thermal gradients on input connections. In resistance measurement, parasitic emf is eliminated by reversing the polarity of measurement current, but for thermocouple measurements, thermal emf cannot be distinguished from thermocouple emf. Parasitic emf is independent of measurement range and measured value. Parasitic emf can be minimized by placing UT-ONE in thermally stable environment and by thermally shielding input connectors.

9.2.1 Specifications for PRT subranges

Range name	Range limit	Effective resolution	Nonlinearity	Short-term drift	Long-term drift	Temperature coefficient
R1	25 Ω	27 µΩ	1 ppm of range	6 ppm of value	15 ppm of value	0.25 ppm/°C
R2	50 Ω	35 µΩ	1 ppm of range	6 ppm of value	15 ppm of value	0.25 ppm/°C
R3	100 Ω	70 µΩ	1 ppm of range	6 ppm of value	15 ppm of value	0.25 ppm/°C
R4	200 Ω	120 µΩ	1 ppm of range	6 ppm of value	15 ppm of value	0.25 ppm/°C
R5	400 Ω	200 µΩ	1 ppm of range	6 ppm of value	15 ppm of value	0.25 ppm/°C
R6	800 Ω	500 µΩ	1 ppm of range	6 ppm of value	15 ppm of value	0.25 ppm/°C

9.2.2 Specifications for thermistor subranges

Range name	Range limit	Effective resolution	Nonlinearity	Short-term drift	Long-term drift	Temperature coefficient
H1	1.25 kΩ	1.5 mΩ	5 ppm of range	8 ppm of value	20 ppm of value	2 ppm/°C
H2	2.5 kΩ	2 mΩ	5 ppm of range	8 ppm of value	20 ppm of value	2 ppm/°C
H3	5 kΩ	3.5 mΩ	5 ppm of range	8 ppm of value	20 ppm of value	2 ppm/°C
H4	10 kΩ	5 mΩ	5 ppm of range	8 ppm of value	20 ppm of value	2 ppm/°C
H5	20 kΩ	10 mΩ	5 ppm of range	8 ppm of value	20 ppm of value	2 ppm/°C
H6	40 kΩ	25 mΩ	5 ppm of range	8 ppm of value	20 ppm of value	2 ppm/°C

9.2.3 Specifications for thermocouple subranges

Range name	Range limit	Effective resolution	Nonlinearity	Short-term drift	Long-term drift	Temperature coefficient	Parasitic emf
E1	15 mV	0.03 µV	10 ppm of range	30 ppm of value	60 ppm of value	2 ppm/°C	0.5 µV
E2	30 mV	0.04 µV	10 ppm of range	30 ppm of value	60 ppm of value	2 ppm/°C	0.5 µV
E3	60 mV	0.07 µV	10 ppm of range	30 ppm of value	60 ppm of value	2 ppm/°C	0.5 µV
E4	125 mV	0.11 µV	10 ppm of range	30 ppm of value	60 ppm of value	2 ppm/°C	0.5 µV
E5	250 mV	0.2 µV	10 ppm of range	30 ppm of value	60 ppm of value	2 ppm/°C	0.5 µV
E6	500 mV	0.5 µV	10 ppm of range	30 ppm of value	60 ppm of value	2 ppm/°C	0.5 µV

9.2.4 Pt-100 specifications

This chapter presents UT-ONE accuracy specification applied to the industrial-grade platinum resistance thermometer with nominal resistance of 100 ohms. Presented accuracy specification is applicable to measurements with normal measurement current (1 mA) and with auto ranging feature enabled. Accuracy for measurements with external resistor depends on accuracy of external resistor, 3 ppm accuracy is used in this example.

Note that presented accuracy is the accuracy of measurement instrument only and does not include probe drift and accuracy!

