



Pressure and temperature  
measurement



# Manual


## Hand-held thermometer CTH7000

Version 1.1, 03/14



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## Conventions used in this manual

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### Structure of manual

The manual is divided into sections. Each section deals with a specific topic or related topics. Sections are displayed in a regular, bold typeface, for example - **1.0 Introduction**. Sections are sub-divided into sub-headings, for example - **1.1 Features**. These may also be subdivided.

### Terminology

The terms Precision thermometer, thermometer, CTH7000 and instrument are used interchangeably in this manual.

### Warnings and Notices

These appear in the body of the text, clearly displayed with a box surrounding the text. The first word within the box displays the type - **Warning** or **Note**.

A **Warning** (double box) is designed to draw attention to an aspect that may cause danger to the user or damage to the instrument. A **Note** (single box) is used to bring special attention to something important requiring action or avoidance.

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## Important safety information

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Read and understand the user instruction manual before attempting to use the instrument. The CTH7000 is a handheld, battery operated, thermometer. It must not be used for any other purpose.

**Warning**

The protection provided by the instrument may be impaired if the equipment is not used in the manner specified.

Only replace items or components with an approved or equivalent spare part. All spare and consumable parts are available from ASL.

**Warning**

The instrument is NOT designed to be used in a potentially explosive atmosphere or medical environment.

- ✘ Do NOT use the instrument near water or in damp conditions
- ✘ Do NOT clean the instrument with solvents
- ✘ Do NOT insert objects into openings
- ✘ Do NOT place the instrument, battery-pack or charger onto a hot or cold surface
- ✘ Do NOT place any weight on top of the instrument, battery-pack or charger
  
- ✓ Do ensure air can freely circulate around the battery compartment during charging
- ✓ Do use the correct USB lead supplied

**Warning**

Do NOT open the case. There are no user serviceable parts inside.

**Warning**

Inspect cables and probes regularly, ensuring that their insulation is not damaged

**Warning**

The instrument and batteries must be disposed of in accordance with local regulations.

**Warning**

The instrument is sensitive to radiated noise and care must be taken to ensure a clean mains supply and controlled EM environment.



**General warning symbol.** This indicates that a hazardous condition or general danger may exist. **You must read the relevant sections in the User Manual before using the instrument.**



**Refer to manual symbol.** When you see this symbol on the instrument it means that there is more information relating to this in the User Manual.

## Important battery charger safety information

---

The battery charger and battery pack are supplied for use with the CTH7000.

**Warning**

Only use the battery charger supplied. Use of any other charger will invalidate the warranty and may lead to the danger of overheating and to permanent instrument damage.

The battery charger supplied must NOT be used with other equipment.

**Warning**

Do NOT cover the battery charger, battery pack or instrument during charging or use.

Ensure air is free to circulate around these items during charging.

**Warning**

Do NOT short the contacts on the battery compartment with any metallic object.



## Important Probe safety information

---

Care must be taken with probes used with the instrument. The following safety information must be observed.

- ✘ Do NOT lift the CTH7000 by any of the leads
- ✓ Do ensure that long probe-leads are kept away from areas where people could trip over them or become tangled in them
- ✓ Do ensure the probe-leads are kept in good condition

### Warning

Because of the nature of the instrument, probes can be excessively HOT or COLD during use. Take suitable precautionary measures when handling probes.

Take care that you (and other people working in the same area) do not come into contact with the metallic probe or the insulating sheath near the probe, which will also be hot/cold.

Precautions apply both during use or when moving the probe from one position to another.

### Warning

Probes may be immersed in various chemicals during use. Some of these chemicals may be dangerous or harmful (even when the probe is cold).

Always assume that the probe has been used this way and DO NOT touch the probe without suitable protective clothing.

## Important disposal information

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If you are responsible for disposal, then please note that this product may contain materials that are regulated in their disposal due to environmental considerations. The presence of these materials is consistent with global regulations applicable at the time this product was placed on the market.



### European Union

This symbol means that the product to be disposed of should not be mixed with commercial or general household waste. Used products must be treated separately in accordance with legislation that requires the proper treatment, recovery and recycling of the product.

If you wish to discard the product, then please contact your dealer, supplier or representative who will advise the correct procedure for disposal.

Disposing of the product correctly will help to save valuable resources and prevent environmental damage.

### Outside the European Union

The symbol only applies within the European Union. If you need to discard the product, then please contact your dealer, supplier or the local authorities and ask for the correct method of disposal.

# 1.0 Introduction

---

## 1.1 Overview

The CTH7000 Precision Handheld Thermometer is a high precision instrument designed for laboratory, commercial and industrial temperature measurement and calibration applications.

Features include:

- Two input channels
- A large graphic LCD display for excellent viewing of temperature measurement values and instrument settings
- USB communication interface as standard for automated monitoring and calibration applications
- Calibration against traceable external standards

The CTH7000 will operate with all 4-wire Pt100 (100 ohm) Platinum Resistance Thermometers (PRTs) and with virtually all thermistors.

Temperature measurement units are user-selectable and can display °C, °F, K and Ω.

Overall system accuracy will depend on the sensor quality and calibration - see the specification section.

## 1.2 Definitions and Terminology

- 0°C = 273.15 K
- 1 mK (milli-Kelvin) = 0.001°C (one milli-degree Celsius)
- 1 milli-degree C = 0.001 °C = 1m°C = 1mK = 1.8m°F
- 1 milli-degree F = 0.001°F = 1m°F = 0.56mK = 0.56m°C
- Alpha, or  $\alpha$ , is the temperature coefficient, or temperature sensitivity, of the platinum wire used in PRTs. In general, the greater the alpha value, the better the PRT thermometer measurement reproducibility, stability and performance
- Abbreviations for platinum resistance thermometers include -
  - PRT (Platinum Resistance Thermometer)
  - Pt100 (PRT with nominally 100Ω resistance at 0°C)
  - RTD (Resistance Temperature Device)
- Abbreviations for thermistor thermometers include -
  - therm

- viii. System accuracy refers to the overall, combined accuracy of the CTH7000 and thermometer.

### 1.3 Principles of measurement

The CTH7000 measures the voltage ( $V_t$ ) developed across the unknown sensor resistance ( $R_t$ ) and the voltage ( $V_s$ ) across a stable internal reference resistance ( $R_s$ ). The voltages are proportional to the resistances so the thermometer resistance is derived from –

$$R_t = R_s \times \frac{V_t}{V_s}$$

This technique achieves immunity from slow moving time and temperature drifts in the electronics, as it is not affected by voltage measurement gain variations or current source fluctuations.

In the same way that AC resistance measurement eliminates thermal EMFs, switched DC achieves a similar advantage. Switched DC works by reversing the current flow on alternate measurement cycles and taking the average value, thereby cancelling any thermal EMF offsets from the measurement.

For PRTs, the relationship between resistance and temperature varies slightly from one PRT to another. Therefore, no matter how accurately the CTH7000 measures the PRT resistance, if the relationship between resistance and temperature for a particular PRT is not known, accurate temperature measurement is not possible. For thermistors, the relationship depends totally on the thermistor type and specifications.

The CTH7000 uses PRT and thermistor calibration data to overcome this problem and calculates the result from temperature conversion functions stored in either the sensors 'SMART' connector or the CTH7000's internal non-volatile memory. This method enables the CTH7000 to convert resistance to temperature, uniquely for each sensor used.

It is very important, therefore, that a sensor without a 'SMART' connector is used on a properly configured input channel and that the probes' coefficients are correctly entered into the instrument.

**Note**

For non-Smart probes, always check that the coefficients are correctly set for the probe being used.

Failure to do so, may lead to incorrect measurements.

System accuracy is a combination of the CTH7000 accuracy in measuring sensor resistance and the calibration uncertainty placed on PRTs and thermistors by the calibrating laboratory.

## 2. Setting up the CTH7000

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### 2.1 Safety information

- Please read the safety information section before attempting to operate the CTH7000.

### 2.2 Unpacking the instrument

When you unpack the CTH7000 thermometer, check that the following items are present before using the instrument<sup>1</sup> -

- CTH7000 precision thermometer
- Battery charger
- Operator's handbook on CD
- Calibration certificate
- USB lead

Please contact the ASL Technical Services Group immediately if any of these items are missing or damaged.

Please retain the packaging. In case of return, servicing or calibration, use the original packaging. Failure to do so may invalidate the warranty and/or incur additional costs outside the warranty period. Please contact your agent, dealer or supplier when the original packaging is unavailable.

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<sup>1</sup> Thermometer probes (if ordered), will be supplied separately

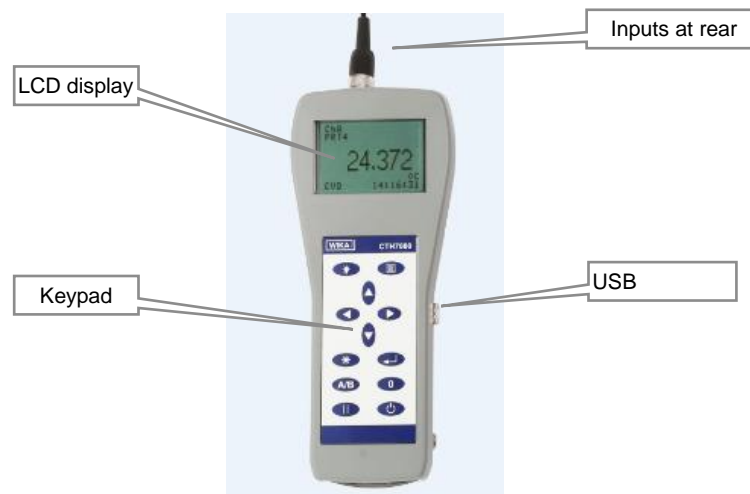
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## 3. About the CTH7000

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This section will introduce you to the features and functions of the CTH7000 Precision Thermometer. Each of the features is explained in turn. Once the CTH7000 has been set-up to your particular requirements, all the commonly used functions are available using single key-strokes.

