$C\epsilon$

ΩE OMEGA®
User's Guide

Shop online at omega.com®

e-mail: info@omega.com
For latest product manuals:
omegamanual.info

DP9601 High Precision Digital Thermometer / Logger for RTD Sensors

ΩE OMEGA®

OMEGAnet® Online Service omega.com	Internet e-mail info@omega.com

Servicing North America:

U.S.A.:
ISO 9001 Certified

Omega Engineering, Inc., One Omega Drive, P.O. Box 4047
Stamford, CT 06907-0047 USA
Toll Free: 1-800-826-6342   TEL: (203) 359-1660
FAX: (203) 359-7700   e-mail: info@omega.com

Canada:

976 Bergar
Laval (Quebec), H7L 5A1 Canada
Toll-Free: 1-800-826-6342   TEL: (514) 856-6928
FAX: (514) 856-6886   e-mail: info@omega.ca

For immediate technical or application assistance:

U.S.A. and Canada: Sales Service: 1-800-826-6342/1-800-TC-OMEGA®
Customer Service: 1-800-622-2378/1-800-622-BEST®
Engineering Service: 1-800-872-9436/1-800-USA-WHEN®

**Mexico/
Latin America:**

En Español: 001 (203) 359-7803   FAX: 001 (203) 359-7807
info@omega.com.mx   e-mail: espanol@omega.com

Servicing Europe:

Benelux:

Managed by the United Kingdom Office
Toll-Free: 0800 099 3344   TEL: +31 20 347 21 21
FAX: +31 20 643 46 43   e-mail: sales@omegaeng.nl

Czech Republic:

Frystatska 184
733 01 Karviná, Czech Republic
Toll-Free: 0800-1-66342   TEL: +420-59-6311899
FAX: +420-59-6311114   e-mail: info@omegashop.cz

France:

Managed by the United Kingdom Office
Toll-Free: 0800 466 342   TEL: +33 (0) 161 37 29 00
FAX: +33 (0) 130 57 54 27   e-mail: sales@omega.fr

Germany/ Austria:

Daimlerstrasse 26
D-75392 Deckenpfronn, Germany
Toll-Free: 0800 6397678   TEL: +49 (0) 7056 9398-0
FAX: +49 (0) 7056 9398-29   e-mail: info@omega.de

United Kingdom:
ISO 9001 Certified

OMEGA Engineering Ltd.
One Omega Drive, River Bend Technology Centre, Northbank
Irlam, Manchester M44 5BD United Kingdom
Toll-Free: 0800-488-488   TEL: +44 (0) 161 777-6611
FAX: +44 (0) 161 777-6622   e-mail: sales@omega.co.uk

Contents

Information in this publication may be subject to change; the DP9601 is a micro-processor based, software driven instrument and may therefore be subject to software and hardware changes in line with our policy of continuous product development.

1. About the DP9601

The DP9601 is a successor to the very successful DP97 thermometer developed over a 25 year period. Like its predecessor, the DP9601 provides laboratory standard temperature measurement with RTD sensors and greater versatility to extend the scope of applications.

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 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 0.01°C: 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 two input ports for 3 or 4 wire RTD sensors; the instrument automatically recognises 3 or 4 wire configurations. The measured temperature can be displayed directly from one of the inputs or differentially between the two inputs. Differential temperature and the two individual channel temperatures are displayed simultaneously.

Individual calibrated sensors can have their appropriate calibration values programmed into the DP9601 using either the keypad or the PC software supplied. The PC software also allows corrections in the form of constants for individual RTD sensors to be programmed in. The non-volatile 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 values at stated temperatures, up to ten such values are entered into the DP9601 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 40 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 For by a special key sequence to prevent accidental or unauthorised changes. Values can be changed by an authorised user at any time.

For the RTD 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 DP9601 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.