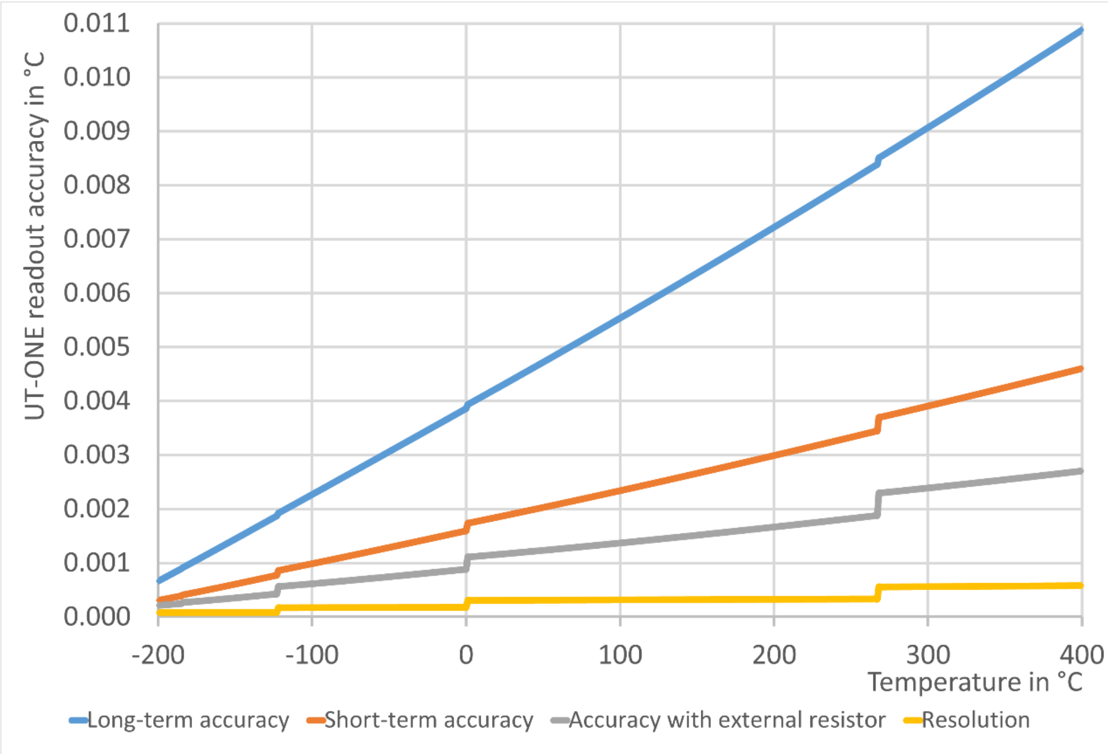


Figure 65: UT-ONE accuracy specification for Pt-100 probe

As a convenience to the user, graphs of Pt-100 probe resistance and sensitivity are presented. Note that this is a general property of this particular type of probes and is not originating from UT-ONE characteristics.

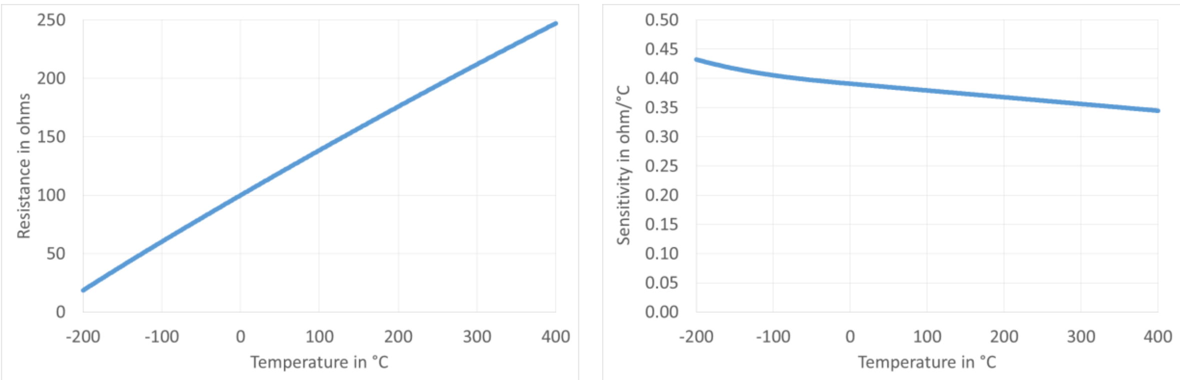


Figure 66: Resistance and sensitivity characteristic for Pt-100 probe

9.2.5 Pt-25 specifications

This chapter presents UT-ONE accuracy specification applied to the standard platinum resistance thermometer with nominal resistance of 25 ohms. Presented accuracy specification is applicable to measurements with normal measurement current (1 mA) and with auto ranging feature enabled. Accuracy for measurements with external resistor depends on accuracy of external resistor, 3 ppm accuracy is used in this example.