### 3.1 The Front Panel



**Figure 3.1- Front panel**

### 3.2 About the display screen

The large graphic LCD screen is your direct link to the instrument, presenting you with the measurement results and information or menus to set and control the instrument.

The LCD screen is designed for reflective-viewing under normal ambient lighting; a backlight is provided for use when ambient conditions are darker.

### 3.3 The Keypad

The CTH7000 keypad is shown below. The keys are used to select the various menu options. Generally, no more than two menu levels are used. A few (infrequently used options) require three menu levels. Operation is simple once you are familiar with instrument.



It may help to have the instrument to hand when reading through these sections.

Refer to section 4 for a detailed description of how to use the keys to operate the instrument

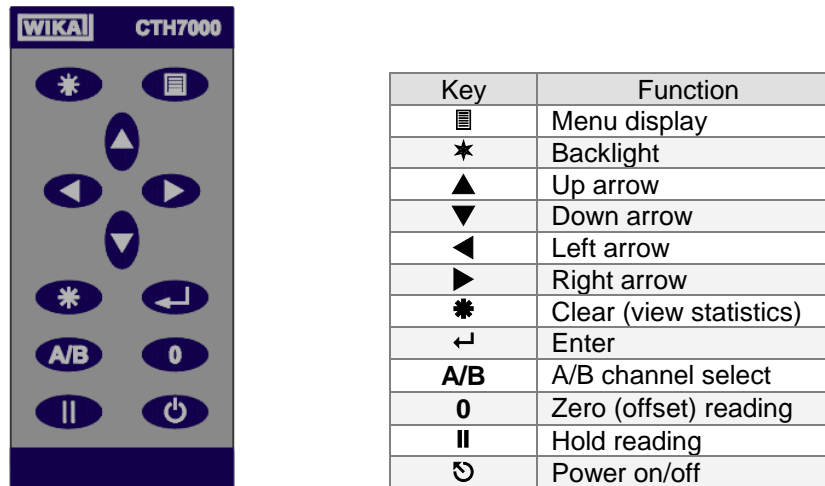


Figure 3.3 – CTH7000 Keypad

### 3.3.1 Keypad overview

The red **Power** () key turns power on and off<sup>2</sup> to the CTH7000.

The CTH7000 uses a menu system. The **Menu** () key is located at the top right of keypad. Use the **Menu** key to access to the less frequently used CTH7000 functions. The four **Arrow** ( ) keys are used to navigate through the menus<sup>3</sup>; the **Enter** () and **Clear** () keys are used to act on the menu selections<sup>4</sup>.

The **Backlight** () key located at the top left of the keypad provides LCD illumination when the ambient light-level is too low for normal viewing.

The **A/B** key is used to select one of the two channels or the difference (A – B)

The **Zero** (**0**) key is used to provide relative (offset) readings.

The **Hold** (**||**) key is used to freeze the current reading.

<sup>2</sup> The CTH7000 may also be set to power-off after a preset period.

<sup>3</sup> The **Up** () and **Down** () keys can be used to change the displayed units

<sup>4</sup> The **Clear** () key is also used to view CTH7000 statistics; press once to select the statistics page. Press any key to return.

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### 3.4 CTH7000 thermometer inputs

There are two input channels; two 5 pin DIN input-sockets are located at the rear of the instrument. These are designed to take either PRT or thermistor probes. Channel A is colour-coded red. Channel B is colour-coded blue.



Figure 3.4 - Rear panel

Either channel can accept either Smart or Passive probes; any combination of probes can be use together. Smart probes (described in section 6.0) contain their own calibration information and communicate this to the CTH7000 as soon as they are used. Passive probes do not contain calibration information and the CTH7000 must be set-up with the calibration information for each probe used (and each time the probe is changed).

Probe connection information for both PRTs and thermistors<sup>5</sup> is shown below (viewed looking towards the sockets) -

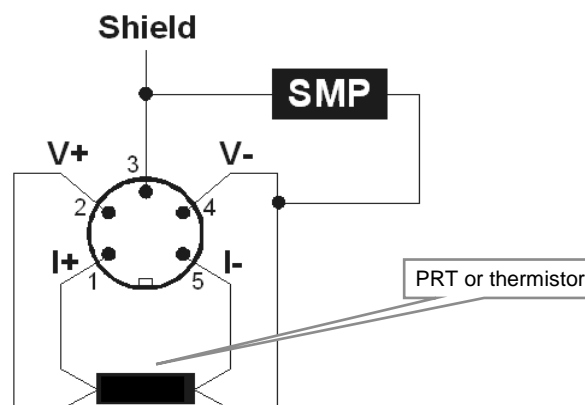
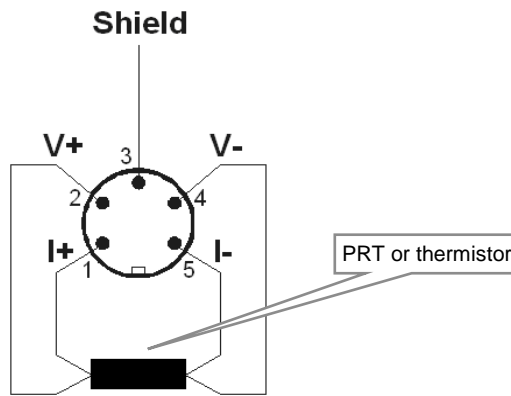


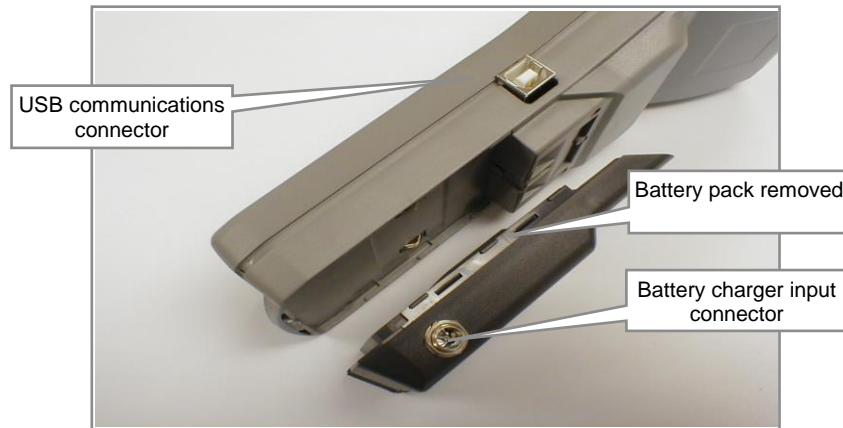
Figure 3.4.1 4-Wire SMART probe (SMP) PRT/thermistor input

<sup>5</sup> Two wire PRTs/thermistors must have pins 1 & 2 connected together and also pins 4 & 5 connected together.



**Figure 3.4.2 4-Wire Passive probe PRT/thermistor input**

### 3.5 Battery Pack



**Figure 3.5 - Base of the CTH7000 showing the battery back removed**

The instrument operates from battery power. The battery pack is replaceable. A low battery indication is shown on the LCD when the battery needs recharging; the instrument also audibly indicates a low battery condition. The battery may be d when attached to the instruments.

#### 3.5.1 Removing and replacing the battery pack

To remove the battery pack, press the latching tab and slide the battery pack backwards. See figure 3.6 for details.



**Figure 3.6 – Removing and replacing the battery pack**

To replace the battery pack, place the pack in position before sliding home. See figure 3.6 for details. Check that the battery pack is securely in position before using the instrument.

### 3.5.2 Battery charger

Please observe the following warnings (repeated from the front of the manual).

**Warning**

Only use the battery charger supplied.

Use of any other charger will invalidate the warranty and may lead to the danger of overheating and to permanent instrument damage.

**Warning**

Take care not to short the battery packs' contacts with any metal object when the pack is not connected to the instrument.

**Warning**

Take care not trap any part of your hand when closing the battery compartment.

**Warning**

Never cover the battery pack or charger during use.

The batteries are located in a removable pack located on the base of the instrument.

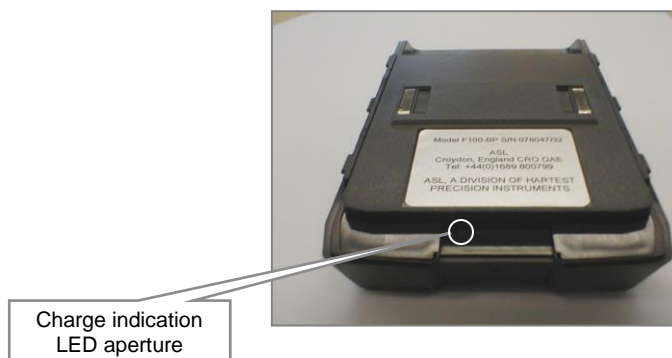
The battery pack contains two NiMH cells (in series) and a charger control circuit. The battery pack must only be charged using the unit supplied.

The battery pack has a socket on its side that accepts the charger's connector. A LED (viewable through an aperture on the top-rear of the pack) indicates the charger status – see figure 3.7.

The battery charger is provided with various interchangeable mains connectors; select the one that you require - see the charger PSU pack for details.

**Note**

Disconnect the charger when not charging the battery pack.



**Figure 3.7 – Charge indication LED**

### 3.5.2.1 Charging the battery pack

The CTH7000 battery pack may be charged during instrument use, when the instrument is off, or when the pack is detached from the CTH7000.

