Model 218 Temperature Monitor

**Features**

- Operates down to 1.4 K with appropriate sensor
- 8 sensor inputs
- Supports diode and RTD sensors
- Continuous 8-input display with readings in K, °C, V, or Ω
- IEEE-488 and RS-232C interfaces, analog outputs, and alarm relays
- Available in two versions: Model 218S and 218E

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**Product Description**

The Model 218 is our most versatile temperature monitor. With eight sensor inputs, it can be used with nearly any diode or resistive temperature sensor. It displays all eight channels continuously in K, °C, V or Ω. The measurement input was designed for the demands of cryogenic temperature measurement, however, the monitor's low noise, high resolution, and wide operating range make it ideal for noncryogenic applications as well.

**Sensor Input Reading Capability**

The Model 218 has eight constant current sources (one for each input) that can be configured for a variety of sensors. The inputs can be configured from the front panel or via a computer interface, and are grouped in two sets of four. Each set of four inputs is configured for the same sensor type (i.e., all 100 Ω platinum or all silicon diodes).

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Two high-resolution A/D converters increase the update rate of the Model 218. It can read sensor inputs more quickly than other scanning monitors because it does not have to wait for current source switching. The result is 16 new readings per second, allowing all inputs to be read twice each second. Inputs can be turned off to obtain a higher reading rate on fewer sensors.

**Temperature Response Curves**

The Model 218 has standard temperature sensor response curves for silicon diodes and platinum RTDs. It can support a wide variety of temperature sensors because a unique 200-point user curve can be stored for each of the eight inputs. CalCurves™ for Lake Shore calibrated sensors can be stored as user curves. The built in SoftCal™ algorithm can also be used to generate improved curves for DT-470 diodes and platinum RTDs that are stored as user curves.

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2 The Lake Shore SoftCal™ algorithm for silicon diode and platinum RTD sensors is a good solution for applications requiring more accuracy than a standard sensor curve but not in need of traditional calibration. SoftCal uses the predictability of a standard curve to improve the accuracy of an individual sensor around a few known temperature reference points.
Instruments

Model 218 Temperature Monitor

Interface

The Model 218 is available with both parallel (IEEE-488, 218S only) and serial (RS-232C) computer interfaces. Each input has a high and low alarm which offer latching and non-latching operation. The eight relays on the Model 218S can be used with the alarms to alert the operator of a fault condition or perform simple on-off control. The Model 218S includes two analog voltage outputs. The user may select the scale and data sent to the output, including temperature, sensor units, or linear equation results. Under manual control, the analog voltage output can also serve as a voltage source for other applications.

Display

The eight display locations on the Model 218 are user configurable. Sources for readout data are temperature units, sensor units, and results of the math function. Input number and data source are always displayed for convenience. The display is updated twice each second.

Sensor Selection

Sensor Temperature Range (sensors sold separately)

