

DSCUSB Advanced Manual

Advanced level user documentation

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USB Strain Gauge or Load Cell Digitiser Module

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Chapter 1 Introduction

This chapter provides a brief introduction to the DSCUSB product and what to expect from this manual.

Overview

The DSCUSB product is a compact, high-precision Strain Gauge Converter; converting a strain gauge sensor input to a **digital** output and is connected to a PC via a USB port. 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 appears as a virtual serial port to the PC.

Simply by plugging the device into a PC, data can be extracted from most strain gauge bridge input sensors and acquired by software which allows data manipulation removing the need for amplifiers, filters & multimeters.

Free-standing module fitted with 9-way 'D' type socket for load cell 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 loadcell 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 loadcell 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 Standard Manual.

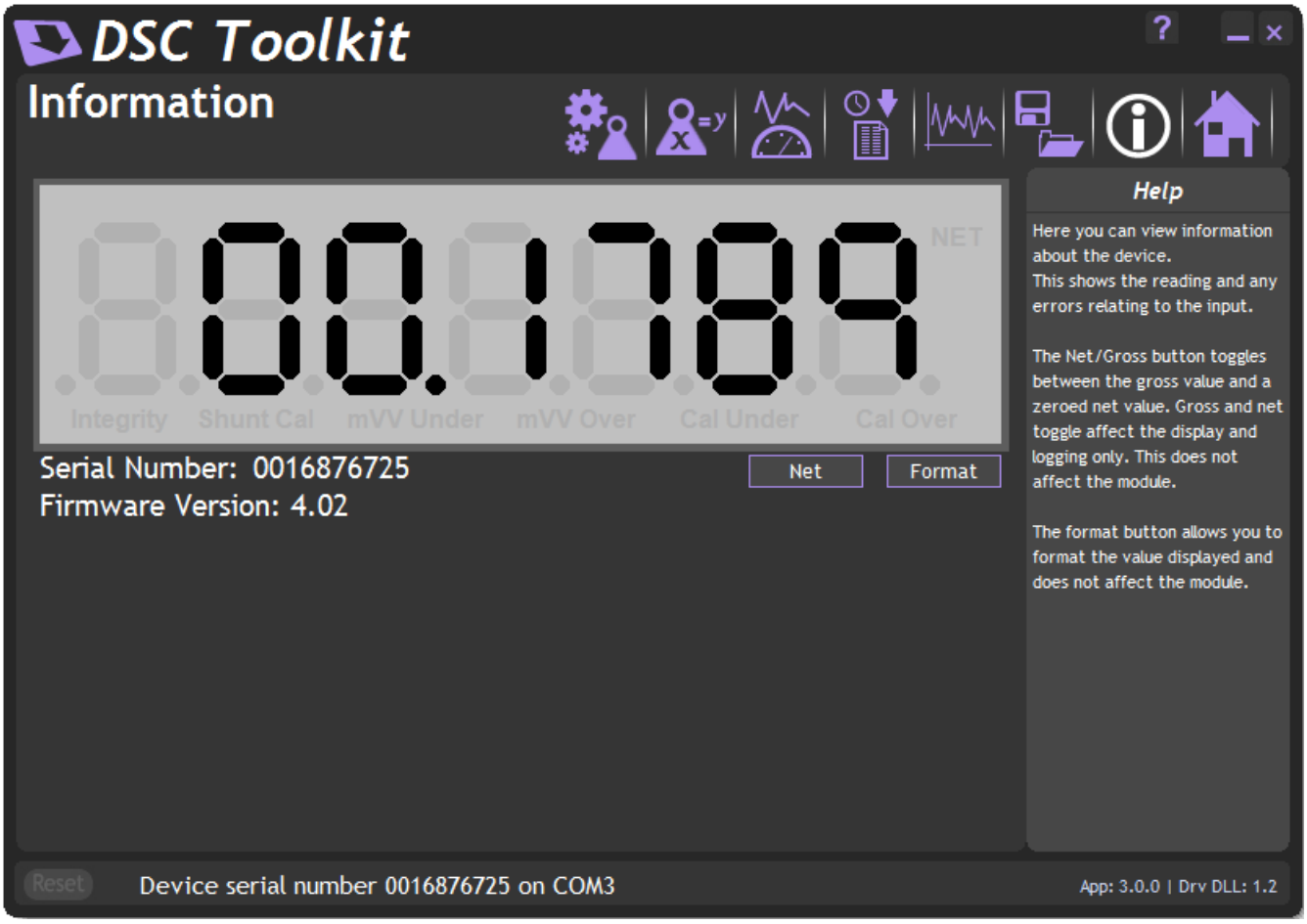
Chapter 2 DSC Toolkit Software

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

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

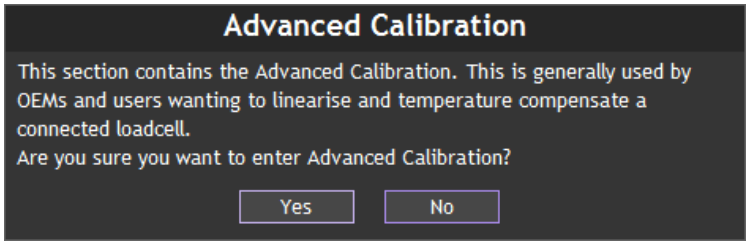
Information Page

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 DSC Toolkit software.

