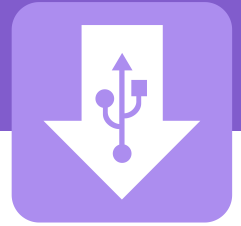


DSCUSB-PT Advanced User Manual

mantracourt.com



DSCUSB

Digital Sensor Card USB – Potentiometer Input

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Chapter 1 Introduction

This chapter provides an introduction to the DSCUSB-PT product, describing the product range and main features.

Overview

The DSCUSB product family comprises of Digital Sensor Cards that connect sensors to your PC via USB. The DSCUSB-PT product is a compact, high-precision potentiometer input module; converting a potentiometer input to a **digital** output. They allow high precision measurements to be made and communicated directly to a PC and is aimed at applications which require high-accuracy measurement repeatability. With the appropriate drivers installed, the DSCUSB-PT appears as a virtual serial port to the PC.

Simply by plugging the device into a PC, data can be extracted from potentiometer input for a wide range of applications.

Free-standing module fitted with 9-way 'D' type socket for potentiometer and optional temperature sensor connections.

Micro USB socket accepts a USB lead with type 'A' connector at the PC end.

Manual Scope

This manual covers Advanced functionality which includes potentiometer profiling calibration, information on writing your own communication software and advice on OEM production techniques.

If you have purchased this module and intend to connect it to a potentiometer and perform linearization or temperature compensation then you will need to refer to this Manual.

For user level calibration and common settings please refer to the DSCUSB-PT Standard Manual.

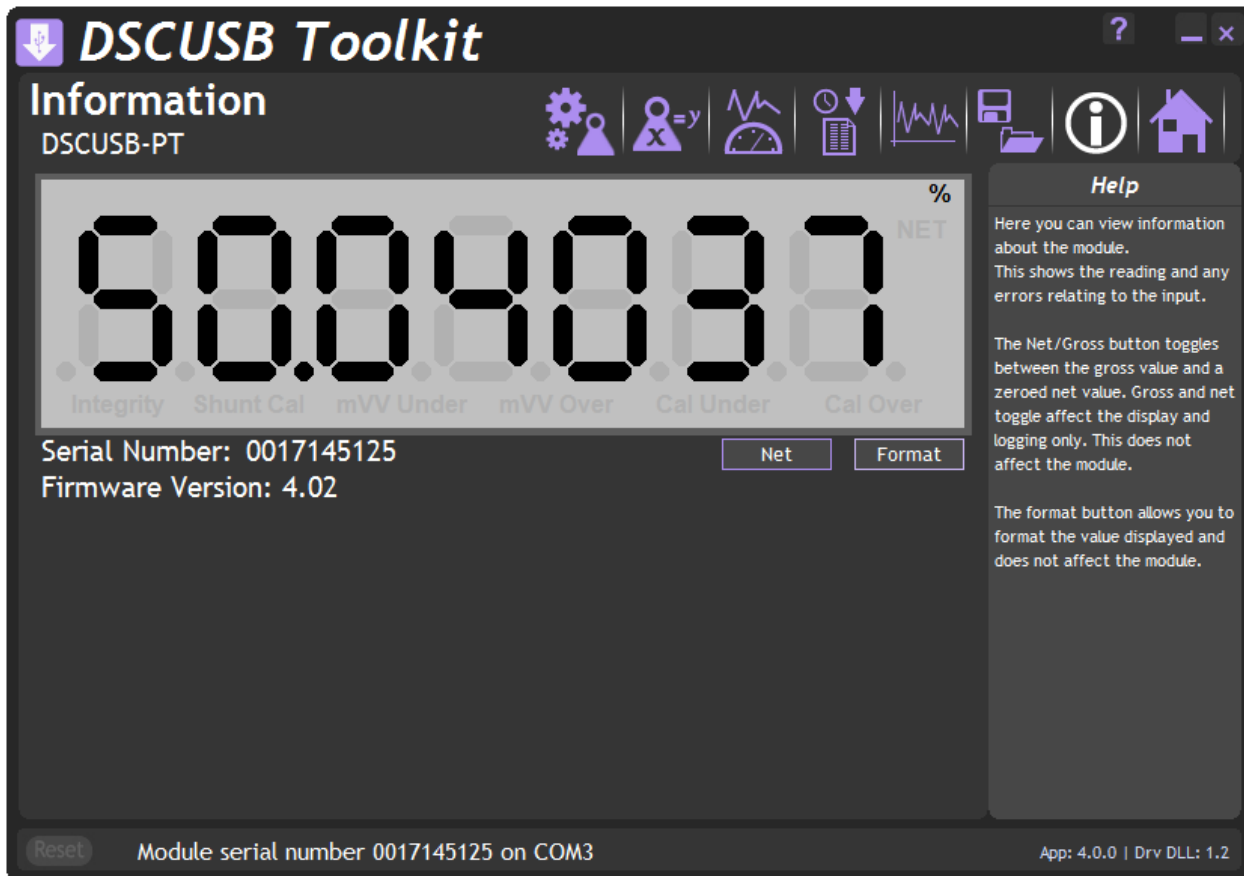
Chapter 2 DSCUSB Toolkit Software

Please refer the DSCUSB-PT Standard manual for information on installing the DSCUSB Toolkit software.


This chapter assumes that you have already installed the DSCUSB Toolkit software.

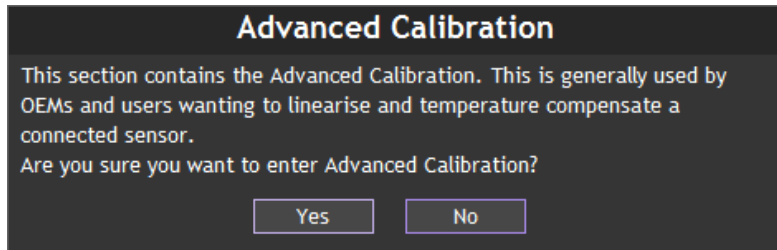
Information Page


When you select a connected module (or if only one module is connected) the information page is displayed. This manual will deal with the Advanced Calibration section of the DSCUSB Toolkit software.

