

# LABCAL PRO HIGH PRECISION THERMOMETER/ LOGGER FOR THERMOCOUPLE & Pt100 SENSORS



The Labcal PRO is a highly accurate, portable digital thermometer / logger for metrology and other exacting laboratory and industrial applications. The Labcal PRO is particularly suitable as a reference measurement standard for thermal calibration baths in pharmaceutical, medical, food, environmental testing, R&D and general industrial applications.



LAB082/1216

## **Key Features**

- *Reference standard thermometer for Pt100 and thermocouple sensors*
- *High accuracy  $\pm 0.01^{\circ}\text{C}$  Pt100,  $\pm 0.18^{\circ}\text{C}$  thermocouple*
- *25 milliKelvin ( $0.025^{\circ}\text{C}$ ) system accuracy with Pt100*
- *Precise linearisation conformity is realised by a hybrid maths polynomial technique*
- *Simple, fast digital matching to calibrated sensors, up to 10 points per channel retained in memory*
- *Additional digital matching to Pt100 sensors using custom constants*
- *Clear, comprehensive user information on alpha numeric display*
- *User selectable resolution, 0.001/0.01 $^{\circ}\text{C}$  for Pt100 inputs*
- *Smart sensor capability Pt100 for corrections stored on probe*
- *Data logging*
- *Wide temperature ranges*
- *Measures Pt100 and thermocouples J, K, T, E, R, S, B and N*
- *Readout directly in  $^{\circ}\text{C}$ ,  $^{\circ}\text{F}$ , K,  $\Omega$  or mV*
- *Exceptional automatic CJC performance, 100:1 rejection*
- *Input circuitry configured to eliminate thermal voltages*
- *External and manual CJ function*
- *Four sensor input ports*
- *Channel A, B or A-B reading including dissimilar sensor types*
- *USB serial communications*
- *USB flash drive port*
- *Excellent long term stability*
- *Supplied with PC software*
- *Programmable analogue (retransmission) output*
- *Front panel data entry and function keys*
- *Our own design and manufacture*
- *Rechargeable Lithium Ion battery/mains powered*
- *CE & RoHS compliant*



**The Labcal PRO is a third generation instrument developed over a 25 year period from the very successful Labcal Plus thermometer. Like its predecessors, the Labcal PRO provides laboratory standard temperature measurement and many user features but provides higher accuracy, higher resolution and greater versatility to extend the scope of applications.**

The Labcal PRO is fully characterised for Pt100 sensors and all major thermocouples J,K,N,T,E,R,S and B. Exceptionally stable automatic cold junction compensation with a rejection of 100:1 is incorporated for thermocouple ranges. Alternatively, external or manual referencing can be selected as required.

Displayed values and user information are indicated on a bright clear OLED screen with diffused backlighting. Data can be displayed in °C, °F, K, Ω or mV as required; nine front panel push keys, the only user controls, are used in conjunction with the display screen. It is this arrangement which makes for very simple and “friendly” operation.

Resolution is a user selectable 0.001 or 0.01°C for Pt100 sensors and 0.1°C for thermocouples. All computations are performed digitally without drift. Overall stability is optimised by utilising only the highest quality components including high precision, expensive metal film resistor networks.

There are four input ports, two for thermocouples and two for 3 or 4 wire Pt100 sensors; the instrument automatically recognises 3 or 4 wire configurations.

The Labcal PRO can accept two Pt100 sensors and/or two thermocouples of similar or different types (J,K,N,T,E,R,S and B). The measured temperature can be displayed directly from one of the inputs or differentially between similar or different inputs. Differential temperature and the two individual channel temperatures are displayed simultaneously.

Individual calibrated sensors can have their appropriate calibration values programmed into the Labcal PRO using either the keypad or the PC software supplied. The PC software also allows corrections in the form of constants for individual Pt100 sensors to be programmed in. The nonvolatile memory ensures that the values are retained (until such time as they are changed) even after switch-off. Where the calibration certificate relating to a particular probe states specific Ω or mV values at stated temperatures, up to ten such values are entered into the Labcal PRO with their relevant temperature points using the front panel keypad or the software. The instrument then digitally self-calibrates to the associated probe over the range embraced in the calibrated values used; the temperature readout is “corrected” accordingly. Additional manual procedures are not required to compute precise temperature readings since these are displayed directly; miscalculation errors are thus eliminated. Very high system accuracies, better than 25 milliKelvins can be achieved using probe matching.