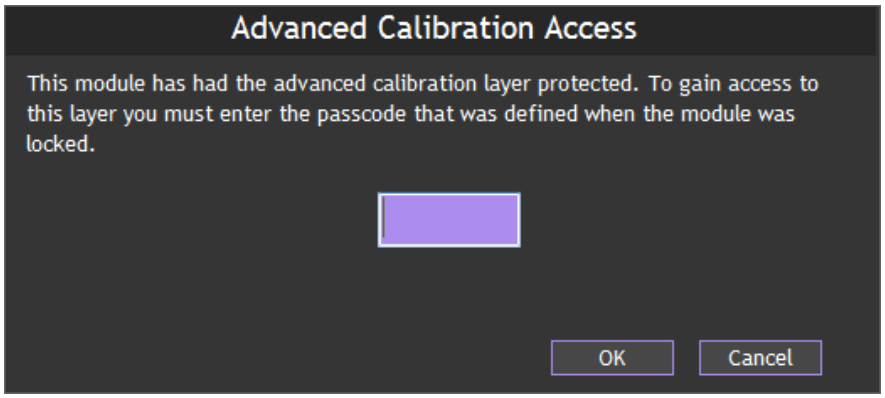


Advanced Calibration Page

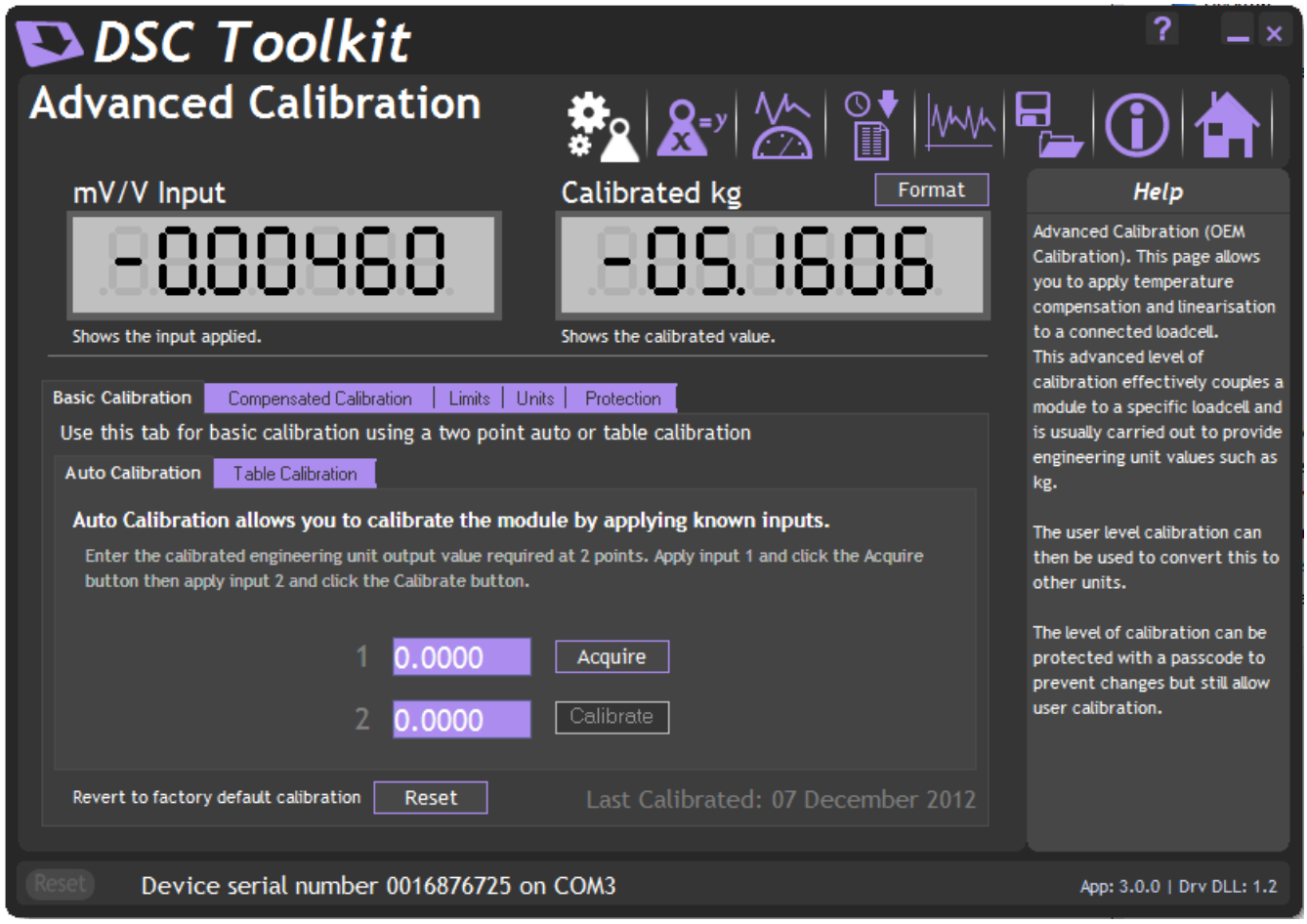
Click on the  icon to open the Advanced Calibration page. The icon will appear like this when the module has not had the Advanced Calibration locked out. A message will appear asking if you are sure you want to enter this advanced level of the software.



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.

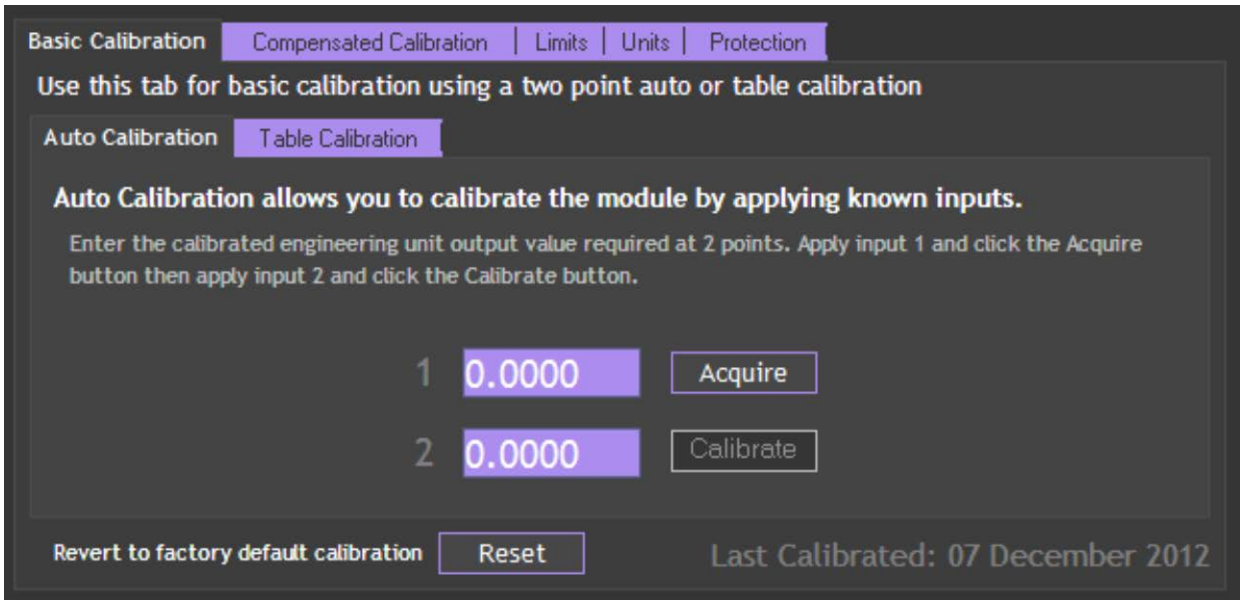
If the DSC module supports it the date of the last change to calibration settings will be displayed.

