I-CAL EASY
LABORATORY INTERFACE
User Maintenance Manual/Handbook

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1. INTRODUCTION

Thank you for choosing I-Cal-Easy - software that will simplify and increase the productivity of your temperature calibration processes. A comprehensive set of temperature calibration tools is now at your fingertips:

Support for a wide range of instruments:

- Communicate with world leading Isotech calibration equipment.
- Record temperature data from your instruments and save to tab-delimited text files, which can be imported directly into spreadsheets such as Microsoft Excel
- Perform full automated calibration tests over a range of set points and save the data for further analysis

Webcam Support:

- Instruments such as glass thermometers and digital indicators that cannot communicate with a computer can also be calibrated using the still-image capture facility built into I-Cal-Easy Laboratory Interface.

Data Analysis and Calibration Certificates:

The accompanying software – I-Cal-Easy Builder – enables you to

- Generate calibration certificates from your acquired data, using WYSIWYG certificate templates that you design yourself
- Analyse your data and generate coefficients for:

  (a) Callender Van Dusen
  (b) ITS 90
  (c) Temperature-voltage conversions for thermocouples
  (d) Regression coefficients for comparison calibrations

The I-Cal-Easy Laboratory Interface is made up of three main parts:

- The interface – where you define and test the instrument set up
- The Data Logger – where you configure calibration tests and record data
- The Data Viewer – where you view current and previous test data

All of these will be described in this volume. I-Cal-Easy Builder is fully described in the second volume.

We really want you to enjoy using this software, and so, we have tried to make it as simple and straightforward as possible to use. In addition to this manual you will find comprehensive help in the program in the form of on-line instructions and pop-up balloon tips.

Best Wishes,

The Isotech Software Team.

Note: Just to clarify; throughout this manual you will see your equipment referred to either as an "instrument" or a "device". They are one and the same the descriptions being interchangeable.

2. THE INTERFACE

2.1 Introduction

Before discussing the Interface, we need to step back into the real world for a moment. You will have a number of temperature instruments that are connected to your computer through the serial (RS 232) ports. Please ensure that you are using the correct cables and that you have followed the manufacturer's instructions for connection and installation. Also note down the names of the serial ports (COM1, COM 2, etc.) to which each of your instruments is connected. You will need to know this when you start to configure the interface.

Back at the software, the Interface is where you tell I-Cal-Easy Laboratory Interface what instruments you have connected and where. When I-Cal-Easy first loads, you will be taken to the Interface set-up page. This consists of three panels, which are:

- The Device Palette
- The Connected Devices selector
- The Device Properties panel

Let us now look at these in detail:

2.2 The Device Palette

The left-hand panel of the Interface window is the Device Palette that, as you can see, has a number of tabs across the top. Each tab has the name of a temperature calibration equipment manufacturer such as Isotech, ASL, Labfacility, etc. By clicking on each tab you will see a series of icons which represent the specific instruments supported for each manufacturer

Figure 2.2 1 – The Device Palette

2.3 The Connected Devices Panel

The large central panel of the interface is the Connected Devices list. There you will see listed under "My Computer" all the COM ports and web-cams available for connection. If devices are connected they will be indicated as branching from their parent serial port. To display the Properties box for any device, click the name of the device on the Connected Devices list.

The I-Cal-Easy Laboratory Interface will automatically locate your computer's serial (RS232) ports and place them under "My Computer" on the Connected Devices panel. It will also detect any web-cam devices that are connected.

To connect an instrument to a serial port simply select the manufacturer's tab on the Device Palette and drag and drop the icon of the required instrument on to the serial port on the Connected Devices panel. When this is done, you will see that two things have happened:

- The device's name now appears under the serial port on the Connected Devices panel and
- The right-hand Device Properties panel, which previously indicated "No Devices Connected", will now show the Properties box for the instrument you have just connected.

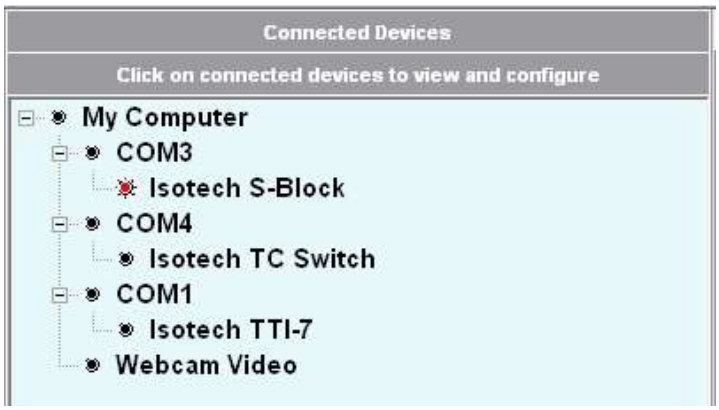


Fig. 2.3.1 – The Connected Devices Panel

In most cases it is simply a matter of clicking the Start button on the Properties box to activate the device to begin receiving data.

2.4 The Device Properties Panel

When an instrument has been connected, instrument's Properties box will appear in the right hand Device Properties panel. To keep things simple, all instrument property panels have a similar appearance.

Along the bottom is a row of buttons entitled "Start Device", "Interface", "Graph", and "Remove", together with an indicator showing the connected serial port. In certain cases, there may be a few other buttons located on this panel, and where this is the case, they will be described in pop-up tool tips or other documentation.

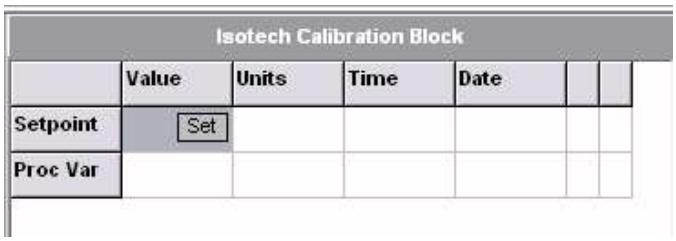


Fig 2.4 The Properties Panel

The main part of the Properties panel is taken up with the data display, which is a grid-like structure with column headers of Value, Units, Time and Date. This will show the most up to date information received from the instrument. To start the two-way serial communications between the instrument and the computer, click the Start Device button. After a few seconds you will see data appearing in the interface.

2.4.1 Device Data

As we have explained, interface data received from each instrument will be displayed in the device's Properties box in the Device Properties panel. The current values of the data will be displayed in the column marked "Value" and, if applicable, the units of the data will be displayed in the "Units" column. Further to the right is the date and time at which the displayed measurement was recorded.

In the last but one column of the display grid you will see a red arrow moving from one cell to another. This indicates the current channel – the latest channel from which data was received.

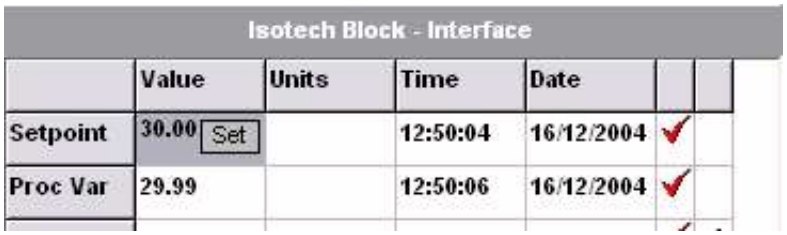


Fig. 2.4.1.2 Interface Data

2.4.2 Enabling/Disabling Channels

The last column indicates which channels are enabled for reading. To enable/disable a channel from being read (and hence from appearing on the data logger) click the appropriate cell entry to either add or remove the red arrow as necessary. Selecting only those channels that are necessary for reading will significantly increase the speed at which the interface receives data from the remaining channels.

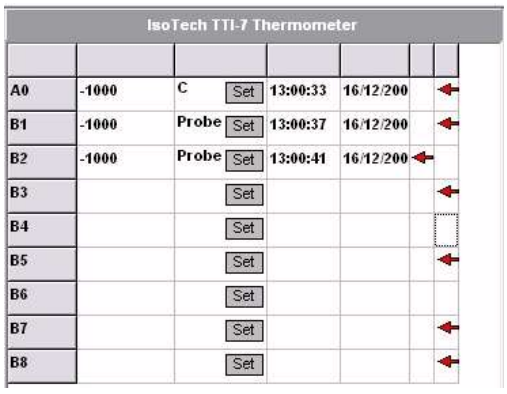


Fig.2.4.2 How to enable and disable channels

2.4.3 Calibration Blocks and Baths

The interface returns the following data for calibration blocks and baths:

- Set-point :the temperature to which the device is set
- Process Variable :the value of the temperature indicated by the device controller

The Isotech "S" series return a third parameter which is the value of the temperature within the block as measured by an accurate on board temperature indicator. This type of block is most commonly used for mobile, on site, work where transportation of delicate temperature standards may be difficult.

To change the set point of the block - bath manually:
The cells in the Setpoint column each have a small button marked "Set". If you wish to change the value of the set point click the Set button and type in your required value in the data entry box that appears. Click OK to continue or Cancel to keep the current set point.

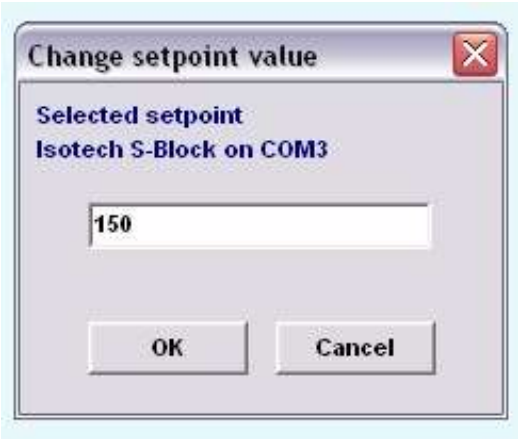


Fig.2.4.3 Changing a set-point manually

2.4.4 Temperature Indicators and Bridges

Each of the available channels for an indicator or bridge will be displayed in the device's Properties box, each row of the grid being an individual channel. In most cases, you will be able to set the units for each individual channel. In some types of calibration you will require the units under test to return their natural or probe units e.g.ohms or mV. I-Cal-Easy enables you to do this.

To change the units of each channel:
If a device is capable of having its units set for example: Centigrade, Fahrenheit, Kelvin, or probe units (milivolts for thermocouples, ohms for Pt100's) clicking the set buttons, in the unit's column can change these. Again if the instrument has the capacity it will be possible to select different units for every channel available on the instrument.