Note that presented accuracy is the accuracy of measurement instrument only and does not include probe drift and accuracy!

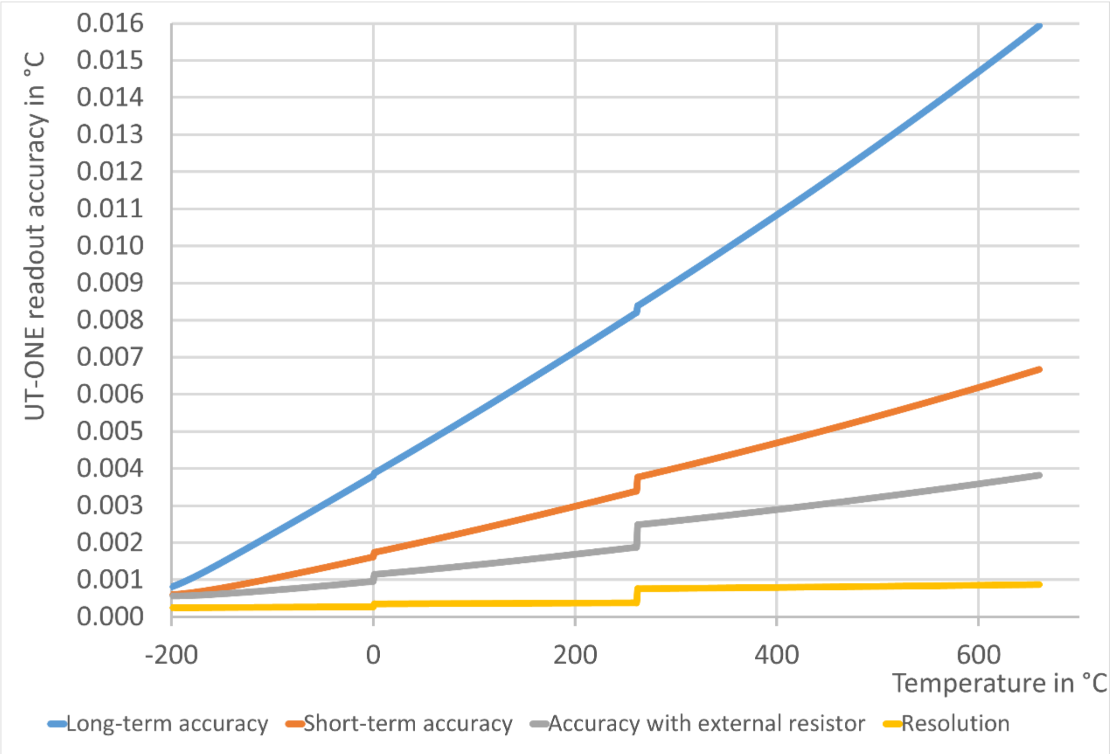


Figure 67: UT-ONE accuracy specification for Pt-25 probe

As a convenience to the user, graphs of Pt-25 probe resistance and sensitivity are presented. Note that this is a general property of this particular type of probes and is not originating from UT-ONE characteristics.