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.

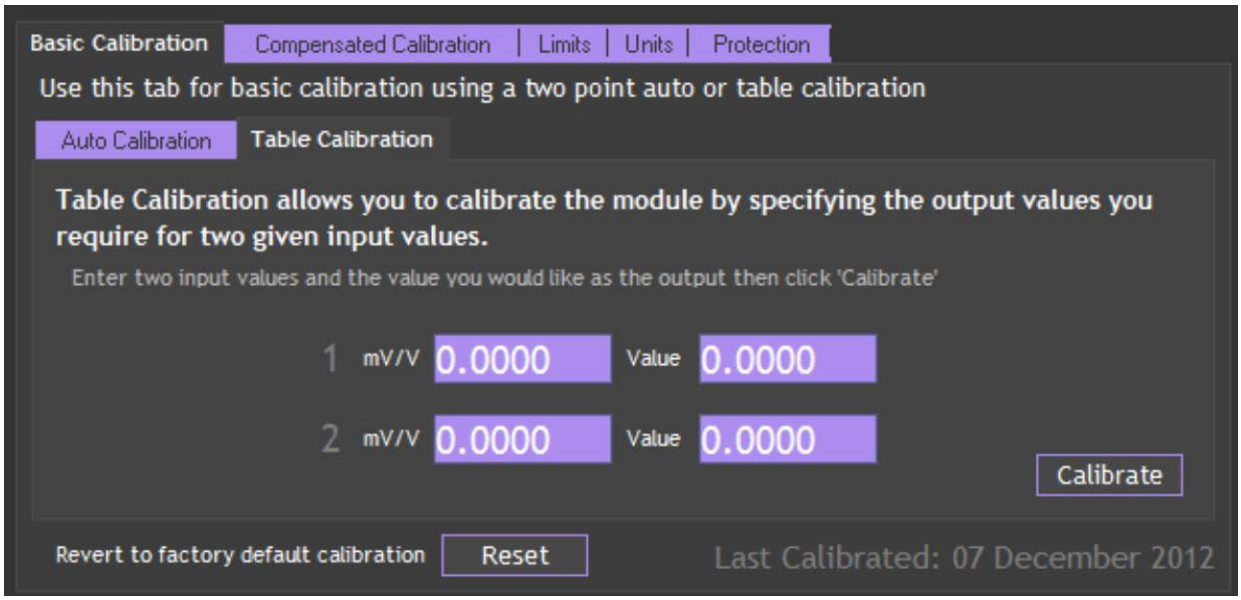
Auto Calibration



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

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

Table Calibration



This option lets you calibrate direct from the loadcell manufacturers certificate without having to apply weights to the input.

Choose 2 points from the loadcell certificate and enter the mV/V values and the weights on the certificate (or convert the certificate weight to any other engineering unit of your choice) click the '**Calibrate'** button and the calibration is complete.

Compensated Calibration

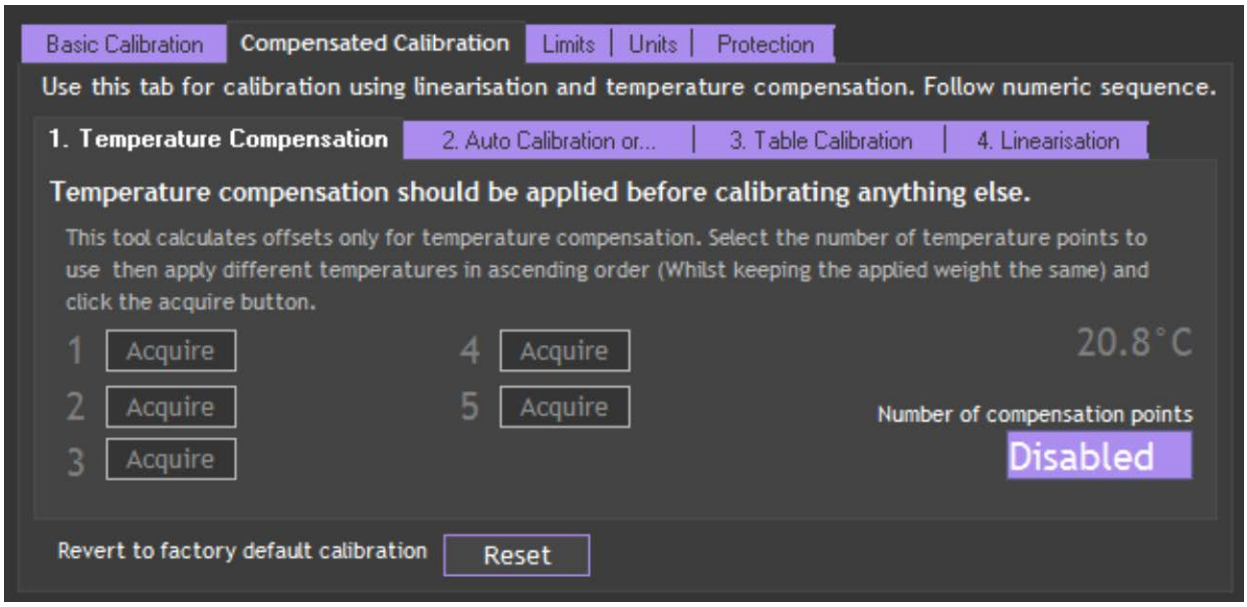
Choose this **instead of** Basic Calibration if you **do** want to perform temperature compensation or linearization.
To perform compensated calibration you must perform the different calibration sections in the following order.

