

### 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

## Model 211 Temperature Monitor



### 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.

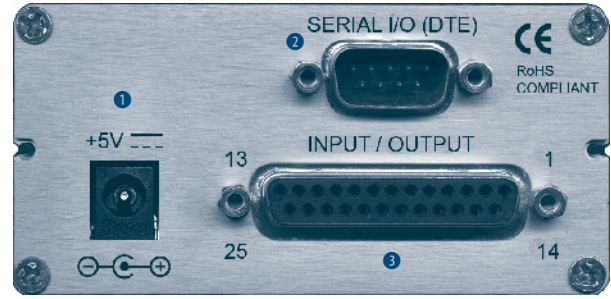
The Model 211 converts voltage or resistance to temperature units based on temperature response curve data for the sensor in use. Standard temperature response curves for silicon diodes and platinum RTDs are included in instrument firmware. The Model 211 also provides non-volatile memory for one 200-point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



- ① Power input connector
- ② Serial (RS-232C) I/O (DTE)
- ③ Analog output

**Sensor Selection**

**Sensor Temperature Range (sensors sold separately)**

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

**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.

<sup>1</sup> Single excitation current may limit the low temperature range of NTC resistors

<sup>2</sup> Non-HT version maximum temperature: 325 K

<sup>3</sup> Low temperature limited by input resistance range

<sup>4</sup> Low temperature specified with self-heating error:  $\leq 5 \text{ mK}$

<sup>5</sup> Low temperature specified with self-heating error:  $\leq 12 \text{ mK}$

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

	Example Lake Shore Sensor	Temp	Nominal Resistance/Voltage	Typical Sensor Sensitivity <sup>6</sup>	Measurement Resolution: Temperature Equivalents	Electronic Accuracy: Temperature Equivalents	Temperature Accuracy including Electronic Accuracy, CalCurve™, and Calibrated Sensor
Silicon Diode	DT-670-SD with 1.4H calibration	1.4 K	1.644 V	-12.49 mV/K	1.6 mK	±26 mK	±38 mK
		77 K	1.028 V	-1.73 mV/K	11.6 mK	±152 mK	±174 mK
		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 with 1.4H calibration	1.4 K	1.6981 V	-13.1 mV/K	1.5 mK	±26 mK	±38 mK
		77 K	1.0203 V	-1.92 mV/K	10.5 mK	±137 mK	±159 mK
		300 K	0.5189 V	-2.4 mV/K	8.4 mK	±88 mK	±120 mK
GaAlAs Diode	TG-120-SD with 1.4H calibration	1.4 K	5.391 V	-97.5 mV/K	0.2 mK	±13 mK	±25 mK
		77 K	1.422 V	-1.24 mV/K	16.2 mK	±359 mK	±381 mK
		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 500 Ω Full Scale	PT-103 with 1.4J calibration	30 K	3.66 Ω	0.19 Ω/K	10.5 mK	±25 mK	±35 mK
		77 K	20.38 Ω	0.42 Ω/K	4.8 mK	±20 mK	±32 mK
		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 <sup>7</sup> with 4M calibration	4.2 K	3507.2 Ω	-1120.8 Ω/K	45 μK	±1.4 mK	±6.4 mK
		77 K	205.67 Ω	-2.4116 Ω/K	20.8 mK	±75.6 mK	±91.6 mK
		300 K	59.467 Ω	-0.1727 Ω/K	290 mK	±717 mK	±757 mK
Germanium	GR-200A-1000 with 1.4D calibration	4.2 K	6674 Ω	-9930 Ω/K	5 μK	±0.3 mK	±4.3 mK
		2 K	1054 Ω	-526 Ω/K	95 μK	±10 mK	±14 mK
		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 with 4L calibration	4.2 K	2260 Ω	-2060 Ω/K	25 μK	±0.5 mK	±4.5 mK
		77 K	21.65 Ω	-0.157 Ω/K	319 mK	±692 mK	±717 mK
		300 K	11.99 Ω	-0.015 Ω/K	3.33 K	±7 K	±7.1 K

<sup>6</sup> Typical sensor sensitivities were taken from representative calibrations for the sensor listed

<sup>7</sup> 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% <sup>8</sup>	100 μV	20 μV	±160 μV ±0.01% of rdg
	negative	0 V to 7.5 V	10 μA ±0.05% <sup>8</sup>	100 μV	20 μV	±160 μV ±0.02% of rdg
PTC RTD	positive	0 Ω to 250 Ω	1 mA ±0.3% <sup>9</sup>	10 mΩ	2 mΩ	±0.004 Ω ±0.02% of rdg
	positive	0 Ω to 500 Ω	1 mA ±0.3% <sup>9</sup>	10 mΩ	2 mΩ	±0.004 Ω ±0.02% of rdg
	positive	0 Ω to 5000 Ω	1 mA ±0.3% <sup>9</sup>	100 mΩ	20 mΩ	±0.06 Ω ±0.04% of rdg
NTC RTD	negative	0 Ω to 7500 Ω	10 μA ±0.05% <sup>8</sup>	100 mΩ	50 mΩ	±0.1 Ω ±0.04% of rdg

<sup>8</sup> Current source error has negligible effect on measurement accuracy

<sup>9</sup> 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
<b>Measurement type</b>	4-lead differential
<b>Excitation</b>	Constant current
<b>Supported sensors</b>	Diodes: Silicon, GaAlAs RTDs: 100 Ω Platinum, 1000 Ω Platinum, Carbon-Glass, Cernox™, and Rox™
<b>Standard curves</b>	DT-470, DT-670, CTI-C, PT-100, and PT-1000
<b>Input connector</b>	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

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

<b>Scales:</b>	<i>Temperature</i>	<i>Sensor units (fixed by type)</i>
	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**

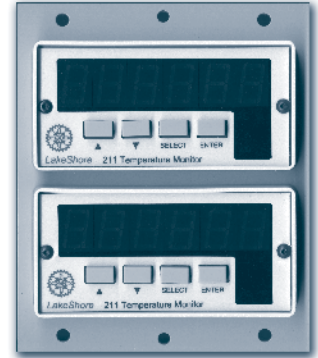
**Ambient temperature**  
**Range** 15 °C to 35 °C at rated accuracy,  
10 °C to 40 °C at reduced accuracy  
**Power requirements** Regulated +5 VDC at 400 mA  
**Size** 96 mm W × 48 mm H × 166 mm D  
(3.8 in × 1.9 in × 6.5 in)  
**Mounting** Panel mount into 91 mm W × 44 mm H  
(3.6 in × 1.7 in) cutout  
**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**

<b>Part number</b>	<b>Description</b>
<b>211S</b>	Model 211 temperature monitor, single channel
<b>211N</b>	Model 211S with no power supply

**Accessories Included with 211S**

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

**Options and accessories**

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

