

## FSU-SSB

Fast Strain USB – Strain Gauge Input

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# Chapter 1 Introduction

This chapter provides an introduction to the FSU products, describing the product range and main features.

## Overview

The FSU product family comprises of Digital Sensor Cards that connect strain bridge sensors to your PC via USB. The FSU 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-speed measurement.

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.

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

## LED Status Indication

The module indicates status via a red Healthy LED.

When the FSU is placed in configuration mode the LED will be on solidly.

When the FSU is in recording mode and transmitting data the LED should flash ON for 100ms every 500ms (LED will be OFF but flash on for a tenth of a second every half a second).

If the integrity of the load cell is in doubt the LED will flash OFF for 100ms every 500ms (LED will be ON but flash off for a tenth of a second every half a second).

## Chapter 2 Getting Started

- Install software (But do not run it)
- Plug FSU module into USB port
- Run software

This chapter explains how to connect to a FSU for the first time and how to get it working.

### Communications Interface Information

FSU modules can connect to a PC by plugging into a USB port and do not require an external power supply as they appear as a 'single unit load' i.e. they draw <100mA.

Appropriate USB drivers must be installed which are automatically installed with the **FSU Toolkit** software.

### FSU Toolkit

The FSU Toolkit is a configuration and analytical tool designed specifically for configuring FSU modules.

This toolkit allows configuration, calibration, data recording and review and for parameter management of the modules.

### What Can The Toolkit Do?

Communications with a **single** module at a time to do the following:

- Viewing of input with indication of integrity errors.
- Two point auto calibration by application of known weight.
- Two point table calibration from load cell calibration certificate.
- Setting System Zero.
- Engineering unit selection.
- Save module settings including user calibration and ability to restore to same or different USB FSU modules.
- Capture up to 30 minutes of data at 4800 Hz. Save data to CSV file. Navigate up to 30 minutes of data captured from the FSU or loaded from a previously saved CSV file.
- Trend chart view of live input. Exportable image and data.
- FFT view to identify frequency components of input signal.
- Simple oscilloscope view for wave based signals between 1 Hz and 500 Hz.
- Easily switch to alternative engineering units (If module has been previously calibrated)

It should be noted that traditional logging (Where the user start and stops a log) is not required with the FSU Toolkit. The FSU module operates in two modes. The first mode is where the measured value is being constantly transmitted at 4800 Hz and the other mode is configuration mode where the Toolkit can talk to the module but the measured value is not being constantly streamed. As will be seen later, the Toolkit allows capturing up to the last 30 minutes of data as long as the user stays out of the configuration pages. This 30 minute block of data is easily and quickly navigated to isolate data of interest.

### Installing FSU Toolkit

Install the FSU Toolkit software by inserting the CD or USB storage device. This should start the 'AutoRun' process, unless this is disabled on your computer.

(If the install program does not start of its own accord, run **FSU Toolkit Setup.exe** from the installation media.

Alternatively launch the installer executable file which may have been downloaded from a web site.

The installation software pre-installs the required USB drivers so that they can be automatically found when the hardware is plugged in later on.

After the software has been installed please connect the module to the PC and see the next section before running the FSU Toolkit