**Note**

Performance may degrade if the batteries are charged during use.

Please follow the instructions below to ensure that the battery pack is fully charged (LED charge status is shown in the table below) –

- Turn off power to the adapter before plugging it into the side of the battery pack.
- Switch on the power adapter (6 Vdc), ensuring the LED flashes orange.
- Leave the battery pack to fully charge. An overnight charge of about 10 hours (for a flat battery with the CTH7000 off<sup>6</sup>) will ensure that the pack is fully charged (the

<sup>6</sup> Allow 5 minutes before use if the batteries are completely flat.

actual time depends on the initial battery state)<sup>7</sup>. Charge time will increase if the CTH7000 is used during this period.

- Turn off and remove the power adapter after charging is complete.

The meaning of the various LED indications is shown on below –

Status LED	LED indication	Description
Slow orange flash (1 s)		Trickle charge
Fast orange flash (0.2 s)		Fast charge
Solid green		Charged (trickle charge enabled)
Slow red flash (1 s)		Low battery temperature (trickle charge enabled)
Solid red		PSU voltage too high <sup>8</sup>
Fast red flash (0.2 s)		Hardware error <sup>9</sup>

<sup>7</sup> Charge times may increase at higher ambient temperatures.

<sup>8</sup> The PSU input voltage must be less than 10 volts (6 volts PSU supplied).

<sup>9</sup> Refer to customer services.



### 3.5.3 Name plate(s)

The instrument rating plate shows the instruments maximum power consumption and instrument serial number.

The label on the battery charger shows its operating voltage, current and frequency.

The label on the battery charger shows its operating voltage, current and pack's serial number.

### 3.5.4 USB Communication interface connector

The USB connector is fitted as standard (see figure 3.1). Communication requires the installation of the USB driver on a PC. See the separate information supplied on the CD. A standard USB cable is supplied with the CTH7000.

The instrument can be used with ASL's ULOG program (supplied on the CD) or simply used to transmit ASCII data, which may be recorded using a simple terminal program.

**Note**

Communication via an USB cable connected to a PC may cause the CTH7000 to be noisy.

ASL can accept no responsibility for any performance degradation when connected to a PC.

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## 4. Operating the CTH7000

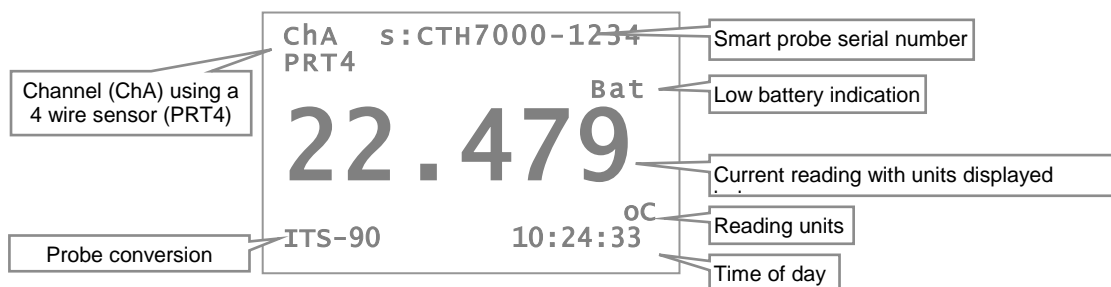
### 4.1 Instrument operating modes

The instrument has two operating modes -

- **Measurement Mode** which displays the measurement readings and status information
- **Menu Mode** which lets you select and alter the instrument operation and its settings

#### 4.1.1 Measurement Mode

In Measurement Mode, the LCD displays the current reading (temperature or resistance), the unit symbol, the channel and type of sensor selected (and conversion method); the time of day is also shown<sup>10</sup>. This is the normal operating display for the CTH7000. The display will look similar to the one shown below -



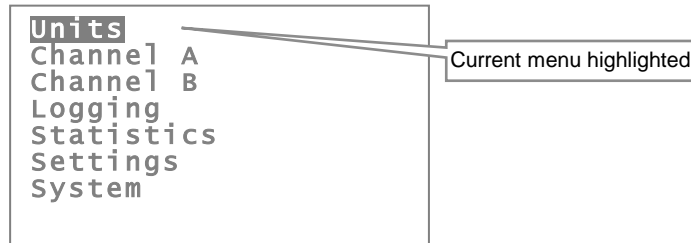
This display will always reflect the operation of the instrument, showing the current reading and settings. Readings are updated at the normal conversion rate of one every two seconds.

<sup>10</sup> The time will be replaced by 'Logging' or 'Remote' when these modes are selected

### 4.1.2 Menu Mode (☰ key)

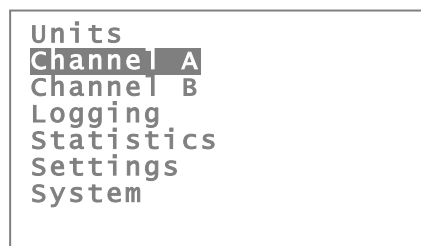
In menu mode, the LCD displays the various options available to control CTH7000 operation.

Press the **Menu** key (☰) to select the menu screen.

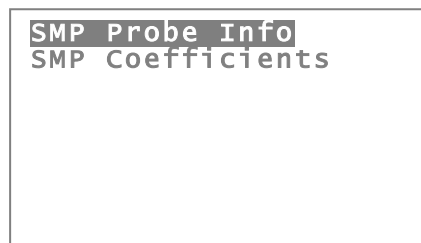


The reverse-video background indicates the menu that will be selected should the **Enter** key (↵) be pressed (Units selection in the example above). Further menu options will follow once the **Enter** key has been pressed.

Press the **Up** (▲) and **Down** (▼) keys to move through the options. Pressing an up/down key will move the reverse video selection one line up or down one line<sup>11</sup>. Once the selection is correct, press the **Enter** key. So, for example, to change channel A options, press the **Down** key (▼) once to obtain the following display -



Now press the **Enter** key (↵) to select this option. The following screen will appear (when a Smart probe is connected to channel A). The display will be different for a passive probe -



Press the **Down** key (▼) once to obtain -

<sup>11</sup> The selection line will wrap round from top to bottom (or bottom to top) on repeated arrow presses.

```

SMP Probe Info
SMP Coefficients

```

Now that this menu has been highlighted, press the **Enter** key (  $\leftarrow$  ) once to obtain –

```

          ChA(s)      CVD
R0      +1.00000e+02
A       +3.90830e-03
B       -5.77500e-03

          Read only
Up/Down          Move
Clear           Exit

```

In this example, pressing the **Up** or **Down** key will display more of the Smart probes' coefficients.

Pressing the **Clear** key (  $\ast$  ) will return the display to the previous menu. Press the **Clear** key (  $\ast$  ) once more to return to Measurement mode. Pressing the **Enter** key (  $\leftarrow$  ) will return the CTH7000 immediately to Measurement Mode (generally applies to all lower level menu options).

No changes can be made in this example. When changes are made, all settings are stored and retained when power is removed.

Refer to the sections on Smart Probes for more details.

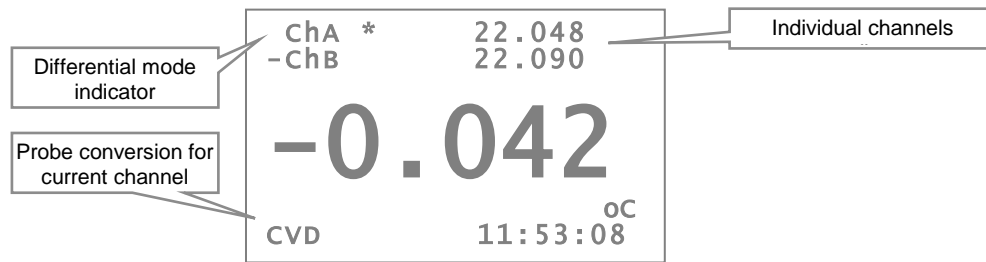
#### 4.1.2.1 Selecting the thermometer input channel and differential mode (A/B key)

The channel **Select** key ( **A/B** ) is used to change between channels and also to select the differential mode ( **A – B** ). The channel selection order is –

**Channel A → Channel B → Channel (A – B) → Channel A**

A missing probe will be indicated on the display by a series of dashed lines.

In differential mode (when both channel A and channel B have probes connected), the screen will look similar to the following example. The asterisk next to the ChA and ChB legends will alternate as readings are updated.

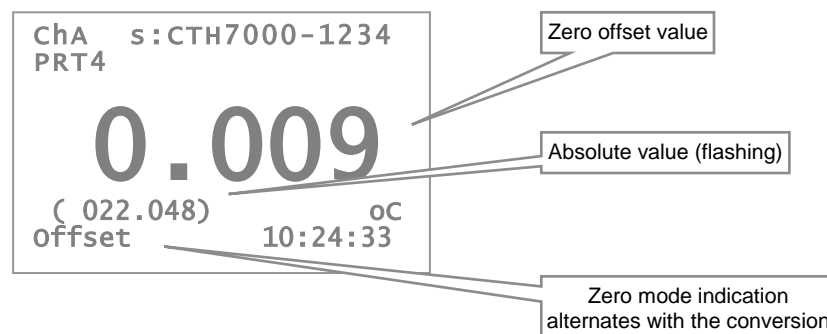


The probe conversion indicator (bottom-left) displays the conversion method for the current reading (and so will alternate if the two channels have different conversion methods).

#### 4.1.2.2 Selecting relative temperature measurement (0 key)

The instrument displays a reading value relative to a fixed offset in Zero (or relative) mode. Press the **Zero (0)** key to select this mode.