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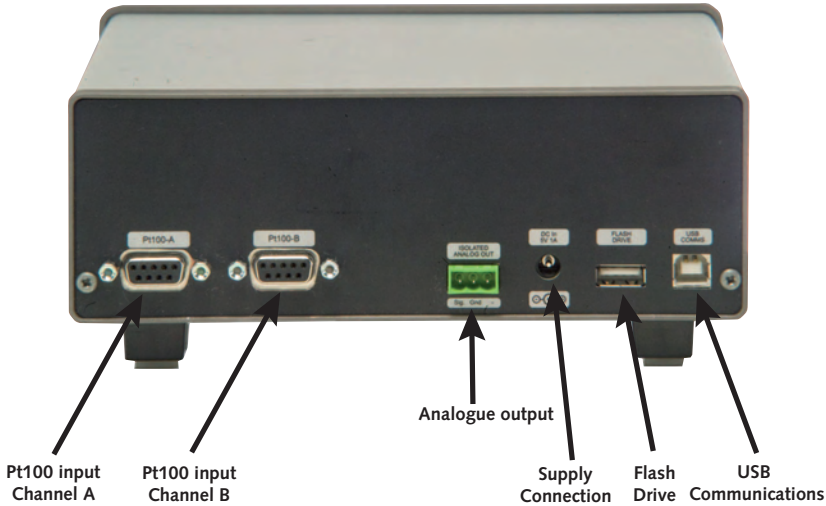
A flash drive USB port is provided to allow data to be stored and/or exported. Firmware update are also facilitated via this port.

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

2.   Installation

The instrument is for bench-top and portable use, folding 'legs' can be extended to provide a convenient viewing angle.

All connections are made to the rear panel as indicated.

Analogue output

Pt100 input Channel A   **Pt100 input Channel B**   **Supply Connection**   **Flash Drive**   **USB Communications**

2a Supply Connection

Refer to the rear panel illustration. Primary power is provided by the internal Lithium Ion battery which provides up to 12 hours of operation from a full charge. The external 90 to 260V 50/60Hz power supply allows recharging and continuous operation. The output lead with its fitted connector is plugged in to the rear panel socket 'DC in 5V IA'.

Pressing the front panel 'POWER' key switches the instrument on / off.

The battery charge indicator in the top right of the display indicates the state of charge. The battery will charge whenever the instrument is connected to the power adaptor.
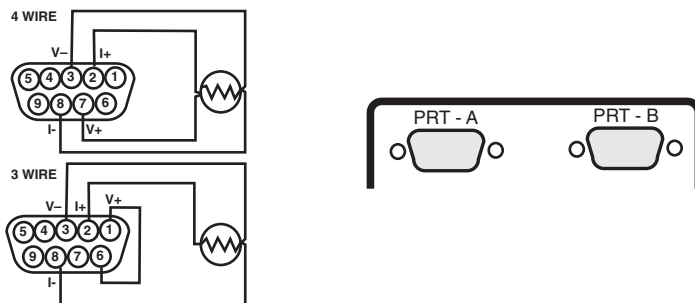
2b Communications Interface

Connect the USB cable supplied between the instrument and the PC. Refer to the rear panel illustration.

2c Input Connection – Sensors

Refer to the rear panel illustration.

RTD sensors

RTDs (Platinum resistance thermometers) must be fitted with a high quality D-plug and connected to input PRT-A and/or PRT-B as required. A 3 or 4 wire configuration can be used but they are connected differently as shown. The instrument will automatically sense which configuration is employed.

Special care must be taken when connecting 3 wire RTD terminations to the connector pins. A good crimp must be achieved to avoid Ohmic contacts which would result in reading errors. Only use good quality connectors with gold contact material; the Labfacility D type is recommended.

Application note: Inputs are not isolated in the DP9601 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.

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

3.   Operation

Ensure that the instrument is connected to a suitable supply and that the required connections are made.

Switch on using the 'POWER' key. The display will show the programme (firmware) designation followed by a short delay while the internal checks are carried out. The instrument will then commence normal operation according to the selected mode prior to switch-off, e.g. if channel B, PRT was in use when switched off, this will be the mode when switched on.