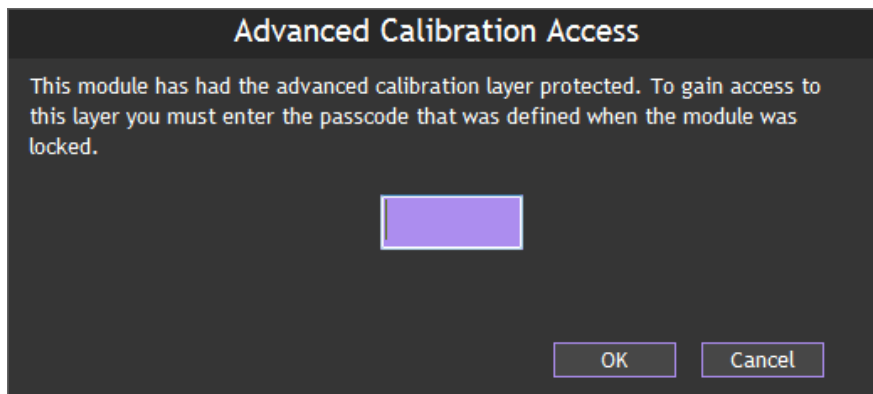


Advanced Calibration Page

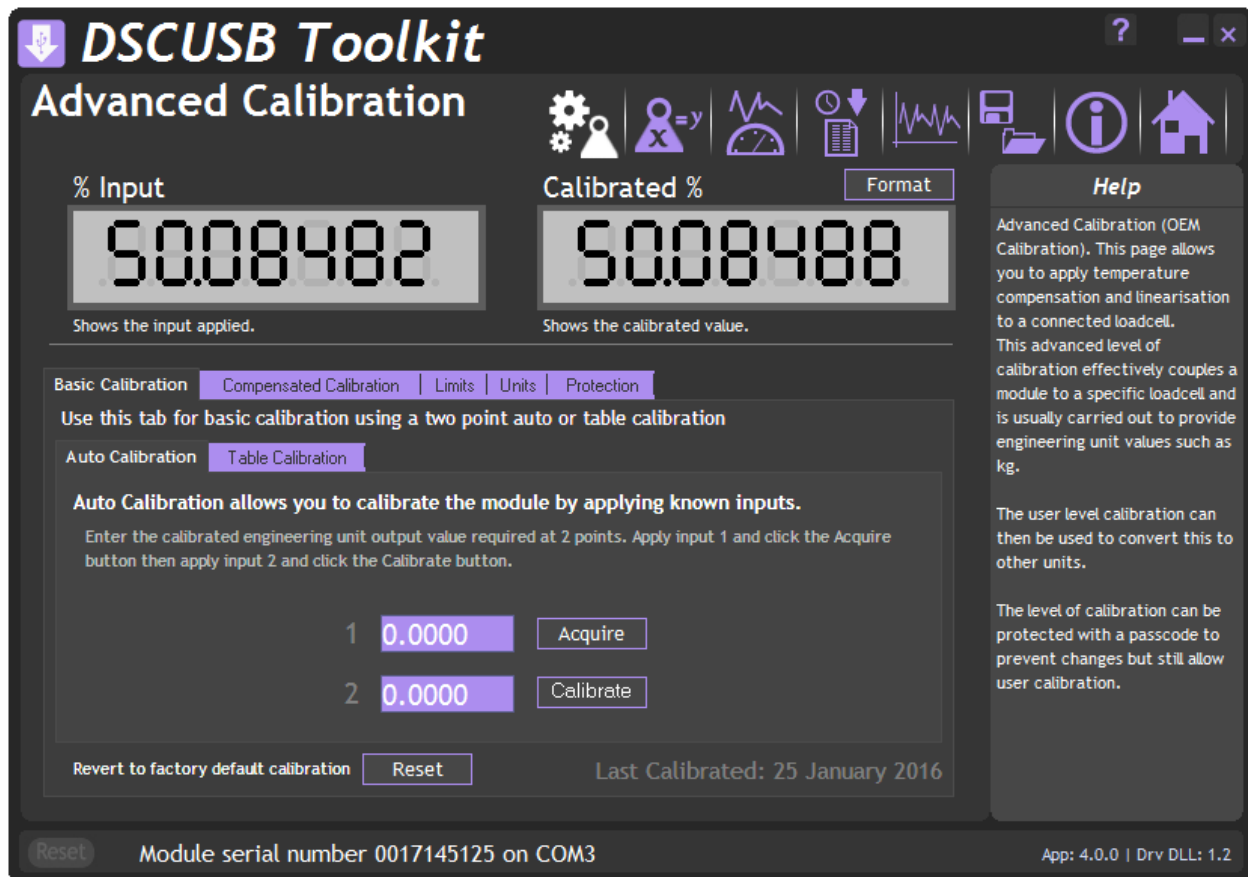
Click on the  icon to open the Advanced Calibration page. The icon will appear like this when the module has not had the Advanced Calibration locked out. A message will appear asking if you are sure you want to enter this advanced level of the software.



If the module has been protected the icon will appear greyed out  and you will have to enter a passcode to access the Advanced Calibration page.



If the module is unlocked or you enter the correct passcode the following page will be displayed.



This page allows you to calibrate the module using various methods, set limits, perform system zero and set units description.

The page is separated by tabbed sections. Click in a tab to change sections.

Revert to factory default calibration – Click the 'Reset' button to remove any custom calibration you have applied.

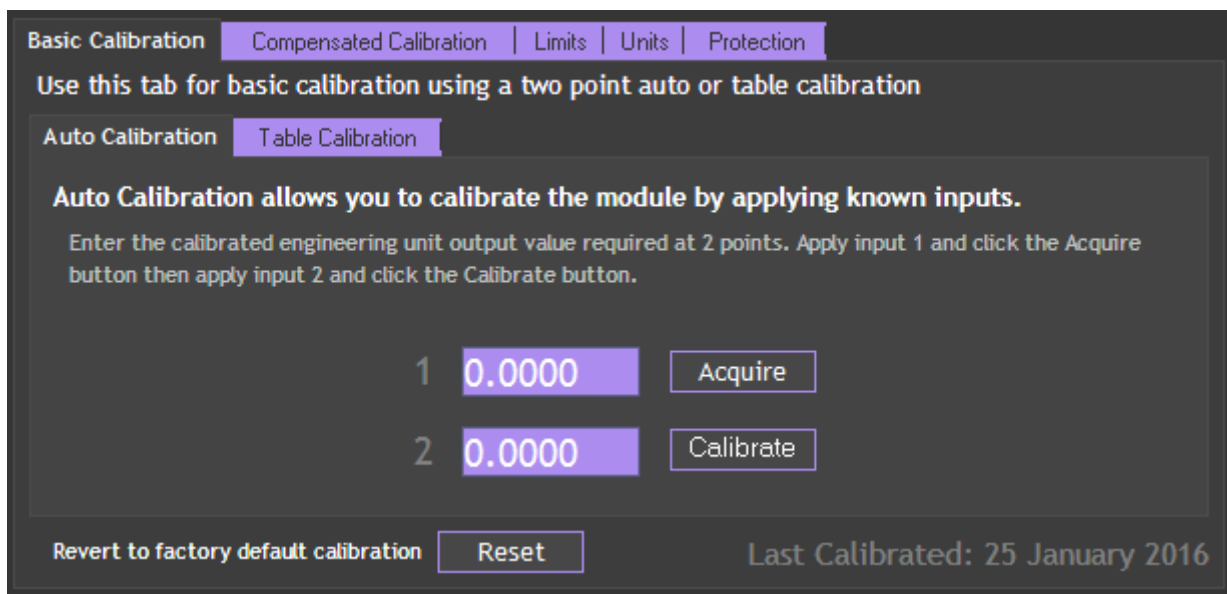
The date of the last change to calibration settings will be displayed.