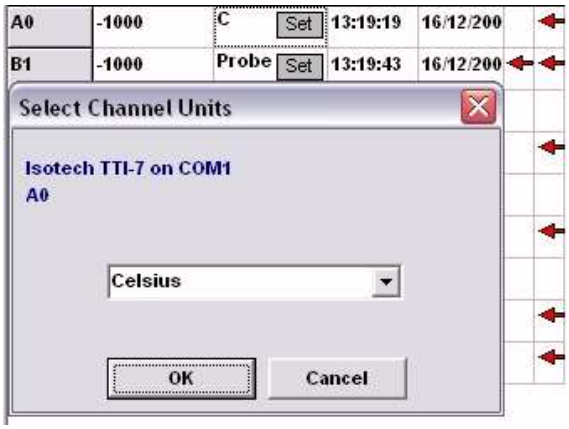


Fig. 2.4.4.1 Changing channel units

2.4.5 Real Time Graph Display

Click the button marked "Graph" to display a real time trend graph of the channel data being returned from each device. You will be able to see the maximum and minimum vales of the Y-axis and set the number of decimal places to which the axis is displayed

2.4.6 Real Time Serial Communications Data

In the bottom panel you will a black box which shows the COM port to which the device has been connected. Click this box and a black scrolling display will appear which shows in real time (i.e. as it is actually happening) data as it is received from, and sent to, the device.

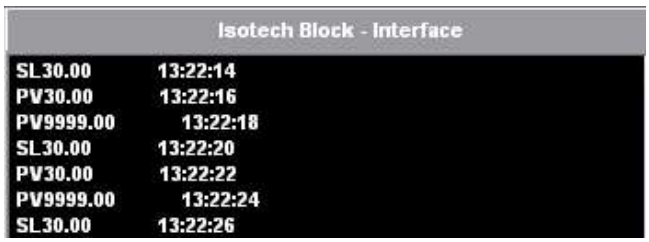


Fig. 2.4.6 Serial Data

2.4.7 Removing a Device from the Interface

Should you have incorrectly connected an instrument or you no longer wish to have it on your interface, simply click the "Remove" button that is in the bottom part of the display to remove it from the interface.

2.4.8 Saving and reloading interface Set Ups

Although you can set up your interface quite quickly each time you run the Laboratory Interface, you may wish to use the Save Interface and Load Interface features to avoid repetitive actions. These are accessed from the File main menu item as shown in fig 2.4.8.

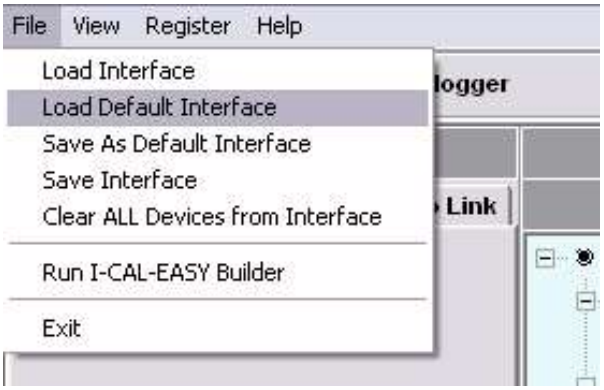


Fig. 2.4.8 Saving and Loading Interfaces

You can save to file for use at any time, or by selecting to save as the default. No file name need be specified.

3. THE DATA LOGGER

You can access the Datalogger by clicking the button at the top of the screen, or from the main menu.

Fig. 3.0 Accessing the Datalogger

Note: Just to repeat - It is essential that all devices are connected and tested to be working for serial communications before accessing the Datalogger page.

You will see across the top of the Datalogger window a row of tabs, which are:

- Current Interface Data
- Last Data Logged
- Trend Graph
- Test Set Up
- Units Under Test

We will now examine these in detail:

3.1 Current Interface Data

Click the Current Interface Data tab. You will now see all the data coming in from your instruments as the Interface receives them. As in the individual interface display Device Properties boxes, you will see the value, units of the channel, plus the time and date that the latest readings were taken. A series of red arrows will also show the current channel being read from each device. The two most right-hand columns of this display are entitled "Ref." and "SP". We will now explain what these are for:

3.1.1 The Reference (Ref) Box

If you are gong to perform a calibration run you will need to specify which of the available data channels is to be used for the reference temperature. In other words the traceable calibrated device that most accurately indicates the true temperature within the bath or block. To specify a reference temperature, click the appropriate reference cell and a RED tick mark will appear (see fig. 3.1.2). Only those channels, which are suitable for references, will be capable of being checked. Only one reference temperature at a time may be selected.

Note: Reference temperature may be corrected using regression coefficients by entering and saving data under the "Units Under Test" tab. Ideally the instrument will be programmed with calibration and return the true corrected temperature. When using an Isotech TTI 7 with a PRT you enter the calibration data and connect the device to channel A. When the instrument has no means to correct measured data internally e.g. when using a thermocouple on TTI 7 then the reference temperature maybe corrected using the regression coefficients by entering and saving data under the Units Under Test tab.

3.1.2 The Set-Point (SP Box)

Again if you are going to perform a calibration test run you will need to indicate which of the available channels is the set-point being used. Clearly only calibration blocks and baths may have a set-point and consequently only these will be available for selection. To specify a set-point, click the appropriate set-point cell and a blue tick mark will appear. Only one set-point at a time may be selected.

TTI-7 B7 COM1	-1000	Probe	13:34:27	16/12/2004			
TTI-7 B8 COM1	-999.5000000	Probe	13:34:31	16/12/2004		✓	
Block Setpoint COM3	30.00		13:34:44	16/12/2004	←		✓

Fig. 3.1.2 Selecting set-points and references

3.2 The Last Data Logged Tab

Click this tab. You will then see below a set of three more tabs marked:

Last Scan	:	Real time data from your instruments
Run Data	:	Latest data from current test run
Data Files	:	A list of all store files being created during a test

These will be updated as data is acquired and processed.

3.2.1 Last Scan

The data channels from all enabled devices connected to the interface will appear here. Each channel occupies a single row on the gird and is the data that was on the Current Interface Data grid, when the last log took pace. The logging interval is set on the "Test Set up" page as will be explained later. The columns contain data as shown in fig 3.2.2.

Current Interface Data | Last Data Logged | Trend Graph | Test Setup

Last Scan | Run Data | Data Files

Channel	Value	Units	Time Acquired	Log Time	Log Date
TTI-7 A0 COM1	-1000	C	13:39:08	13:39:09	16/12/2004
TTI-7 B1 COM1	-1000	Probe	13:38:49	13:39:09	16/12/2004
TTI-7 B3 COM1	-1000	Probe	13:38:53	13:39:09	16/12/2004
TTI-7 B5 COM1	-1000	Probe	13:38:57	13:39:09	16/12/2004

Fig. 3.2.1 Last Scan Data – as it is shown in the software

Name	Contents
Channel	The name of the data channel
Value	The latest logged data for the channel
Units	The units of the measurement (where possible)
Time Acquired	The time at which the data was received from the interface
Log Time	The time at which the data was saved by the Datalogger
Log Date	The date at which the data was saved by the Datalogger

Fig 3.2.2 Last Scan Data - definitions

3.2.2 Run Data

The Run-Data grid shows the up to the last 20 logged readings for a particular channel during a single set point that forms part of a calibration test. Along the bottom of the grid you will a series of tabs that enables you to view this data for every channel configured for the test

Fig.3.2.2.1 Selecting channel to view on the Run Data Grid

The grid shows the current status for the set-point, the latest values being at the top of the grid. There are 9 columns of data, the significance of which are below:

	Block Proc Var COM	Chan Mean	Reference	Ref Mean	Setpoint	Spread Tol	Offset Tol	Status
Reading 1	29.8300000	30.006667	29.8300000	30.006667	10.0000	TRUE	FALSE	unstable
Reading 2	29.8800000	30.042000	29.8800000	30.042000	10.0000	TRUE	FALSE	unstable
Reading 3	29.9600000	30.082500	29.9600000	30.082500	10.0000	TRUE	FALSE	unstable
Reading 4	30.0500000	30.123333	30.0500000	30.123333	10.0000	TRUE	FALSE	unstable
Reading 5	30.1400000	30.160000	30.1400000	30.160000	10.0000	TRUE	FALSE	unstable
Reading 6	30.1800000	30.180000	30.1800000	30.180000	10.0000	TRUE	FALSE	unstable

Fig. 3.2.2.2 The Run Data grid

Column 1 Run Number
This shows the run number 1-20. The latest reading being Run No. 1 and the first the 20th.

Column 2 Channel Name
The grey fixed call at the top of Column 12 shows the name of the data channel

Column 3 Channel Mean
This shows the mean value for the channel over the range of required test points specified in the test set up page (for more information on this refer to the Section "Configuring a test"

Column 4 Reference
This shows the value of the corrected reference temperature at the time at which the reading was logged

Column 5 Reference Mean
This represents the mean value over the specified range of test points for the reference value

Column 6 Set Point
This shows the nominal value of the temperature to which the bath or bock is set

Column 7 Spread
This column indicates either a true or false value. It will show false if the mean reference value falls outside the tolerance specified on the test set up page and will show true when it is within these tolerances

Column 8 Offset
This will show true when the reference mean value lies within the tolerance specified in the test set up page.

Working together with the spread tolerance dictates that the specified number of temperature reference readings is not only within a pre set band width but also that the band lies within a predetermined tolerance of the set point.

Column 9 Status
This indicates three values:

- Unstable
- Pre stability
- Post stability

Refer to the section "Configuring a Test Set Up" for more details on the exact meaning of these entries.

3.2.3 Data Files

When you start a test run you will be prompted to specify location for the storage of the data files generated by the software. You do this by specifying two things as shown in Figure 3.2.3.1 below. These are:

- The folder to store the data
- The data block name

These are explained below.