In Zero mode, the instrument stores the last reading (at the time of **Zero** key press) to subtract from all subsequent readings. It continues doing this until it is either cancelled by pressing the Zero key again or until power is removed.

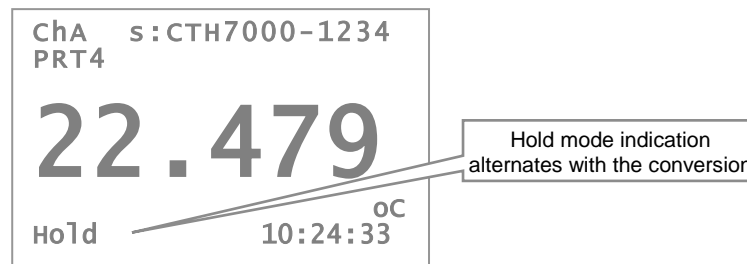


Zero mode may be used on differential measurements (A – B). In this case, the difference is set to zero at the time the key is pressed and the absolute value in the example above, is replaced by the absolute difference value.

To cancel the relative measurement mode, press the **Zero (0)** key again. Zero mode is cancelled when power is turned off.

### 4.1.2.3 Selecting run/hold mode (H)

Instrument measurements stop completely when **Hold** mode is active. This is indicated on the bottom-left of the display where **Hold** mode indication alternates with the current conversion method, providing a flashing indication. Hold mode may be used when the CTH7000 is in differential mode.



Press the **Hold (H)** key to alternate between run and hold modes. **Hold** mode is cancelled when power is turned off.

### 4.1.2.4 Backlight key (★)

Press the **Backlight** key (★) to illuminate the display. Once on, the backlight will go automatically off after about 10 seconds; alternatively, press the key again to turn it off.

#### Note

When the CTH7000 is battery operated, using the backlight will dramatically reduce battery life (by about 30% if used continually at full-brightness).

The brightness level can be set on the **Settings** menu (see later section). Reducing the brightness value will increase battery life when the backlight is used.

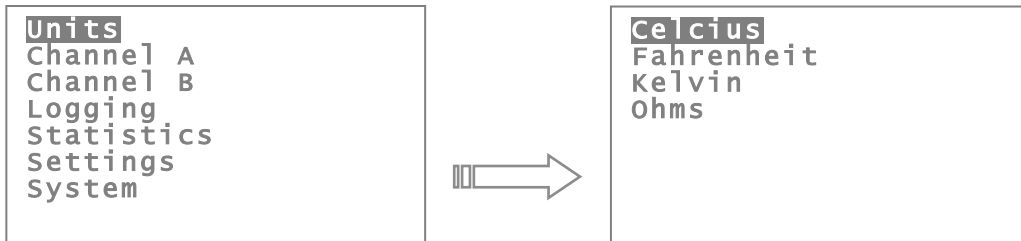
## 4.1.3 Other menu options

This section describes the other options available through menu selection. Generally, these options are set once and then altered rarely. The set-up is stored in non-volatile memory and recalled when power is reapplied.

In the following sections, the top level menu is shown, followed by the sub-menu(s) that it selects.

### 4.1.3.1 Selecting Units<sup>12</sup>

Press the **Menu** key ( ) to change the measurement units. The **Units** menu will be highlighted. Press the **Enter** key once to reach the **Units** selection menu.



Select the units required with the **Up/Down** keys and then press the **Enter** key. Units of Celsius (°C), Fahrenheit (°F), Kelvin (K) or Resistance (Ω) can be selected; the current units are shown on the Measurement Menu screen. Changing units will automatically clear any statistics. The current measurement units are retained when power is removed.

Having selected the new units, press the **Menu** key to return to Measurement Mode.

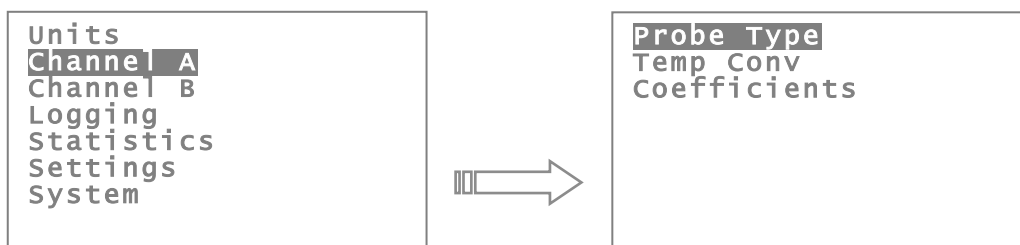
### 4.1.3.2 Channel options menu (Channel A or Channel B)

Operation of channel A and channel B is identical; Press the **Enter** key to select the sub-menu

–

#### a) Probe type

The sub-menu is used to select the type of probe attached. There are two completely different probe types - either PRT or Thermistor. This probe selection sub-menu is used to set these options.



<sup>12</sup> Alternatively, the **Up** (▲) and **Down** (▼) keys can be used to change the displayed units

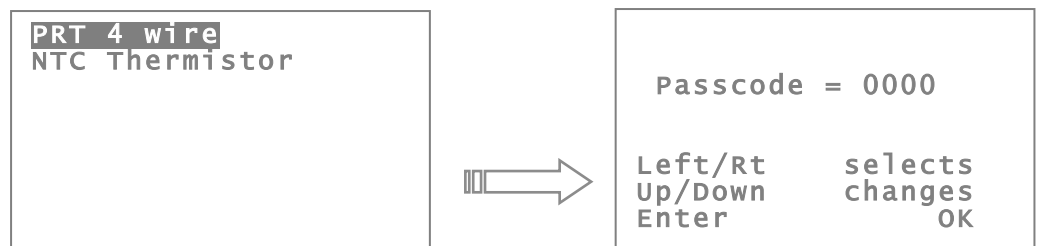


The currently selected sensor type is always shown at the top left of the measurement screen (see the example shown in section 4.1.1).

Channel A is always used for the PRT probe and channel B is always used for the Thermistor probe.

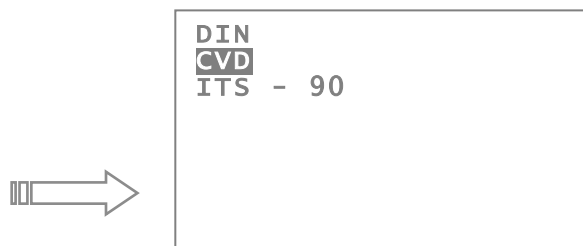
Use the **Down** key (twice) to select the thermistor probe on channel B. When the menu is entered again, the thermistor line will be highlighted.

Selection of PRTs is more involved since the conversion method has to be set at the same time as the probe is changed. Selecting one of the PRT menus will display the passcode screen –



#### b) Conversion method

Use the **Up/Down** arrow keys to increment or decrement the passcode. Use the **Enter** key once the correct passcode has been set; this procedure helps to prevent inadvertent changes. The default passcode setting<sup>13</sup> is 4300.



This screen will only appear once the correct passcode has been entered. This screen shows that the CVD conversion method is currently selected. Use the **Up** and **Down** keys to highlight the required conversion method and then use the **Enter** key to select it.

<sup>13</sup> This can be changed using the **Settings** menu; keep careful note of the new value if changed. A lost password can be retrieved, but you will need to contact ASL directly for further information.

For PRTs, the instrument provides three standard algorithms for converting resistance to temperature. The choice of algorithm will depend on the type of PRT and its calibration –

- DIN (1992) - used for un-calibrated industrial PRTs with 0.00385 'alpha' value, to provide a conversion of resistance to temperature in accordance with BS EN60751 (ITS 90) standard
- CVD coefficients - Callendar van Dusen used for calibrated industrial or low alpha PRT's of 0.00385
- ITS-90 coefficients - used for calibrated high alpha PRT's of values 0.003926 to 0.003928

The choice of conversion method and the relevant coefficients are set from this menu.

For Thermistors, the instrument provides one standard algorithm for converting resistance to temperature –

- Steinhart and Hart

### c) Probe coefficients

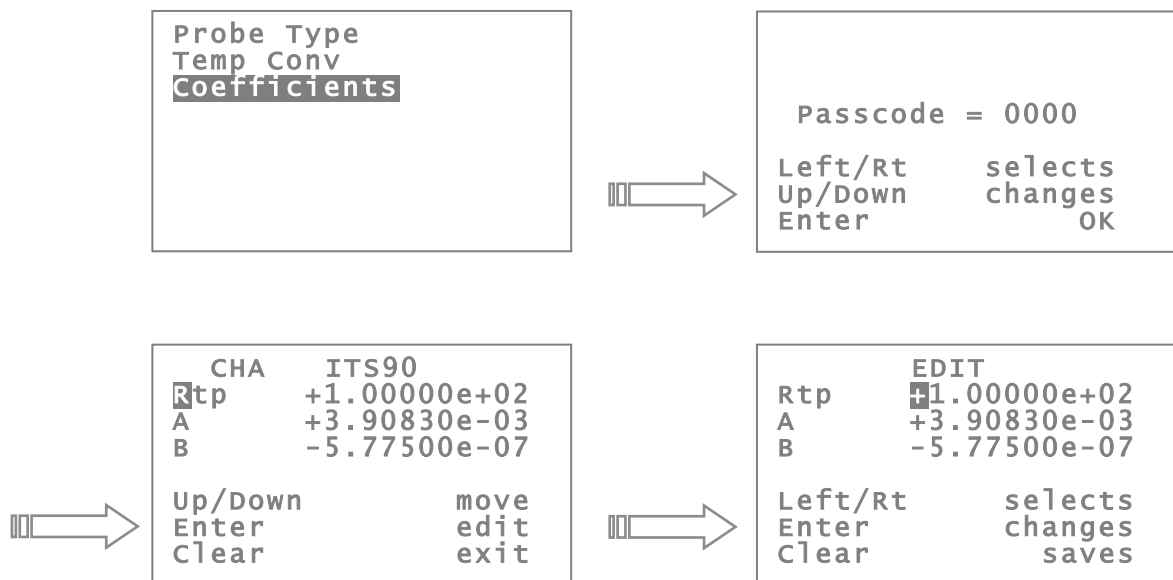
Both PRT and Thermistor probes must be correctly calibrated to produce their most accurate performance. The CTH7000 can store calibration data for each of the two channels; this information is only required when passive probes are being used. When Smart probes are used, the calibration data is stored in the probe and the coefficients held in the CTH7000 are not required or used.