OPERATION requires the selection of appropriate menus which are shown on the display screen. Menu screens are obtained as shown in the following sections although the procedure is described in the text in each case.

Display brightness can be adjusted as required in the 'SETTINGS' sub-menu described later.

Main Menu Correct — Enter → Pt100 Corr — Next → Corr Chan — Next → Coeff Chan — Next
Escape

Main Menu Logging — Enter → View Log — Next → Write Log — Next → Start Log — Next → Erase Log — Next
Escape

Main Menu Settings — Enter → Smart Probe — Next → System — Next → Set Time — Next → About — Next
Escape

Main Menu Brightness — Enter → Set Bright
Escape

Main Menu D>A Setup — Enter → D>A Zero — Next → D>A Span — Next
Escape

ENTER to edit
then
INC/DEC to change
ENTER to accept

Main Menu A–B Null — Enter → Use Null ENTER to toggle on or off — Next → New Null — Next
Escape

ENTER
Null is computed
then returns to main
menu screen

Next

3a To read sensor temperature directly

```
 23.78 C ▌
Chan   A
Units  Deg C
Type   Pt100
Wires  Four
Res.   Low
Cor't  Outside
```
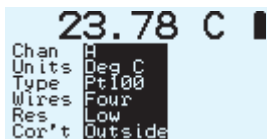
Press 'SENSOR' key to select the required type of sensor if different to that currently indicated

Brief repeated key presses will step through the various types or holding the key depressed will auto-repeat (scroll through); this applies to other functions as well. **NOTE: If for any selected channel the sensor is either not connected (including sensor open circuit) the display will show 'BROKEN PROBE'.**

Press 'CHANNEL' to select inputs A, B or A-B (differential)

Press UNITS to display the desired units °C, °F, K or Ω (dependent on the type of sensor selected).

Press 'RESOLUTION' to display the desired resolution, either 0.01 or 0.001 for °C, K and Ω only. Only 0.01 resolution can be used with °F.

3b To read differential temperature

The difference in temperature between two sensors can be obtained by displaying channel A-B. Ensure that the required sensors are connected to the appropriate A and B inputs.

Press 'CHANNEL' to select A-B after first setting up the individual channels A and B with sensor type and corrections ON/OFF as required. Press 'UNITS' to display the desired temperature units which must be appropriate to both types of sensor. The value now displayed is the difference value between sensors A and B as selected (i.e. A-B).

For calorimetry and certain other applications, to optimise the precision of such differential measurements, the probe tolerances can be nulled as follows:

Nulling procedure requires the relevant probes A and B to be tagged for repeatability. Ensure that both sensors are held at the same temperature (say 0°C or other value) and measure A-B.

It is possible to null out differences between the two sensors measured differentially as follows:

Obtain the 'NULL' menu A-B Null by scrolling through the sub-menus until the menu appears. Press 'ENTER'.

The display screen shows: **=USE NULL ON/OFF & VALUE=**

i)   Acquiring a new null

ii)   Applying a measured null value

The last null value will be applied such that the display value used is (A-B) – (Null value).

The display screen shows: **ACQUIRE NEW A-B**
NULL VALUE (DEG C)
VALUE =

3c Matching DP9601 to calibrated sensors

It is possible to automatically match the DP9601 to RTD sensors with dedicated calibration values via the PC software (see p17). Such values published in associated certificate indicate true Ω, °C and value corresponding to accurately known reference temperatures.

Viewing corrections via the keypad

1.   Obtain the required thermocouple (TC) or Pt100 (PRT) 'CORRECTIONS' menu; press 'MENU' and then 'CORRECT'. Press 'ENTER'.

```
Main Menu ▯
 Correct
```

The display screen shows: **VIEW CORRECTIONS   or   VIEW CORRECTIONS**
FOR THERMOCOUPLES   FOR Pt100 SENSORS

3d SMART probe operation

SmartProbe▯
View Smart-Probe Data

In the main menu, scroll down to 'SETTINGS' and press 'ENTER'. The smart probe screen is shown. Press 'ENTER' to view the Smart Probe data (table of values). The probe tag and values are displayed when an appropriate probe is connected to the instrument.

smPROBE A S/No 1234 ▯

    Deg C   Ohms
    2.111   102.111
    Point Number ▯▮

For custom coefficients

In the correction menu, scroll down to 'COEFF' screens and follow the prompts to view values and to specify relevant channel (ie A / B / Both / off). Press ENTER to select.