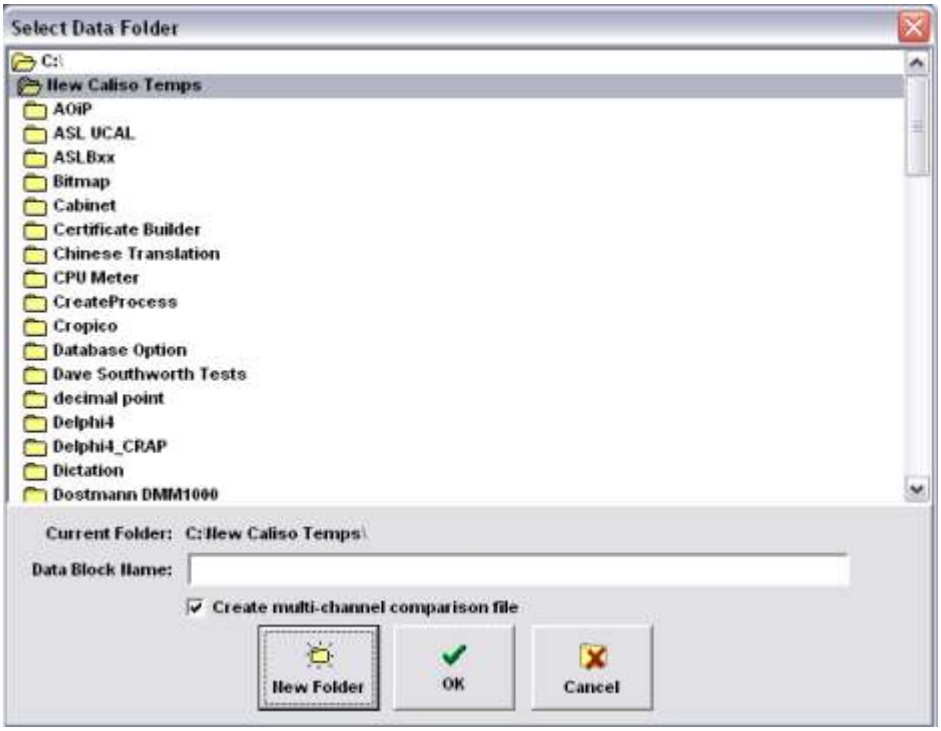


Fig 3.2.3.1 Data File Storage Location

Firstly, a folder is specified and this is where the data files will be stored. The actual file name is made up of three components: the data Block name, the data logger channel name and the extension ".ctd". Figure 3.2.3 below shows how the files are displayed whilst the test is running.

Note: Multi channel data

Certain test procedures require that several units under test be displayed on a single calibration certificate. Certificate Builder has the ability to do this but first you need to store a multi channel data file. To do this ensures that the "Create multi-channel comparison file" box is checked.

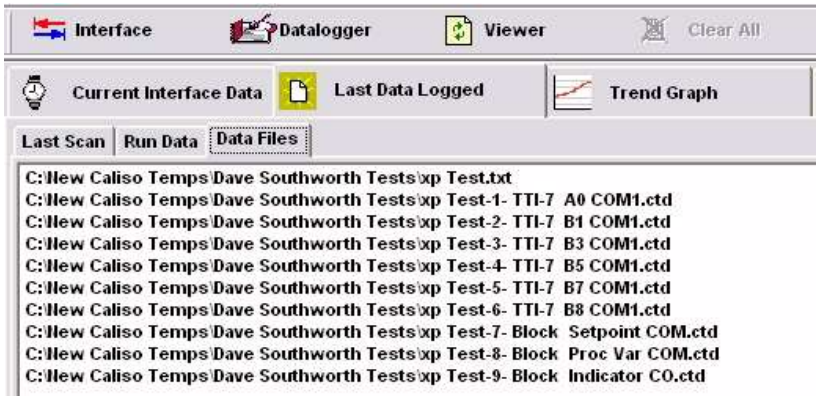


Fig. 3.2.3 Data files created during test

I-Cal-Easy Laboratory Interface produces two types of data file. The first is a text file, which contains in tab delimited format all of the logged data from the start to the finish of the test. It therefore contains a complete record of the calibration test regardless of any stability criteria that may apply. The file may be exported directly to a word processor or a spreadsheet (such as MS Excel).

The second type of file is a CDT (Caliso Temperature Data) file and this is used in Builder to perform calculations of calibration co-efficient and to generate calibration certificates. Refer to the section later which shows the format for saving these files.

3.3. Trend Graph Tab

Click this tab. You will be able to alter parameters of the real time trend graph. Properties of pen width, number of decimal places and the range of the Y-axis. The X-axis contains time-stamps for the reading taken.

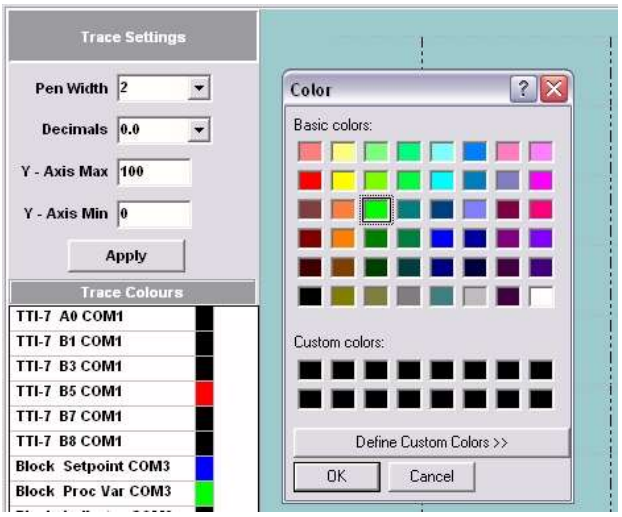


Fig. 3.3.1 Adjusting the trend-graph display

You will also be able, using the trace colours selector, to select the individual line colours for each channel represented on the trend graph.

3.4 Test Set-up Tab

This is very important and will be explained in some detail. This is where you set up your test and enter details about the reference standard and displayed decimal places. Let us look at the Test Parameters tab first:

Down the left-hand side you will see a number of data boxes. We will now look at these individually.

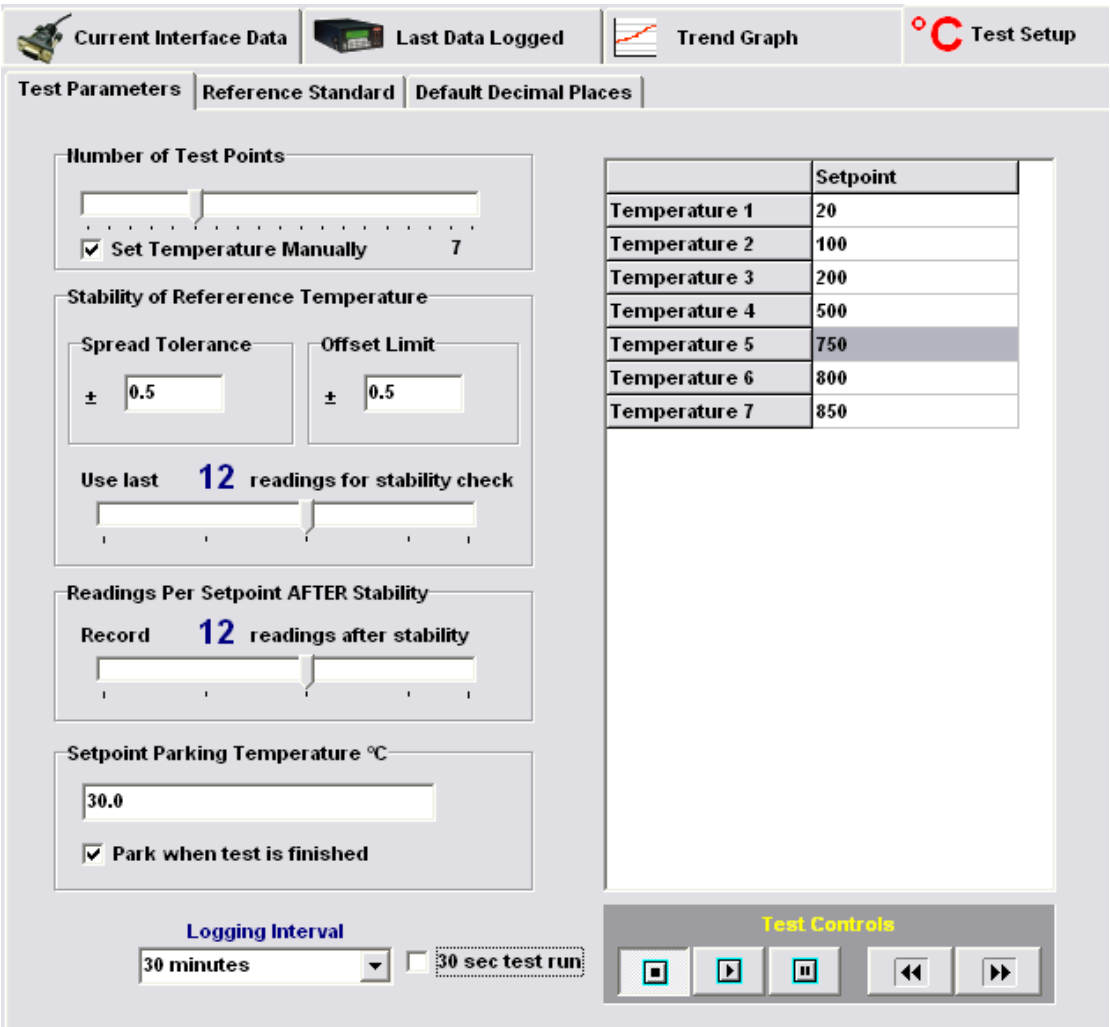


Fig 3.4.1 Test Setup

3.4.1 Number of test points

This is the number of calibration set points that will be used in your test. Slide the scroll bar to the left or to the right to obtain the required number of calibration set points. Note that as you do so that the number of rows on the set point grid to your right will change to contain the required number of set points.

3.4.2 The stability of reference temperature data input

Firstly enter a value for the spread tolerance i.e. the maximum permitted difference between the mean reference temperature and the current set point. The purpose of this is to compensate for any inaccuracies in the bath/block temperature at stability. A nominal value of ±0.5° C is entered.

3.4.3 The Offset Limit & Spread Tolerance

The offset limit is the difference between the mean reference temperature and the set temperature. Its purpose is to ensure that all reference temperature readings lie within an acceptable temperature band. The spread tolerance is the difference between the mean reference temperature and each mean temperature reading. By using both the spread tolerance and offset limit a truly representative and stable reference temperature can be obtained.