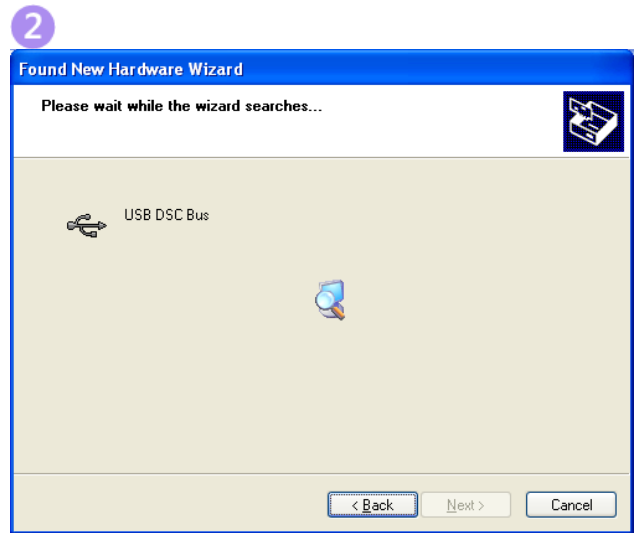
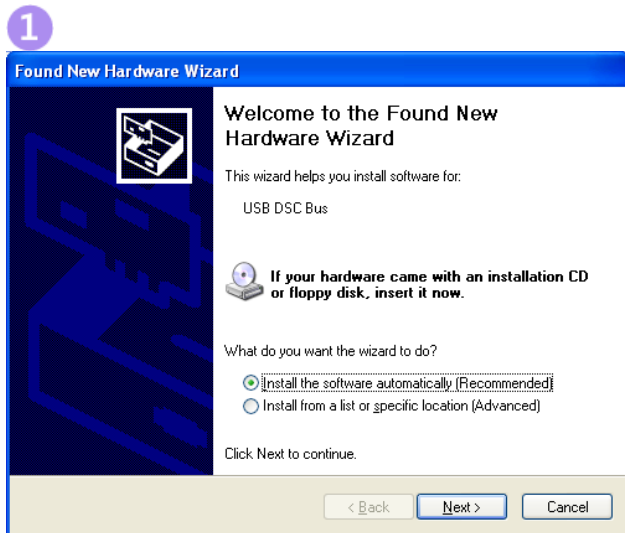
## Connecting the Module to the Computer

Connect to a USB port on the Windows PC using the cable provided with the module.

## Using the Found New Hardware Wizard

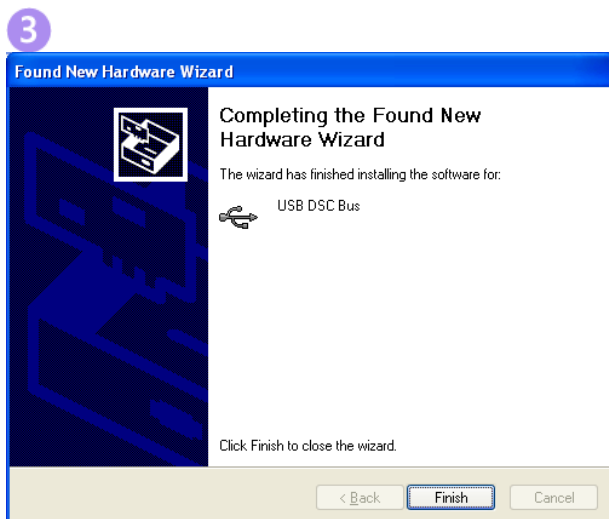
Connecting the module will cause the following dialog windows to appear. NOTE: Different operating systems may present different dialog windows but the dialogs shown below should allow you make the correct choices regardless of operating system.

Note that the FSU shares the drivers with the DSC range of modules so the driver is described as the **USB DSC Bus**.



The 'Found New Hardware Wizard' should now appear. Select 'No, not at this time' if you are asked whether the drivers should be searched for online. Click 'Next'.

Now the wizard will start searching for the drivers.



The wizard should then proceed with installing the software drivers.

## Using the Software

You can now launch the FSU Toolkit software.

Only one FSU module at a time can be connected to a PC!

The **FSU Toolkit** automatically detects the connected FSU module.

If the FSU module is detected when you launch the **FSU Toolkit** it will be automatically selected and the **Information** page will be displayed.

If the module is not detected you will see the **Home** page at which you can wait until the FSU module is connected. Pressing the **Detect** button will start the detection process.

The **Review** page is also available at this point. See later in the manual for using the **Review** page. This will allow you to review previously saved data.

Recording occurs continuously in the background while on any of the following pages:

 Capture,  Review,  Scope,  FFT


and will continue even while navigating between these pages.