#### Note

Smart probes use their own internal calibration data. The instrument coefficients are ignored when a Smart probe is attached.

When passive probes are used, correct entry of the parameter values is absolutely critical to obtain accurate readings. For this reason, the coefficients menu is passcode protected. The passcode screen (below) will appear once the **Coefficients** menu has been selected. Use the **Up** and **Down** arrow keys to increment or decrement the passcode value.

Use the **Enter** key once the correct passcode has been set; this procedure helps to prevent inadvertent changes. The default passcode setting<sup>14</sup> is 4300.



The coefficient edit screen will appear once the correct passcode has been entered. In this example, the edit screen for CVD coefficients is shown; the first digit of the  $R_0$  coefficient will be highlighted (in this case the '1'). This is the current cursor position. Use the **Up** and **Down** keys to change the value under the cursor. Once this value is correct, use the **Left** and **Right** keys to select the next digit to set. Use the **Enter** key once the complete coefficient has been edited correctly; alternatively use the **Clear** key to move on to the next coefficient<sup>15</sup>. The coefficients will be set to the value shown when the **Enter** key is pressed.

Once the first coefficient has been edited, the screen will scroll (if more than three coefficients are required). Note that DIN coefficients cannot be edited.

Follow a similar procedure for entry of NTC thermistor coefficients.

#### 4.1.3.3 Data logging menu

The CTH7000 can log data. Logging status is always shown at the bottom right-hand of the measurement screen (see section 4.1.1).

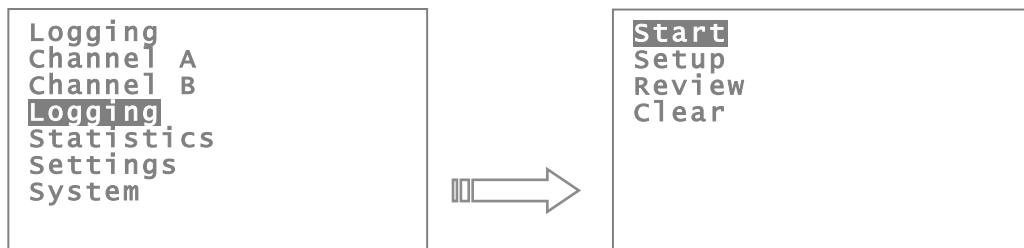
<sup>14</sup> This can be changed using the **Settings** menu; keep careful note of the new value if changed. A lost password can be retrieved, but you will need to contact ASL directly for further information.

<sup>15</sup> Use the **Clear** key repeatedly to exit without changing any of the coefficients.

Data can be logged at regular intervals (the interval is set when **Setup** selected), reviewed and logging can be turned on and off.

Press the **Enter** key to select the sub-menu used to set the various logging options.

Note that there are a finite number of data points that can be stored, so eventually, any old results will be overwritten as the selected log will eventually wrap-round – i.e. the oldest reading will be overwritten first<sup>16</sup>.

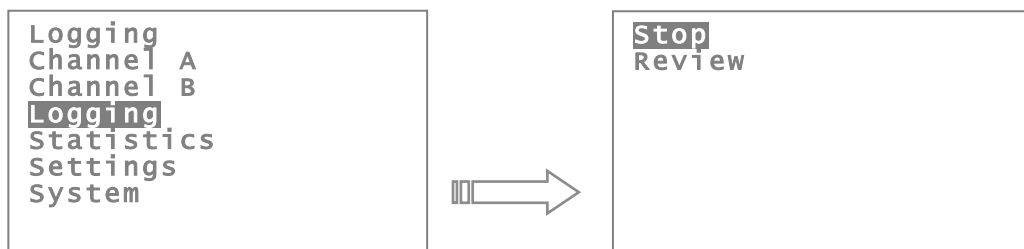


Use the **Start** menu item to begin logging.

Select **Clear** to clear the log and return to the main menu.

Selecting **Stop** (see below) will halt logging. Logging can be restarted using the **Start** menu item (logging will then continue after the last point previously logged).

Only two menu options will be available when the instrument is logging.



<sup>16</sup> After approximately 8000 points when continuously logging; starting and stopping the log will decrease this number points available.

**a) Review**

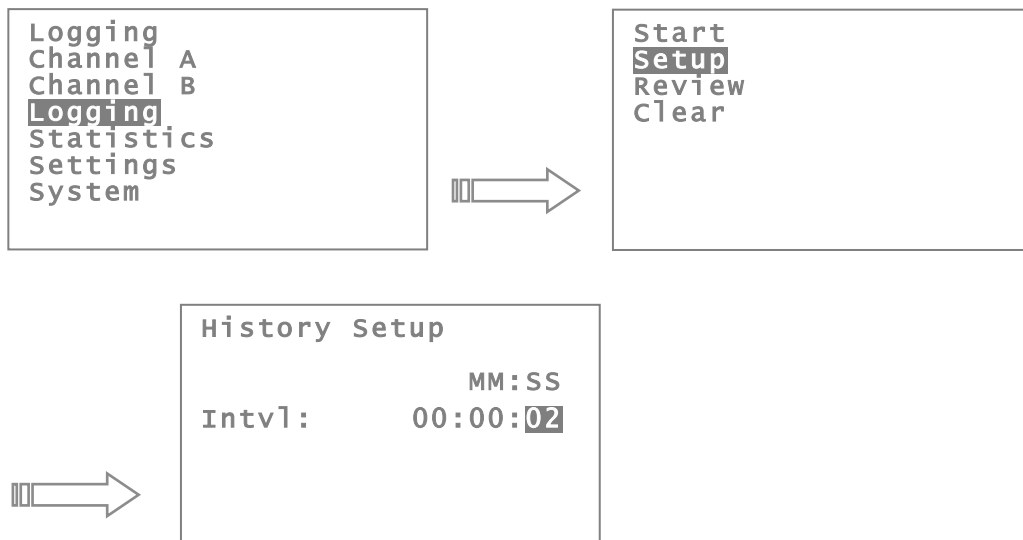
Results similar to the following example will appear once the **Review** key has been pressed.; exact details will vary with the instrument setup. The example shows channel A results logged at 2 second intervals.

Hour of reading &	10 - 18 April	0	Current page
Minutes/seconds and channel	22:27 A	120.000F	Reading and units
	22:29 A	120.000F	
	22:31 A	120.000F	
	22:33 A	120.000F	
	22:35 A	120.000F	
	22:37 A	120.000F	
Use the down key to select the next page	Dn	Next Pg	

Use the **Down** key to scroll through the logged readings a page at a time.

Press the **Clear** key ( \* ) to return to the main menu screen.

**b) Setup**



Use the setup menu to set the logging interval. Either select the required interval with the **Enter** key or use the **Clear** key to return to the measurement menu.

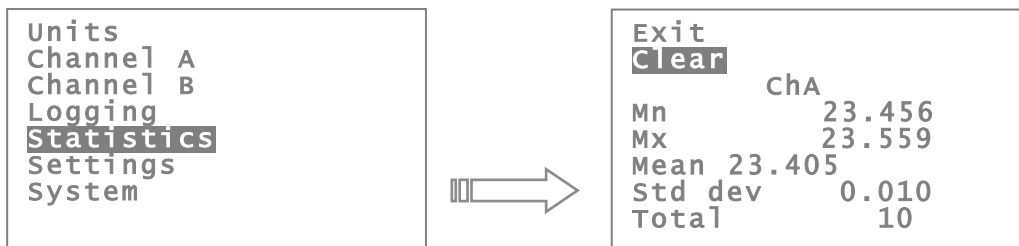
The interval can be set anywhere between 1 second and 59 minutes 59 seconds (a logging interval of 2 seconds is shown in the example). Selecting an interval of 00:00 will log data as fast as possible; select an interval that best matches your requirements. Logging with a larger data intervals effectively increases the total period for which data can be logged.

Logging will stop when the power is turned off.

#### 4.1.3.4 Statistics menu

The CTH7000 provides statistics on the data it is collecting. Press the **Enter** key to select the statistics sub-menu.

Statistical information is calculated continuously from the moment statistics are cleared (see sub-menu). Changing any parameter that affects the calculation (e.g. units) will automatically clear and restart calculation.



The **Exit** option is used to return to the Measurement Menu after viewing statistics.

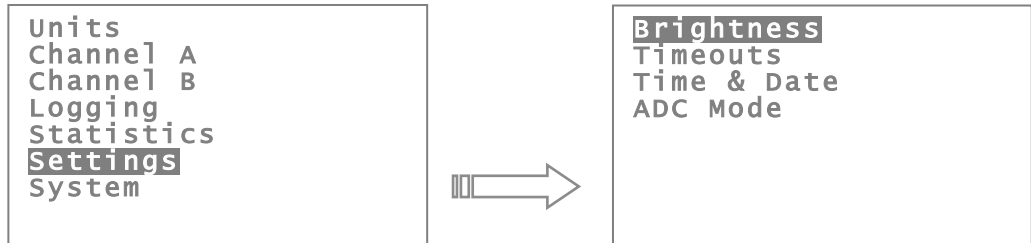
Alternatively, press the **Clear** key ( \* ) to return to Measurement Menu without clearing statistics.