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.



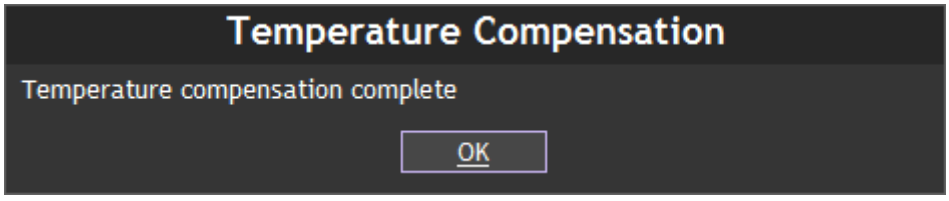
If you do not want to use temperature compensation select Disabled from the drop down list presented when you click the **Number of compensation points** field.

Selecting any number of points from 2 to 5 will enable the first **Acquire** button. You need to keep the same weight (or no weight) on the loadcell 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 the loadcell chassis to stabilise at that temperature and that will depend on the chassis mass and material. Try and get the DTemp sensor close to the strain gauge element.

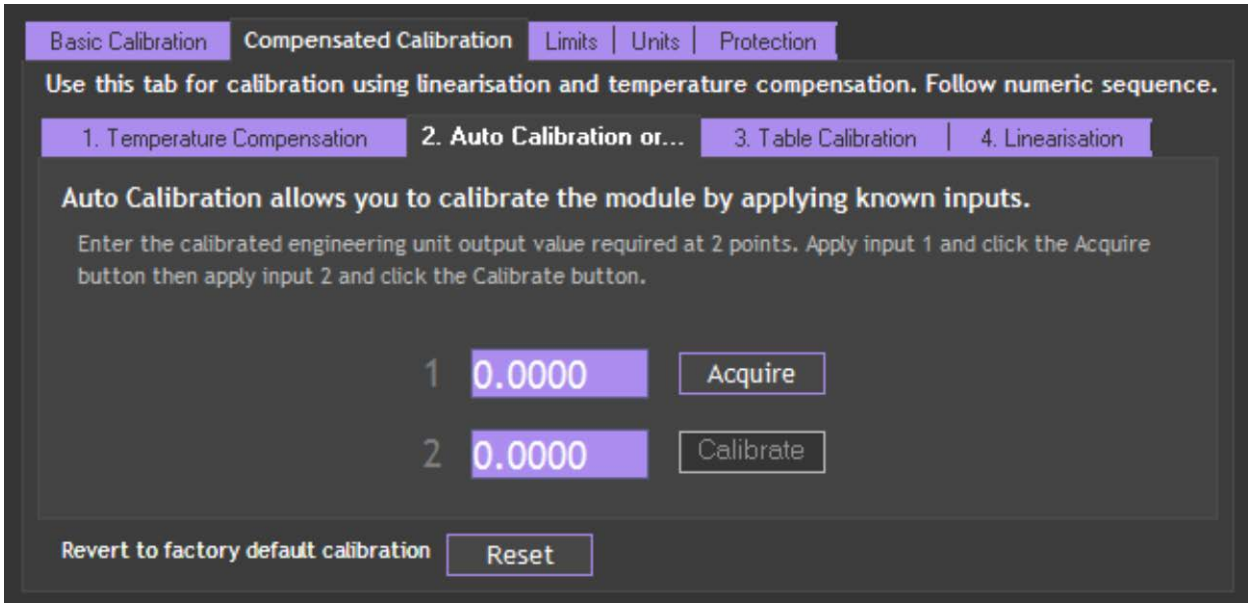
Once enough time has elapsed for the temperature to stabilise you can click the **Acquire** button and that button will become disabled and the next enabled.

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.