<table>
<thead>
<tr>
<th>Diodes</th>
<th>Model</th>
<th>Useful Range</th>
<th>Magnetic Field Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon Diode</td>
<td>DT-670-SD</td>
<td>1.4 K to 500 K</td>
<td>T ≥ 60 K &amp; B ≤ 3 T</td>
</tr>
<tr>
<td>Silicon Diode</td>
<td>DT-670E-8R</td>
<td>30 K to 500 K</td>
<td>T ≥ 60 K &amp; B ≤ 3 T</td>
</tr>
<tr>
<td>Silicon Diode</td>
<td>DT-414</td>
<td>1.4 K to 375 K</td>
<td>T ≥ 60 K &amp; B ≤ 3 T</td>
</tr>
<tr>
<td>Silicon Diode</td>
<td>DT-421</td>
<td>1.4 K to 325 K</td>
<td>T ≥ 60 K &amp; B ≤ 3 T</td>
</tr>
<tr>
<td>Silicon Diode</td>
<td>DT-470-SD</td>
<td>1.4 K to 500 K</td>
<td>T ≥ 60 K &amp; B ≤ 3 T</td>
</tr>
<tr>
<td>Silicon Diode</td>
<td>DT-471-SD</td>
<td>10 K to 500 K</td>
<td>T ≥ 60 K &amp; B ≤ 3 T</td>
</tr>
<tr>
<td>GaAlAs Diode</td>
<td>TG-120-P</td>
<td>1.4 K to 325 K</td>
<td>T ≥ 42 K &amp; B ≤ 5 T</td>
</tr>
<tr>
<td>GaAlAs Diode</td>
<td>TG-120-PL</td>
<td>1.4 K to 325 K</td>
<td>T ≥ 42 K &amp; B ≤ 5 T</td>
</tr>
<tr>
<td>GaAlAs Diode</td>
<td>TG-120-SD</td>
<td>1.4 K to 500 K</td>
<td>T ≥ 42 K &amp; B ≤ 5 T</td>
</tr>
<tr>
<td>100 Ω Platinum</td>
<td>PT-102/3</td>
<td>14 K to 873 K</td>
<td>T ≥ 40 K &amp; B ≤ 25 T</td>
</tr>
<tr>
<td>100 Ω Platinum</td>
<td>PT-111</td>
<td>14 K to 673 K</td>
<td>T ≥ 40 K &amp; B ≤ 25 T</td>
</tr>
<tr>
<td>Rhodium-Iron</td>
<td>RF-800-4</td>
<td>1.4 K to 500 K</td>
<td>T ≥ 77 K &amp; B ≤ 8 T</td>
</tr>
<tr>
<td>Rhodium-Iron</td>
<td>RF-1007/U</td>
<td>1.4 K to 325 K</td>
<td>T ≥ 77 K &amp; B ≤ 8 T</td>
</tr>
</tbody>
</table>

Positive Temperature Coefficient RTDs

<table>
<thead>
<tr>
<th>Model</th>
<th>Useful Range</th>
<th>Magnetic Field Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Ω Platinum</td>
<td>PT-102/3</td>
<td>14 K to 873 K</td>
</tr>
<tr>
<td>100 Ω Platinum</td>
<td>PT-111</td>
<td>14 K to 673 K</td>
</tr>
<tr>
<td>Rhodium-Iron</td>
<td>RF-800-4</td>
<td>1.4 K to 500 K</td>
</tr>
<tr>
<td>Rhodium-Iron</td>
<td>RF-1007/U</td>
<td>1.4 K to 325 K</td>
</tr>
</tbody>
</table>

Negative Temperature Coefficient RTDs

<table>
<thead>
<tr>
<th>Model</th>
<th>Useful Range</th>
<th>Magnetic Field Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cernox™</td>
<td>CX-1010</td>
<td>2 K to 325 K⁴</td>
</tr>
<tr>
<td>Cernox™</td>
<td>CX-1030-HT</td>
<td>3.5 K to 420 K²⁵</td>
</tr>
<tr>
<td>Cernox™</td>
<td>CX-1050-HT</td>
<td>4 K to 420 K²⁵</td>
</tr>
<tr>
<td>Cernox™</td>
<td>CX-1070-HT</td>
<td>15 K to 420 K²</td>
</tr>
<tr>
<td>Cernox™</td>
<td>CX-1080-HT</td>
<td>50 K to 420 K²</td>
</tr>
<tr>
<td>Germanium</td>
<td>QR-200A/8-1000</td>
<td>2.2 K to 100 K¹</td>
</tr>
<tr>
<td>Germanium</td>
<td>QR-200A/1500</td>
<td>2.6 K to 100 K¹</td>
</tr>
<tr>
<td>Germanium</td>
<td>QR-200A/2500</td>
<td>3.1 K to 100 K¹</td>
</tr>
<tr>
<td>Carbon-Glass</td>
<td>CGR-1-500</td>
<td>4 K to 325 K⁴</td>
</tr>
<tr>
<td>Carbon-Glass</td>
<td>CGR-1-1000</td>
<td>5 K to 325 K⁴</td>
</tr>
<tr>
<td>Carbon-Glass</td>
<td>CGR-1-2000</td>
<td>6 K to 325 K⁴</td>
</tr>
<tr>
<td>Rox™</td>
<td>RX-102A</td>
<td>1.4 K to 40 K⁴</td>
</tr>
</tbody>
</table>