There are two main calibration methods. You can choose Basic Calibration for a simple 2 point auto or table calibration or choose Compensated Calibration if you are going to perform linearization or temperature compensation.

Basic Calibration

Choose this **instead of** Compensated Calibration if you **do not** want to perform temperature compensation or linearization.

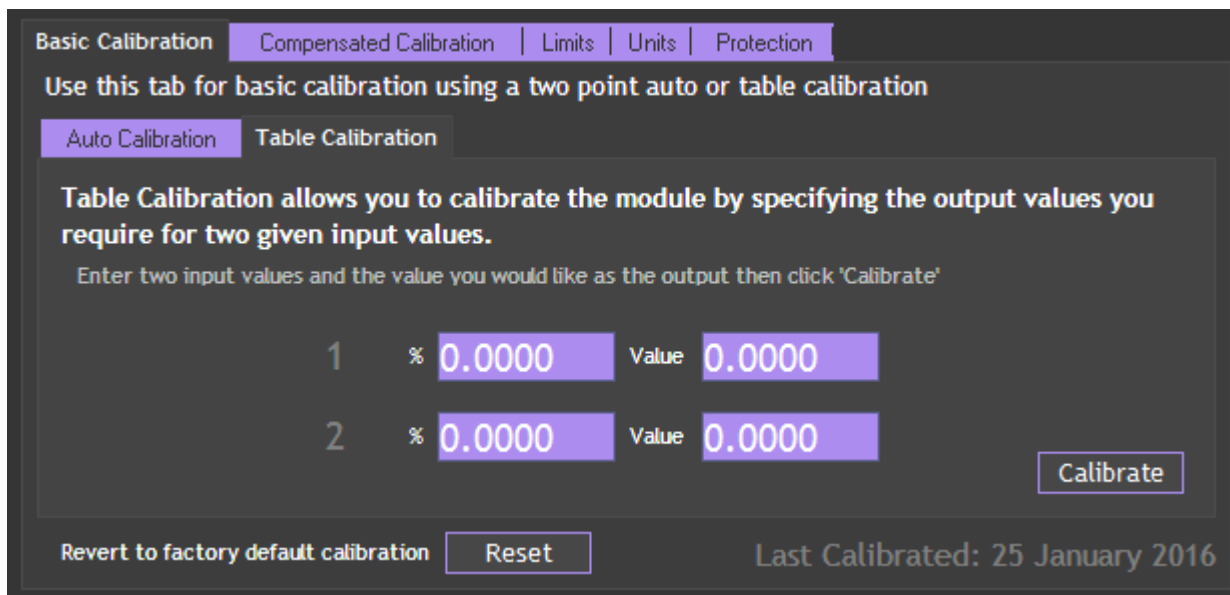
Auto Calibration



The automatic calibration requires that you apply two known (ascending) inputs in sequence. Just enter the required engineering unit value for the two inputs in the fields marked 1 and 2.

Next, apply the low input and allow a settle time. Click the '**Acquire**' button then apply the high input. After another settle time click the second '**Acquire**' button and the calibration is complete.

Table Calibration



This option lets you calibrate direct from the sensor manufacturers certificate without having to apply inputs to the module.

Choose 2 points from the sensor documentation and enter the % values and the required engineering units from the document and click the **Calibrate** button and the calibration is complete.

Compensated Calibration

Choose this **instead of** Basic Calibration if you **do** want to perform temperature compensation or linearization. To perform compensated calibration you must perform the different calibration sections in the following order.

- 1 **Temperature Compensation** is optional.
- 2 **Auto Calibration** must be completed OR complete the Table Calibration
- 3 **Table Calibration** must be completed if you did not use Auto Calibration.
- 4 **Linearisation** is optional.

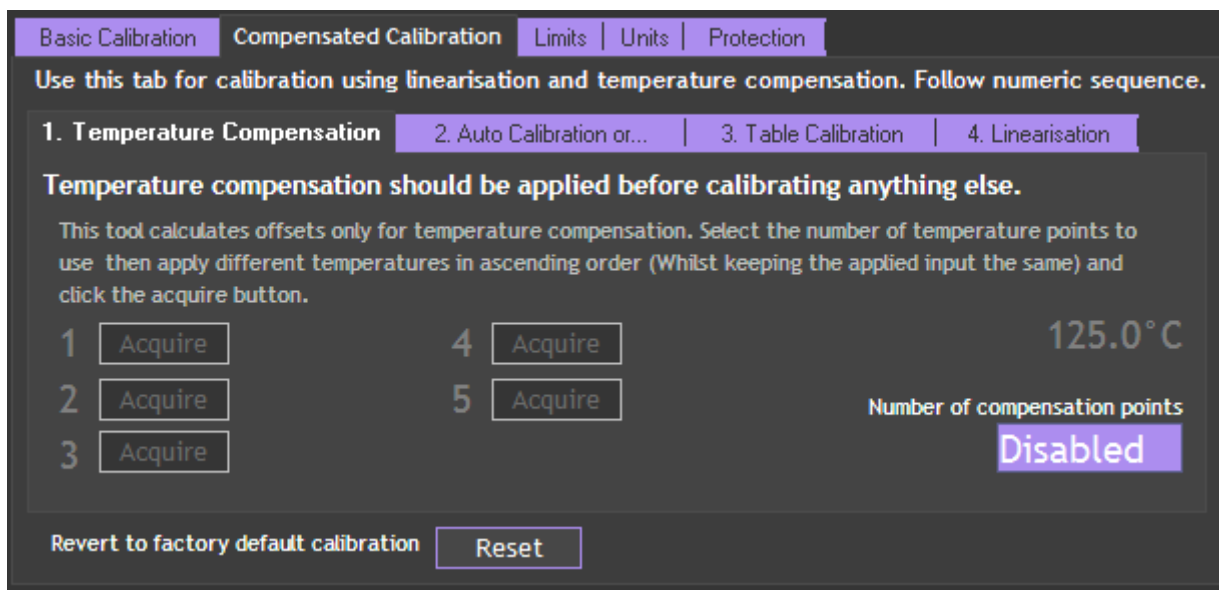
If you go back and redo any of these tabs then you must also redo any later numbered tabs.