Corrections which are “programmed in” can be displayed for confirmation. However, initial input, adjustment, enabling and disabling of corrections are protected by a special key sequence to prevent accidental or unauthorised changes. Values can be changed by an authorised user at any time.

For Pt100 inputs, SMART probes can be used which incorporate dedicated 'correction values' within the connector of each probe. When a SMART probe is connected to input A or B or both inputs, the corrections are automatically applied without the need for user intervention.

A common application for the Labcal PRO is the comparison calibration of "working" sensors against a calibrated reference standard or semi-standard sensor. For example, the sensor under test in channel B is compared against the reference sensor (with programmed corrections) in channel A. When applied, the null function corrects the differential temperature readout between two sensors to zero. For example, the apparent temperature difference between two sensors known to be at the same actual temperature can be corrected to zero prior to, for example, heat exchanger experiments.

All four inputs can be scanned and values logged according to parameters set up by the user in the PC software; the instrument incorporates a real-time clock and on-board memory. The adjustable contrast OLED display screen provides data readout, user prompts and mode annunciation. This very important feature ensures a high degree of user friendliness and confidence.

User prompts indicate which buttons to press in the appropriate sequence when selecting parameters and functions and when setting calibration values. Mode annunciation indicates which mode of operation is currently selected.

A flash drive USB port is provided to allow data to be stored and/or exported. Firmware updates are also facilitated via this port.

PC software running in WINDOWS is provided as standard; it allows programming of custom calibration, remote control & measure and logging functions.

## SPECIFICATIONS

**All values are valid for a nominal 240V 50Hz instrument supply and 20°C ambient temperature (± 2°C)**

### General

#### Inputs/Ranges/Sensors

Type	Pt100 to IEC 751 (ITS 90 refers). -200°C to +850°C Ro = 100Ω 3 or 4 wire connection with automatic recognition (with manual override) Thermocouples to IEC 584 No isolation exists between inputs.
Type	Type S -50 to 1768°C Type R -42 to 1766°C Noble Metal Type B +254 to 1818°C Type J -200 to 1200°C Type K -195 to 1370°C Type E -190 to 995°C Base Metal Type N -160 to 1300°C Type T -193 to 399°C

**Overall Accuracy**

Pt100  
 $\pm 0.01^{\circ}\text{C} \pm 0.0005\%$  of span

Thermocouples

i) Base Metal	ii) Noble Metal
$\pm 0.2^{\circ}\text{C}$ from $-50^{\circ}\text{C}$ to $700^{\circ}\text{C}$	$\pm 0.3^{\circ}\text{C}$ from $850^{\circ}\text{C}$ to full scale
$\pm 0.4^{\circ}\text{C}$ from $-200^{\circ}\text{C}$ to $-50^{\circ}\text{C}$	$\pm 0.4^{\circ}\text{C}$ below $850^{\circ}\text{C}$
$\pm 0.4^{\circ}\text{C}$ from $700^{\circ}\text{C}$ to full scale	$\pm 0.7^{\circ}\text{C}$ below $0^{\circ}\text{C}$

Note: Type B not characterized below  $+200^{\circ}\text{C}$

**Linearisation Conformity**

Pt100  
 Better than  $\pm 0.01^{\circ}\text{C}$

Thermocouples  
 $\pm 0.05^{\circ}\text{C}$  base metal ( $-200^{\circ}\text{C}$  to span)  
 $\pm 0.1^{\circ}\text{C}$  noble metal above  $200^{\circ}\text{C}$

*Note: Performance of ADC ( $0.5\mu\text{V}$  resolution) is superior to published thermocouple table best resolution of  $1\mu\text{V}$ .*

**Stability (vs ambient temperature)**

Pt100  
 Better than  $0.0025^{\circ}\text{C}$  per  $1^{\circ}\text{C}$  ambient change

Thermocouples  
 Zero: negligible drift excluding CJC effect  
 Scale:  $< \pm 0.1^{\circ}\text{C}$  in  $15^{\circ}\text{C}$

**Warm-up**

Negligible under normal ambient conditions. Allow 5-10 minutes for full stability unless stored at low temperature, then 30 minutes minimum.