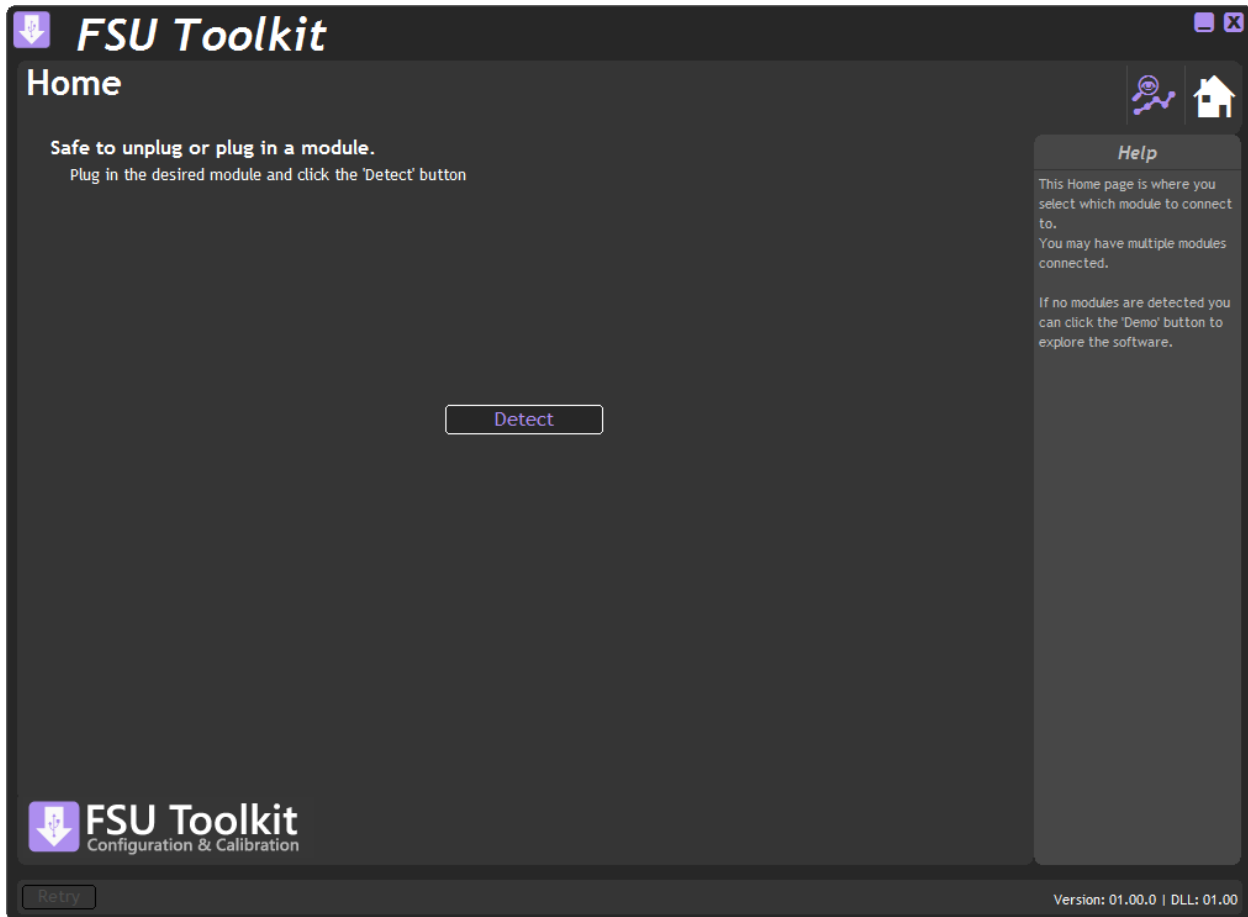
However, switching to any of the other pages

 Home,  Information,  Save & Restore,  Lock,  Calibration

will cause the recording to stop.

## Home Page

Click the  icon to access the Information page.