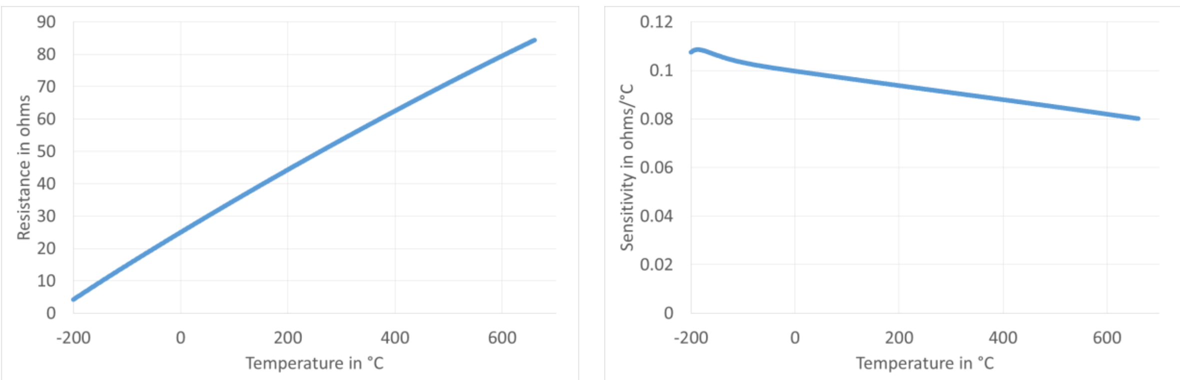


Figure 68: Resistance and sensitivity characteristic for Pt-25 probe

9.2.6 Thermistor 3K3A specifications

This chapter presents UT-ONE accuracy specification applied to the thermistor probe with nominal resistance of 3000 ohms. Presented accuracy specification is applicable to measurements with normal measurement current (20 µA) and with auto ranging feature enabled. Accuracy for measurements with external resistor depends on accuracy of external resistor, 3 ppm accuracy is used in this example.

Note that presented accuracy is the accuracy of measurement instrument only and does not include probe drift and accuracy!

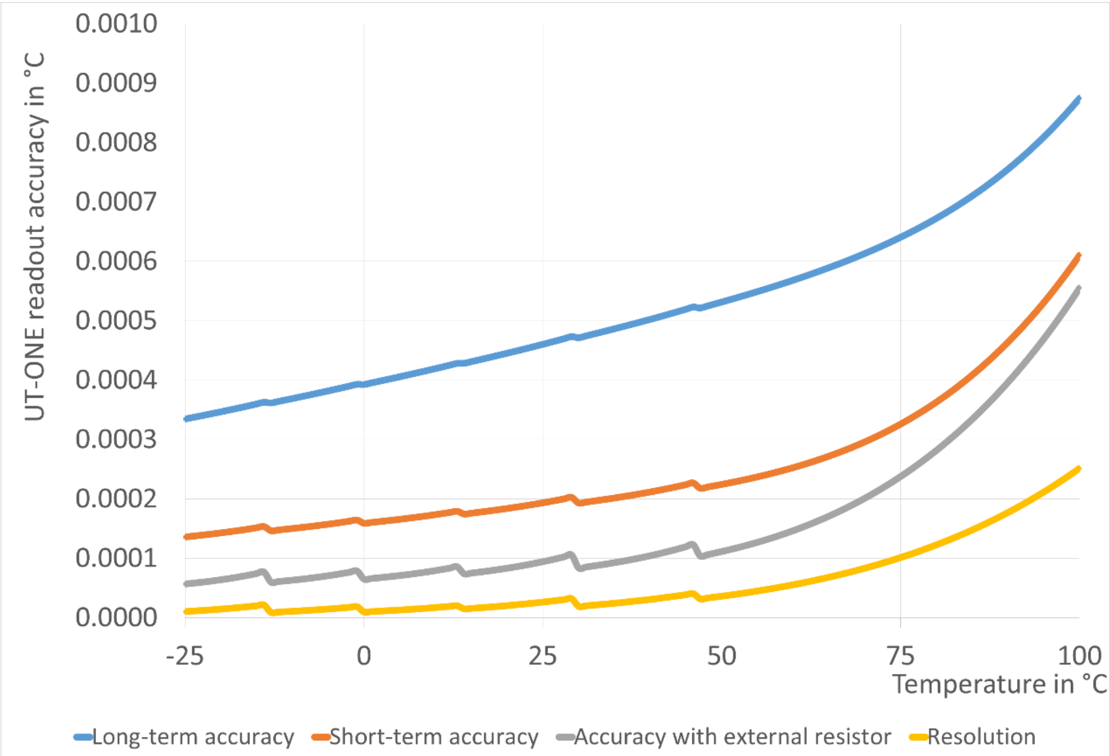


Figure 69: UT-ONE accuracy specification for 3K3A thermistor probe

As a convenience to the user, graphs of 3K3A thermistor probe resistance and sensitivity are presented. Note that this is a general property of this particular type of probes and is not originating from UT-ONE characteristics.

