Model 211 Temperature Monitor

Features

- Operates down to 1.4 K with appropriate sensor
- One sensor input
- Supports diode and RTD sensors
- 0 V to 10 V or 4 mA to 20 mA output
- Large 5-digit LED display
- RS-232C serial interface and alarm relays

Product Description

The Lake Shore single-channel Model 211 Temperature Monitor provides the accuracy, resolution, and interface features of a benchtop temperature monitor in an easy to use, easily integrated, compact instrument. With appropriate sensors, the Model 211 measures temperature from 1.4 K to 800 K including temperatures in high vacuum and magnetic fields. Alarms, relays, user-configurable analog voltage or current output, and a serial interface are standard features on the Model 211. It is a good choice for liquefied gas storage and monitoring, cryopump control, cryo-cooler, and materials science applications, and for applications that require greater accuracy than thermocouples allow.

Sensor Input Reading Capability

The Model 211 Temperature Monitor supports diode temperature sensors and resistance temperature detectors (RTDs). The Model 211 can be configured for the type of sensor in use from the instrument front panel. Ensuring high accuracy and 5-digit measurement resolution are 4-lead differential measurement and 24-bit analog-to-digital conversion.

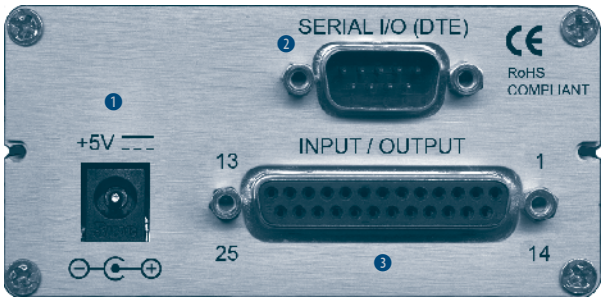
The Model 211 converts voltage or resistance to temperature units based on temperature response curve data for the sensor in use. Standard temperature response curves for silicon diodes and platinum RTDs are included in instrument firmware. The Model 211 also provides non-volatile memory for one 200-point temperature response curve, which can be entered via the serial interface.

Interface

With an RS-232C serial interface and other interface features, the Model 211 is valuable as a stand-alone monitor and is easily integrated into other systems. Setup and every instrument function can be performed via serial interface or the front panel of the Model 211. Temperature data can be read up to seven times per second over computer interface; the display is updated twice each second. High and low alarms can be used in latching mode for error limit detection and in non-latching mode in conjunction with relays to perform simple on-off control functions. The analog output can be configured for either 0 to 10 V or 4 to 20 mA output.

Display

The Model 211 has a 6-digit LED display with measurements available in temperature units K, °C, °F, or sensor units V or Ω.



❶ *Power input connector*
❷ *Serial (RS-232C) I/O (DTE)*
❸ *Analog output*

Sensor Selection

Sensor Temperature Range (sensors sold separately)