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
**Specifications**

### Input Specifications

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Temperature Coefficient</th>
<th>Input Range</th>
<th>Excitation Current</th>
<th>Display Resolution</th>
<th>Measurement Resolution</th>
<th>Electronic Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode</td>
<td>negative</td>
<td>0 V to 2.5 V</td>
<td>10 µA ± 0.1%</td>
<td>100 µV</td>
<td>20 µV</td>
<td>±160 µV ± 0.01% of rdg</td>
</tr>
<tr>
<td></td>
<td>negative</td>
<td>0 V to 7.5 V</td>
<td>10 µA ± 0.1%</td>
<td>100 µV</td>
<td>20 µV</td>
<td>±160 µV ± 0.02% of rdg</td>
</tr>
<tr>
<td>PTC RTD</td>
<td>positive</td>
<td>0 Ω to 250 Ω</td>
<td>1 mA ± 0.3%</td>
<td>10 mΩ</td>
<td>2 mΩ</td>
<td>±0.004 Ω ± 0.02% of rdg</td>
</tr>
<tr>
<td></td>
<td>positive</td>
<td>0 Ω to 500 Ω</td>
<td>1 mA ± 0.3%</td>
<td>10 mΩ</td>
<td>2 mΩ</td>
<td>±0.004 Ω ± 0.02% of rdg</td>
</tr>
<tr>
<td></td>
<td>positive</td>
<td>0 Ω to 5000 Ω</td>
<td>1 mA ± 0.3%</td>
<td>100 mΩ</td>
<td>20 mΩ</td>
<td>±0.06 Ω ± 0.04% of rdg</td>
</tr>
<tr>
<td>NTC RTD</td>
<td>negative</td>
<td>0 Ω to 7500 Ω</td>
<td>10 µA ± 0.1%</td>
<td>100 mΩ</td>
<td>50 mΩ</td>
<td>±0.1 Ω ± 0.04% of rdg</td>
</tr>
</tbody>
</table>

#### Thermometry

- **Number of inputs**: 8
- **Input configuration**: Inputs separated into two groups of four (each group must be the same sensor type) – inputs can be configured from the front panel to accept any of the supported input types
- **Input accuracy**: Sensor dependent – refer to Input Specifications table
- **Measurement resolution**: Sensor dependent – refer to Input Specifications table
- **Maximum update rate**: 16 readings per s total
- **User curves**: Room for 8 (1 per input) 200-point CalCurves™ or user curves

#### Thermometry, continued

- **SoftCal** improves accuracy of DT-470 diode to ±0.25 K from 30 K to 375 K; improves accuracy of platinum RTDs to ±0.25 K from 70 K to 325 K; stored as user curves
- **Math**: Maximum, minimum, and linear equation (Mx + B) or M(x + B)
- **Filter**: Averages 2 to 64 input readings

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6 Typical sensor sensitivities were taken from representative calibrations for the sensor listed
7 Non-HT version maximum temperature: 325 K
Model 218 Temperature Monitor

Sensor Input Configuration

<table>
<thead>
<tr>
<th>Diode/RTD</th>
<th>4-lead differential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement type</td>
<td>8 constant current sources</td>
</tr>
<tr>
<td>Excitation</td>
<td>Diodes: Silicon, GaAlAs, Platinum, 1000 Ω platinum, Germanium, Carbon-Glass, Cernox™, and Rox™</td>
</tr>
<tr>
<td>Supported sensors</td>
<td>DT-470, DT-500D, DT-670, CTI-C, PT-100, and PT-1000</td>
</tr>
<tr>
<td>Standard curves</td>
<td>Input connector 25-pin D-sub</td>
</tr>
</tbody>
</table>