Coeff Chan▯
 Select Coefficient
Pt100 correction Mode

Set to ▮Off▮

3e   Temperature Measurement with Calibrated Sensor

To use the DP9601 with its associated calibrated sensor, ensure that;

1. The appropriate sensor(s) is/are connected to the relevant input(s) A or B.

2. Select the relevant channel to suit, ensure that the correct sensor type is selected.

3. Then obtain 'correct' menu; press 'MENU'; the 'correct' menu is obtained. Scroll through options as required.

Main Menu ▯
 Correct

CORRECT	OFF
CORRECT	A
CORRECT	B
CORRECT	A+B

Press 'ENTER" to select.

Press 'ESCAPE' to return to the main display which will confirm the corrections status (CORRECT OFF OR CORRECTED).

There are eight annunciations to indicate the status of corrections when taking readings with the DP9601:

Display screen annunciation   **Status**

1) OFF
2) N/A   (i.e. when units are mV or Ohms)
3) OUTSIDE   Tables either Local or Probe are selected but the current electrical measurement is beyond the electrical range defined in tables)
4) No Pts   (Tables selected, but no table found)
5) Local T   (Local tables i.e. in the instrument are applied)
6) Local C   (Local coefficients i.e. in the instrument are applied)
7) Probe T   (Probe tables i.e. in the Probe are applied)
8) Probe C   (Probe coefficients i.e. in the Probe are applied)

3f   Using DP9601 to obtain a secondary Calibration

There are two ways in which a non-calibrated sensor can be converted into a secondary standard using a 'sensor matched' DP9601.

By means of CHANNEL A-B measurement. Connect the certified sensor to Channel A and the un-calibrated sensor to Channel B. The sensors can be of similar or dissimilar type, e.g. RTD certified sensor on Channel A and type K thermocouple on T/C B.

NOTE: A-B display values at various stable, isothermal calibration temperatures and compute sensor B corrected values accordingly.

Connect the certified sensor to Channel A and the un-calibrated sensor to Channel B.

Compare direct A and B readings in turn at various stable, isothermal calibration temperatures and compute sensor B corrected values accordingly. On this basis, a range of values can be obtained for use in 'correct B' matching (procedure as section 3iii)

3g On-Board Logging

View Log []

Select 'LOGGING' in the MENU. Press 'ENTER' to view, write, start, erase log. Select the required memory slot (1 to 15) and enter the logging parameters. Follow the on-screen prompts. Press 'ESCAPE' to exit the logging menu.

3h Error indications

The DP9601 has several modes of error indication according to internal or external problems as follows:

DISPLAY	CAUSE
BROKEN PROBE	Open circuit sensor or sensor not connected to input
OUT OF RANGE	Thermocouple ranges only; input mV value outside calibration range (below min. Value or above full span value
ILLEGAL A-B MODE	A-B mode will only operate with C, F or Kelvin units
CAL LOST	All calibration values corrupted or lost. Perform re-calibration or RETURN TO FACTORY
CPU ERROR	Failure of the two microprocessors to communicate. RETURN TO FACTORY
BATTERY FLAT PLEASE RE-CHARGE	Inadequate battery charge to sustain operation within specification

Note: During normal operation, if selected probe is disconnected from the instrument the display will indicate BROKEN PROBE. If the same probe is re-connected, normal operation will be resumed.

3i   3 or 4 Wire Recognition (RTD)

The DP9601 requires a minimum of 80 milliOhms lead resistance (e.g. 1 metre of 7 stranded 0.2mmΩ wire) to recognise a 4 wire probe. Otherwise the instrument will default (perhaps correctly) to 3 wire mode.