		Model	Useful Range	Magnetic Field Use
Diodes	**Silicon Diode**	DT-670-SD	1.4 K to 500 K	T ≥ 60 K & B ≤ 3 T
	Silicon Diode	DT-670E-BR	30 K to 500 K	T ≥ 60 K & B ≤ 3 T
	Silicon Diode	DT-414	1.4 K to 375 K	T ≥ 60 K & B ≤ 3 T
	Silicon Diode	DT-421	1.4 K to 325 K	T ≥ 60 K & B ≤ 3 T
	Silicon Diode	DT-470-SD	1.4 K to 500 K	T ≥ 60 K & B ≤ 3 T
	Silicon Diode	DT-471-SD	10 K to 500 K	T ≥ 60 K & B ≤ 3 T
	GaAlAs Diode	TG-120-P	1.4 K to 325 K	T > 4.2 K & B ≤ 5 T
	GaAlAs Diode	TG-120-PL	1.4 K to 325 K	T > 4.2 K & B ≤ 5 T
	GaAlAs Diode	TG-120-SD	1.4 K to 500 K	T > 4.2 K & B ≤ 5 T
Positive Temperature Coefficient RTDs	**100 Ω Platinum**	PT-102/3	14 K to 873 K	T > 40 K & B ≤ 2.5 T
	100 Ω Platinum	PT-111	14 K to 673 K	T > 40 K & B ≤ 2.5 T
	Rhodium-Iron	RF-800-4	1.4 K to 500 K	T > 77 K & B ≤ 8 T
	Rhodium-Iron	RF-100T/U	1.4 K to 325 K	T > 77 K & B ≤ 8 T
Negative Temperature Coefficient RTDs[1]	**Cernox™**	CX-1010	2 K to 325 K[4]	T > 2 K & B ≤ 19 T
	Cernox™	CX-1030-HT	3.5 K to 420 K[2,5]	T > 2 K & B ≤ 19 T
	Cernox™	CX-1050-HT	4 K to 420 K[2,5]	T > 2 K & B ≤ 19 T
	Cernox™	CX-1070-HT	15 K to 420 K[2]	T > 2 K & B ≤ 19 T
	Cernox™	CX-1080-HT	50 K to 420 K[2]	T > 2 K & B ≤ 19 T
	Germanium	GR-200A/B-1000	2.2 K to 100 K[3]	Not Recommended
	Germanium	GR-200A/B-1500	2.6 K to 100 K[3]	Not Recommended
	Germanium	GR-200A/B-2500	3.1 K to 100 K[3]	Not Recommended
	Carbon-Glass	CGR-1-500	4 K to 325 K[4]	T > 2 K & B ≤ 19 T
	Carbon-Glass	CGR-1-1000	5 K to 325 K[4]	T > 2 K & B ≤ 19 T
	Carbon-Glass	CGR-1-2000	6 K to 325 K[4]	T > 2 K & B ≤ 19 T
	Rox™	RX-102A	1.4 K to 40 K[4]	T > 2 K & B ≤ 10 T

Silicon diodes are the best choice for general cryogenic use from 1.4 K to above room temperature. Diodes are economical to use because they follow a standard curve and are interchangeable in many applications. They are not suitable for use in ionizing radiation or magnetic fields.

Cernox™ thin-film RTDs offer high sensitivity and low magnetic field-induced errors over the 2 K to 420 K temperature range. Cernox sensors require calibration.

Platinum RTDs offer high uniform sensitivity from 30 K to over 800 K. With excellent reproducibility, they are useful as thermometry standards. They follow a standard curve above 70 K and are interchangeable in many applications.

[1] Single excitation current may limit the low temperature range of NTC resistors
[2] Non-HT version maximum temperature: 325 K
[3] Low temperature limited by input resistance range
[4] Low temperature specified with self-heating error: ≤ 5 mK
[5] Low temperature specified with self-heating error: ≤ 12 mK

Typical Sensor Performance – *see Appendix F for sample calculations of typical sensor performance*