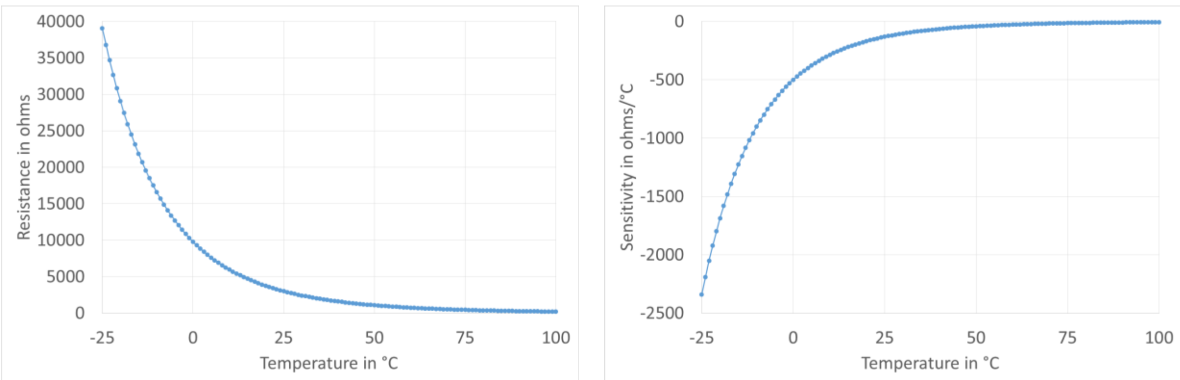


Figure 70: Resistance and sensitivity characteristic for 3K3A thermistor probe

9.2.7 Thermistor 10K3A specifications

This chapter presents UT-ONE accuracy specification applied to the thermistor probe with nominal resistance of 10000 ohms. Presented accuracy specification is applicable to measurements with normal measurement current (20 µA) and with auto ranging feature enabled. Accuracy for measurements with external resistor depends on accuracy of external resistor, 3 ppm accuracy is used in this example.

Note that presented accuracy is the accuracy of measurement instrument only and does not include probe drift and accuracy!

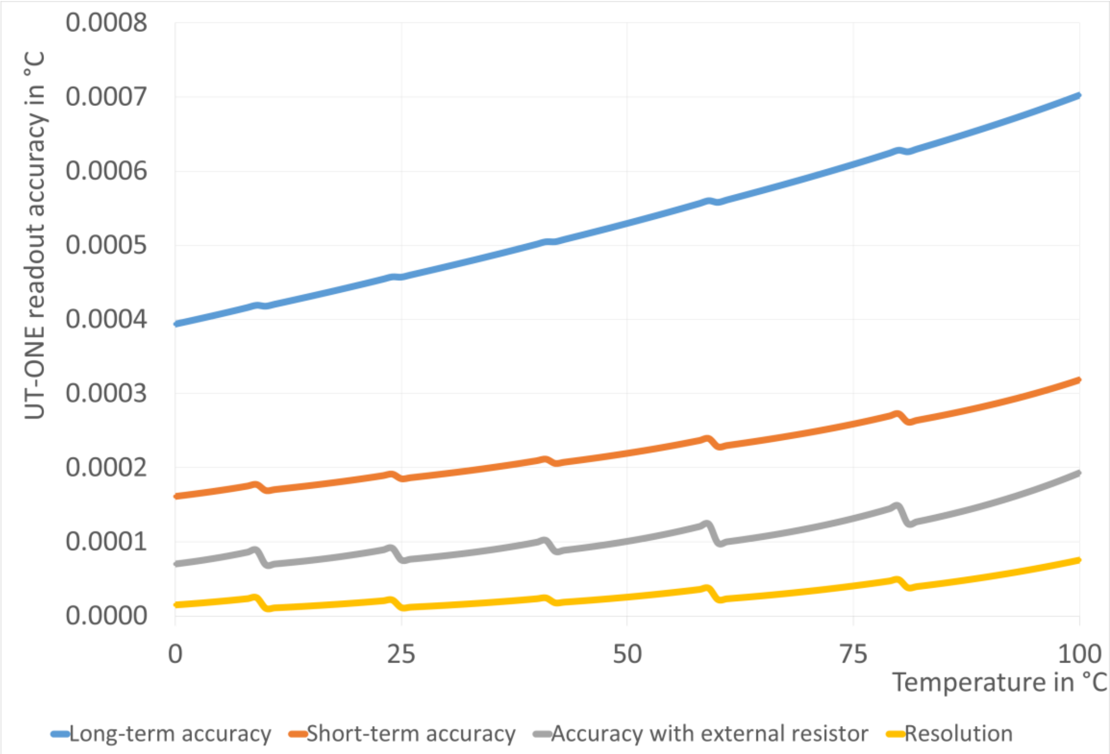


Figure 71: UT-ONE accuracy specification for 10K3A thermistor probe

As a convenience to the user, graphs of 10K3A thermistor probe resistance and sensitivity are presented. Note that this is a general property of this particular type of probes and is not originating from UT-ONE characteristics.