If simulating a sensor input or calibrating the instrument, ensure 80mΩ lead resistance between the resistance source and D plug (e.g. 1 metre of 7 x 0.2mm Copper Cable).

3j   Variable Filter Rate

In high resolution mode (RTD inputs only), the sampling rate can be varied between 4 and 64 (i.e. the number of measurements averaged per display update). The selection is made via the edit filter menu obtained as follows:

```
Main Menu ▯
  Filter
```

Press 'MENU' then 'NEXT'. The edit filter menu is obtained.

The Display indicates: **SELECT FILTER LENGTH 0.1 SECONDS EACH VALUE =**

Using the 'Up/Down' keys, enter the required value. Press 'ENTER' and the resultant value will be stored until changed by the user. Press 'ESCAPE' to return to the main display.

4.   Operation with a PC

4a   Install the Software

For use with a PC the software supplied with the DP9601 must be installed on the PC and communication established (on-line green indicator showing) via the USB lead supplied. System requirements for installing the software: Windows XP with at least one USB port. All Windows operating systems prior to XP do not support USB natively and are not recommended.

4b   Control Panel

In the PRO Software window, double click on the 'PRO Control Panel' icon. The following window is opened:
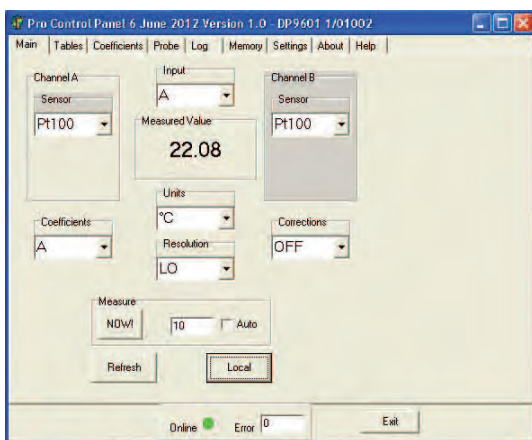

Note: When the control panel is opened subsequently, the tab selected prior to closing will be applicable.

The on-line indicator shows 'green' when communications between the instrument and the PC are established (see 'settings' on page 16). Local control of the instrument is not possible (locked out) when communications between instrument and PC are established and 'Remote' selected (remote control). The front panel indicates 'REM'. To revert to local control of the instrument (via the front panel), click 'LOCAL'; remote control via the PC is disabled.
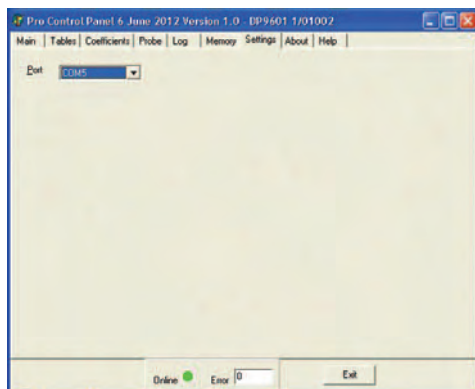
4c Sensor Indication

In the 'Main' window, the sensors for channel A and B are indicated in the relevant boxes.
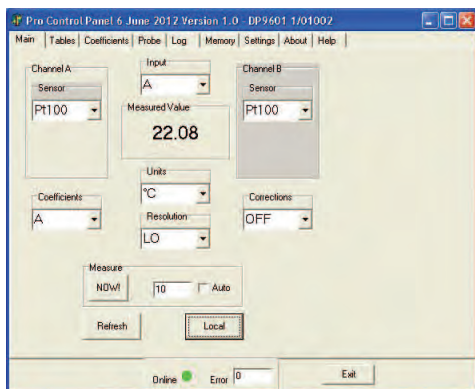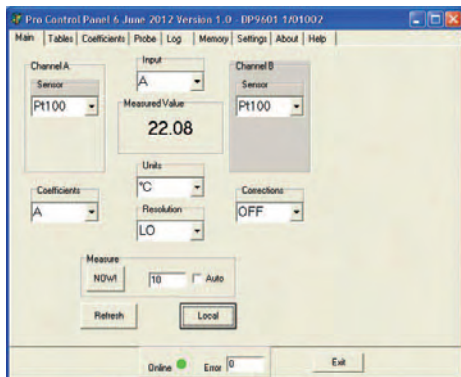

4d Settings

Click on the 'SETTINGS' tab for port selection if required. In many cases this may not be required since communications may be established automatically. If not, simply click on the appropriate port.