It is advisable that you click the Revert to factory default calibration button before you start a complete calibration sequence on an unknown module or one that has been calibrated before.

1 Temperature Compensation

Please note that this software only allows you to compensate for temperature offsets!

The module must have an optional DTemp sensor wired to it and if this is functioning you will see a temperature displayed on the middle right of the tab.



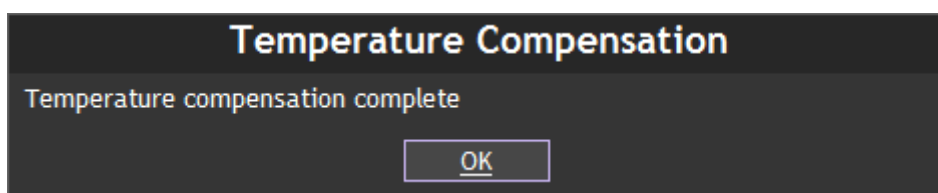
If you do not want to use temperature compensation select Disabled from the drop down list presented when you click the **Number of compensation points** field.

Selecting any number of points from 2 to 5 will enable the first **Acquire** button. You need to keep the same input whilst subjecting it and the DTemp sensor to up to 5 different temperatures covering the temperature range you wish to operate over.

You need to wait enough time at each temperature for potentiometer to stabilise at that temperature and that will depend on the physical characteristics of the potentiometer. Try and get the DTemp sensor close to the potentiometer.

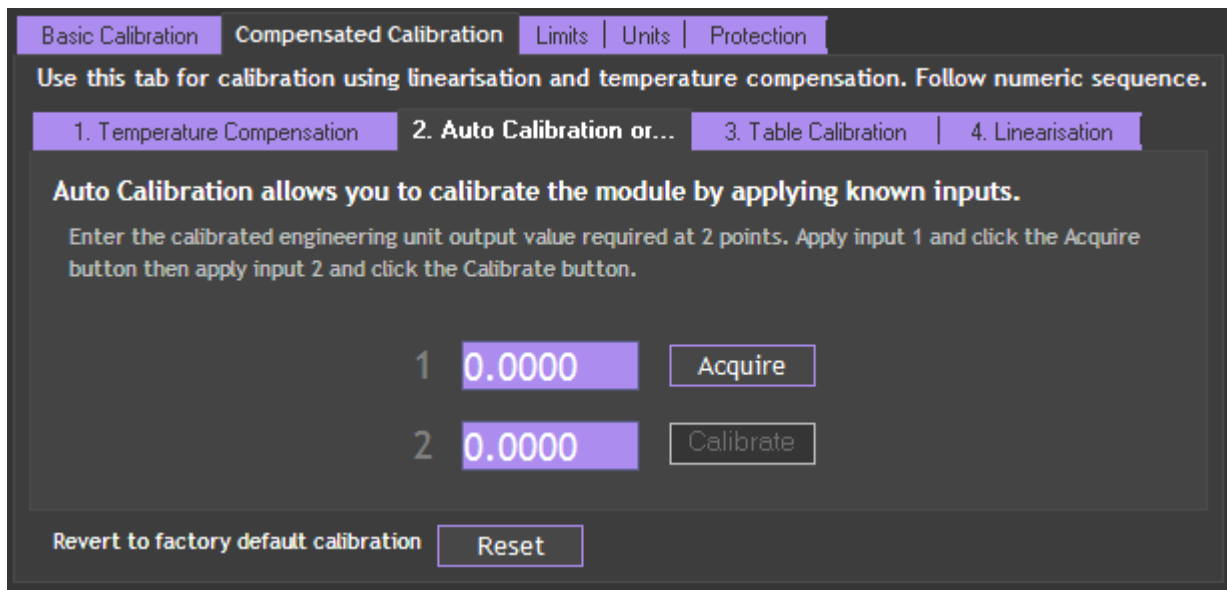
Once enough time has elapsed for the temperature to stabilise you can click the **Acquire** button and that button will become disabled and the next enabled.

Once you have completed all the required points you will see the following message.



You can now move on to either Auto Calibration or Table Calibration.

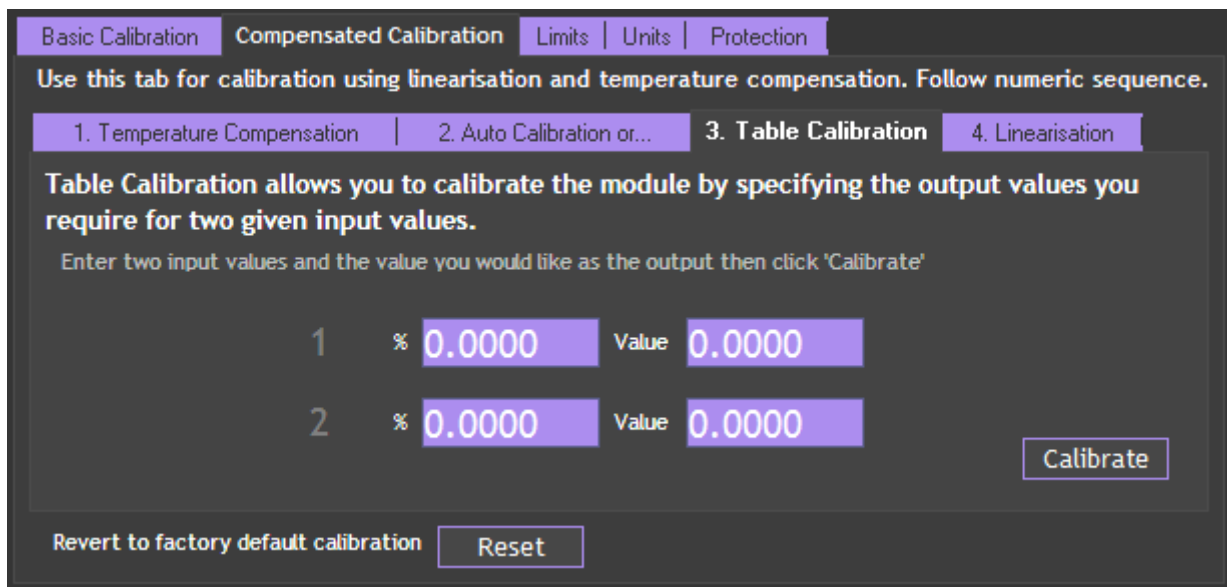
2 Auto Calibration



The automatic calibration requires that you apply two known (ascending) inputs in sequence. Just enter the required engineering unit value for the two inputs in the fields marked 1 and 2.