Below the tolerance boxes is another slider bar, which enables you to set the number of readings, which have to be within the applied tolerances before recording takes place for each individual set point. The default value set is 10. Below that is the reading set point after stability control. Once stability has been reached use this value to set the number of subsequent readings that have been taken but note that if any values should subsequently go out of stability the counter will be re-set.

3.4.4 Set Point Parking Temperature

Enter a value from the temperature at which you wish the bath block to return once the calibration run has been completed. Ensure that there is a tick in the box below to enable this facility. Note: this is commonly used to se the temperature of the first set point of any runs that are to follow.

3.4.5 The Set-point Entry Box

Enter a numerical value into each cell to represent the set points that you require to be carried out. Do not use non-numerical characters (i.e.0 to 9 and a decimal place).

3.4.6 Logging Interval

Select from the drop down list the interval at which you wish data to be recorded. Please note that data is recorded from the instruments on the interface as quickly as the device can transmit it. At each time the logging interval has elapsed the current interface data will be recorded.

3.4.7 The Control Buttons

Below the set point entry grid you will see three buttons: start, stop and pause. Use these buttons to control the flow of your calibration tests. If no set point or reference temperature has been entered you will only be able to use this feature in data logging mode i.e. only tab limited will be saved to file. You will need to specify your data file before logging can commence.

Fast forward and rewind buttons are available to force the set point to the next or previous values.

3.5 Web-cam Support

Not every piece of temperature equipment is capable of communicating directly with your computer, these will include:

- Simple digital temperature indicators
- Mercury (or liquid) in glass thermometers
- Paper chart recorders

Nevertheless, you may still need to calibrate such devices. The I-Cal-Easy Laboratory Interface allows you to do this using standard, low cost digital cameras (web-cams). It does this by taking a still-image picture of whatever the camera is pointing at when the stability criteria for each set-point are met. At the end of the test you will have a series of 'JPG' images that capture the image of the instrument for each set-point. The temperatures may then be read from these images.

Fig 3.5.1 Still image capture using a web-cam

In the top left-hand corner of each image you will see a red box that contains the date and time at which the image was captured together with the reference value at stability.

In order for this feature to work correctly, it is important that suitable equipment is properly installed and connected to your PC.

3.5.1 Using the Web-cam Feature

To activate the still-image capture, drag and drop the 'Caliso Video Link' icon onto the 'Webcam Video' entry of the Connected Devices panel.

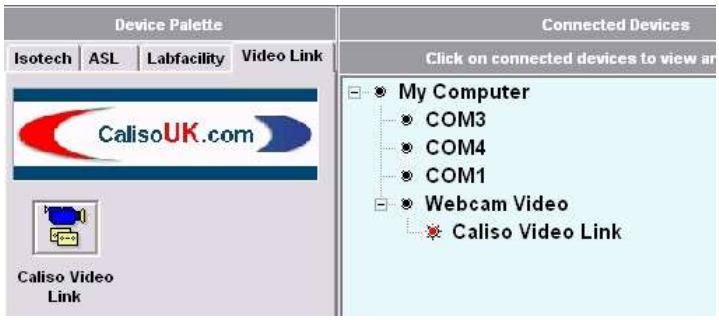


Fig 3.5.2 Enabling still image capture

Similar to any other device, the web-cam's Properties panel will now appear. At the top of the panel are 2 tabs: "Interface" and "Images". Click the "Start" button and a live video will appear in the "Live" box. Each time the "Capture" button is clicked the current image is frozen and displayed in the box below. (During an actual test, this capturing is done automatically.)

Click the "Images" tab and an array of thumbnail pictures of the captures images will be seen. Click on the images to display a full size image below.

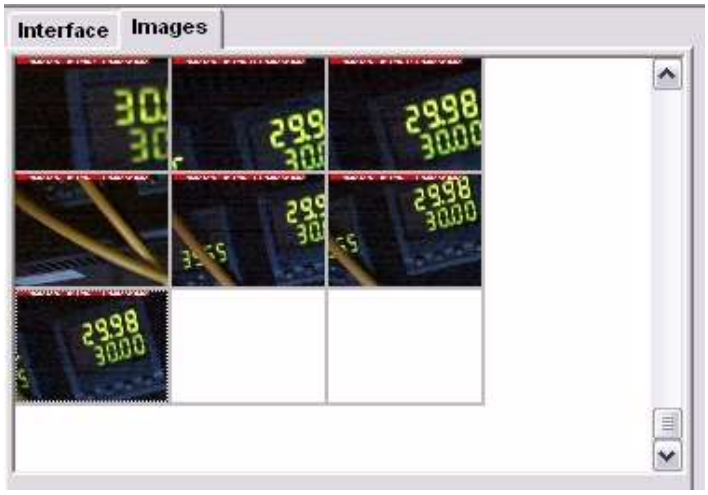


Fig 3.5.3 Thumbnails of captured images

Before starting a test ensure that the camera is correctly aligned and focussed on the target and securely fixed.

3.6 Screen Capture Facility

It has to be said that I-Cal Easy does not support every single piece of temperature equipment that has an interface to a computer. In certain cases, such equipment may be supplied with it's own software which records the current device values. This is where the I-Cal Easy screen capture facility come into it's own. The basic concept is very much like the web-cam feature where a series of images (in that case from the camera) are taken, one for each stable set-point position. The big difference here is that, at stability, the software records and image of your computer screen (desktop), underneath I-Cal Easy. This is done by briefly making I-Cal Easy invisible just before the image is grabbed.

In fig 3.6.1 below by way of example, Windows Explorer was running below I-Cal Easy. When the calibration block's reference temperature satisfied the stability criteria, the image shown was stored, together with a date-time stamp, and the reference temperature.

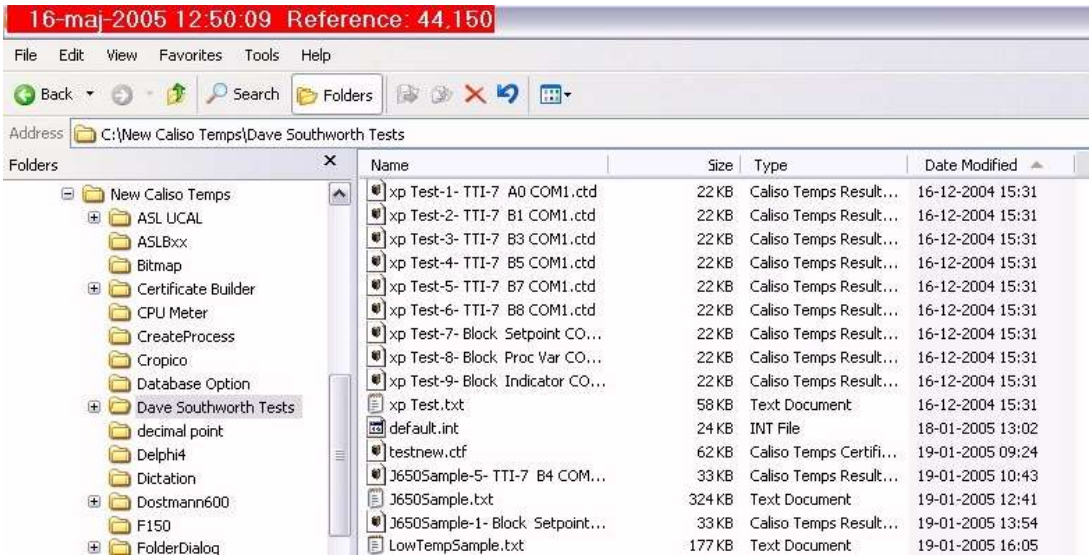


Fig 3.6.1 Capturing screen images

Each time you start a test you will be asked whether you want to make use of this feature.

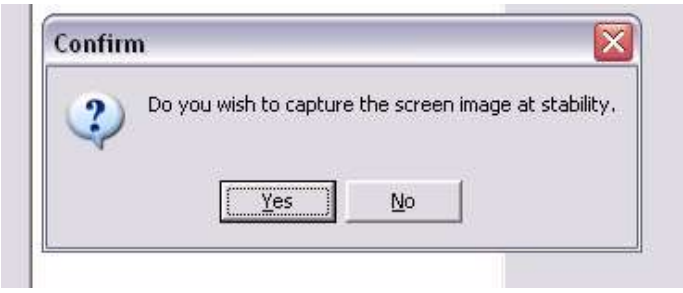


Fig 3.6.2 Turning-on the screen capture facility

The pictures are stored as 'jpg' files in the same folder that you specified to stall all the other data for that test.

3.7 The Units Under Test Tab

The very right-hand tab of the Datalogger page is where you enter important information about the devices you will be calibrating, and the instrument that you will be using as your reference standard.

Before entering data here, make sure that all of your devices are connected and working on the Interface. When you click the tab, you will see that the page is divided vertically into 2 parts: the left-hand side is concerned with the reference standard, and the right-hand side, the units under test. We will look at the units under test first.

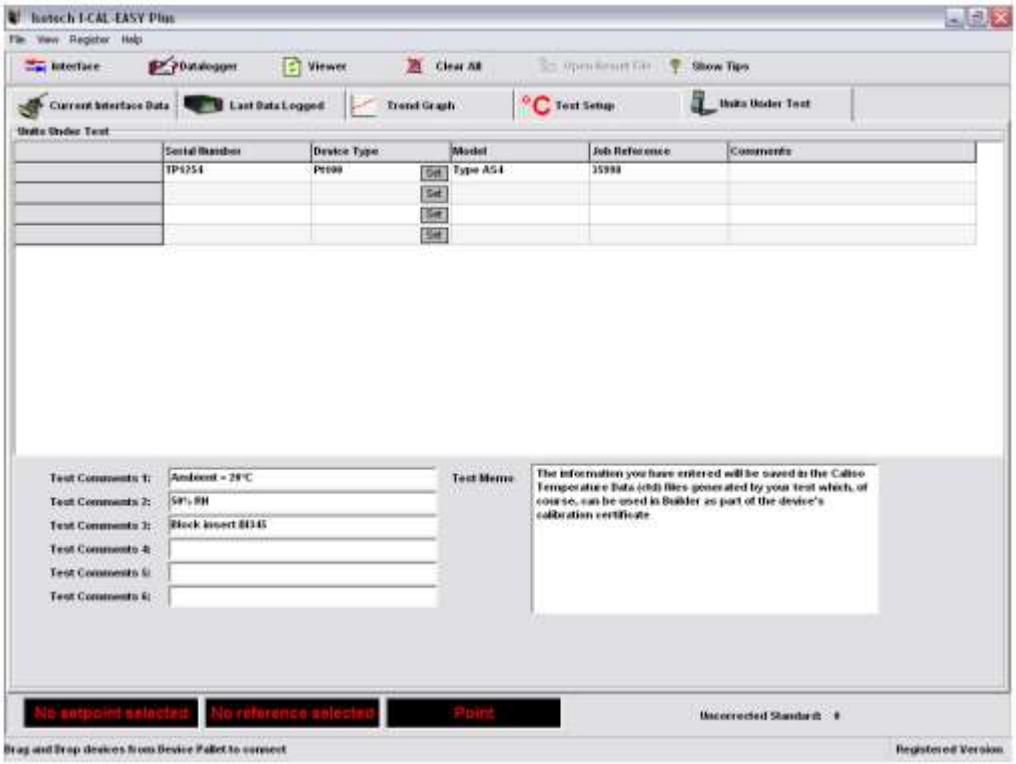


Fig 3.7.1 Units under test data

At the top of the screen you will see a data-entry grid, the left-hand column of which enables you to enter details of all of the devices used in the test (this is the reason that you needed the instruments up and running first). You can enter the following information about each device:

- Serial number
- Device type
- Model
- Job reference
- Comments

To select the device types, click each of the 'Set' buttons, and select from the drop-down list. Click 'OK' to confirm your selection.