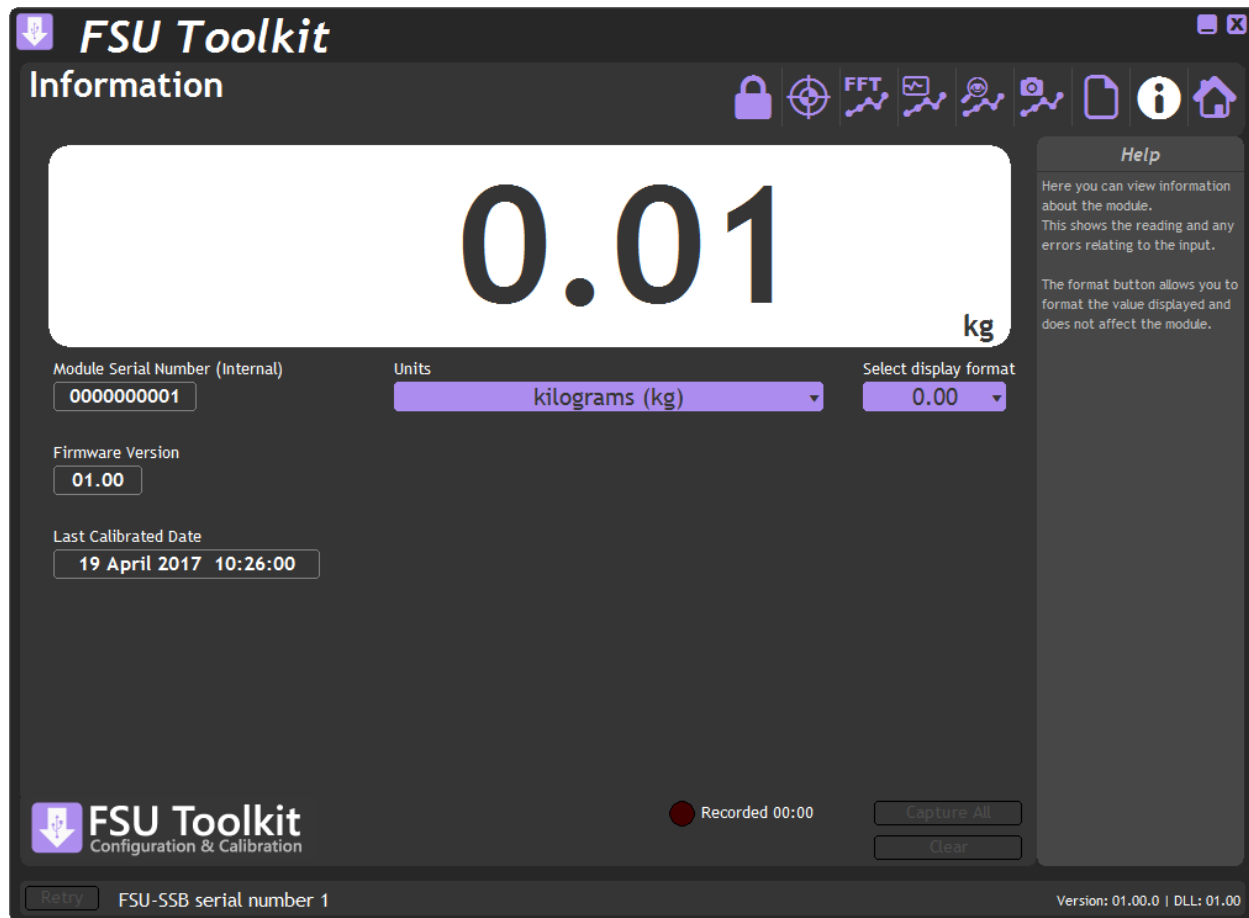
After clicking the 'Detect' button and a module is detected you will then see the Information page.



## Information Page

Click the **i** icon to access the Information page.

No data is recorded while on this page.

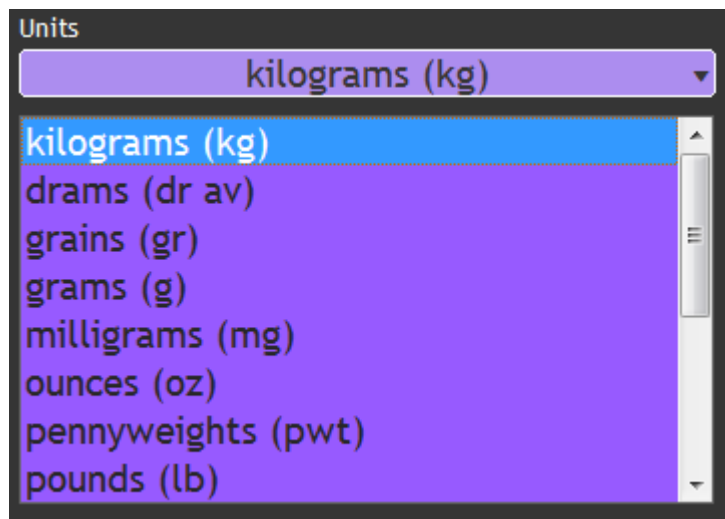


This simply shows a large display and indicates if any error conditions are present by displaying an information box. The module serial number, firmware version and last calibration date are also shown.