Next, apply the lowest input and allow a settle time. Click the '**Acquire**' button then apply the higher input. After another settle time click the second '**Acquire**' button and the calibration is complete.

3 Table Calibration



This option lets you calibrate direct from the sensor manufacturers certificate without having to apply inputs to the module.

Choose 2 points from the sensor documentation and enter the % values and the required engineering units from the document and click the '**Calibrate**' button and the calibration is complete.

4 Linearisation

Basic Calibration | Compensated Calibration | Limits | Units | Protection

Use this tab for calibration using linearisation and temperature compensation. Follow numeric sequence.

1. Temperature Compensation | 2. Auto Calibration or... | 3. Table Calibration | 4. Linearisation

This is the final stage of calibration where actual known inputs are applied.

Select the number of inputs you can apply. Enter the known inputs at these points then apply the inputs and click the Acquire buttons. The Calibrated Value may not look correct until all points complete.

| | | | | | | | | |
|---|--------|---------|---|--------|---------|--------------------------------|--------|----------|
| 1 | 0.0000 | Acquire | 4 | 0.0000 | Acquire | 7 | 0.0000 | Acquire |
| 2 | 0.0000 | Acquire | 5 | 0.0000 | Acquire | Number of linearisation points | | Disabled |
| 3 | 0.0000 | Acquire | 6 | 0.0000 | Acquire | | | |

Revert to factory default calibration | Reset

This stage is optional. If you do not want to use linearization then select **Disabled** from the drop down list that is presented when you click the **Number of linearization points** field.

To use linearization select the number of points you wish to use from 2 to 7. Once selected this will enable the appropriate number of text fields for you to enter the known inputs you are going to apply. You should enter these in the same engineering units that were used in either the Auto Calibration or the Table Calibration.

The linearization points are usually spread out evenly between the two points used for auto calibration but if you know that a particular section of the range is less linear you may want to concentrate the points in that area.

Once you have entered the engineering units values for each point you can apply the input, wait a settle time then click the appropriate **Acquire** button.

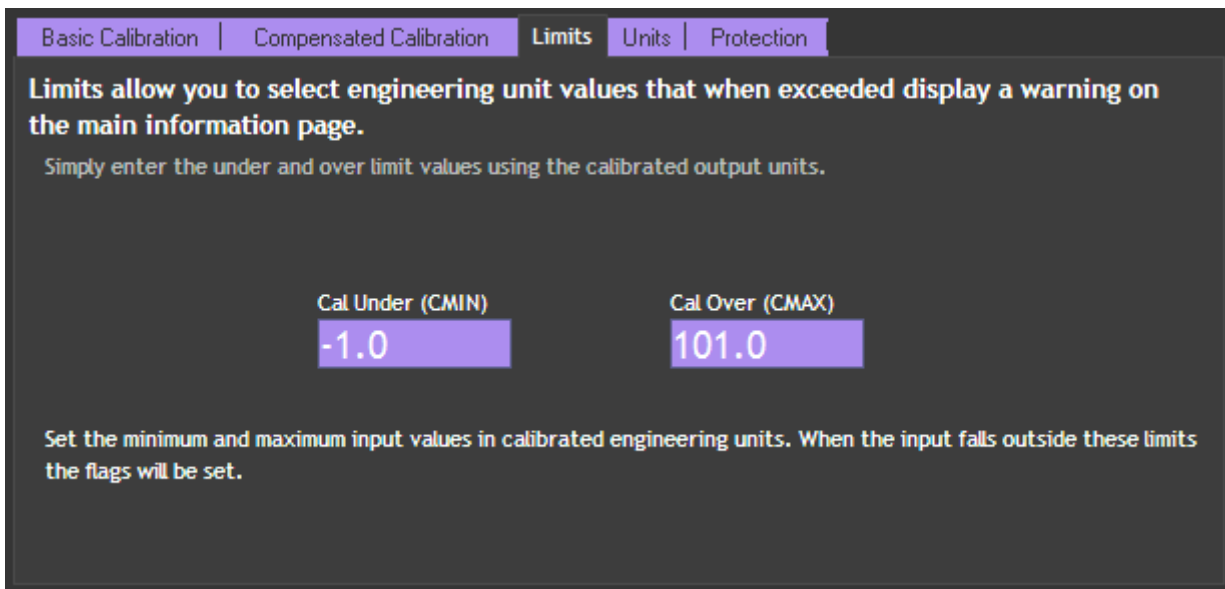
Once you have completed all points the following message will be displayed.

Linearisation

Linearisation calibration complete

OK

Limits



Basic Calibration | Compensated Calibration | **Limits** | Units | Protection

Limits allow you to select engineering unit values that when exceeded display a warning on the main information page.

Simply enter the under and over limit values using the calibrated output units.

Cal Under (CMIN) Cal Over (CMAX)

-1.0 101.0

Set the minimum and maximum input values in calibrated engineering units. When the input falls outside these limits the flags will be set.

Here you can set limits below and above which the warning indicators will be displayed on the Information Page for the standard user. These limits should cover the operational range that the combined potentiometer and DSCUSB-PT are allowed to operate over.

Units

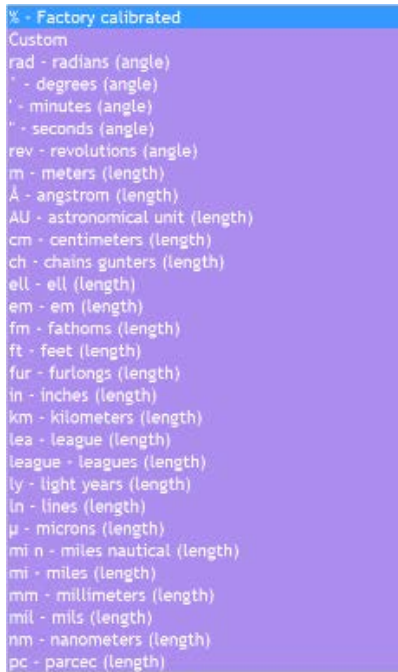
The screenshot shows a software interface with a dark background and a light-colored navigation bar at the top. The navigation bar contains five tabs: "Basic Calibration", "Compensated Calibration", "Limits", "Units", and "Protection". The "Units" tab is currently selected. Below the navigation bar, there is a main instruction: "You can specify the unit text here. This should be the engineering units that the module has been calibrated to." Below this instruction is a note: "NOTE: If possible you should use one of the units from the list that appears when you click below. If you select one of the recognised units the user is able to convert between units easily at a later date." The main content area is divided into two columns. The left column has the label "Units Text" followed by a text input field containing "%". Below the input field is a button labeled "Copy To User". The right column contains two paragraphs of text. The first paragraph says: "Click the edit box to the left to display a list of recognised units. If you do not find the units you require select Custom and you will be able to enter up to 6 characters of custom text." The second paragraph says: "Click to copy the current OEM units to the end user units. These will then be displayed on the users pages. The OEM limits will also be copied."