The minimum, maximum, mean, standard deviation and total number of readings are displayed on this screen<sup>17</sup>. Select **Clear** to immediately clear and restart the statistical calculations.

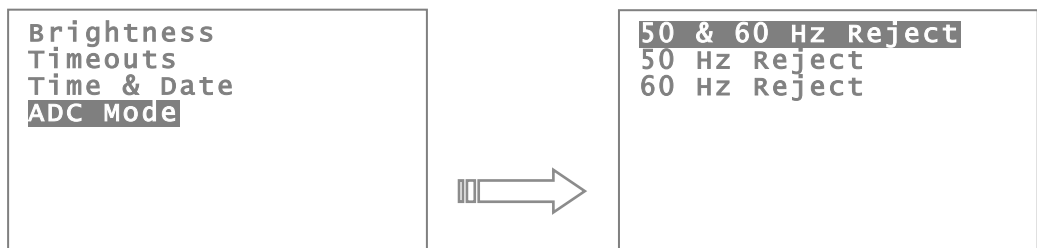
<sup>17</sup> The maximum and minimum values are also displayed continuously on the measurement menu screen.

### 4.1.3.5 Settings menu

Several operational parameters can be changed in the Settings menu. Press the **Enter** key to select the Settings sub-menu. For example, to change the ADC mode (50/60 Hz) setting -

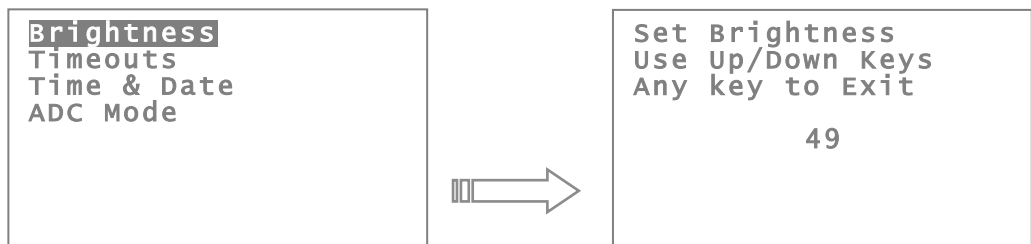


CTH7000 has been set to 50 Hz & 60 Hz reject (rejection filter) by default. Select 50 Hz or 60 Hz, depending on the operational mains frequency in your area. This can provide better noise rejection. See the menu screen shown below.



#### a) Brightness

Selecting this option allows the brightness of the LCD backlight to be adjusted. Use the **Enter** key once you are happy with the backlight intensity. Use the **Clear** key to exit without altering the set value.

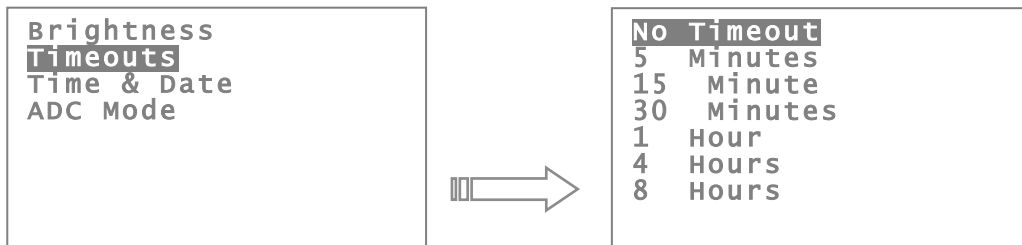


**Note**

When the CTH7000 is battery operated, using the backlight will dramatically reduce battery life. The current used increases as the backlight intensity rises.

**b) Timeouts**

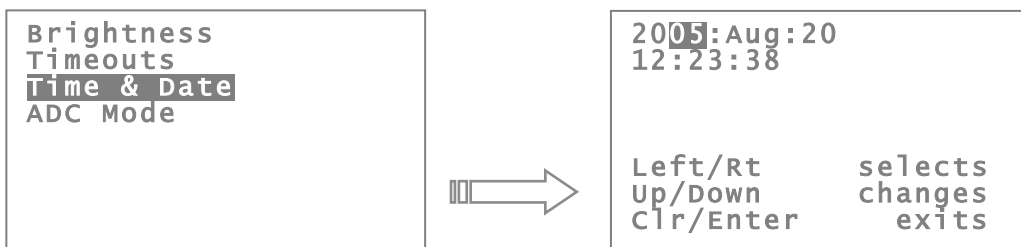
The CTH7000 can be set to timeout after a preset period (to save battery life); by default the timeout is off. Selecting this option allows the various timeout values to be set. Use the **Up** and **Down** keys to select the required timeout and then press the **Enter** key to select it (or use the **Clear** key to return to the Measurement Menu).



**c) Time/Date menu**

The CTH7000 contains a real-time clock<sup>18</sup>. The Time/Date menu is used to set the clock. The menu keys are used to change the settings. Use the **Up** and **Down** keys to alter the value under the reverse-video cursor. Once the correct value is set, use the **Right** and **Left** keys to move to the next field. Use the **Clear** key to exit without changing the values. The **Enter** key will set the clock to the new values.

It is important to set the clock correctly when using data logging.



**d) ADC mode**

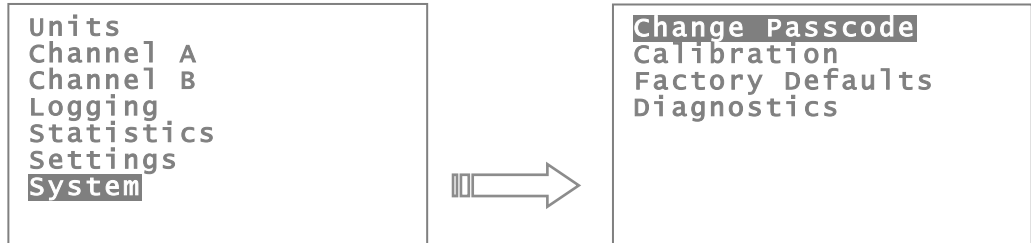
See the example at the start of this section.

<sup>18</sup> The clock battery is contained internally; the battery pack is not used for the real time clock.



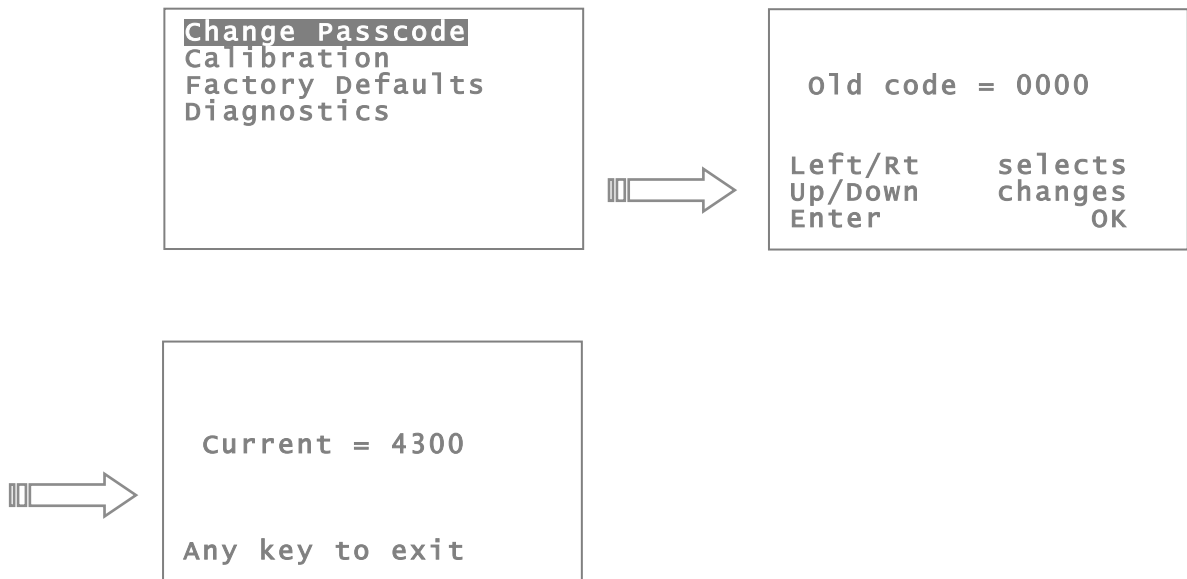
4.1.3.6 System menu

The settings menu allows the remainder of the instrument parameters to be set.



a) Change Passcode

Selecting this option allows the CTH7000 passcode to be set to another value<sup>19</sup>. The current passcode has to be entered before it can be altered. The passcode screen will always show the value '0000' when it is first displayed; use the **Up** and **Down** keys to change this to the current passcode value. Press **Enter** when the current passcode is correct. The new value can then be set. In the example below, the passcode is '4300'.