**Cold Junction Compensation**

Automatic on all thermocouple ranges. Better than  $\pm 1^{\circ}\text{C}$  max shift for  $\pm 10^{\circ}\text{C}$  ambient variation (100:1) or External via Pt100 on channel A or B or Manual input of CJ temperature value.

**Pt100 Sensor Current**

0.5mA

**Resolution of data display**

Pt100  
 0.01/0.001 user select for  $^{\circ}\text{C}$ , K and  $\Omega$

**Variable filter**

Sampling rate selectable between 4 and 64 (measurements averaged per reading).

**Thermocouples**

$0.1^{\circ}\text{C}$  all ranges



**Measurement Units** °C, °F, K,  $\Omega$  or mV as applicable to sensor

**Measurement Modes**

A, B or A-B. Any combination of sensor types.

**Custom Calibration**

Up to 10 calibration values can be allocated to Pt100 input A & B and to thermocouples input A & B. Values are retained in non-volatile memory until replaced by user. Alternatively, for Pt100 inputs ITS 90 or IPTS 68 coefficients can be used for custom calibration.

**Smart Sensor Connection**

Pt100 inputs only. Correction values stored in connector.

**Null Function**

Corrects differential temperature readout between two sensors to zero.

**Sensor Lead**

Pt100

**Resistance 5 $\Omega$  each lead maximum**

Thermocouples  
300 $\Omega$  loop total

**Logging**

8000 readings

**Supply**

Internal Lithium Ion rechargeable batteries. Mains 90-260V 50/60Hz universal adaptor included. Battery charge life up to 12 hours with full charge.

**Series Mode Rejection**

60dB @ 50Hz (50mV RMS applied)

**Common Mode Rejection**

30V RMS applied between input and earth produces no measurable effect.



**Display** 128 x 64 pixel OLED with diffused backlighting.  
Wide viewing angle, high contrast (adjustable).

**Front Panel Controls**  
9 membrane push-keys to control all instrument functions

**Mechanical/Case** Metal bench top case / adjustable tilt

**Dimensions** Overall: 190mm(W) x 70mm(H) x 250mm(D)

**Weight** 3.0kg approx.

**Input Connections** 2 x Pt100 via D type connectors  
2 x Thermocouple via standard sockets.

**USB Serial Communications**  
Isolated, 38400 Baud, 8 data, no parity, 1 stop bit.  
Remote control and measure.

**PC Software (standard)**  
Supplied as standard on CD ROM. Remote control and measure: Log readings to file/Download to PC/Programming corrections

**Analogue Output (standard)**  
User programmable, 0 to 1V

**Application Note:**  
*Inputs are not isolated in the Labcal PRO which is primarily designed for laboratory applications and site calibration of industrial temperature sensors. Probes connected to the instrument must therefore be isolated from high voltage pick-up. Particular care must be taken when high temperature thermocouples are used with ceramic (refractory oxide) sheaths; these can become electrically conductive at elevated temperatures and mains pick-up can occur from electrical heaters.*

***The instrument should be disconnected from the mains adaptor and operated from its internal batteries in such situations.***

## **UKAS Calibration**

**LP - UKAS:** UKAS calibration of instrument alone.

**LP - SYS.CAL:** UKAS calibration of instrument and sensor together at five points.

**LP - COR.CAL:** UKAS calibration of instrument and sensor together at five points, after initial calibration of sensor only and programming of corrections.

## **ACCESSORIES**

Labcal PRO is supplied complete with switch mode power supply (90-260V, 50/60Hz), two Pt100 "D" connectors, operating manual and PC software.