You can also enter a range of comments for the overall calibration. The information you have entered will be saved in the Caliso Temperature Data (ctd) files generated by your test which, of course, can be used in Builder as part of the device's calibration certificate

3.7.1 The Reference Standard

The reference standard is essential to any successful calibration. This is because it provides your traceable link back to national standards. I-Cal Easy will accept any of its temperature channels as being the reference standard. Furthermore, because these channels can be in different units (°C, Ohms, mVolts, etc), the software will enable you to perform calculations and corrections on the raw instrument data to arrive at an accurate, traceable calibration reference standard. We will now explain how to do this:

The reference data, depending upon the type of instrument that generates it will be received by the Interface in a variety forms:

(i) PRTs

- Raw resistance values
- Resistance values converted into temperature units (by the instrument) using ITS-90, Callendar Van Dusen, or other method

(ii) Thermocouples

- Raw voltage values
- Voltages converted into temperature units (by the instrument) using polynomials containing internationally accepted coefficients.

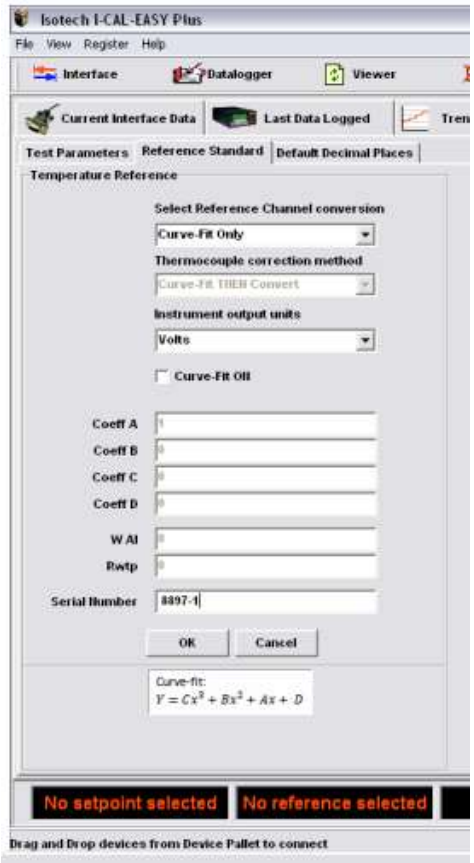


Fig 3.7.2 Correcting the reference standard

3.7.1.1 Correcting Reference PRTs

Most instruments that use PRTs can store Callendar-Van Dusen or ITS-90 coefficients internally and use them to convert resistance values into temperatures. However, this usually means that for different reference probes the corresponding set of coefficients will be to be entered into the unit. I-Cal Easy makes this process much more simple by enabling you to save the ITS 90 coefficients which are then used to convert output resistance into temperature. This is also very useful if your instrument does not have it's own internal temperature conversion facility, as might be the case with for example a digital multimeter.

To select the ITS90 conversion select ITS90 from the "Select Reference Channel Conversion" list box as shown in Figure 3.7.2.

Alternatively, some instruments will output temperature directly. In this case, if the coefficients are those which relate directly to the temperature probe being used, then no further corrections are necessary. If, however, the coefficients are those defined in a particular standard, it is usual practise to correct the output to a calibration master using a regression polynomial, such as that generated by Builder's 'Curve Fit' calibration type. The calibration data is obtained by performing a temperature to temperature comparison calibration.

Note: When the OK button is clicked the settings will be saved, so that you don't have to re-enter them each time you start the program.
To correct a reference PRT in this way follow these steps
Set the 'Select Reference Channel Conversion' list-box to 'Curve-Fit Only' (conversions are only used for thermocouples as will be described later).
Make sure that the 'Curve-Fit On' checkbox is ticked (no corrections will be applied if this box is empty).
Enter the correct values for coefficients A, B, C and C

3.7.1.2 Correcting Reference Thermocouples

Here there are 3 basic methods available. The first two are to be used when the instrument's output is a voltage. The choice of which of the two to use will depend upon the form in which your reference standard was calibrated.

Method 1: Curve-Fit Voltage then Convert

This method fits in with Builders 'Thermocouple' calibration type. When the probe was calibrated, at each set-point the temperature was measured using a traceable probe. Then, using the internationally accepted inverse-coefficients for a thermocouple of the same type as your probe, the voltage that would be generated by a 'perfect' probe of the same type is calculated. The difference between your probe's voltage and that of the perfect probe is called the Probe Voltage Correction.

Values for the Probe Correction are calculated for each test set-point, and a curve-fit between Reference Temperature and Probe Voltage Correction performed to yield the coefficients A, B, C, and D. These enables the correction to be calculated at any temperature.

Finally, using the forward coefficients for a perfect probe, the corrected reference temperature is calculated using the corrected voltage.

To correct a reference thermocouple in this way follow these steps:

- Set the 'Select Reference Channel Conversion' list-box to the correct thermocouple type
- Set the Thermocouple correction method list-box to 'Curve-Fit Voltage THEN Convert'
- Make sure that the 'Curve-Fit On' checkbox is ticked
- Select the correct voltage output for your measuring instrument
- Enter the correct values for coefficients A, B, C and C

Method 2: Curve-Fit AFTER Correction

Although simpler, this method is less commonly used.

The input voltage is converted into temperature using the temperature coefficients (internationally accepted) for a thermocouple of the same type. A curve-fit is then carried out, using coefficients A, B, C and D, to correct the probe temperature to the traceable standard used in its calibration.

To correct a reference thermocouple in this way follow these steps:

- Set the 'Select Reference Channel Conversion' list-box to the correct thermocouple type
- Set the Thermocouple correction method list-box to 'Curve-Fit AFTER Correction'
- Make sure that the 'Curve-Fit On' checkbox is ticked
- Select the correct voltage output for your measuring instrument
- Enter the correct values for coefficients A, B, C and C

Method 3: Curve-Fit Only

Use this method when your reference thermocouple output is in temperature units and it was calibrated using the temperature to temperature comparison method. For each measure reference temperature a curve-fit carried out, using coefficients A, B, C and D, to correct the probe temperature to the traceable standard used in its calibration.

To correct a reference thermocouple in this way follow these steps

- Set the 'Select Reference Channel Conversion' list-box to 'Curve-Fit Only'
- Make sure that the 'Curve-Fit On' checkbox is ticked (no corrections will be applied if this box is empty).
- Enter the correct values for coefficients A, B, C and C

3.7.2 Default Decimal Places

In most cases you will want to display the reference temperature and probe outputs in a standard format for example you may wish to display temperatures to two decimal places and probe output e.g. milivolts to three decimal places. I-Cal Easy enables you to save a default configuration for these, although you can if you wish use any other values.

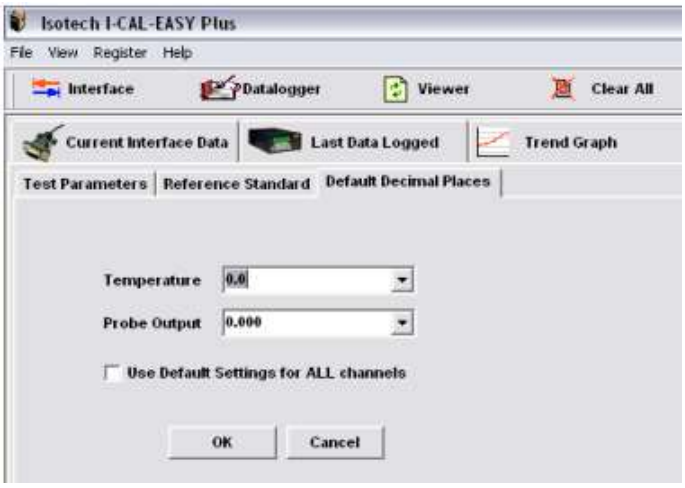


Fig 3.7.3 Specifying Displayed Decimal Places

4. A STEP BY STEP GUIDE TO CONFIGURING A TEST

Example 1: TTI-7 and Isotech Block

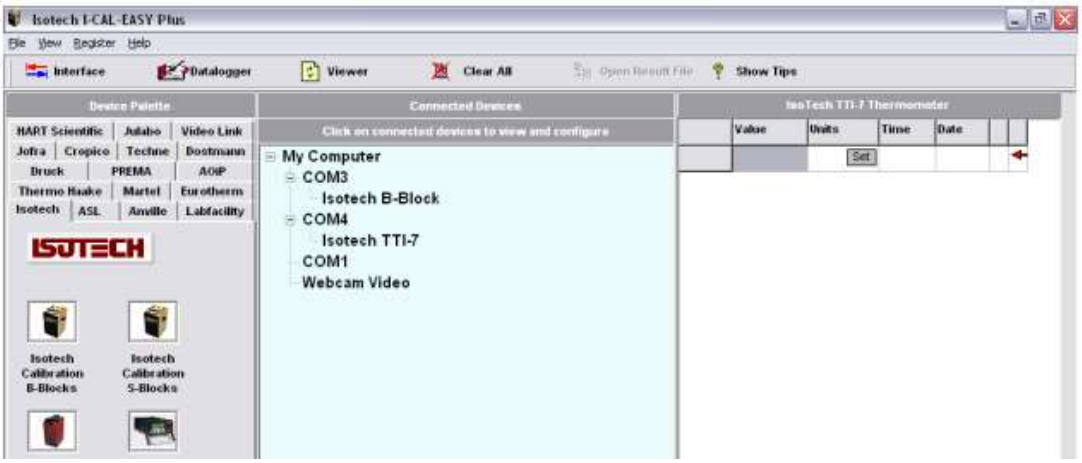
The following example will use an Isotech B-Series Calibration Block and a TTI-7 Precision Thermometer with a combination of PRT reference, and thermocouple unit under test. You may follow these instructions but change the instruments to suit your own calibration set up. Also do the same with set-point and tolerance values.