	Example Lake Shore Sensor	Temp	Nominal Resistance/ Voltage	Typical Sensor Sensitivity[6]	Measurement Resolution: Temperature Equivalents	Electronic Accuracy: Temperature Equivalents	Temperature Accuracy including Electronic Accuracy, CalCurve™, and Calibrated Sensor
Silicon Diode	DT-670-SD	1.4 K	1.644 V	-12.49 mV/K	1.6 mK	±26 mK	±38 mK
	with 1.4H	77 K	1.028 V	-1.73 mV/K	11.6 mK	±152 mK	±174 mK
	calibration	300 K	0.5597 V	-2.3 mV/K	8.7 mK	±94 mK	±126 mK
		500 K	0.0907 V	-2.12 mV/K	9.4 mK	±80 mK	±130 mK
Silicon Diode	DT-470-SD-13	1.4 K	1.6981 V	-13.1 mV/K	1.5 mK	±26 mK	±38 mK
	with 1.4H	77 K	1.0203 V	-1.92 mV/K	10.5 mK	±137 mK	±159 mK
	calibration	300 K	0.5189 V	-2.4 mV/K	8.4 mK	±88 mK	±120 mK
		475 K	0.0906 V	-2.22 mV/K	9.1 mK	±77 mK	±127 mK
GaAlAs Diode	TG-120-SD	1.4 K	5.391 V	-97.5 mV/K	0.2 mK	±13 mK	±25 mK
	with 1.4H	77 K	1.422 V	-1.24 mV/K	16.2 mK	±359 mK	±381 mK
	calibration	300 K	0.8978 V	-2.85 mV/K	7 mK	±120 mK	±152 mK
		475 K	0.3778 V	-3.15 mV/K	6.4 mK	±75 mK	±125 mK
100 Ω Platinum RTD	PT-103	30 K	3.66 Ω	0.19 Ω/K	10.5 mK	±25 mK	±35 mK
500 Ω Full Scale	with 1.4J	77 K	20.38 Ω	0.42 Ω/K	4.8 mK	±20 mK	±32 mK
	calibration	300 K	110.35 Ω	0.39 Ω/K	5.2 mK	±68 mK	±91 mK
		500 K	185.668 Ω	0.378 Ω/K	5.3 mK	±109 mK	±155 mK
Cernox™	CX-1050-SD-HT[7]	4.2 K	3507.2 Ω	-1120.8 Ω/K	45 μK	±1.4 mK	±6.4 mK
	with 4M	77 K	205.67 Ω	-2.4116 Ω/K	20.8 mK	±75.6 mK	±91.6 mK
	calibration	300 K	59.467 Ω	-0.1727 Ω/K	290 mK	±717 mK	±757 mK
		420 K	45.03 Ω	-0.0829 Ω/K	604 mK	±1.43 K	±1.5 K
Germanium	GR-200A-1000	2 K	6674 Ω	-9930 Ω/K	5 μK	±0.3 mK	±4.3 mK
	with 1.4D	4.2 K	1054 Ω	-526 Ω/K	95 μK	±10 mK	±14 mK
	calibration	10 K	170.9 Ω	-38.4 Ω/K	1.3 mK	±4.4 mK	±9.4 mK
		100 K	2.257 Ω	-0.018 Ω/K	2.78 K	±5.61 K	±5.77 K
Carbon-Glass	CGR-1-2000	4.2 K	2260 Ω	-2060 Ω/K	25 μK	±0.5 mK	±4.5 mK
	with 4L	77 K	21.65 Ω	-0.157 Ω/K	319 mK	±692 mK	±717 mK
	calibration	300 K	11.99 Ω	-0.015 Ω/K	3.33 K	±7 K	±7.1 K

[6] *Typical sensor sensitivities were taken from representative calibrations for the sensor listed*
[7] *Non-HT version maximum temperature: 325 K*

Specifications

Input Specifications

	Sensor Temperature Coefficient	Input Range	Excitation Current	Display Resolution	Measurement Resolution	Electronic Accuracy
Diode	negative	0 V to 2.5 V	10 μA ±0.05%[8]	100 μV	20 μV	±160 μV ±0.01% of rdg
	negative	0 V to 7.5 V	10 μA ±0.05%[8]	100 μV	20 μV	±160 μV ±0.02% of rdg
PTC RTD	positive	0 Ω to 250 Ω	1 mA ±0.3%[9]	10 mΩ	2 mΩ	±0.004 Ω ±0.02% of rdg
	positive	0 Ω to 500 Ω	1 mA ±0.3%[9]	10 mΩ	2 mΩ	±0.004 Ω ±0.02% of rdg
	positive	0 Ω to 5000 Ω	1 mA ±0.3%[9]	100 mΩ	20 mΩ	±0.06 Ω ±0.04% of rdg
NTC RTD	negative	0 Ω to 7500 Ω	10 μA ±0.05%[8]	100 mΩ	50 mΩ	±0.1 Ω ±0.04% of rdg

[8] *Current source error has negligible effect on measurement accuracy*
[9] *Current source error is removed during calibration*

Thermometry

Number of inputs	1
Input configuration	Input can be configured from the front panel to accept any of the supported input types
Isolation	Measurement is not isolated from chassis ground
A/D resolution	24-bit
Input accuracy	Sensor dependent – refer to Input Specifications table
Measurement resolution	Sensor dependent – refer to Input Specifications table
Maximum update rate	7 rdg/s
User curve	One 200-point CalCurve™ or user curve in non-volatile memory

Sensor Input Configuration

	Diode/RTD
Measurement type	4-lead differential
Excitation	Constant current
Supported sensors	Diodes: Silicon, GaAlAs RTDs: 100 Ω Platinum, 1000 Ω Platinum, Carbon-Glass, Cernox™, and Rox™
Standard curves	DT-470, DT-670, CTI-C, PT-100, and PT-1000
Input connector	Shared 25-pin D-sub