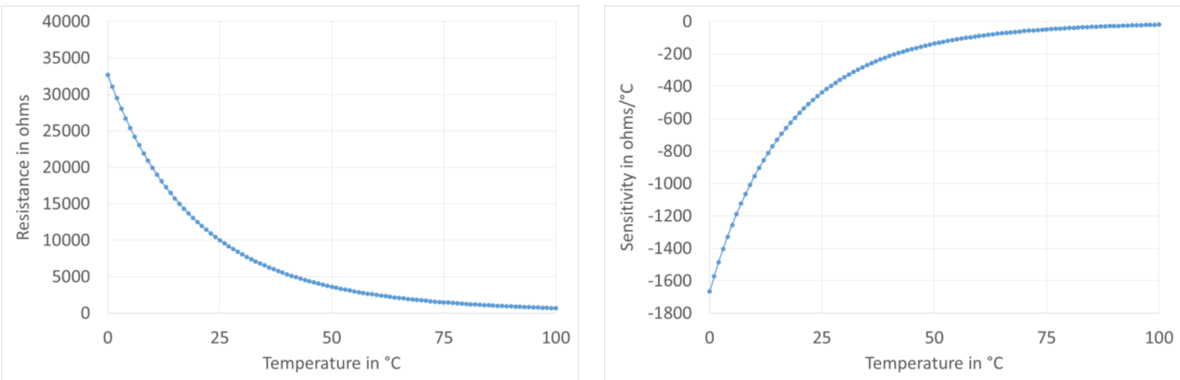


Figure 72: Resistance and sensitivity characteristic for 10K3A thermistor probe

9.2.8 Thermocouple Type K specifications

This chapter presents UT-ONE accuracy specification applied to the thermocouple probe of type K. Presented accuracy specification is applicable to measurements with auto ranging feature enabled and use of external cold-junction compensation. For measurements with internal cold-junction compensation, add the specified cold-junction accuracy.

Note that presented accuracy is the accuracy of measurement instrument only and does not include probe drift and accuracy!

