AC resistance thermometry bridge
Model CTR6500

Applications

- High-performance AC resistance thermometry bridge for very accurate temperature measurements in a range of -200 ... +962 °C
- High-precision instrument designed for laboratory, commercial and industrial temperature measurement and calibration applications

Special features

- Resolution 0.1 ppm / 0.001 mΩ / 0.01 mK
- 25 Ω and 100 Ω internal reference resistors
- Channels expandable from 1 to 60 via multiplexers
- Multifunction VFD with numeric, statistical or graphical information

Description

The performance of the model CTR6500 resistance thermometry bridge is improved significantly by using the proven AC bridge technology. Due to the elimination of thermal EMF errors and the automatic cancellation of probe and cable reactance effects, the CTR6500 provides exceptional stability with time and ambient temperature and has an excellent resolution thanks to inherently low noise.

These make the CTR6500 perfectly suited to high-accuracy temperature measurement and calibration.

The CTR6500 has 25 Ω and 100 Ω internal standard resistors and can also be used with external standard resistors. It has a ratio range of 0 ... 4,9999999 or 0 ... 500 Ω resistance and is capable of measuring temperature ranges to meet ITS 90, CVD and EN 60751 standards.

The results are shown on the large-scale, multi-function VFD screen. The mean, min and max value, standard deviation and the sampling rate can also be displayed with a separate graphical display. To ensure the long-term reliability the CTR6500 uses surface mount technology with no mechanical relays.
### Specifications

**Model CTR6500**

**Probe types**  Industrial platinum resistance thermometers (PRTs) and standard platinum resistance thermometers (SPRTs) with Ro = 25 Ω and 100 Ω up to an alpha of 0.00392

**Input channels**  2 on the main device (one PRT, SPRT or resistor + one reference resistor)

60 over multiplexer CTS9000

**Input connections**  4 x BNC + shield (front panel)

**Data entry format**  ITS 90 and CVD for calibrated probes; or EN 60751 for uncalibrated probes

### Measuring ranges

**Sense current**  100 µA, 200 µA, 500 µA, 1 mA, 2 mA, 5 mA, 10 mA

**Sense current multipliers**  x √2

**Temperature range**  -200 ... +962 °C, depending on thermometer probe

**Resistance range**  0 ... 500 Ω

### Internal resistors

**Values**  25 Ω, 100 Ω

**Thermal stability TCR**  ±0.1 ppm/°C

**Accuracy**  ±0.01 % (uncalibrated)

**Accuracy 1)**

- Ratio range 0 ... 1 accuracy 0.4 ppm equivalent to 0.1 mK at 0 °C
- Ratio range 1 ... 2 accuracy 0.6 ppm equivalent to 0.3 mK full range
- Ratio range 2 ... 3 accuracy 0.8 ppm equivalent to 0.8 mK full range
- Ratio range 3 ... 5 accuracy 1 ppm equivalent to 1.25 mK full range

### Display

**Screen**  large graphic VFD display screen (adjustable brightness)

**Units**  Ratio, °C, °F, K or Ω

**Resolution**  0.1 ppm

0.01 mK

0.001 mΩ

### Functions

**Real-time clock**  integrated clock with date

### Voltage supply

**Power supply**  AC 90 ... 264 V, 47 ... 63 Hz; universal rear input on rear panel

**Power consumption**  max. 95 VA

### Permissible ambient conditions

**Operating temperature**  15 ... 25 °C

**Storage temperature**  -20 ... +50 °C

### Communication

**Interface**  USB, RS-232 or IEEE-488.2

### Case

**Dimensions**  455 x 150 x 450 mm (W x H x D)

**Weight**  9 kg

1) The accuracy in K defines the deviation between the measured value and the reference value. (Only valid for indicating instruments.)