If the module has been allocated engineering units these will be displayed in the lower right of the LCD display.

### Units

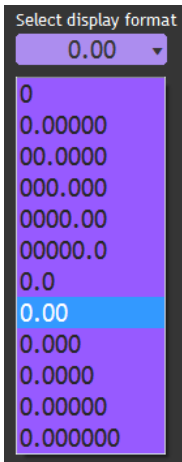
If the calibrated units have been defined for this module then you can select from a list of alternative engineering units to use.



This feature may be locked on certain modules.

### Format

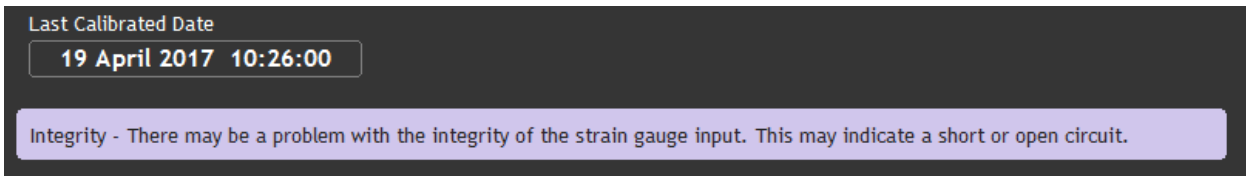
Clicking the 'Format' button allows you to select a new format for the displayed value. By using this you can hide unwanted decimal places.



Just click the required display format in the list.


### Error Indication

If any errors are detected these will be shown under the main display. The following screenshot shows an Integrity error present.