If you have calibrated the module to standard units you can specify them here. The advantages are that the standard user will see the units displayed and if the units are recognised by the software the standard user can simply convert to another unit scale without recalibration.

Click on the **Units Text** field to pop up the unit selection dialog window.

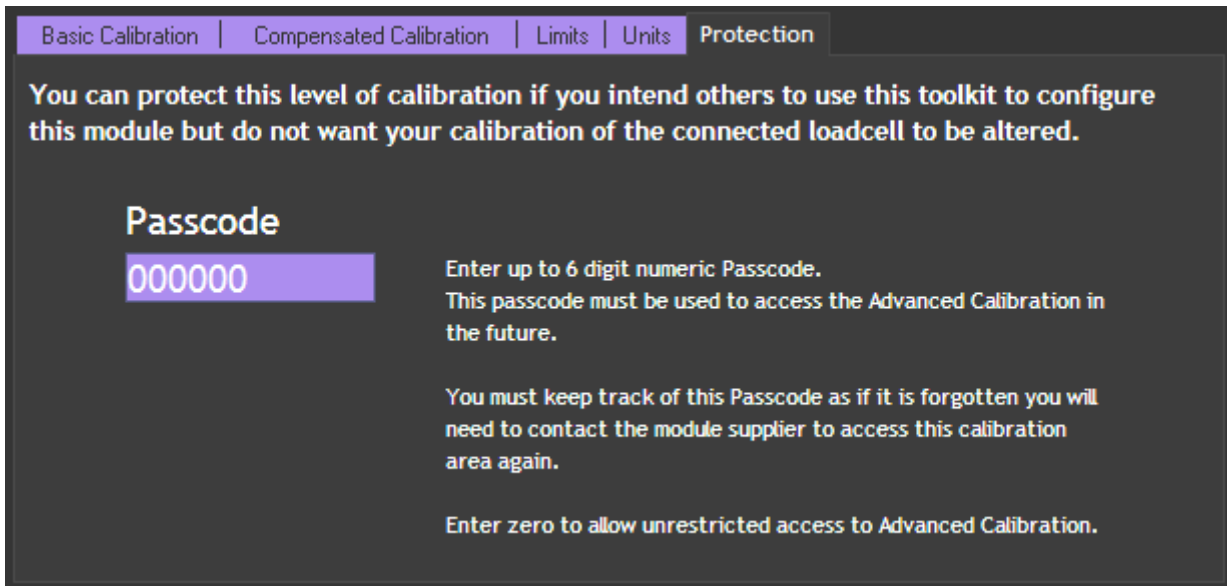
The screenshot shows a dialog box titled "Calibrated Units". The dialog box has a dark background and a light-colored title bar. Below the title bar, there is a text label: "Select the units that this module is calibrated in." Below the label is a drop-down menu with a light-colored background and a dark border. The text inside the drop-down menu is "% - Factory calibrated". Below the drop-down menu are two buttons: "OK" and "Cancel".

Select the desired units from the drop down list.



If you desired units are not in the list choose Custom and you can type in up to 6 characters.

Copy To User button – Usually you will want to click this to make your units selection visible to the standard user. If you do not click this then the standard user may see previously entered units or in the case of a new module there will be no units displayed.



You can protect the module against a standard user being able to enter any of the **Advanced Calibration** pages of the DSCUSB Toolkit.

If you do not want to protect the module (or want to remove protection from a previously protected module) enter zero after clicking the **Passcode** field.

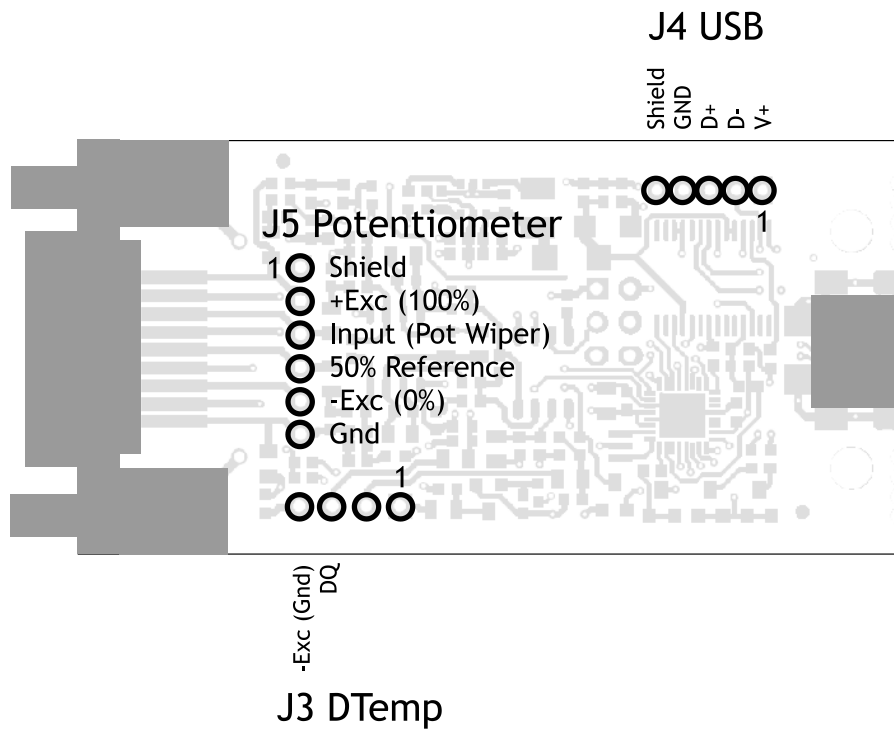
To protect a module enter up to 6 numeric digits after clicking the **Passcode** field. This 6 digit passcode will then be required by a standard user to enable the **Advanced Calibration** section of the software.

If you forget the passcode you will need to contact your module supplier so please remember the passcode and keep it safe.

Chapter 3 Hardware

Alternative Form Factors

As well as being available in a plastic case there may be some variations of the DSCUSB-PT that are supplied uncased. These variants may or may not have connectors fitted. Please find connection details below.