We will assume the following connections:

- Calibration Block : COM1
- TTI-7 thermometer : COM4

Step 1 Connect the calibration block to COM1

Select the Isotech manufacturer's tab and drag and drop the B-Series from the Device Palette on to the COM1 entry of the Connected Devices panel.



Steps 1 and 2 Connecting devices

You will now see that Isotech B Block appears below COM1 and the block property window has appeared in the right hand panel. Click the Start Device button to enable serial communications and ensure that data is appearing in the interface grid.

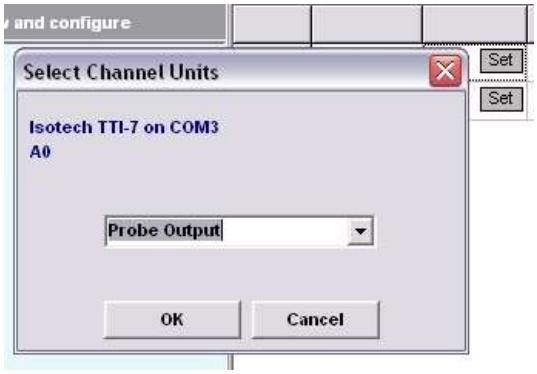
Step 2 Connect the Isotech TTI-7 to COM4

Drag and drop the TTI-7 on to COM4. You will now see that Isotech TTI-7 has appeared below COM4 and the TTI-7 property window is visible in the Properties panel. Click the Start Device button to enable serial communications and ensure that data is appearing in the interface grid.

Step 3 Select channels for logging

All devices are now activated and should be returning data. The only thing that remains to be done on the Interface is to specify which channels will be logged. Click the Interface button on the TTI-7's properties then click the cells in the right-hand column so that arrow marks appear to indicate whether or not these channels are required. Clearly, in this case, you require BOTH channels – the default setting.

To change the units for each of the channels click the Set button in the third column for each channel and specify which units are required.



Step 3 Changing units for each channel

You may select Celsius, Fahrenheit, or Kelvin as temperature units. A fourth option is "Probe Output" which will return the natural units for each instrument (i.e. Ohms for PRTs and mV for thermocouples).

Example 2: TTI-7, Dry Block and Switchboxes

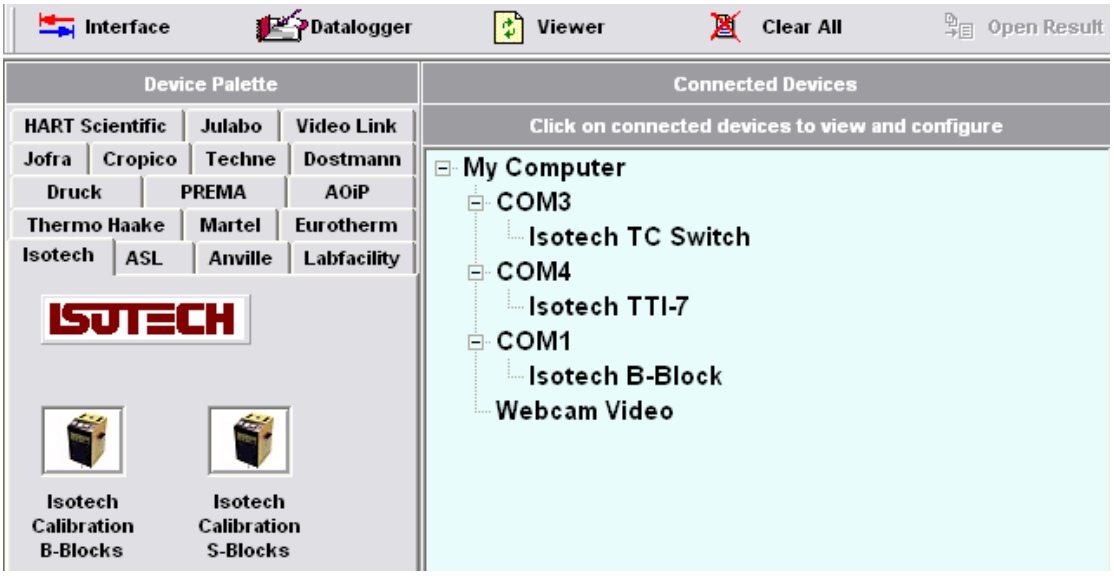
The following example will use an Isotech B-Series Calibration Block a TTI-7 Precision Thermometer, an Isotech Thermocouple Selector Switch Model 958 and an Isotech PRT Selector Switch Model 958with a combination of PRT reference, and thermocouple and PRT units under test. You may follow these instructions but change the instruments to suit your own calibration set up. Also do the same with set-point and tolerance values.

We will assume the following connections:

- Calibration Block : COM1
- TTI-7 thermometer : COM4
- Thermocouple Switch : COM3

Step 1 Connect the calibration block to COM1

Select the Isotech manufacturer's tab and drag and drop the B-Series from the Device Palette on to the COM1 entry of the Connected Devices panel.



Steps 1 and 2 Connecting devices

You will now see that Isotech B Block appears below COM1 and the block property window has appeared in the right hand panel. Click the Start Device button to enable serial communications and ensure that data is appearing in the interface grid.

Step 2 Connect the Isotech TTI-7 to COM4

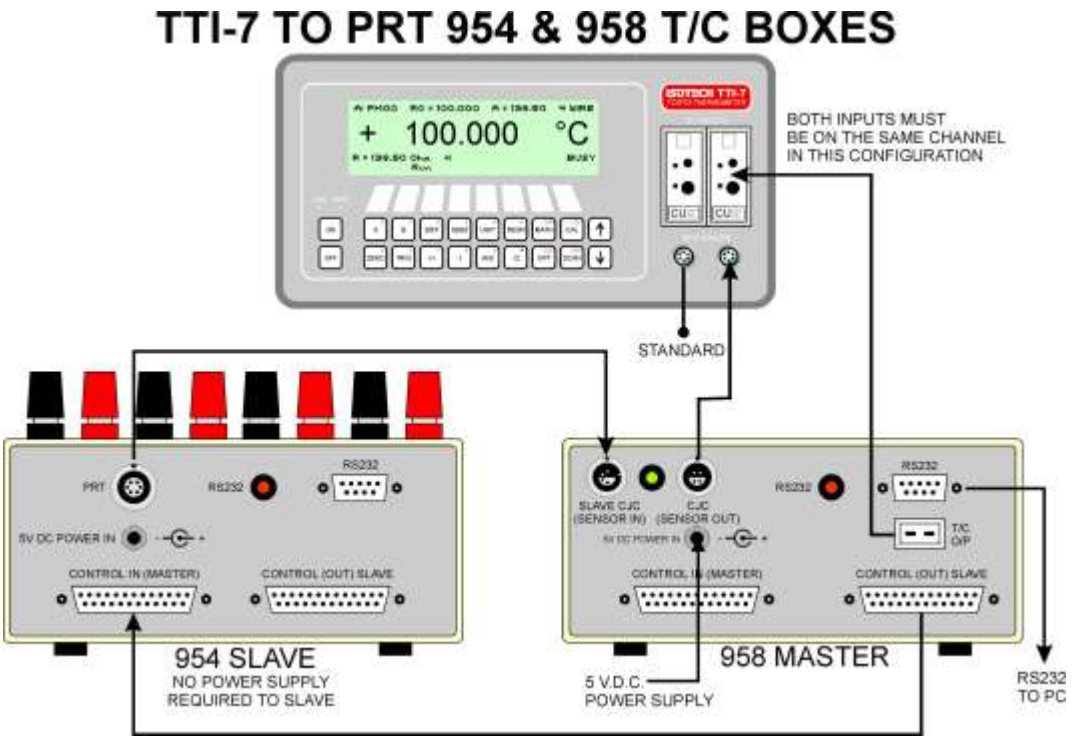
Drag and drop the TTI-7 on to COM4. You will now see that Isotech TTI-7 has appeared below COM4 and the TTI-7 property window is visible in the Properties panel. Do not start the device before the switch boxes are configured.

Step 3 Connect the Thermocouple Switch to COM1

The thermocouple switch must be connected as the master device with RS232 and power connections.

Step 4 Connect the PRT Switch

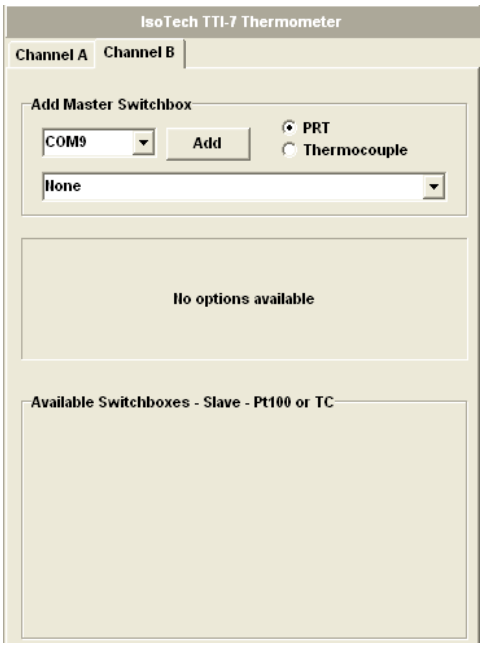
Connect the PRT Switch as a slave to the thermocouple box. Refer to the Selector Switch manuals for further assistance.