Front Panel

- Display: 4 line by 20 character backlit LCD display
- Number of reading displays: 1 to 8
- Display annunciators: Remote operation, alarm, data logging, max, min, and linear
- Keypad: Membrane keypad, 20-key, numeric and specific functions
- Front panel curve entry and keypad lock-out

Interface

- IEEE-488.2 interface (218S)
- RS-232C electrical format
- 9-pin D-sub connector
- Max baud rate: 2400 baud
- 8 constant current sources
- 4-lead differential
- Temperature, sensor units, max, min, and linear equation
- Front panel curve entry and keypad lock-out

Serial Interface

- Source, high setpoint, low setpoint, deadband, latching or non-latching, and audible on/off
- Display annunciator, beeper, and relays (218S)

Alarms

- Number: 16: high and low for each input
- Data source: Temperature, sensor units, and linear equation
- Setting: Source, high setpoint, low setpoint, deadband, latching or non-latching, and audible on/off
- Actuators: Display annunciator, beeper, and relays (218S)

Relays

- Number: 8
- Contacts: Normally open (NO), normally closed (NC), and common (C)
- Contact rating: 30 VDC at 5 A
- Operation: Each input may be configured to activate any or all of the eight relays – relays may be activated on high, low, or both alarms for any input, or manually
- Connector: Detachable terminal block

Analog voltage output

- Number: 2
- Scale: User selected
- Update rate: To 16 readings per s
- Data source: Temperature, sensor units, and linear equation
- Range: ±10 V
- Resolution: 1.25 mV
- Accuracy: ±2.5 mV
- Min load resistance: 1 kΩ (short-circuit protected)

Data logging

- Channels: 1 to 8
- Operation: Data log records can be stored in memory or sent to the printer; stored data may be displayed, printed, or retrieved by computer interface
- Data memory: Maximum of 1500 single reading records, non-volatile

General

- Ambient temperature: 15 °C to 35 °C at rated accuracy, 10 °C to 40 °C at reduced accuracy
- Power requirement: 100, 120, 220, 240 VAC, (+6%, -10%), 50 or 60 Hz, 18 VA
- Size: 216 mm W × 89 mm H × 318 mm D (8 in × 3.5 in × 12.5 in), half rack
- Weight: 3 kg (6.6 lb)
- Approval: CE mark

Ordering Information

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>218S</td>
<td>Standard Temperature Monitor (8 inputs, IEEE-488 and serial interface, alarms, relays, corrected analog output, data logging)</td>
</tr>
<tr>
<td>218E</td>
<td>Economy Temperature Monitor (8 inputs, serial interface, alarms, data logging)</td>
</tr>
</tbody>
</table>

Select a power configuration:
- VAC-100 Instrument configured for 100 VAC with U.S. power cord
- VAC-120 Instrument configured for 120 VAC with U.S. power cord
- VAC-120-ALL Instrument configured for 120 VAC with U.S. power cord and universal Euro line cord and fuses for 220/240 VAC setting
- VAC-220 Instrument configured for 220 VAC with universal Euro line cord
- VAC-240 Instrument configured for 240 VAC with universal Euro line cord

Accessories Included

- 4005: 1 m IEEE-488 (GPIB) computer interface cable assembly – includes extender which allows connection of IEEE cable and relay terminal block simultaneously
- 8000: The CalCurve™ breakpoint table from a calibrated sensor loaded on a CD-ROM for customer uploading
- 8001: The breakpoint table from a calibrated sensor stored in the instrument
- 8002-05-218: The breakpoint table from a calibrated sensor stored in a NOVRAM for installation at the customer location
- CAL-218-CERT: Instrument recalibration with certificate
- RM-1½: Kit to mount one ½ rack temperature monitor in a 482.6 mm (19 in) rack
- RM-2: Kit to mount two ½ rack temperature monitors in a 482.6 mm (19 in) rack

Options and accessories

- Calibration certificate
- Model 218 user manual
- Two 14-pin connectors used for relays & analog outputs (218S only)
- Two 14-pin D-sub plugs used for sensor input connector
- Two 14-pin D-sub shells used for sensor input connector
- Two 14-pin connectors for relays & analog outputs

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