Front Panel

Display	5-digit LED
Number of reading displays	1
Display units	K, °C, °F, V, and Ω
Reading source	Temperature and sensor units
Display update rate	2 rdg/s
Temp display resolution	0.001° from 0° to 99.999°, 0.01° from 100° to 999.99°, 0.1° above 1000°
Sensor units display resolution	Sensor dependent to 5 digits
Display annunciators	K, °C, °F, and V/Ω
Keypad	4 full travel keys, numeric and specific functions
Front panel features	Display brightness control, keypad lock-out

Interface

Serial interface

Electrical format	RS-232C
Max baud rate	9600 baud
Connector	9-pin D-sub
Reading rate	Up to 7 rdg/s

Alarms

Number	2, high and low
Data source	Temperature
Settings	High setpoint, Low setpoint, Dead band, Latching or Non-latching
Actuators	Display message, relays

Relays

Number	2
Contacts	Normally Open (NO), Normally Closed (NC), and Common (C)
Contact rating	30 VDC at 1 A
Operation	Activate relays on high or low input alarm or manual
Connector	Shared 25-pin D-sub

Analog output

Isolation	Output is not isolated from chassis ground
Update rate	7 readings per s
Data source	Temperature

	Voltage	*Current*
Range	0 V to 10 V	4 mA to 20 mA
Accuracy	±1.25 mV	±2.5 μA
Resolution	0.3 mV	0.6 μA
Min load resistance	500 Ω	NA
Compliance voltage	NA	10 V
Load regulation	NA	±0.02% of reading 0 to 500 Ω

Scales:	*Temperature*	*Sensor units (fixed by type)*
	0 K to 20 K	Diodes: 1 V = 1 V
	0 K to 100 K	100 Ω Platinum: 1 V = 100 Ω
	0 K to 200 K	1000 Ω Platinum: 1 V = 1000 Ω
	0 K to 325 K	NTC Resistor: 1 V = 1000 Ω
	0 K to 475 K	
	0 K to 1000 K	
Settings	Voltage or current, scale	
Connector	Shared 25-pin D-sub	

General

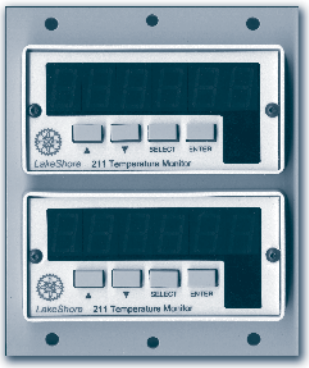
Ambient temperature

Range	15 °C to 35 °C at rated accuracy, 10 °C to 40 °C at reduced accuracy
Power requirements	Regulated +5 VDC at 400 mA
Size	96 mm W × 48 mm H × 166 mm D (3.8 in × 1.9 in × 6.5 in)
Mounting	Panel mount into 91 mm W × 44 mm H (3.6 in × 1.7 in) cutout
Weight	0.45 kg (1 lb)
Approvals	CE mark, RoHS compliant

Power Supply (109-132)

Power requirements	100 – 240 VAC, 50 or 60 Hz, 0.3 A max
Output	+5 V at 1.2 A
Size	40.5 mm W × 30 mm H × 64 mm D (1.6 in × 1.2 in × 2.5 in)
Weight	0.15 kg (0.33 lb)

2111 *Single 1/4 DIN panel-mount adapter, 105 mm W × 132 mm H (4.1 in × 5.2 in)*



2112 *Dual 1/4 DIN panel-mount adapter, 105 mm W × 132 mm H (4.1 in × 5.2 in)*

Ordering Information

Part number	**Description**
211S	Model 211 temperature monitor, single channel
211N	Model 211S with no power supply

Accessories Included with 211S

109-132	100-240 V, 6 W power supply (universal input, interchangeable input plugs)
G-106-253	Sensor input mating connector (DB-25)
G-106-264	Shell for sensor input mating connector
——	Calibration certificate
MAN-211	Model 211 user manual

Options and accessories

2115	Power supply splitter cable — allows two Model 211Ss to be powered from one supply
2111	Single 1/4 DIN panel-mount adapter
2112	Dual 1/4 DIN panel-mount adapter
8000	CalCurve™, CD-ROM (included with calibrated sensor)
8001-211	CalCurve™, factory installed
CAL-211-CERT	Instrument recalibration with certificate
CAL-211-DATA	Instrument recalibration with certificate and data

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