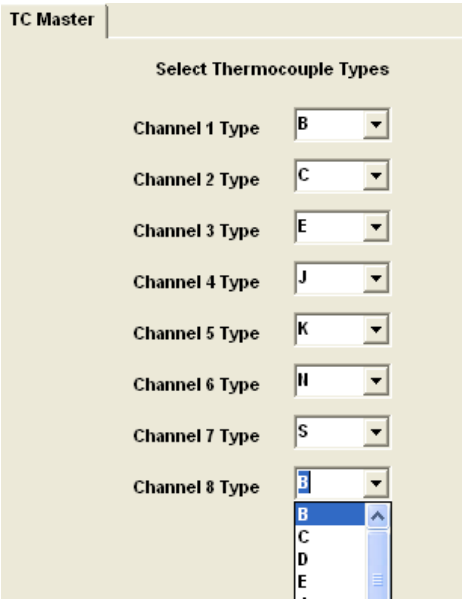
Step 5 Configure the TC Switch

Set the COM Port to Com Port 4 to suit the switch. Select the Thermocouple and click Add

You will now see the thermocouple options

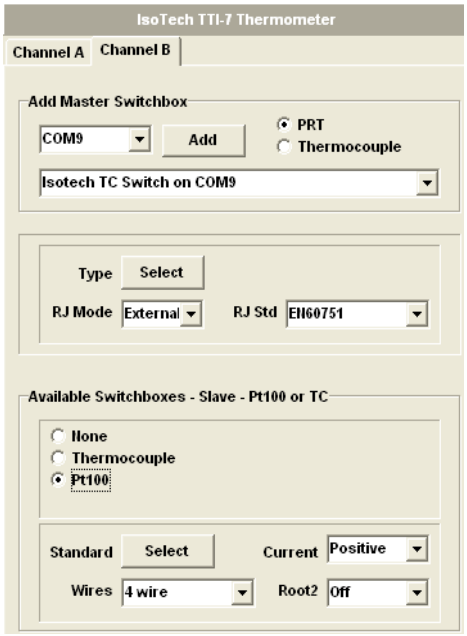


Set the Thermocouple types to suit those that will be used with the switch



Step 6 Configure the PRT Switch

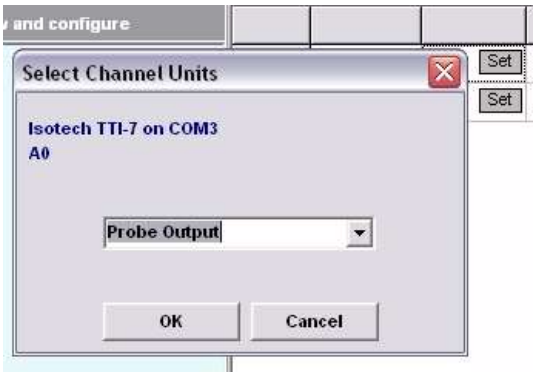
Return to the TTI-7 and select Pt100 as the available Slave Switchbox. The Pt100 type can be set for each channel in a way similar to that for the thermocouple box.



Step 7 Select channels for logging

All devices are now activated and should be returning data. The only thing that remains to be done on the Interface is to specify which channels will be logged. Click the Interface button on the TTI-7's properties. Start the TTI-7 with the Start button then click the cells in the right-hand column so that arrow marks appear to indicate whether or not these channels are required.

To change the units for each of the channels click the Set button in the third column for each channel and specify which units are required.



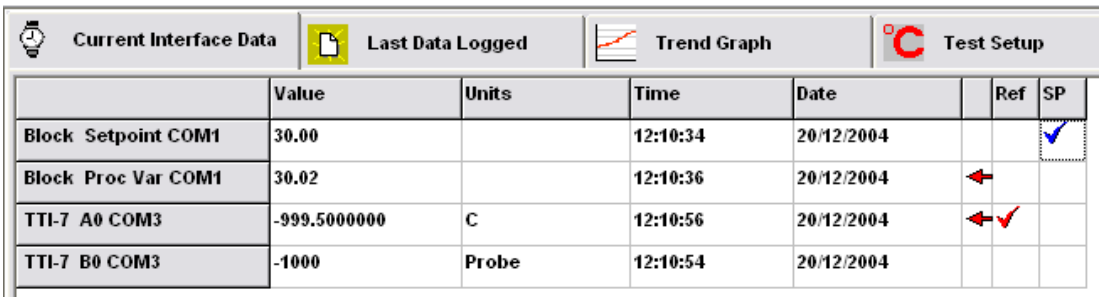
Step 3 Changing units for each channel

You may select Celsius, Fahrenheit, or Kelvin as temperature units. A fourth option is "Probe Output" which will return the natural units for each instrument (i.e. Ohms for PRTs and mVolts for thermocouples).

Step 8 Select the Set-point and Reference Channels

You now have your devices connected and working.

Click the Datalogger button at the top of the screen and then select the Current Interface Data tab. Ensure that all of the channels required are being received and updated. Select the Isotech block set-point entry to be the test set-point by placing a BLUE tick mark in the setpoint box (SP) and place a RED tick in the TTI-7 – A0 reference box (Ref) to set this as the reference temperature for your test.

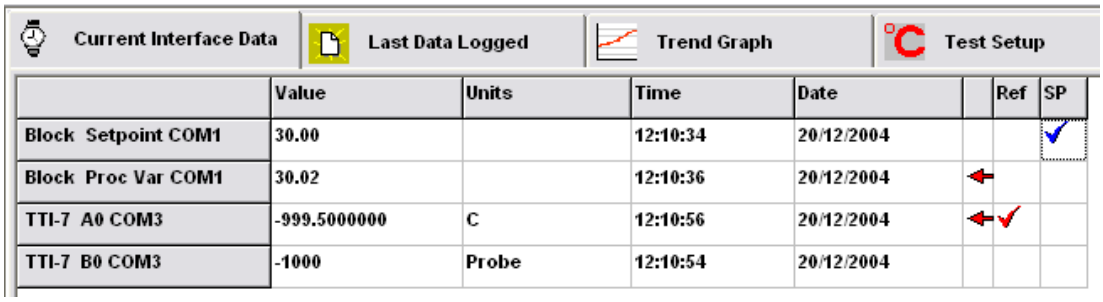


Step 4 Select reference and set-point

Step 9 Select the Set-point and Reference Channels

You now have your devices connected and working.

Click the Datalogger button at the top of the screen and then select the Current Interface Data tab. Ensure that all of the channels required are being received and updated. Select the Isotech block set-point entry to be the test set-point by placing a BLUE tick mark in the setpoint box (SP) and place a RED tick in the TTI-7 – A0 reference box (Ref) to set this as the reference temperature for your test.



Step 4 Select reference and set-point

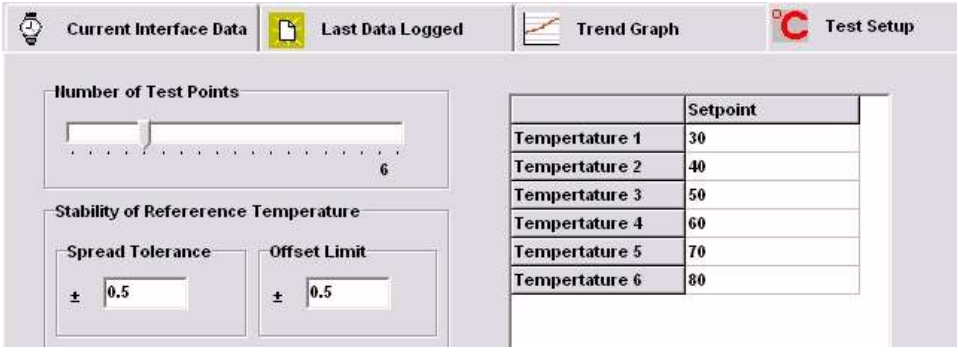
Step 10 Click the Test Setup tab and configure test settings

5a Number of set-points and their values

Set the number of test points to six and enter values in the grid of 30,40,50,60 and 70 and 80°C as the set-points. You may wish to vary these to suit your own test requirements.

5b Tolerance and off set Limit

The default values for these are ±0.5°C. Accept these for the moment, but experiment later-on to find your own optimum values.



Steps 5a and 5b Enter set-point data

5c Set stability criteria

Set the number of readings for stability check to be somewhere between 10 and 20. This is usually sufficient to ensure accurate stability. Then set the number of readings per set point after stability - again - to be between 5 and 10.

Step 5c Stability criteria

5d Start your test

Select your logging interval to be one minute and then on the control button click the Start button. You will then be prompted to enter the select a file name for the tests to be carried out.

Fig 5d Starting your test

5e Let the software do the rest!

That's it, you need do no more! The software will now do the rest of the work for you, setting the block to the correct temperatures and recording data values for you. If you want you can keep an eye on how things are going. Along the bottom of the Data-Logger three status indicators tell you the current set-point etc. At the end of the test, the right-hand indicator will display "Test Complete".

Fig 5e(i) Test status indicators

It is also a good idea to monitor the Trend Graph display. This can help you decide whether the stability tolerances have been set correctly.