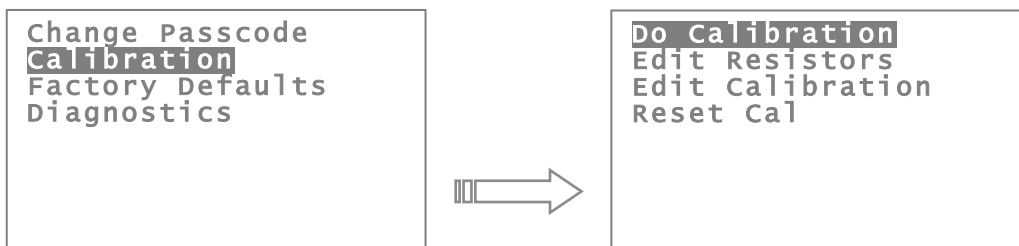
<sup>19</sup> Set to 4300 by default

**b) Instrument calibration**

Selecting this option allows the CTH7000 to be calibrated; this option will overwrite and replace the exiting calibration data. The correct equipment, environment and accurately calibrated resistors are required. For this reason, a passcode (9900) has to be entered first –

**Note**

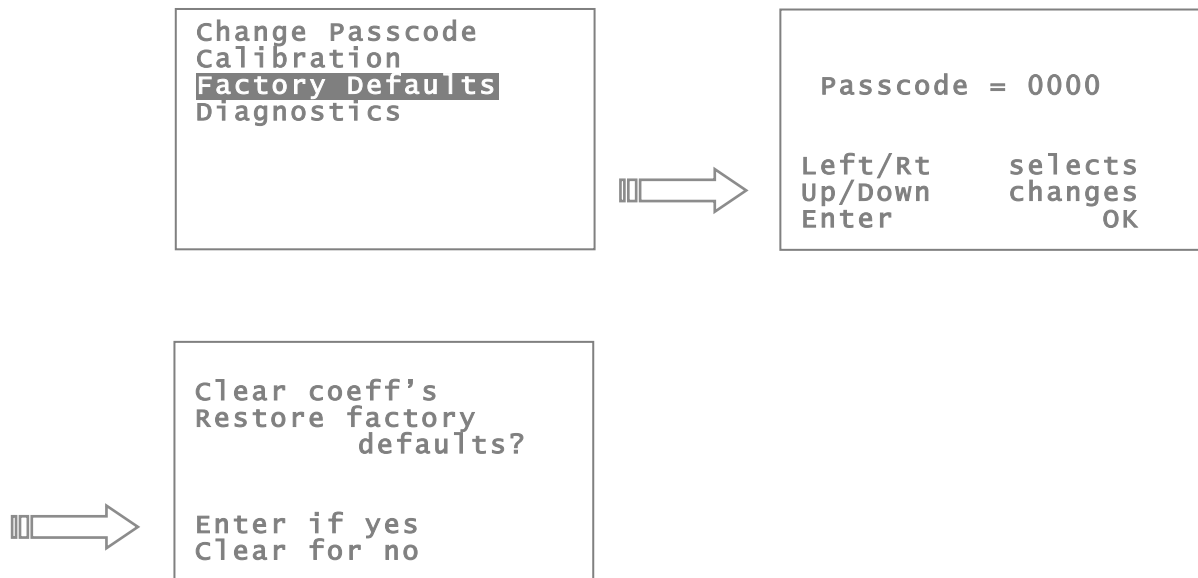
Selecting this option will overwrite the instrument calibration data. Do not attempt to do this unless you have the correct equipment, environment and suitably trained personnel.

**Note**

Specialised equipment is required to proceed further with this procedure.

### Factory defaults

The instrument parameters can be set to the factory defaults. Selecting this option will overwrite any existing calibration data. For this reason, a passcode (9900) must be entered (see below) -



#### Note

Selecting this option will overwrite all instrument calibration data and settings. Do not attempt to do this unless you have the correct equipment, environment and suitably trained personnel.

### c) Diagnostics

Not available for use.

#### 4.1.4 Setting up Temperature measurement

To enable accurate resistance to temperature conversion to be carried out by the instrument, PRT or characterisation data is required for both –

- temperature conversion algorithm, and
- temperature conversion algorithm coefficients

For Thermistors, characterisation data is only required for –

- temperature conversion algorithm coefficients

The data can be stored in either a Smart probe or the instruments' internal non-volatile memory, each thermometer input channel stores one set of PRT/Thermistor characterisation data. See the relevant section above for details on entering the data.

##### 4.1.4.1 Temperature measurement with Smart probe (s)

If a Smart probe is detected on a selected input channel, the PRT calibration data is loaded directly from the Smart probe. Smart probe data always takes precedence over the internal CTH7000 coefficient data (but does not overwrite the instrument data).

#### Note

The CTH7000 may take up to 5 seconds to recognise and acquire data from the Smart Probe after switch-on before displaying a measurement.

##### 4.1.4.2 Instrument calibration

This is not usually a customer option; refer to separate documentation.

##### 4.1.4.3 Firmware Version

The firmware version is shown at the bottom of the LCD when the instrument is first powered.

#### 4.1.5 Smart Probe review

The Smart probe data can be reviewed, but not changed on the CTH7000. The Smart probe data contains the following information -

**Version** Smart probe data format

**Lock** Password protection state

00 = Smart probe data locked can not be changed from the instrument

01 = Smart probe data unlocked can be changed from the instrument

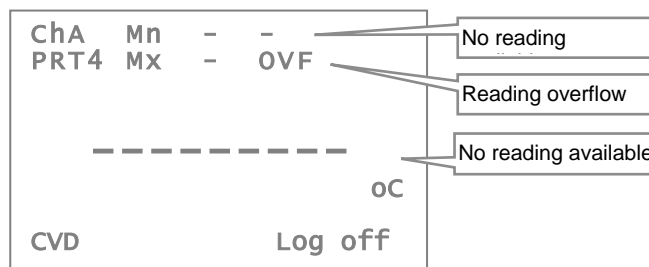
---

<b>Cal type</b>	Selected method of resistance to temperature conversion algorithm to use, DIN, ITS90, CvD or Steinhart and Hart (for thermistors)
<b>Cal date</b>	Date of the Smart probe calibration
<b>Due date</b>	Date the Smart probe calibration is next due
<b>Source</b>	Company that carried out the Smart probe calibration
<b>Serial Number</b>	Serial number of the Smart probe
<b>Max since cal</b>	Maximum recorded temperature the Smart probe has been exposed to since it was last calibrated (units are in resistance)
<b>Min since cal</b>	Minimum recorded temperature the Smart probe has been exposed to since it was last calibrated (units are in resistance)
<b>Max ever</b>	Maximum recorded temperature the Smart probe has been exposed to during its working life (units are in resistance)
<b>Min ever</b>	Minimum recorded temperature the Smart probe has been exposed to during its working life (units are in resistance)

## 5. Instrument Measurement Range

### 5.1 Instrument measurement working range

The instrument can detect the following conditions Open Circuit Probe<sup>20</sup>, Over Range measurement and Under Range measurement. These conditions are shown by a line of dashes '-----' on the LCD display.



### 5.2 Measurement Ranges

Measurement Units Thermistor	Conversion	Under Range	Over Range	Units
Resistance	None	0	400,000	ohms
Temperature	S & H	Thermistor dependent		°C/°F/K

Measurement Units PRT	Conversion	Under Range	Over Range	Units
Resistance	None	0	410	ohms
Temperature	Din90	-201	+851	°C/°F/K
	CvD	-201	+850	°C/°F/K
	ITS90	-201	+963	°C/°F/K

<sup>20</sup> Because of the potentially high resistances of thermistors, it may not be possible to determine the difference between connected and disconnected probes for these sensors.

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## 6. Smart Probes

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### 6.1 About Smart Probes

Smart probes are similar to passive probes except for one key advantage - all the probe details, calibration data and probe history are stored within the probe itself and not within the measurement instrument.

Smart probes can be moved freely from channel to channel or from instrument to instrument without the need to manually enter any data into the instrument.

### 6.2 How Smart Probes Work

Each Smart probe is fitted with a small non-volatile memory device; this device is transparent during normal temperature measurement.

The probe is interrogated before a measurement cycle and the probe data is read into the instrument for use in the measurement process.

### 6.3 Smart Probe Data Security

To maintain a high level of data security, the Smart probe has a built in data-lock. If the data-lock is set, the Smart probe data cannot be modified.

### 6.4 Smart Probe Calibration Supervisor

To assist in maintaining valid calibration, the instrument checks the Smart probe calibration date and compares it with the instrument's current date. If the Smart probe date is found to have expired, the instrument will warn the operator 'Probe is out of calibration'.

### 6.5 Smart Probe Working Range Monitor

The Smart probe working range monitor is used to monitor a Smart probe's working range and to notify a user if it is used outside its specified range.

### 6.6 Smart Probe Errors

Smart probe errors should never occur. They take the form – "Error 0xNN", where NN is the error code. Please refer to ASL Technical Services if this error is seen.



## 7. Calibrating the CTH7000

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### 7.1 CTH7000 Instrument calibration

The dc bridge measurement technique used in the CTH7000 is inherently very stable and linear. However some small drift of the internal reference resistor may occur with time, making periodic re-calibration advisable.

### 7.2 Equipment

Temperature controlled environment at  $+20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ .  
Set of stable, calibrated (1ppm) resistors (3 ranges, 6 resistors).

### 7.3 Calibration procedure

See separate documentation.

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## 8. Communications Interface

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### 8.1 Introduction

The CTH7000 is fitted with USB communication interface as standard. The connected PC must have the correct USB driver installed. Please refer to the installation CD and the ULOG help system (ULOG version 3.3 onwards).

The USB PC interface will be installed as a virtual COM driver. The communication protocol is -

Bits per second	9600
Data bits	8
Stop bits	1
Parity	none
Flow control	none

An interval of 1ms to 2 ms should be allowed between transmitted characters.

### 8.2 USB Command syntax

The programming command language is based on the SCPI command format. Commands are case insensitive.

Commands consist of one or more command words with each command word separated by a colon (:) or a question mark (?). For commands requiring a response, a white space character is used to separate the command parameter from the command words (e.g. UNIT:TEMP <units>).