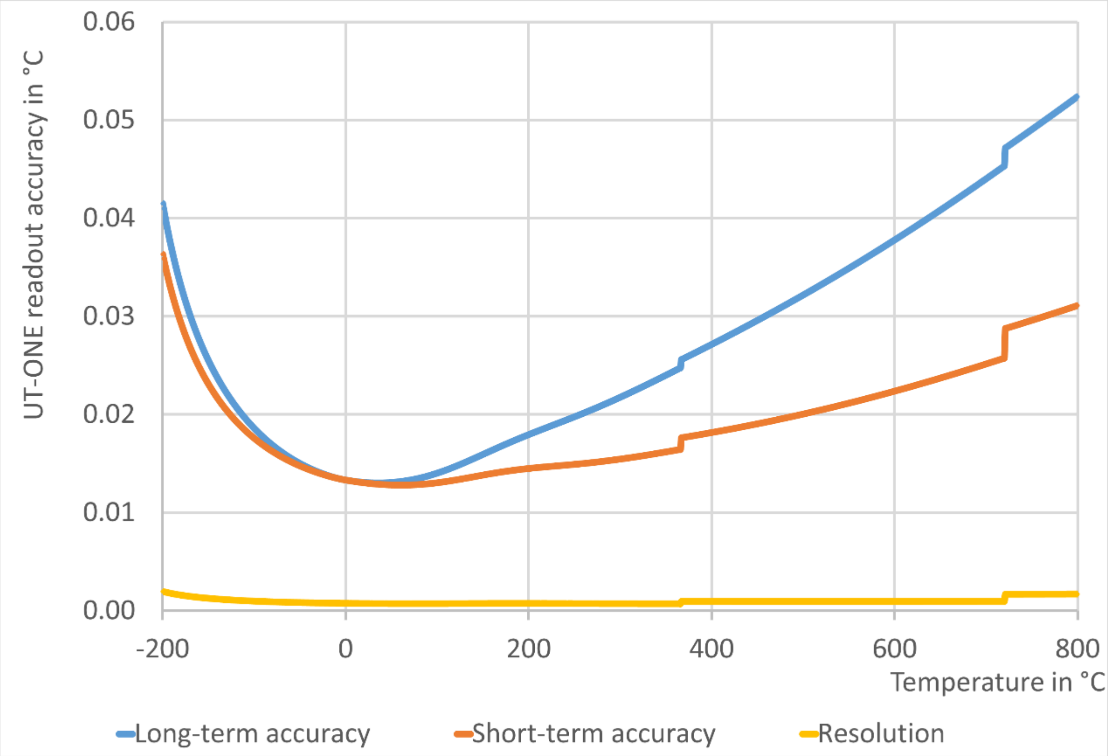


Figure 73: UT-ONE accuracy specification for type K thermocouple probe

As a convenience to the user, graphs of type K thermocouple probe emf and sensitivity are presented. Note that this is a general property of this particular type of probes and is not originating from UT-ONE characteristics.

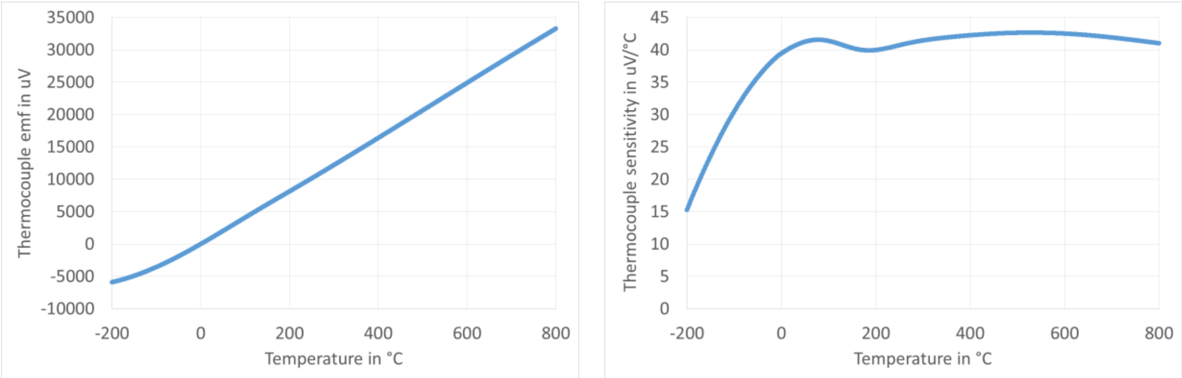


Figure 74: Emf and sensitivity characteristic for type K thermocouple probe

9.2.9 Thermocouple Type S specifications

This chapter presents UT-ONE accuracy specification applied to the thermocouple probe of type S. Presented accuracy specification is applicable to measurements with auto ranging feature enabled and use of external cold-junction compensation. For measurements with internal cold-junction compensation, add the specified cold-junction accuracy.

Note that presented accuracy is the accuracy of measurement instrument only and does not include probe drift and accuracy!