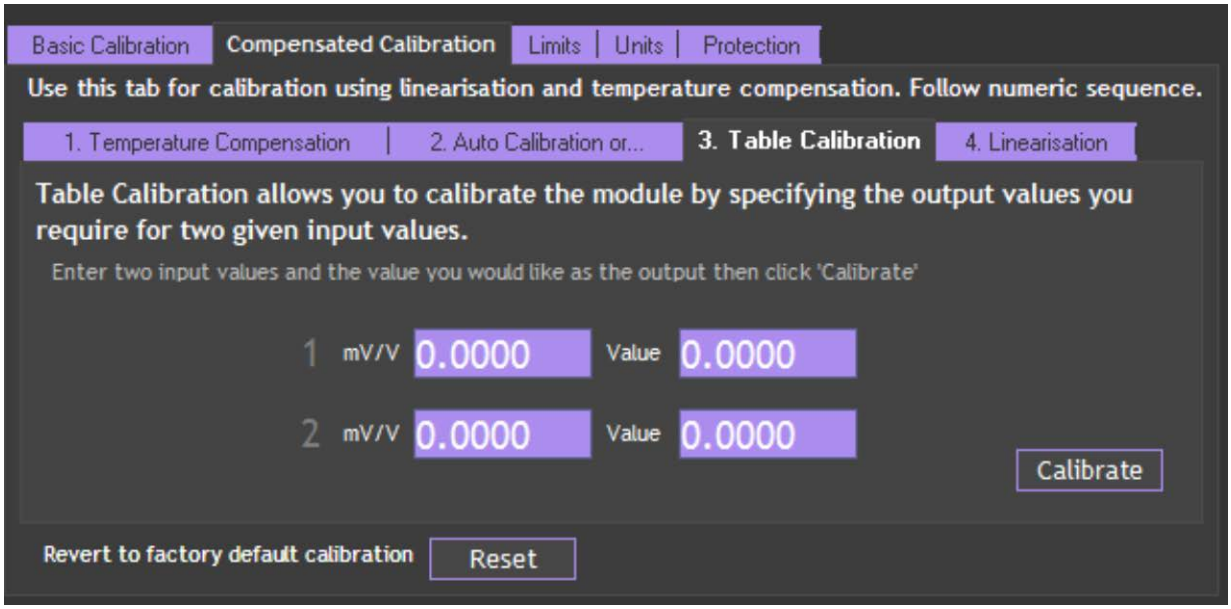
2 Auto Calibration



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

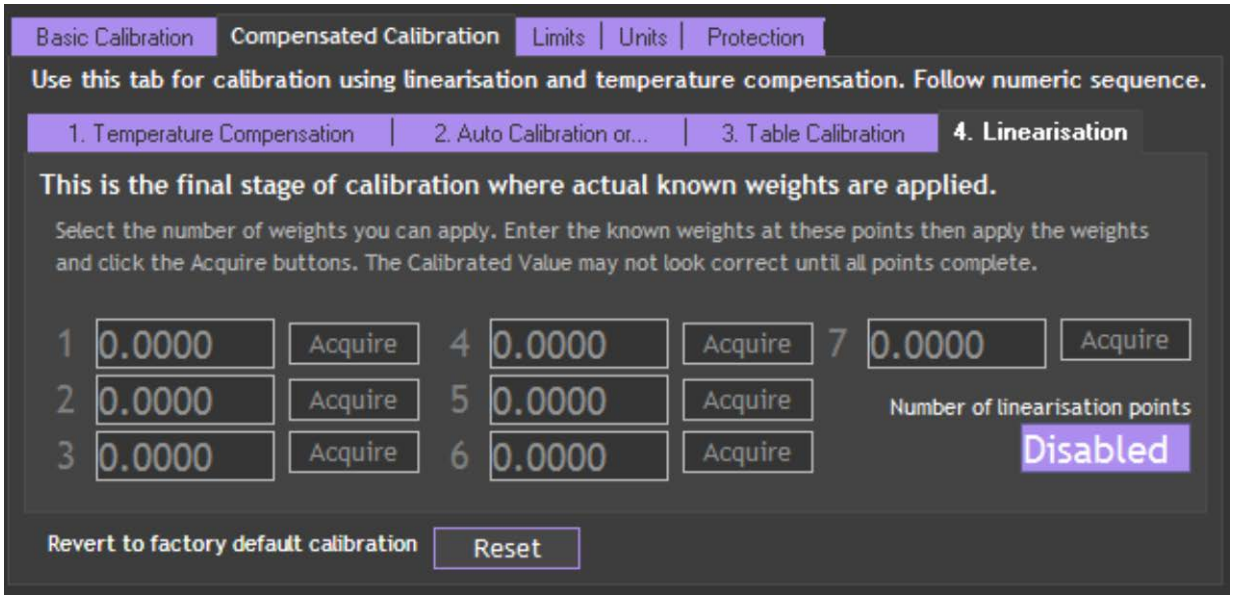
Next, apply the lowest weight and allow a settle time. Click the '**Acquire'** button then apply the higher weight. After another settle time click the second '**Acquire'** button and the calibration is complete.

3 Table Calibration



This option lets you calibrate direct from the loadcell manufacturers certificate without having to apply weights to the input.

Choose 2 points from the loadcell certificate and enter the mV/V values and the corresponding weights on the certificate (or convert the certificate weight to any other engineering unit of your choice) click the '**Calibrate'** button and the calibration is complete.



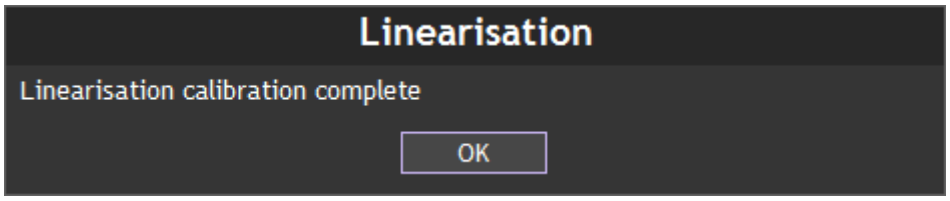
This stage is optional. If you do not want to use linearization then select **Disabled** from the drop down list that is presented when you click the **Number of linearization points** field.

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 weights 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.

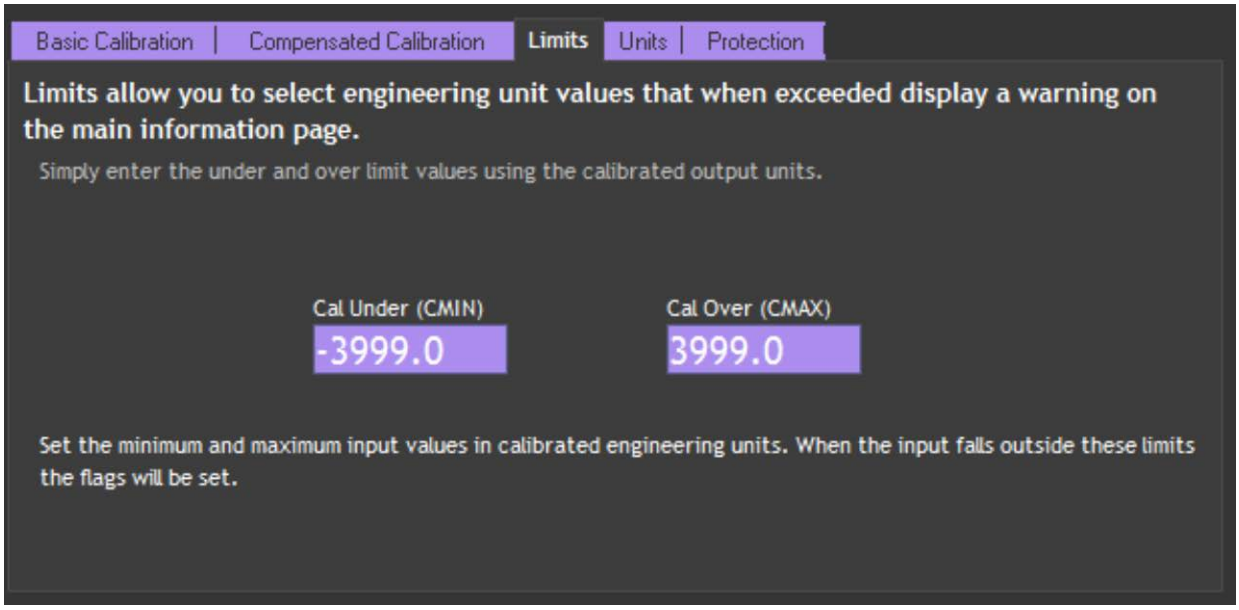
The linearization points are usually spread out evenly between the two points used for auto calibration but if you know that a particular section of the range is less linear you may want to concentrate the points in that area.