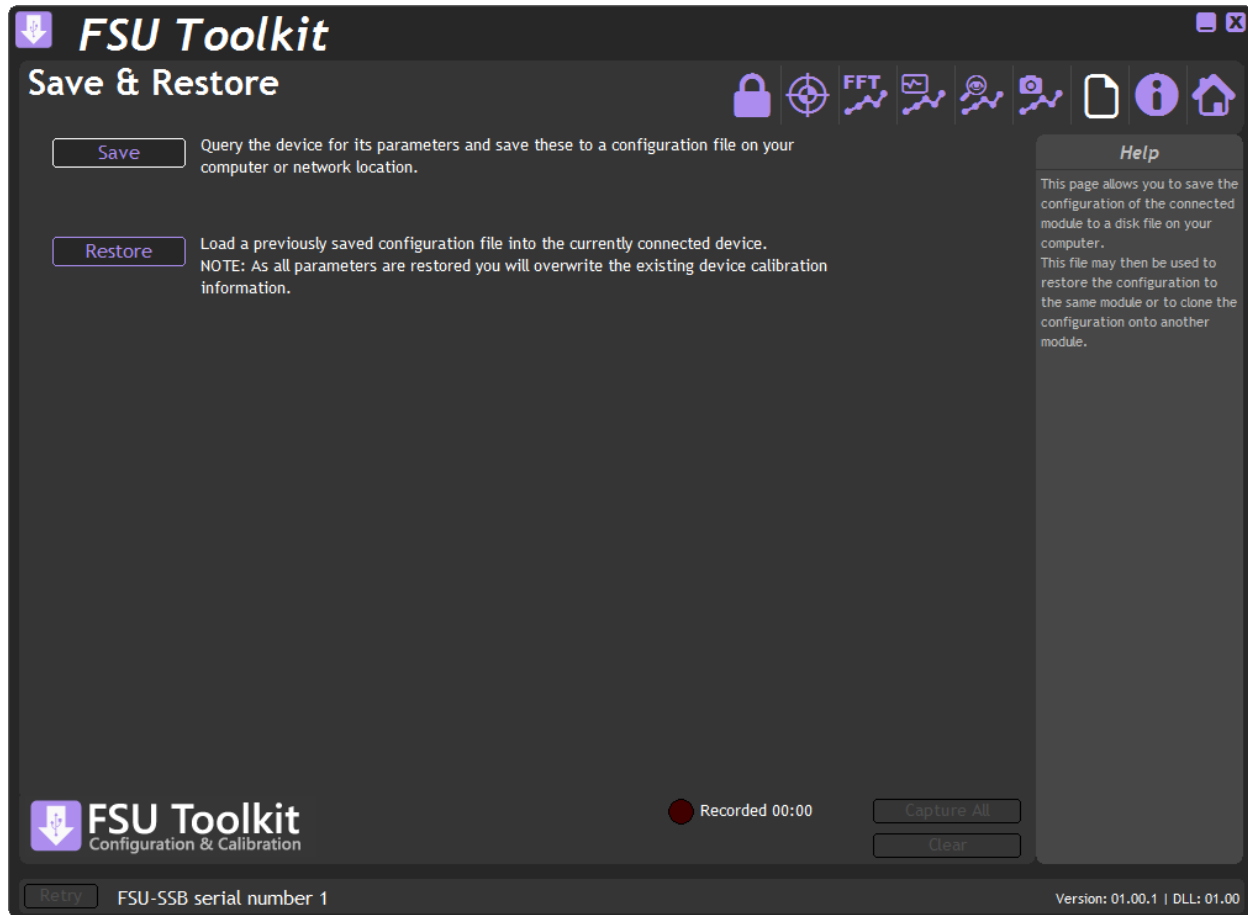


The error box will disappear once the error is no longer present.

## Save and Restore Page

Click on the  icon to open the Save & Restore page.


No data is recorded while on this page.



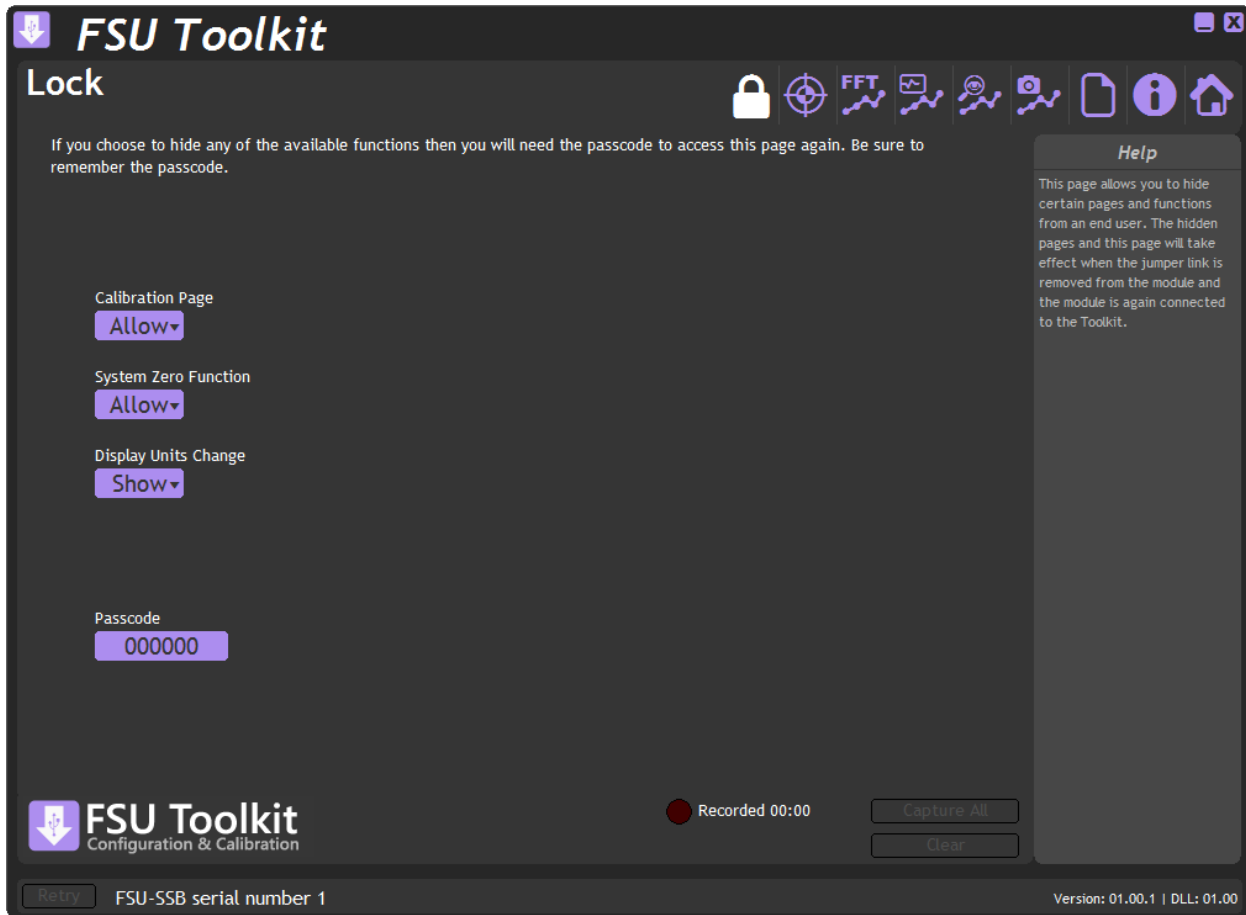
Clicking the '**Save**' buttons will allow you to specify a file to which the configuration of the connected module is written.