Chapter 4 Communications

Interface Explained

The USB connection on the DSCUSB-PT module requires specific hardware drivers to enable it to be detected correctly and to operate. These drivers are installed along with the DSCUSB Toolkit but are available from Mantracourt if you are writing your own software so you can include them in your own installation SW-DSCUSBDRV. These drivers create a virtual serial port (COM port) for each DSCUSB-PT module that is plugged in and so the modules can be communicated with as if they were plugged into serial ports.

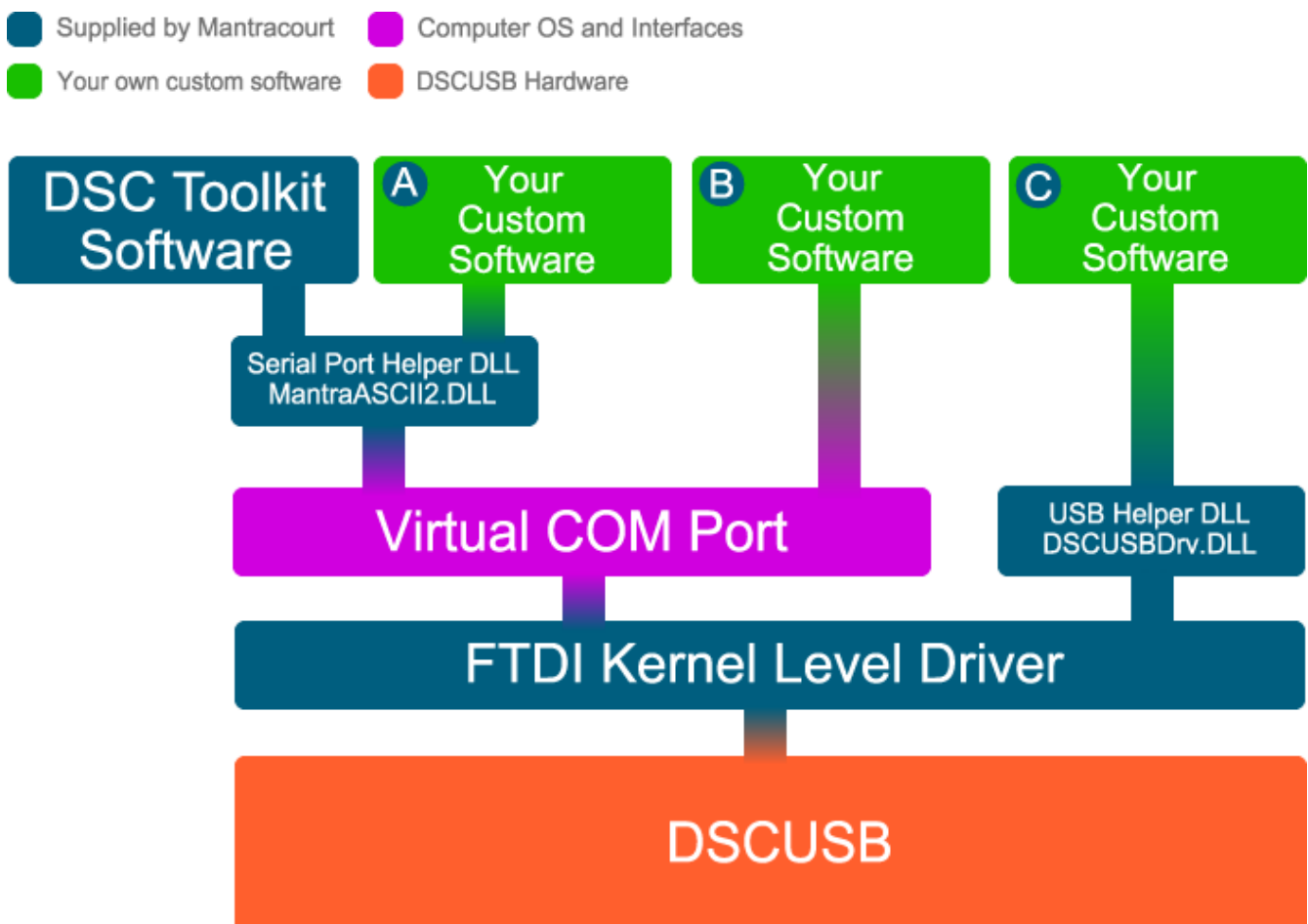
The DSCUSB Toolkit software detects the allocated COM port but if you are writing your own software you need to be aware that these virtual serial ports are being allocated.

Once a COM port has been allocated, plugging the same module into the same USB socket will result in the same COM port being allocated. But plugging that same module into a different USB port or plugging a different DSCUSB-PT module into the same USB socket will result in a **new** COM port being allocated.

Using the Windows Hardware Manager it is possible to reallocate the COM port.

Mantracourt provide two free drivers (As well as the hardware driver) that can help when writing your own software. You can use one of these drivers or communicate directly with the virtual COM port by using the communications protocol described later in the manual.

The diagram below shows the three ways (A, B and C) that your own custom software can connect to the DSCUSB-PT.



Communication Options

The next sections describes the three methods that are available for your own custom software to connect to the DSCUSB-PT.

B

Virtual Serial Port Connection

You can open the virtual COM port with your own custom software and communicate with the DSCUSB-PT module directly using the protocol information listed later in this manual. This will be your only option if you cannot utilise the standard Windows DLLs that Mantracourt provides.

A

MantraASCII2.DLL standard Windows DLL driver

This driver communicates with the DSCUSB-PT module via the virtual COM port but the driver only opens a single COM port. Therefore virtual serial port connections to DSCUSB-PTs are only useful for single modules. This driver was designed for the complete range of DSC modules but happens to be usable with the DSCUSB-PT because it creates a virtual COM port. This wraps up timeouts and structures the data sent to make it much easier for you to use.

To use this driver you will need to know that the baudrate is 115200 and the command to use to retrieve the result value is `SYS`.

This is available from our website and is named **SW-ASCIIDLL**.

C

DSCUSBDrv.DLL standard Windows DLL driver

With this driver you can communicate with the DSCUSB-PT module directly over USB via the kernel level driver by referencing its serial number. You can connect as many DSCUSB-PT devices as your PC and USB hubs support which may be as many as 127. You do not need to know anything about serial COM ports using this method. This is the preferred method of communications.

To use this driver you will need to know that the command to use to retrieve the result value is `SYS`.

This is available from our website and is named **SW-DSCUSB DLL**.