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

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

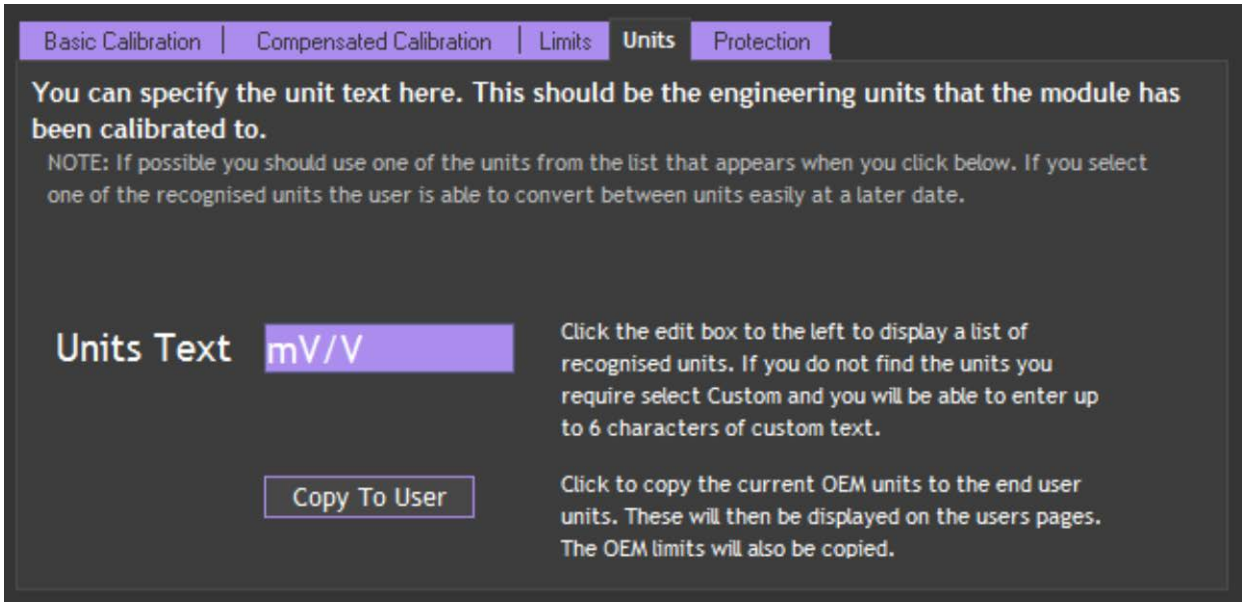


Limits



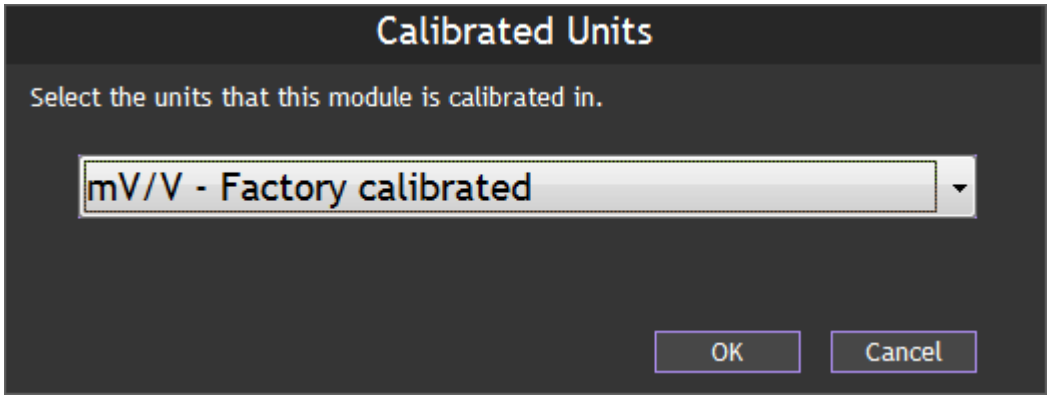
Here you can set limits below and above which the warning indicators will be displayed on the Information Page for the standard user. These limits should cover the operational range that the combined loadcell and DSCUSB are allowed to operate over.

Units

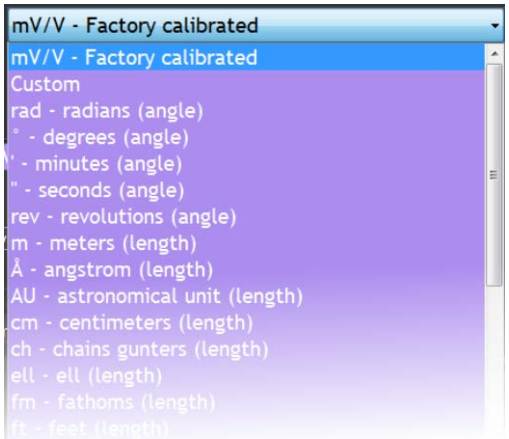


If you have calibrated the module to standard units you can specify them here. The advantages are that the standard user will see the units displayed and if the units are recognised by the software the standard user can simply convert to another unit scale without recalibration.