4e   Input Channel

Select A or B from the 'INPUT' box in the top centre of the control panel; the measured value is displayed below in the 'MEASURED VALUE' box when 'MEASURE NOW' button is clicked.


4f   Units and Resolution

These are selected via the appropriate boxes in the 'Control Panel'.

4g Coefficients and Corrections

These are selected as required for each channel, their values having been set (or default settings) via screens obtained by selecting tables 'coefficients' and/or 'Tables'.

Matching to calibrated sensors (Tables Tab):

i)   Select the desired input A or B in the MAIN window appropriate to the chosen calibrated probe.

ii)   Click on the 'TABLES' Tab
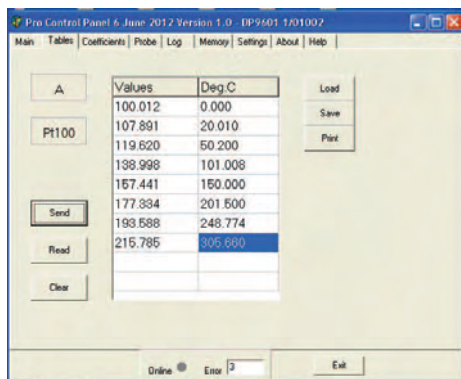
iii)   Enter up to ten values of engineering units with 3 decimal places
       (e.g. 100.100Ohms & 0.000°C) corresponding to the temperature as stated
       on the calibration certificate for the 'reference' probe and click 'SEND';
       this sends to table of values to the instrument. Existing values will be
       overwritten.

iv)   Stored 'correction' values can be switched ON or OFF as required in the
       'Main' window.

v)   Clicking 'READ' displays stored values (may be rounded up or down).

vi)   Clicking 'CLEAR' clears values entered in the table on the window (not from
       the instrument).

vii)   Click 'LOAD' to load a corrections table from file.

viii) Click 'SAVE' to save the corrections table to file.

ix)   Click 'PRINT' to print the corrections table.

4h Custom Coefficients

These can be used to effectively modify the transfer characteristic of a sensor if
required. The default coefficients are those for ITS 90; IPTS 68 was required for
example, the appropriate values could be entered.

i)   The required channel, A or B as appropriate to the sensor in question must
       be selected in the 'MAIN' window.

ii)   Click on the 'COEFFICIENTS' tab.
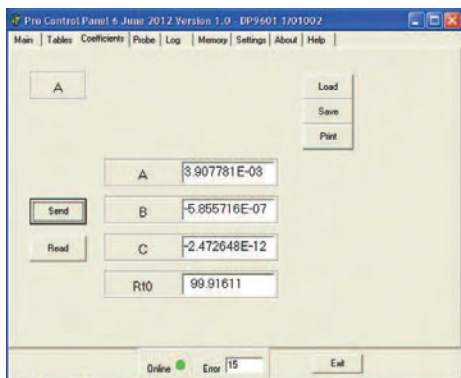
iii)   Enter the required values for A, B, C and Rto as appropriate and click 'SEND'
       to send these values to the instrument; existing values will be overwritten.

iv)   Click 'READ' to see stored values at any time.

v)   Click 'LOAD' to load a set of coefficients from file.

vi)   Click 'SAVE' to save file.