### CE conformity, certificates

**CE conformity**  2004/108/EC, EN 61326 emission (group 1, class B) and interference immunity (portable test and measuring equipment)

Approvals and certificates, see website
**Recommended temperature probes**

**Resistance thermometer**

![Diagram of resistance thermometer]

<table>
<thead>
<tr>
<th>Model</th>
<th>Dimensions</th>
<th>Temperature range</th>
<th>Detector length</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTP5000-652</td>
<td>Pt100, d = 6 mm, l = 450 mm (without spring strain relief, 100 mm handle)</td>
<td>-70 ... +650 °C</td>
<td>30 mm</td>
</tr>
<tr>
<td>CTP5000-651</td>
<td>Pt100, d = 7.5 mm, l = 450 mm (125 mm handle)</td>
<td>-189 ... +650 °C</td>
<td>50 mm</td>
</tr>
</tbody>
</table>

**Resistance thermometer**

![Diagram of resistance thermometer]

<table>
<thead>
<tr>
<th>Model</th>
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<th>Detector length</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTP5000-T25</td>
<td>Pt25, d = 6.5 ... 7.5 mm, l = 480 mm</td>
<td>-189 ... +660 °C</td>
<td>45 mm</td>
</tr>
</tbody>
</table>

**Input connections**

The BNC input connectors are located to the left of the display. The central connector is used when a screen connection is required. The two right-hand connections are only used when an external reference resistor is selected; they are not required when one of the internal reference resistors is used. The unknown resistance or probe is connected to the left-hand BNCs.
Features of the precision thermometer

- Easy to use
- Large graphic VFD display screen
- 4-wire measurement
- 2 channels as standard with optional up to 60 channels over multiplexer CTS9000

Front panel

1 Reference channel RS
2 VFD display
3 Function keys
4 Status LED
5 Back key
6 Navigation keys
7 Menu key
8 Numeric keypad
9 Four soft keys
10 Input channel Rt

The two indicator LEDs to the right are used to indicate that electrical power is applied and to indicate that the bridge is in standby mode (graphical display in low power mode).
The four keys under the display are soft keys so their function varies with the instrument operating mode (whenever these keys can be used, their current function is displayed above each key).

Rear panel

1 Main input, switch and fuse
2 Earth connector
3 USB, RS-232 or IEEE connector
4 Expansion port 1
5 Analogue output
6 Expansion port 2
7 Electrical rating
The instrument’s keys are grouped by type and consist of nine function keys, a twelve-key numerical keypad, navigation keys and an OK key, four soft keys and separate menu and back keys. The combination of function and soft keys is used to access data and/or functions within the instrument.

The keys are used to select the various menu options and to control the instrument. Generally, no more than one menu level is required for commonly used settings. A few (infrequently used options) require two or three menu levels.

The functions under the keys are accessed by pressing the right-hand shift key and then the required key (e.g. to access the probe menu press shift and then the chan key).

### Instrument functions keys

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instrument function keys</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disp</td>
<td>Select display type</td>
<td>Alternates numerical, graphical, standby display</td>
</tr>
<tr>
<td>Chan</td>
<td>Select input channel</td>
<td>Opens and closes the Rs/Rs channel select menu</td>
</tr>
<tr>
<td>Zero</td>
<td>Zero display measurement</td>
<td>Opens and closes the display zero (null) menu</td>
</tr>
<tr>
<td>Hold</td>
<td>Hold display measurement</td>
<td>Starts and stops display (measurement continues)</td>
</tr>
<tr>
<td>Curr</td>
<td>Select operating current</td>
<td>Opens and closes the sensor-current menu</td>
</tr>
<tr>
<td>Gain</td>
<td>Select instrument gain</td>
<td>Opens and closes the instrument-gain menu</td>
</tr>
<tr>
<td>Filter</td>
<td>Select filter value</td>
<td>Opens and closes measurement-bandwidth menu</td>
</tr>
<tr>
<td>Units</td>
<td>Select display units</td>
<td>Opens and closes the display-units menu</td>
</tr>
<tr>
<td>Shift key</td>
<td>Shift key</td>
<td>Selects lower function keys (and, Exp or +)</td>
</tr>
<tr>
<td><strong>Instrument function shift keys</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Func</td>
<td>Select function menu</td>
<td>Selects function menu</td>
</tr>
<tr>
<td>Probe</td>
<td>Select probe menu</td>
<td>Opens and closes probe menu</td>
</tr>
<tr>
<td>=0=</td>
<td>Zero check</td>
<td>Selects zero check</td>
</tr>
<tr>
<td>=1=</td>
<td>Unity check</td>
<td>Selects unity check</td>
</tr>
<tr>
<td>√2</td>
<td>Set current</td>
<td>Sets root 2 current</td>
</tr>
<tr>
<td>Auto/Man</td>
<td>Reserved turns</td>
<td>Automatic gain selection ON/OFF</td>
</tr>
<tr>
<td>Rs</td>
<td>Select reference resistor</td>
<td>Opens the reference resistor menu</td>
</tr>
<tr>
<td><strong>Menu function keys</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back</td>
<td>Clear data entry/return</td>
<td>Clears any data entry errors or returns from a menu</td>
</tr>
<tr>
<td>Menu</td>
<td>Menu selection</td>
<td>Displays other submenus</td>
</tr>
<tr>
<td>▲▼◄►</td>
<td>Arrow keys</td>
<td>Used to navigate through the menus</td>
</tr>
<tr>
<td>OK</td>
<td>Save entry</td>
<td>Saves data entry and returns to previous menu</td>
</tr>
</tbody>
</table>