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



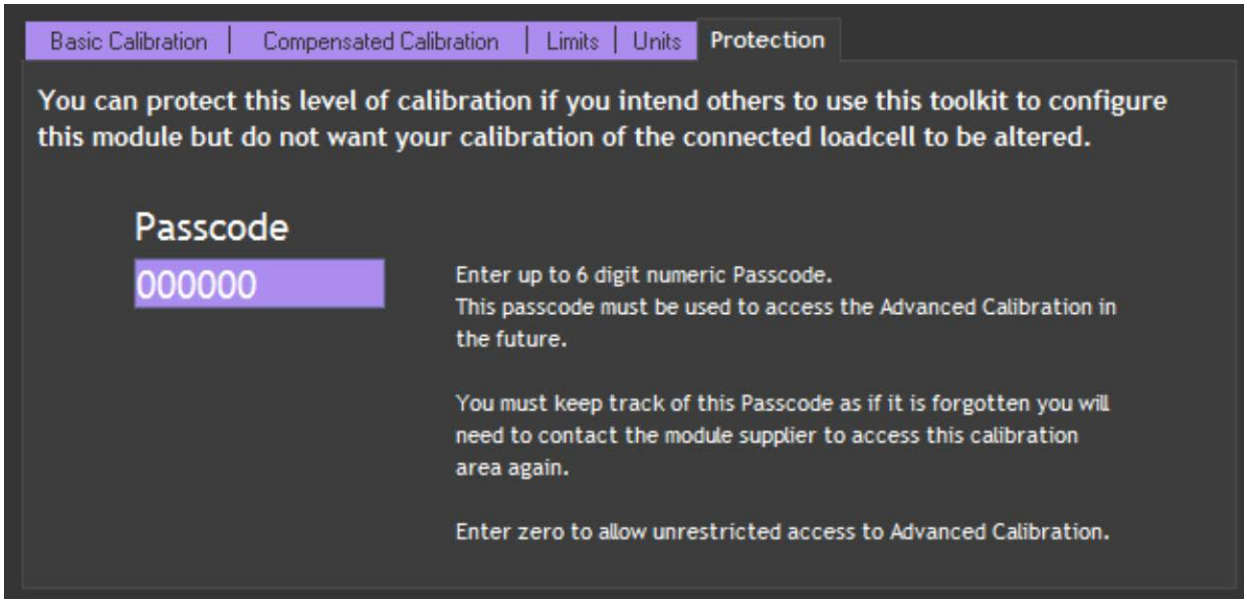
Select the desired units from the drop down list.



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.

Protection



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

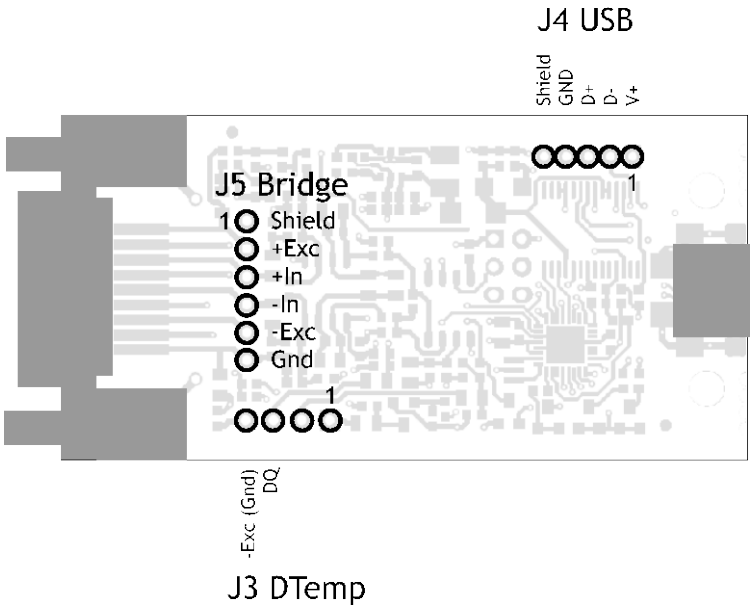
To protect a module enter up to 6 numeric digits after clicking the **Passcode** field. This 6 digit passcode will then be required by a standard user to enable the **Advanced Calibration** section of the software.

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

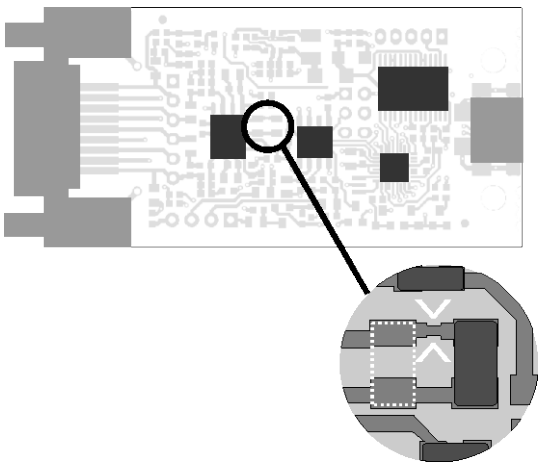
As well as being available in a plastic case there are some variations of the DSCUSB that are supplied uncased. These variants may or may not have connectors fitted. Please find connection details below.



Changing Sensitivity

The DSCUSB was designed for bridges with a nominal sensitivity of 2.5mV/V.
The absolute maximum bridge output that can be accommodated is 3mV/V. If you use bridges with a lower sensitivity (Such as 1mV/V) you will only be using a portion of the input range so resolution suffers.
When bridges with higher than 3mV/V sensitivity must be used or those with a sensitivity less that 2mV/V that would not yield enough resolution you will need to alter the gain of the module. This is classed as an advanced operation and will void the module warranty.
If you want to test with an input of more than 2.5mV/V, you will have to adjust the hardware sensitivity to avoid saturating the input. If it is less, you can correct in software alone, but increasing sensitivity will generally improve accuracy.
To adjust the mV/V for DSC, an extra resistor 'Rg' is fitted across the pads as shown below and you may be required to break the link track as indicated.

Identifying the 'Rg' Resistor



If the DSCUSB module is cased the printed circuit board (PCB) needs to be removed from the case by undoing the two screws on the rear.
On the PCB the Rg resistor is the pair of pads identified in this image by the dotted outline. There is no dotted outline present on the PCB. The pair of white arrows are present on the PCB and may be used to identify the correct position.

The resistor is 0805 size surface mount chip.
A 0.1%, 5ppm/Deg C resistor must be used to maintain performance.

Identifying the Link Track

The link can be cut to disconnect the internal 100R gain resistor: This is needed for lowering the sensitivity. The track is identified between two white arrows (above diagram) and should be carefully cut using a scalpel or other sharp blade.

Reducing Sensitivity

To accommodate a maximum sensor output larger than 2.5mV/V, it is necessary to reduce the electrical sensitivity of the input circuitry.