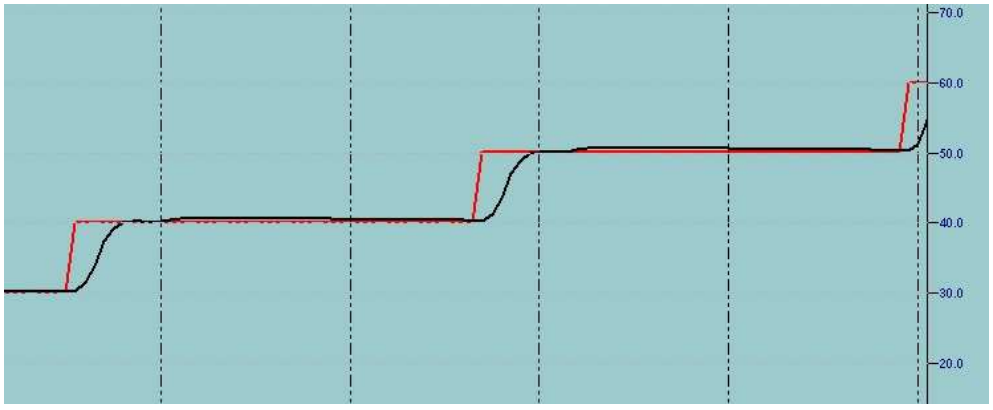


Fig 5e(ii) Trend-graph display

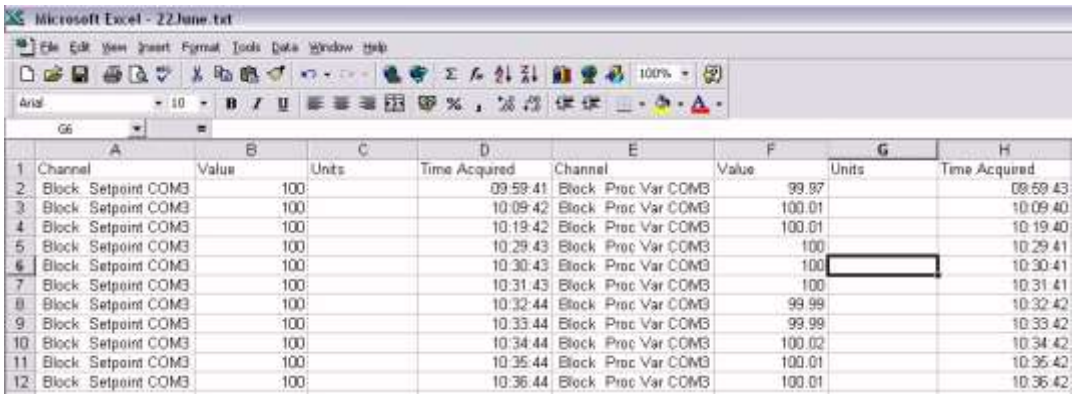
There is little point in setting the tolerances to be tighter than those that the equipment can actually achieve because it will be impossible for the test to satisfy them and, hence, progress through the test. On the other hand, if the tolerances are too wide, it is possible for the test to move on before the desired level of stability is reached.

5. THE DATA VIEWER

The data viewer is accessed from either the main menu or by clicking the "Viewer" button at the top of the screen. When you first load the program the data viewer will contain no data. We will just take a moment to review the two forms of data that is produced by the I-Cal-Easy Laboratory Interface.

5.1 Tab delimited text

Once you have set your datalogger running with your configured interface, data will always be written to a tab delimited text file. What does this mean? Each scan o f the datalogger is recorded on a new line and each entry for the individual readings from the devices on each line are separated by what is known as a tab character.



	A	B	C	D	E	F	G	H
1	Channel	Value	Units	Time Acquired	Channel	Value	Units	Time Acquired
2	Block Setpoint COM3	100		09:59:41	Block Proc Var COM3	99.97		09:59:43
3	Block Setpoint COM3	100		10:09:42	Block Proc Var COM3	100.01		10:09:40
4	Block Setpoint COM3	100		10:19:42	Block Proc Var COM3	100.01		10:19:40
5	Block Setpoint COM3	100		10:29:43	Block Proc Var COM3	100		10:29:41
6	Block Setpoint COM3	100		10:30:43	Block Proc Var COM3	100		10:30:41
7	Block Setpoint COM3	100		10:31:43	Block Proc Var COM3	100		10:31:41
8	Block Setpoint COM3	100		10:32:44	Block Proc Var COM3	99.99		10:32:42
9	Block Setpoint COM3	100		10:33:44	Block Proc Var COM3	99.99		10:33:42
10	Block Setpoint COM3	100		10:34:44	Block Proc Var COM3	100.02		10:34:42
11	Block Setpoint COM3	100		10:35:44	Block Proc Var COM3	100.01		10:35:42
12	Block Setpoint COM3	100		10:36:44	Block Proc Var COM3	100.01		10:36:42

Fig 5.1 Tab delimited text viewed in a spreadsheet.

Files of this type are often used as the basis for Excel or other types of spreadsheet. Regardless of whether you are conducting a set-point test or recording data, information will always be written to a tab delimited text of your choosing. The tab delimited text file contains on a line by line basis data from all channels on the interface together with the date and time stamp and units for each channel.

5.2 Caliso Temperature Data (CTD) Files

This type of file contains what is known as "structured data". It is an efficient and space saving means of holding a large amount of information and rapidly recalling it. Caliso Temperature Data Files may only be opened and viewed in the I-Cal-Easy Builder Software and the Laboratory Interface Data Viewer. Individual Caliso Temperature Data files contain information for each of the channels in the test. They will be automatically named to contain the name of the channel that is being recorded. For example, if you are recording data from an Isotech TTI-7, there will be 2 ctd files, one for channel A0 and another for channel B0.

This enables data from each instrument, in other words each individual device under calibration, to be analysed separately and for calibration certificates to be generated for each, thus allowing different templates to be used (refer to the documentation of I-Cal-Easy Builder).

5.2.1 Opening and viewing Caliso Temperature Data Files

Files may be opened in two ways, either from the main menu by clicking the "Open Result File" menu item, or by clicking the button at the top of the screen also entitled "Open Result File".

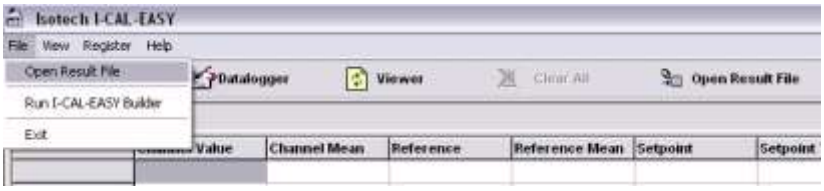


Fig 5.2.1a Opening a result file

Using the familiar Windows File Open box that will appear, select your Caliso Temperature Data File. This can either be data from a test that you have conducted some time ago or the actual test that is currently being carried out, in which case the display will be constantly updated when information is written to the file.

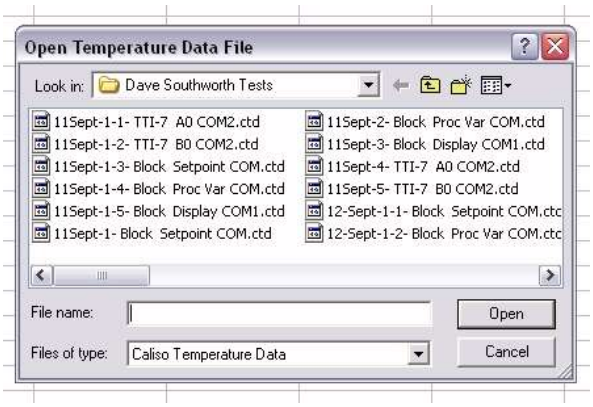


Fig 5.2.1b Selecting the file to open

When the required file has been opened, you will see 2 tabs along the top of the Viewer, one is titled "Run Data" and the other "Results".

Run Data contains the actual readings taken, at each set-point, for the number of pre and post-stability readings stipulated in the test set-up. Results contain the means of these values.

5.3 Run Data

Run data is grouped according to the set-points used in the tests.

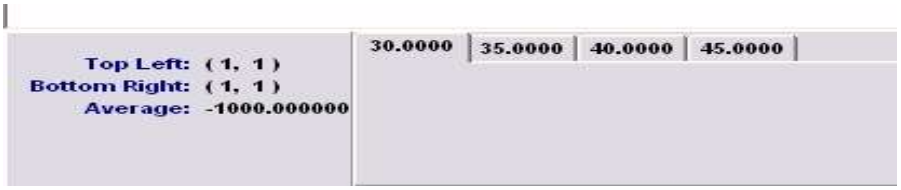


Fig 5.3(i) Set-point tabs

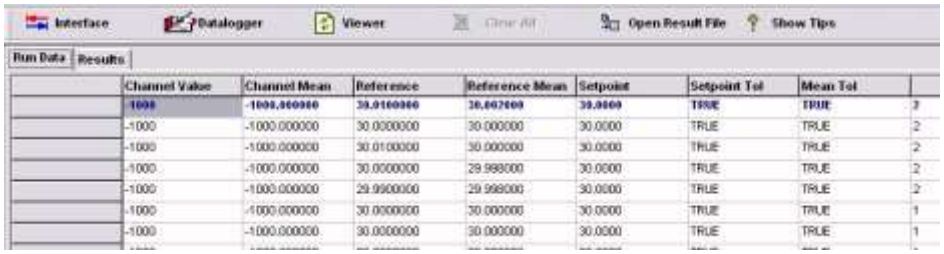


Fig 5.3(ii) Run data

You will see a spreadsheet-like grid containing data from individual set-points of your test run. Along the bottom you will see a row of tabs indicating the temperature of each individual set-point. Click these to show the data for each of the set-points.

Data is arranged in a series of columns and rows – each row being one stable reading. The columns contain:

- Channel value the value recorded
- Channel mean average value calculated
- The reference temperature

- The reference mean
- The set-point
- Set point tolerance and mean tolerance. For an explanation of these please refer to the test set-up documentation earlier.

The final column indicates whether the readings were pre or post-stability and are therefore for reference only.

5.3.1 Manual Computations

Should you wish to calculate averages of your own, note that in the bottom left hand corner (see fig 5.3 (i) to the left of the test point, you will see a grey box showing:

- Top left
- Bottom right
- Bottom average

To illustrate the purpose of this in any highlighted cells in a column will be averaged e.g. try clicking and highlighting a number of cells in the channel value column and look at the bottom box. You will see that the cell references are shown together with the average value for the highlighted cells.

5.4 The Results Tab

Click the Results tab and you will see the results grid. This shows for each individual set point the average channel reading and the average reference value. These are the numbers used in I-Cal-Easy Builder to calculate either your calibration co-efficient according to the various temperature standards.

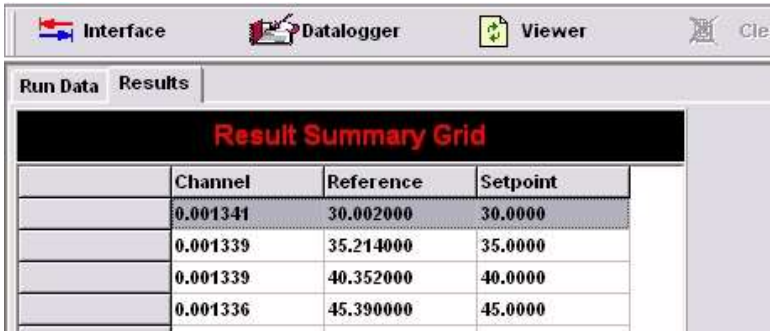


Fig 5.4 The Results tab

Note: For more details on the Data Viewer please refer to the documentation in the Builder section.