The numeric keypad is used to enter numerical values (and may also be used to select submenu options when these are shown on the screen).

### Numeric keypad function

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Numeric keys</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 ... 9</td>
<td>Numerical data entry</td>
<td>Enters a numerical digit or selects a numeric menu</td>
</tr>
<tr>
<td>-</td>
<td>Minus key</td>
<td>Used during numerical data entry</td>
</tr>
<tr>
<td>.</td>
<td>Decimal point</td>
<td>Used during numerical data entry</td>
</tr>
<tr>
<td><strong>Numeric shift keys</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exp</td>
<td>Exponent key</td>
<td>Used for numerical data entry (with the shift key)</td>
</tr>
<tr>
<td>+</td>
<td>Plus key</td>
<td>Used for numerical data entry (with the shift key)</td>
</tr>
</tbody>
</table>
Model CTS9000 multi-channel systems for thermometry bridges

ASL’s thermometry bridges can be used with up to six 10-channel multiplexers. The multiplexers, available as stand-alone units or as part of a fully integrated system as shown, can be operated manually or under remote control via the driver. The RS-232-C or IEEE interfaces are optional.

The CTR6500 can be used with either one model CTS9000 multiplexer without a driver or with a driver for multi-channel calibration of up to 60 channels.

The model CTS9000 is a 10-channel multiplexer which provides full 4-wire plus ground switching using high-performance reed relays and has two unique features:

- **Multiplexer standby current**
  When in use the temperature of a platinum resistance thermometer (PRT) is increased slightly by the “self-heating effect” of the constant current. This effect may vary by PRT and is therefore determined during calibration. The problem arises if you wish to take a measurement as soon as you select a PRT as probes can take a minute, sometimes more to stabilise once selected.

  The solution is to keep the probes always selected with an identical current, standby current, from its own power source. When the PRT is selected for the bridge it is already at “operating temperature” and a precise measurement can be made immediately! Any value up to 10 mA may be factory set, individually for each channel.

- **Optimised bridge performance**
  To optimise bridge performance when using PRT’s of different $R_0$ values, for example 25 Ω and 100 Ω, measurements are made against a reference fixed resistor of matching values.

  Up to four channels of the first CTS9000 scanner can be configured to switch reference resistors ($R_s$) rather than platinum resistance thermometers so that as thermometers are selected, the correct value of $R_s$ can also be automatically selected. Usual configurations ($R_t$:$R_s$) are 10:0 (10 platinum resistance thermometers, 0 reference fixed resistors), 8:2, 7:3 and 6:4.
Scope of delivery

- Model CTR6500 AC resistance thermometry bridge incl. power cord and USB cable
- Choice of model CTP5000 temperature probes
- Choice of model CTS9000 multiplexer
- Choice of model CER6000 resistances

Option

- Model CTS9000, 10-channel automatic/remote scanner, current source for unselected PRTs
- Precision resistor module FR4 (standard values = 1, 10, 25 and 100 Ω, oven controlled)

Accessories

- 100 Ω, test resistor, 0.1 %, 3 ppm/°C
- BNC to BNC cable (3 m) - connection bridge to adapter box FA3
- BNC to open end (3 m) - connection bridge to reference resistors
- PRT adapter box (4 terminals to BNC)
- BNC to 2 x 4 mm banana terminals (2 per pack)
- BNC to 2 x 4 mm banana plugs (2 per pack)
- Adapter BNC to 5-pin DIN plug (1 m)

Software

- ULog

Ordering information

CTR6500 / Interface / Numbers of multiplexer CTS9000 / Standby current / Definition standby current / Interface driver module / Housing / Precision resistor module / Resistor value 1 / Resistor value 2 / Resistor value 3 / Resistor value 4 / Additional order information

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