Once saved this file can be selected, after clicking the '**Restore**' button, and the settings restored to the same module or to another module.

## Lock Page

Click on the  icon to open the Lock page.

No data is recorded while on this page.



This page will allow the locking of certain functions. Once any item has been changed from Show to Hide or Allow to Lock then subsequent attempts to open this page (And thus show the hidden functions again) will result in the user being asked for a Passcode.

The Passcode entered must match the one entered on this page to grant access.


It is important to remember the Passcode before leaving this page after any of the options have been set to Hide. You will need to contact Mantracourt to aid in Passcode recovery should the Passcode be forgotten!

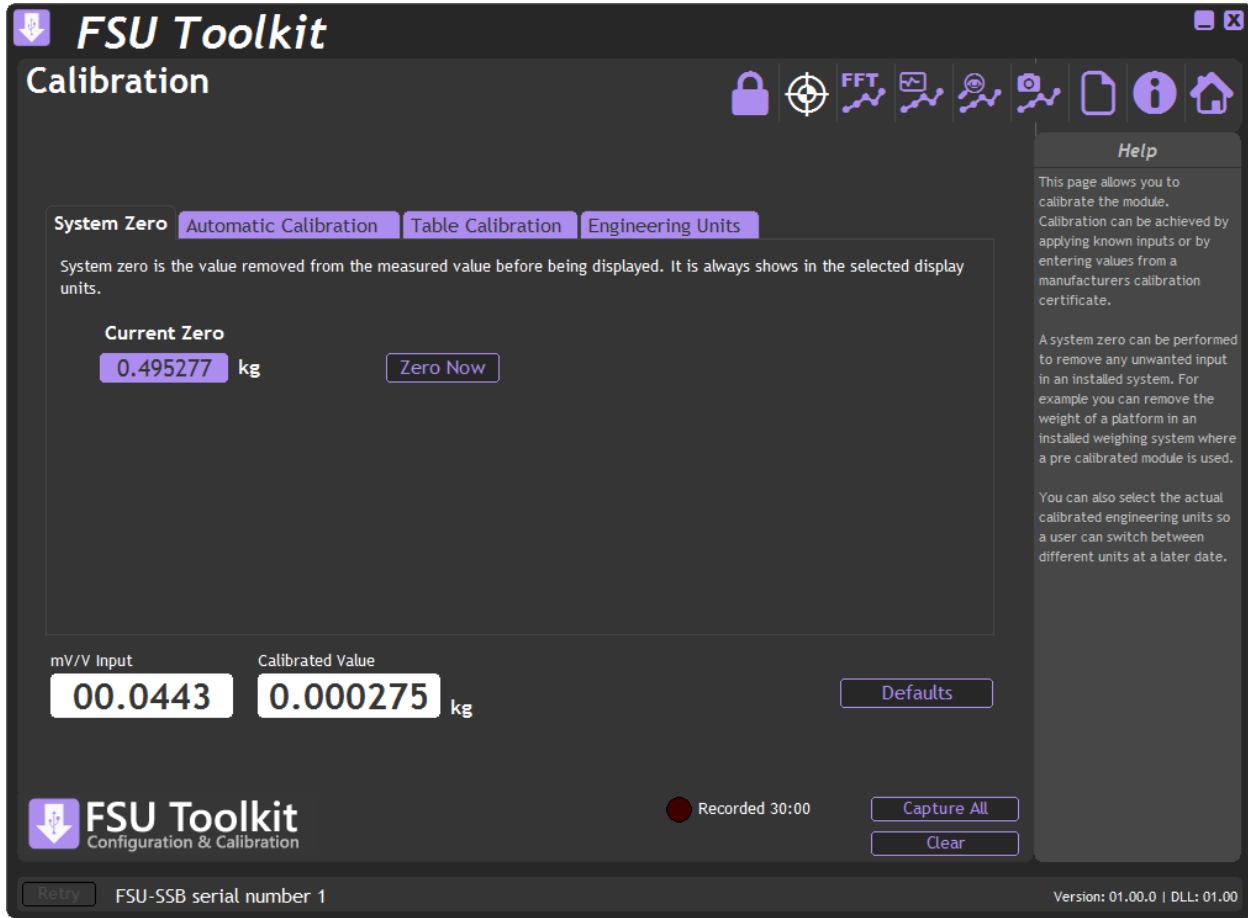
**Calibration Page** – Allows you to either Allow or Lock access to the calibration page.