A response to a command returns a list of parameters (<parameter>) with each parameter separated by a comma (,). The last parameter will be followed by a command terminator carriage return (CR).

:	(colon)	Separates command words
?	(question mark)	Command requires a response
,	(comma)	Separates parameters list

Unrecognized commands will return ERR CMD after the CR character.

#### 8.2.1 Command terminators (CR) or (CR)(LF)

All commands sent to the instrument must be terminated with a carriage return (CR) character. A carriage return/line feed pair (CR)(LF) can also be sent to terminate a message; the (LF) is ignored.

## 8.2.2 Command details

A list of the commands follow -

### 8.2.2.1 SYSTEM:REMOTE

<b>Command</b>	SYSTEM:REMOTE
<b>Return</b>	None
<b>Function</b>	Places the CTH7000 in remote mode for USB control. CTH7000 indicates remote on the instrument display. Disables the instrument front panel keys (excluding backlight and power keys).

### 8.2.2.2 SYSTEM:LOCAL

<b>Command</b>	SYSTEM: LOCAL
<b>Return</b>	None
<b>Function</b>	Returns the instrument to local mode. Removes the remote indication from the instrument display. Enables the instrument front panel keys.

### 8.2.2.3 \*IDN?

<b>Command</b>	*IDN?										
<b>Return</b>	<manufacturer>,<model no>,<serial no>,<firmware version>,<date>										
<b>Parameters</b>	<table border="0"> <tr> <td>&lt;manufacture&gt;</td> <td>ASL</td> </tr> <tr> <td>&lt;model no&gt;</td> <td>CTH7000</td> </tr> <tr> <td>&lt;serial no&gt;</td> <td>Serial number of the instrument.</td> </tr> <tr> <td>&lt;firmware version&gt;</td> <td>Current firmware version</td> </tr> <tr> <td>&lt;date&gt;</td> <td>date.</td> </tr> </table>	<manufacture>	ASL	<model no>	CTH7000	<serial no>	Serial number of the instrument.	<firmware version>	Current firmware version	<date>	date.
<manufacture>	ASL										
<model no>	CTH7000										
<serial no>	Serial number of the instrument.										
<firmware version>	Current firmware version										
<date>	date.										
<b>Function</b>	Reads the instrument's identification code consisting of the manufacturers name, instrument model number, instrument serial number, firmware version and date.										

NB: If the serial number is not entered, the instrument will return 00000

#### 8.2.2.4 MEASURE:CHANNEL? <channel>

<b>Command</b>	MEASURE:CHANNEL? <channel>	
<b>Parameters</b>	<channel> 1 to 2	single channel measurement
	<channel> -	differential measurement mode
	<measurement>	last measurement value.
	<units>	currently selected units.
<b>Return</b>	<channel>,<measurement>,<units>	
<b>Function</b>	Responds when a measurement is available.	

#### 8.2.2.5 UNIT:TEMP? <units>

<b>Command</b>	UNIT:TEMP <units>	
<b>Parameters</b>	<units>	
	C or CEL	Degrees celcius
	F or FAR	Degrees fahrenheit
	K	Degrees kelvin
	R	Resistance
<b>Return</b>	None	
<b>Function</b>	Sets the temperature units.	

#### 8.2.2.6 LOG:DUMP 1

<b>Command</b>	LOG:DUMP 1	
<b>Return</b>	<date>,<time>,<units>,<measurement CH1>,<measurement CH2>,<differential>	
<b>Function</b>	Downloads the complete CTH7000 data log.	

### 8.2.2.7 LOG:ERASE 1

**Command** LOG:ERASE

**Return** <complete>

**Function** Erases (clears) the complete CTH7000 data log.

### 8.2.3 Example log output

An example of the log output, saved as a \*.csv file and loaded into Excel, is shown below.

Log Date	Time	UNITS	CH1	CH2	DIFF
05-May-06	13:09:26	C	5.172		
.....					
05-May-06	13:20:04	C	5.172		
05-May-06	13:20:06	C	5.173		
05-May-06	13:20:08	C		No Probe	
05-May-06	13:20:10	C		No Probe	
05-May-06	13:20:12	C		No Probe	
05-May-06	13:20:14	C			No Probe
05-May-06	13:20:16	C			No Probe
05-May-06	13:20:18	C			No Probe
05-May-06	13:20:20	C			No Probe
05-May-06	13:20:22	C	No Probe		
05-May-06	13:20:24	C		No Probe	
05-May-06	13:20:26	C		No Probe	
05-May-06	13:20:28	C			No Probe
05-May-06	13:20:30	C			OV_Range
05-May-06	13:20:32	C			No Probe
05-May-06	13:20:34	C			No Probe
05-May-06	13:20:36	C			No Probe
05-May-06	13:20:38	C			No Probe
05-May-06	13:35:52	R	102.016		
05-May-06	13:35:54	R	102.02		
.....					
05-May-06	13:36:32	R	109.488		
05-May-06	13:36:34	R	110.02		
05-May-06	13:36:36	R	110.02		
48 readings					
End of log					
#					

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## 9. Specification

### 9.1 Resistance thermometer measurement

PRT characterization	ITS90 Din90 BS EN60751:1996, IEC60751:1983
Thermistor characterization	CvD BSEN1904:1984, IEC751:1983 Steinhart and Hart (NTC)
Resistance measurement range (PRT)	1 to 400 ohm
Resistance measurement range (Thermistor)	1 to 400,000 ohm
Temperature measurement range	ITS90 -200 to +962°C Din90 -200 to +850°C CvD -150 to +850°C Thermistor – type dependent
Accuracy (PRT)	± 0.015°C (15mK)
Accuracy (NTC Thermistor) 1 to 400 ohm	± 0.006 ohm
400 to 50k ohm	± 0.01% of reading
50 to 400k ohm	± 0.02% of reading
Resistance measurement uncertainty	± 6mΩ (+20°C ±5°C)
Temperature coefficient (resistance measurement)	0.2ppm/°C (0.05mK/°C)
Long term stability (resistance measurement)	± 25ppm (±2.5m°) / year
Sense current (PRT)	1mA (DC) polarity switchable
Sense current (NTC Thermistor)	1mA, 10µA, 3µA auto-select
User selectable measurement display units	°C/ °F/ K or ohms
Input channels	2
Input connection	2 x 5 pin DIN
Measurement configuration	4 wire
Input impedance	> 10MΩ
Max common and differential mode input voltage	±40VDC, 28Vrms



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## 9.2 Display

User interface, display	128 x 64 LCD with (optional) backlight
Resolution	0.001 °C

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## 9.3 Functions

Memory	8,000 values approx.
Statistical analysis	Min/Max, average, standard deviation
Functions	Hold, Zero, one-shot measurement, log
Real-time clock	integrated clock with date and year
Interface	USB

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## 9.4 Supply

Mains charger supply voltage range	90 – 264Vac
Power consumption	3VA max
Supply frequency range	47 - 63Hz
Battery supply	Nickel-Metal Hydride (Ni-MH) rechargeable battery, low battery indicator
Battery life	20 hours of operation approx

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## 9.5 Environmental

Storage temperature range	-20°C to +50°C
Service temperature range	0°C to +40°C
Specified operating temperature range	+15°C to +25°C
Operating relative humidity conditions	<80% RH, non-condensing

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## 9.6 Dimensions and weight

Dimensions	232 x 97 x 53 mm (L x W x D)
Weight	0.5kg (1.1 lbs)

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## 9.7 CE conformity

EMC directive	2004/108/EC, EN 61326 emission (group 1, class B) and interference immunity (portable test and measuring equipment)
Approvals and certificates, see website	

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## 10. Cleaning and Maintenance

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### 10.1 Cleaning

Make sure the CTH7000 is disconnected from any leads before cleaning.

Clean the outside of the instrument with a soft, clean cloth, slightly dampened with mild detergent. Do not allow water to enter the instrument.

**Warning**

Never use alcohol or thinners as these will damage the instrument.

Never use a hard or abrasive cloth or brush..

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## 11. Service and Warranty

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CTH7000 equipment and accessories, (unless stated otherwise), are covered by a 12 month warranty on parts and labour from the date of dispatch from ASL (provided the instrument has not been damaged in use or tampered with). This warranty does not include costs incurred in returning the equipment to the factory for repair.

### 11.1 Technical Support

For all technical support, repair, warranty and service inquiries please contact:

Technical Services  
WIKAI UK  
4 Gatton Park Business Centre  
Wells Place  
Merstham, Redhill  
RD1 3LG  
ENGLAND  
United Kingdom.

Telephone: +44 (0) 1737 644 008

Fax: +44 (0) 1737 644 403

E-Mail: [service@asltd.co.uk](mailto:service@asltd.co.uk)

Web Page: [www.wika.co.uk](http://www.wika.co.uk)

## 12. Appendix A

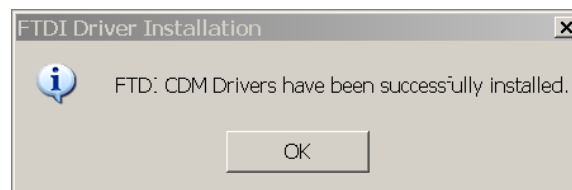
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### 12.1 USB device driver

The CTH7000 normally communicates with a PC on which a Virtual Communications Port (VCP) driver has been installed. This makes the USB system look like a standard serial port (COM port) to the PC. With this approach, the PC can use any program that works with standard serial communication protocols.

### 12.2 USB device driver installation

Run the program **CDM\_Setup.exe** from the directory **D:\Downloader** on the CD supplied with the instrument<sup>21</sup>. This will install the USB drivers. You will see the following message once this is complete.



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<sup>21</sup> Replace the 'D' with the name of your CD device as necessary