Communications Protocol

If you are writing your own software to communicate with the DSCUSB-PT module you will need to adhere to the ASCII protocol to request data from the module. The ASCII protocol uses only printable characters and carriage-return ('<CR>'), which allows a "dumb" terminal device or a PC programme like Hyper-Terminal to interrogate the device.

The protocol allows you to

- Read a parameter or result
- Write a value to a parameter
- Execute a command

In this manual we will cover only the reading of a value. If you want to perform other communication functionality such as performing calibration you will need to refer to the DCell & DSC Manual available on our web site. This manual contains detailed information regarding the MantraASCII protocol.

This communications protocol was designed to handle multiple modules on a bus so you will find references to a Station Address. The DSCUSB-PT modules have a fixed Station Address of 1.

Read a Parameter

| Framing Character | Station Address | Separator | Command Identifier | Access Code | End of frame |
|-------------------|-----------------|-----------|--------------------|-------------|--------------|
| ! | 001 | : | SYS | ? | <CR> |

To ask for the latest reading from the module we need to request the SYS parameter so we would structure the ASCII request as follows:

!001:SYS?<CR>

An Explanation of Each Field is as Follows:

- **Framing Character** A "!" character is used to signal the start of a new message. This character is only ever transmitted by the host, for framing purposes
- **Station Address** A three-digit ASCII decimal number (0-999), determining which slave device(s) the command is intended for. All three digits must be sent. In the case of the DSCUSB-PT this will always be 001
- **Separator** always present. As no checksum or message verification technique is used, slaves use this as an extra check on message validity
- **Command Identifier**. Up to 4 alpha-numeric characters, case insensitive, giving the name of the required command.
- **Access Code**. Defines what sort of response is expected :-
 - '=' means write data is expected to follow
 - '?' means the host is expecting to receive read data back
 - <CR> (i.e. nothing more before end) means the command is an action type (execute)
- End of frame. A <CR> is always present to indicate the end of the message

Response Message Formats

There are Three Possible Types of Response: acknowledge (ACK), acknowledge with data (for a read), and not-acknowledge (NAK)

ACK-with-data is a decimal number, followed by <CR>. This confirms a read and returns the data value.

NAK is an '?' <CR> sequence. The device rejected the command.

There are several possible reasons for a NAK response

- Command identifier not recognised.
- Badly formatted command: Missing command identifier, unrecognised access-code character, or unexpected character somewhere else.
- Access attempted not supported by this command.

So a successful response example would be:

123.456<CR>

Software Command Reference

Serial Port Settings

The communications settings for the virtual COM port are:

- 115200 baudrate
- 8 data bits
- 1 stop bit
- No parity

NOTES:

- From receipt of the host's terminating <CR> to a response from the device (if any) will be at most 50mS. After this, it can be assumed there is no response.

Commands in Access Order

| ASCII name | description | datatype | access |
|------------|---------------------------------|----------|--------|
| CMVV | Temp Compensated % | float | RO |
| STAT | Status | int | RO |
| MVV | Filtered & factory calibrated % | float | RO |
| SOUT | selected output | float | RO |
| SYS | main output | float | RO |
| TEMP | temperature | float | RO |
| SRAW | raw system output | float | RO |
| CELL | cell output | float | RO |
| FLAG | error flags | int | RW |
| CRAW | raw cell output | float | RO |
| ELEC | electrical output | float | RO |
| SZ | system zero | float | RW |
| SYSN | snapshot result | float | RO |
| PEAK | Peak value | Float | RO |
| TROF | Trough value | Float | RO |
| CFCT | Communications failure count | Float | RW |
| VER | software version | byte | RO |
| SERL | serial number low | int | RO |
| SERH | serial number high | int | RO |
| STN | station number | int | RW |
| BAUD | baud rate select | byte | RW |
| OPCL | Output Control (Value select) | byte | RW |
| RATE | reading rate select | byte | RW |
| DP | digits after point | byte | RW |
| DPB | digits before point | byte | RW |
| NMVV | Nominal % for scaling ELEC | float | RW |
| CGAI | cell gain | float | RW |
| COFS | cell offset | float | RW |
| CMIN | cell range min | float | RW |
| CMAX | cell range max | float | RW |
| CLN | lin n-points | byte | RW |
| CLX1..7 | lin raw-values | float | RW |
| CLK1..7 | lin corrections | float | RW |
| SGAI | system gain | float | RW |
| SOFS | system offset | float | RW |
| SMIN | system range min | float | RW |
| SMAX | system range max | float | RW |
| FFLV | Dynamic Filter Level | Float | RW |
| FFST | Dynamic filter steps | Float | RW |
| RST | reboot | - | X |
| SNAP | take snapshot | - | X |
| RSPT | Reset peak & trough | - | X |
| SCON | Shunt cal ON | - | X |
| SCOF | Shunt cal OFF | - | X |
| OPON | Digital Output on | - | X |
| OPOF | Digital output off | - | X |
| CTN | tempco n-points | byte | RW |
| CT1..5 | tempco Temp points | float | RW |
| CTG1..5 | tempco gain-adjust | float | RW |
| CTO1..5 | tempco offset-adjust | float | RW |

Chapter 5 Production Environments

COM Port Allocation

Once a COM port has been allocated, plugging the same module into the same USB socket will result in the same COM port being allocated. But plugging that same module into a different USB port or plugging a different DSCUSB-PT module into the same USB socket will result in a new COM port being allocated.

If enough different modules are connected to the same PC then eventually a problem can arise because there are no more COM ports to allocate and even the newer operating systems (Windows 7 and 8) have issues once all the 255 available COM ports have been allocated.

In a production environment where many modules are being plugged into a single PC for testing or calibration the allocation of unique COM ports is a disadvantage because of the problem with using up all the allocated COM ports as well as having to detect on which COM port the module currently resides.

Mantracourt has some free software available to fix a PC so that the same COM port is allocated regardless of what module is plugged in. Contact Mantracourt if you would like this software.

When you first plug in a DSCUSB-PT module a unique COM port will be allocated but you can change that using Device Manager to whatever COM port you would like to use. From that point onwards different modules will be allocated the same COM port.

Please note that if you plug a module into a different USB socket a different COM port may be allocated.

For those of you that would like to activate this feature without using Mantracourt software it is a simple registry key. Below you will find text that could be placed in a REG file to be merged with the registry.

Windows Registry Editor Version 5.00

```
[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\usbflags]
"IgnoreHWSerNum17810BAD"=hex:01
```

Disable by setting the key value to 00

NOTE: Ideally this should be configured BEFORE the FTDI kernel level drivers are installed.



In the interests of continued product development, Mantracourt Electronics Limited reserves the right to alter product specifications without prior notice.