To decrease sensitivity, the Link Track is cut, and the value of the resistor fitted, in Ω, should be –
Rg = (required mV/V) x 40

Example: For 10mV/V
Rg = 10 x 40 = 400Ω

Increasing Sensitivity

When the full-scale output is smaller than 2.5 mV/V, it may be desired to increase sensitivity.

To increase sensitivity, the Link Track is left in place, so that the fitted Rg appears in parallel (this gives better temperature stability). Its value should then be

RG = 1 / ((0.025 / required mV/V) – 0.01)

The following effects should be noted:

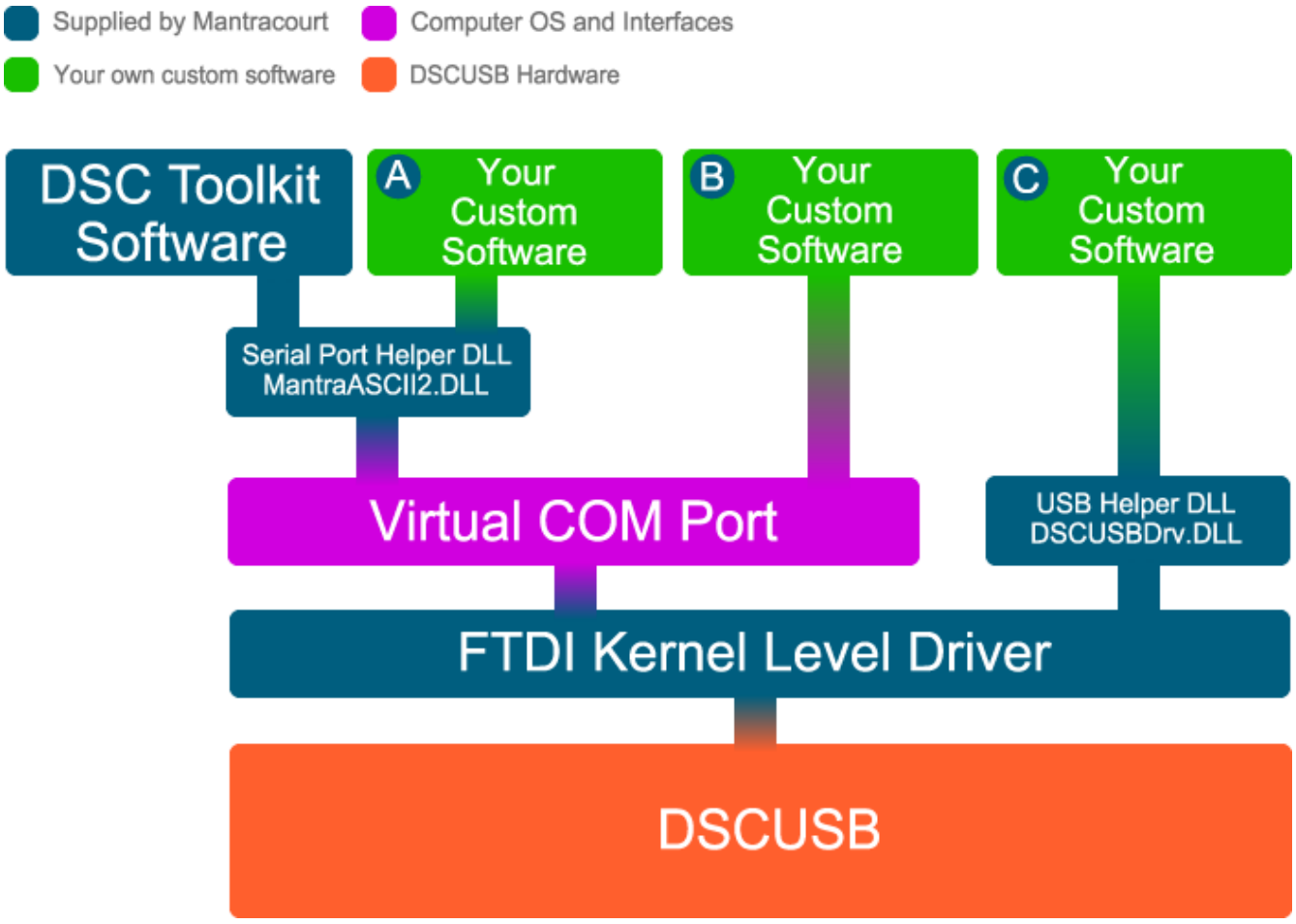
1. Changing the resistors will alter the factory mV/V calibration. You will no longer be able to use any table calibration functions of the toolkit software and calibration will have to be redone after this change.
2. The purpose of increasing sensitivity is to reduce reading noise, which governs the effective resolution. Using software gain alone obviously gives reduced performance.
3. The sensitivity should, however, not be set greater than typically 1mV/V: Beyond this, input noise usually dominates and no extra benefit can be achieved.

Chapter 4 Communications

Interface Explained

The USB connection on the DSCUSB module requires specific hardware drivers to enable it to be detected correctly and to operate. These drivers are installed along with the DSC 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 module that is plugged in and so the modules can be communicated with as if they were plugged into serial ports.
The DSC 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 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.



Communication Options

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

Virtual Serial Port Connection B

You can open the virtual COM port with your own custom software and communicate with the DSCUSB 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.

MantraASCII2.DLL standard Windows DLL driver A

This driver communicates with the DSCUSB module via the virtual COM port but the driver only opens a single COM port. Therefore virtual serial port connections to DSCUSBs 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 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**.

DSCUSBDrv.DLL standard Windows DLL driver C

With this driver you can communicate with the DSCUSB module directly over USB via the kernel level driver by referencing its serial number. You can connect as many DSCUSB 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-DSCUSBDLL**.

Communications Protocol

If you are writing your own software to communicate with the DSCUSB 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 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 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 mV/V	float	RO
STAT	Status	int	RO
MVV	Filtered & factory calibrated mV/V	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 mV/V 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
USR1..9	g.p. storage values	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 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 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.

Designed, manufactured and supported in the UK

ISO 9001 REGISTERED FIRM

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

Code No. 517-934 Issue 1.2 22.04.15