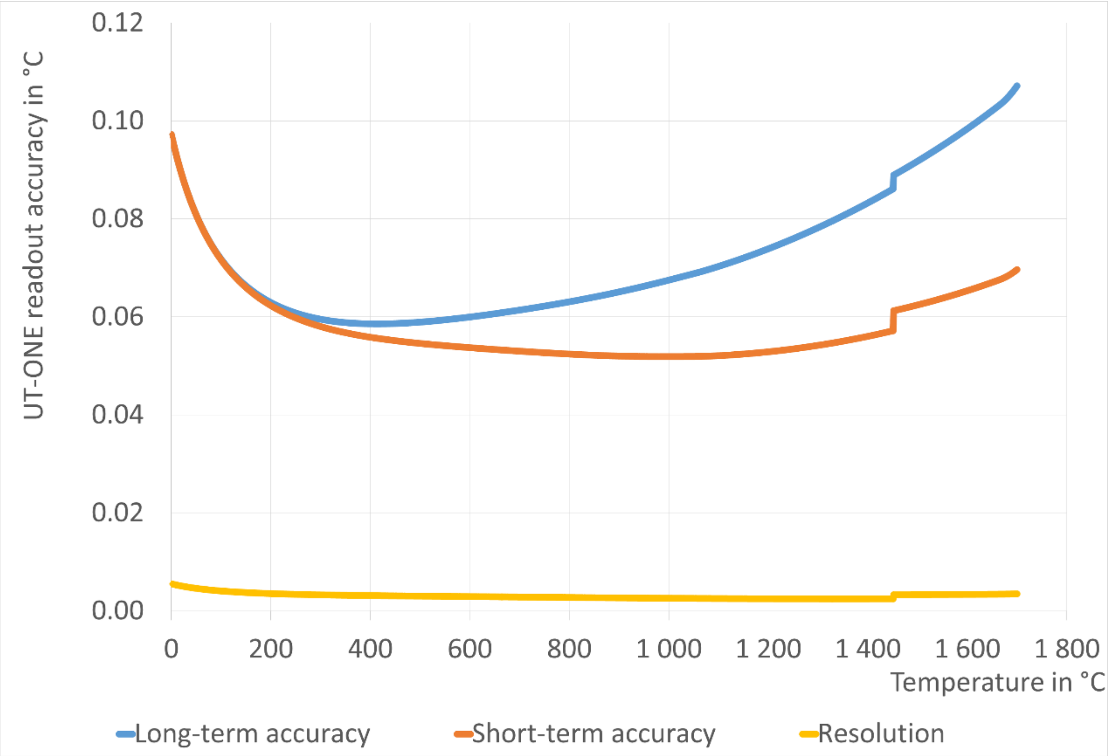
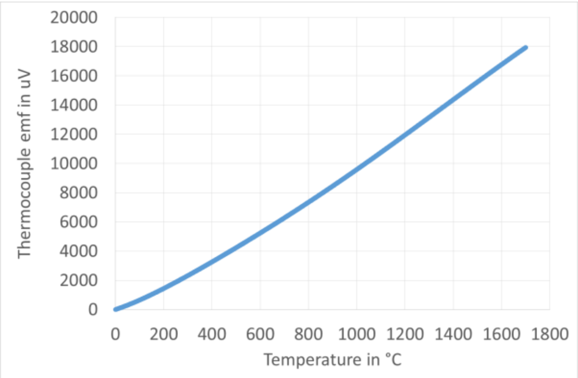


Figure 75: UT-ONE accuracy specification for type S thermocouple probe

As a convenience to the user, graphs of type S thermocouple probe emf and sensitivity are presented. Note that this is a general property of this particular type of probes and is not originating from UT-ONE characteristics.



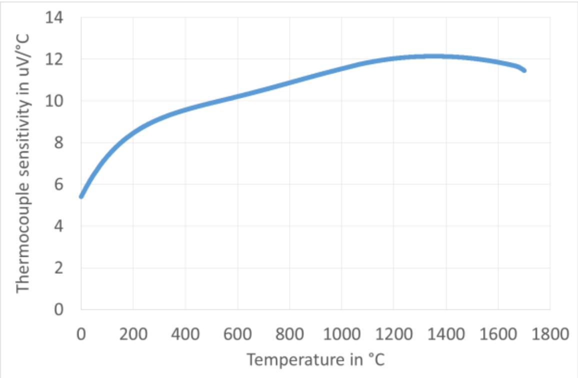


Figure 76: Emf and sensitivity characteristic for type S thermocouple probe

9.3 Auxiliary channels

Internal CJC thermometer	
Sensor type	Digital temperature sensor
Sampling period	1 second
Response time	10 minutes (typical)
Probe characterization	Polynomial correction function
Temperature range	5 to 45 °C
Temperature resolution	0.01 °C
Temperature accuracy	±0.4 °C
CJC accuracy	±0.5 °C (assuming stable ambient temperature)

Internal ADC thermometer	
Sensor type	Digital temperature sensor
Sampling period	Synchronized with readings on main channels
Response time	10 minutes (typical)
Probe characterization	Polynomial correction function
Temperature range	5 to 45 °C
Temperature resolution	0.01 °C
Temperature accuracy	±0.5 °C

9.4 Environmental specifications

Operating environment:	laboratory and light industrial environment, indoor use only, avoid dust, water vapour and fumes
Operating temperature:	10 °C to 36 °C
Operating relative humidity:	30% to 70%, non-condensing
Storage temperature:	5 °C to 45 °C
Storage relative humidity:	20% to 80%, non-condensing