vii)   Click 'PRINT' to print the coefficients.
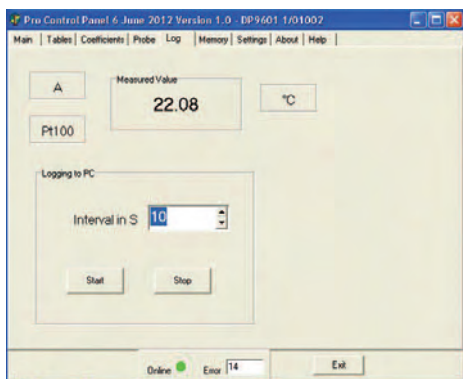
4i   SMART Probe
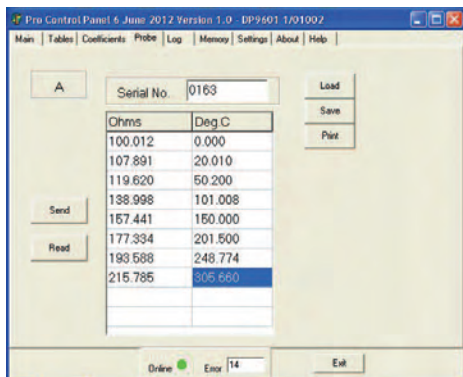
Click on the 'Probe ' tab to view the SMART probe window. This window is very similar to the one in the ' Tables' tab and the values stored in the probe can be read, entered or edited.

The probe Serial No. is shown and can be modified to suit.

Click SAVE to save the values to the probe as required.

4j   Log

This tab is used to control PC logging of measured values (i.e. readings are saved to file on the PC and not on-board the instrument). Readings are saved in the same folder as that in which the software resides.

The selected channel (as configured in the 'Main' tab) is indicated and the selected sensor type. Measured value and units are also displayed. In the 'Logging to PC' panel, the logging interval is selected (1 to 3600 seconds). Logging commences when 'START' is clicked and stopped when 'STOP' is clicked.

4k Memory
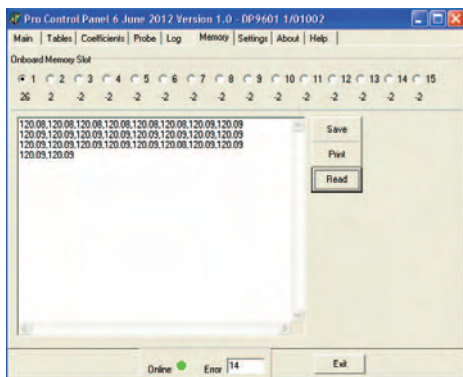
In this tab, readings stored on board the instrument can be retrieved and saved to file (normally in the same folder which contains the PC software).

i)   Click 'READ' to read the values.

ii)   Click 'SAVE' to save the readings to file.

iii)   Click 'PRINT' to print the readings.
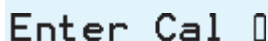
5.   Analogue (D to A) re-transmission output

In the main menu, scroll down to D>A Setup and press 'ENTER'. Follow the on-screen prompts to set up zero and span (degrees C) values. Press 'ENTER' to Edit Zero (value) and press 'NEXT' to highlight the existing value; press 'NEXT' repeatedly to obtain the desired value. Then press 'ENTER' to store the specified value. Press 'ESCAPE' and then 'NEXT'; repeat the procedure for the span value.

6. Instrument Re-Calibration

It is recommended that this procedure is carried out by the supplier or by an accredited laboratory facility.

```
Enter Cal  ▯
```

Calibration must only be performed by an authorised person and in the laboratory with a steady ambient temperature; access to the calibration level of the software is via a 5 digit 'engineer' code; this must be entered at the prompt by pressing 'INC/DEC' sequentially for the first digit. Then press 'UNITS' to move to the next digit.

```
Password? ▯
Use SENSOR and CHAN
   to select Digit
    ▮0000
  Engineer Code
```

Re-calibration of the DP9601 is unlikely to be required routinely since its design provides very good short and long term stability.

Item required for calibration:

i)   A highly accurate resistance source providing 100.000Ω and 250.000Ω (No lead resistance).

ii) Suitable connectors for the rear panel sockets as appropriate.

