

Keithley Instruments

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Instrument Specifications

The Model 2510 Thermoelectric Cooler Controller is designed to:

- Control the power to the TEC to maintain a constant temperature, current, voltage, or thermistor resistance
- Measure the resistance of the TEC
- Provide greater control and flexibility through a software PID loop

CONTROL SYSTEM SPECIFICATIONS

Set	Constant Peltier temperature, Constant Peltier voltage, Constant Peltier current, Constant thermistor resistance
Control method	Programmable software PID loop Proportional, Integral, and Derivative gains independently programmable
Setpoint short term stability	± 0.005 °C RMS ^{1, 2}
Setpoint long term stability	± 0.01 °C ^{1, 3}
Setpoint range	-50 °C to 225 °C
Overtemperature limit	250 °C max
Under-temperature limit	-50 °C max
Setpoint resolution	0.001 °C, 1 mV, 100 μ A, 0.01 % of nominal (25 °C) thermistor resistance
Hardware current limit	1.0 A to 5.25 A ± 5 %
Software voltage limit	± 0.5 to 10.5 V ± 5 %

TEC OUTPUT SPECIFICATIONS

Output range	± 10 V DC at up to ± 5 A DC
Output ripple	<5 mV RMS ⁴
AC Resistance excitation	$\pm(9.6$ mA + 190 μ A) ^{5, 6}

¹ With 10 k Ω thermistor as sensor.

² Short-term stability is defined as 24 hours with Peltier and Model 2510 at 25 °C ± 0.5 °C.

³ Long-term stability is defined as 30 days with Peltier and Model 2510 at 25 °C ± 0.5 °C.

⁴ 10 Hz to 10 MHz measured at 5 A output into a 2 Ω load.

⁵ AC Ohms is a dual pulsed measurement using current reversals available over bus only.

⁶ @23 °C ± 5 °C.

TEC MEASUREMENT SPECIFICATIONS

Function	1 year, 23 °C ±5 °C
Operating resistance ^{7, 8, 9, 10}	±(2.0 % of rdg + 0.1 Ω)
Operating voltage ^{7, 8}	±(0.1 % of rdg + 4 mV)
Operating current ⁸	±(0.4 % of rdg + 8 mA)
AC resistance ^{7, 11}	±(0.10 % of rdg + 0.02 Ω)

OPEN SHORTED THERMOELECTRIC DETECTION

Load impedance	Stable into 1 μF typical
Common mode voltage	30 V DC maximum
Common mode isolation	>10 ⁹ Ω <1500 pF
Max. Sense lead resistance	1 Ω for rated accuracy
Max. Force lead resistance	0.1 Ω

THERMAL FEEDBACK ELEMENT SPECIFICATIONS (1 YEAR, 23 °C ±5 °C)

Sensor type	RTD		Thermistor				Solid State	
	100 Ω	1 kΩ	100 Ω	1 k Ω	10 k Ω	100 kΩ	Current Output (I _{ss})	Voltage Output (V _{ss})
Excitation ¹²	2.5 mA	833 μA	2.5 mA	833 μA	100 μA	33 μA	+13.5 V	2.5 mA
Compliance						833 μA max	833 μA	15.75 V max
Nominal resistance range	0 to 250 Ω	0 to 2.5 kΩ	0 to 1 kΩ	0 to 10 kΩ	0 to 80 kΩ	0 to 200 kΩ		
Excitation Accuracy	±3.7 %	±3.7 %	±3.7 %	±3.7 %	±3.7 %	±3.7 %	±12 %	±3.7 %
Nominal Sensor Temperature Range	-50 °C to +250 °C	-50 °C to +250 °C	-50 °C to +250 °C	-50 °C to +250 °C	-50 °C to +250 °C	-50 °C to +250 °C	-40 °C to +100 °C	-40 °C to +100 °C
Sensor Coefficients	α, β, δ	α, β, δ	A, B, C	A, B, C	A, B, C	A, B, C	Slope and offset	Slope and offset
Measurement Accuracy ±(% rdg + offset)	0.04 + 0.07 Ω	0.04 + 0.4 Ω	0.04 + 0.07 Ω ⁷	0.04 + 0.4 Ω ⁷	0.04 + 3 Ω ⁷	0.04 + 21 Ω ⁷	0.03 + 100 nA	0.03 + 500 μV

⁷ With remote voltage sense.

⁸ Common mode voltage = 0 V (meter connect enabled, connects Peltier low output to thermistor measure circuit ground).

⁹ Resistance range 0 Ω to 20 Ω for rated accuracy.

¹⁰ Current through Peltier > 0.2 A.

¹¹ Resistance range 0 Ω to 100 Ω for rated accuracy.

¹² Default values shown, selectable values of 3 μA, 10 μA, 33 μA, 100 μA, 833 μA, 2.5 mA. Note that temperature control performance will degrade at lower currents.

THERMISTOR MEASUREMENT ACCURACY¹³

Nominal thermistor resistance	0 °C	25 °C	50 °C	100 °C
100 Ω	0.021 °C	0.035 °C	0.070 °C	0.27 °C
1 kΩ	0.015 °C	0.023 °C	0.045 °C	0.18 °C
10 kΩ	0.006 °C	0.012 °C	0.026 °C	0.15 °C
100 kΩ	0.009 °C	0.014 °C	0.026 °C	0.13 °C

**OPEN/SHORTED ELEMENT DETECTION
SOFTWARE LINEARIZATION FOR THERMISTOR AND RTD**

Common mode voltage	30 V DC maximum
Common mode isolation	>10 ⁹ Ω <1000 pF
Max.voltage drop in input force leads	1 volt
Max. sense lead resistance	100 Ω for rated accuracy
Sense input impedance	>400 kΩ

GENERAL SPECIFICATIONS

Item	Limitation and description
Noise rejection	
Speed	Normal
NPLC	1.00
CMRR ¹⁴	90 dB
Source output modes	Fixed DC level
Programmability	IEEE-488 (SCPI-1995.0), RS-232, 3 user-definable power-up states plus factory default and *RST
Power supply	Nominal 100 to 240 V AC RMS, 50 to 60 Hz, 90 VA
Warranty	1 year
Emc	Conforms to European Union EMC Directive
Safety	Conforms to European Union Low Voltage Directive
Vibration	MIL-PRF-28800F Class 3 Random Vibration
Warm-up	1 hour to rated accuracies
Dimensions, weight	89 mm high x 213 mm wide x 370 mm deep (3-1/2 in. x 8-3/8 in. x 14-9/16 in.) Bench configuration (with handle and feet): 104 mm high x 238 mm wide x 370 mm deep (4-1/8 in. x 9-3/8 in. x 14-9/16 in.) Net Weight: 3.8 kg (8.38 lb)
Environment	Operating: 0 °C to 50 °C, 70 % R.H. up to 35 °C. Derate 3 % R.H./ °C, 35 °C to 50 °C. Storage: -25 °C to 65 °C

¹³ Accuracy figures represent the uncertainty that the Model 2510 may add to the temperature measurement, not including thermistor uncertainty. These accuracy figures are for thermistors with typical A, B, C constants.

¹⁴ For 1 kΩ unbalance in LO lead. Minimum amplifier specification.