**CAUTION – Do not proceed unless all specified items are available.
Failure to do so may invalidate the warranty.**

Connect a 100 Ohm resistance to the PRT-A input port. The instrument displays the value of the 100 Ohm input according to its previous calibration. The instrument now measures the precise resistance and displays the value. Press 'ENTER' and the value is sampled and entered. Press 'ESCAPE' if calibration of the channel is not required.

a) *The display screen now shows;*   **CALIBRATION**
     CH A PRT 100 OHMS

Connect a 250 Ohm resistance to the PRT-A port. The instrument now measures the precise resistance and displays the value. Press 'ENTER' and the value is sampled and entered.

b) *The display screen now shows;*   **CALIBRATION**
     CH B PRT 100 OHMS

Repeat the procedure as in c) above but using the PRT-B input port.

c) *The display screen now shows;*   **CALIBRATION**
     CH B PRT 250 OHMS

Repeat the procedure as in d) above but using the PRT-B input port.

7. Specifications

General

	Inputs/Ranges/Sensors
Type	RTD (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)
Overall Accuracy	± 0.01°C ± 0.0005% of span
Linearisation Conformity	Better than ± 0.01°C
Stability (vs ambient temperature)	
	Better than 0.0025°C per 1°C ambient change
Warm-up	Negligible under normal ambient conditions. Allow 5-10 minutes for full stability unless stored at low temperature, then 30 minutes minimum.
Pt100 Sensor Current	0.5mA
Resolution of data display	0.01
Variable filter	Sampling rate selectable between 4 and 64 (measurements averaged per reading).
Measurement Units	°C, °F, K, Ω
Measurement Modes	A, B or A-B.
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. ITS 90 or IPTS 68 coefficients can be used for custom calibration.
Smart Sensor Connection	Correction values stored in connector
Null Function	Corrects differential temperature readout between two sensors to zero.
Sensor Lead Resistance	5Ω each lead maximum
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 character OLED screen 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
USB Serial	Isolated, 38400 Baud, 8 data, no parity, 1 stop bit.
Communications	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 5V

Application Note:

Inputs are not isolated in the instrument, 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.

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

Shop online at omega.com℠

TEMPERATURE
- ☑ Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- ☑ Wire: Thermocouple, RTD & Thermistor
- ☑ Calibrators & Ice Point References
- ☑ Recorders, Controllers & Process Monitors
- ☑ Infrared Pyrometers

PRESSURE, STRAIN AND FORCE
- ☑ Transducers & Strain Gages
- ☑ Load Cells & Pressure Gages
- ☑ Displacement Transducers
- ☑ Instrumentation & Accessories

FLOW/LEVEL
- ☑ Rotameters, Gas Mass Flowmeters & Flow Computers
- ☑ Air Velocity Indicators
- ☑ Turbine/Paddlewheel Systems
- ☑ Totalizers & Batch Controllers

pH/CONDUCTIVITY
- ☑ pH Electrodes, Testers & Accessories
- ☑ Benchtop/Laboratory Meters
- ☑ Controllers, Calibrators, Simulators & Pumps
- ☑ Industrial pH & Conductivity Equipment

DATA ACQUISITION
- ☑ Data Acquisition & Engineering Software
- ☑ Communications-Based Acquisition Systems
- ☑ Plug-in Cards for Apple, IBM & Compatibles
- ☑ Data Logging Systems
- ☑ Recorders, Printers & Plotters

HEATERS
- ☑ Heating Cable
- ☑ Cartridge & Strip Heaters
- ☑ Immersion & Band Heaters
- ☑ Flexible Heaters
- ☑ Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL
- ☑ Metering & Control Instrumentation
- ☑ Refractometers
- ☑ Pumps & Tubing
- ☑ Air, Soil & Water Monitors
- ☑ Industrial Water & Wastewater Treatment
- ☑ pH, Conductivity & Dissolved Oxygen Instruments

M-5181/0012