**System Zero Function** – Locking this function will also force locking of the Calibration Page. This is useful if the Calibration Page has been locked but you want to still offer the ability to set the System Zero. Just set this to Allow after setting the Calibration Page to lock.

**Display Units Change** - Hiding this function will also force locking of the Calibration Page. This is useful if you want to lock access to the Calibration Page but allow the user to change the displayed engineering units. Just set this to Show after setting the Calibration Page to lock.

## Calibration Page

Click on the  icon to open the Calibration page.



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

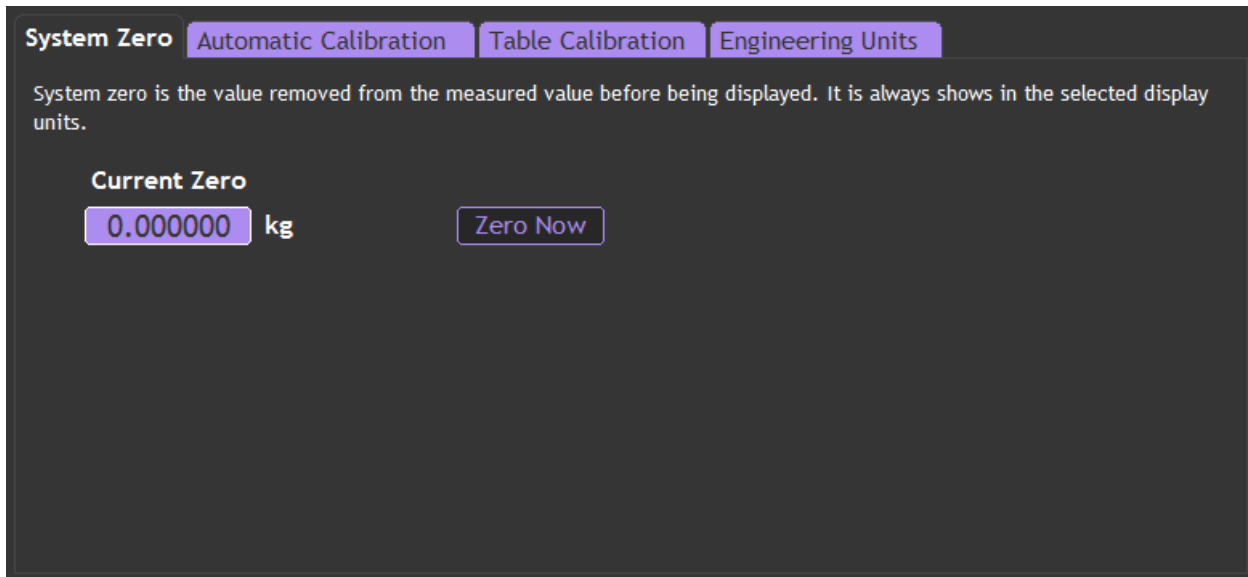
**mV/V Input** – Shows the actual mV/V input as measured by the module.

**Calibrated Value** – Shows the calibrated value.

**Defaults** – Clicking the Defaults button will remove any user level calibration and return the module to its factory calibrated state.

The page is separated by tabbed sections; *Automatic Calibration*, *Table Calibration* and *Engineering Units*. Click a tab to change sections.

## System Zero



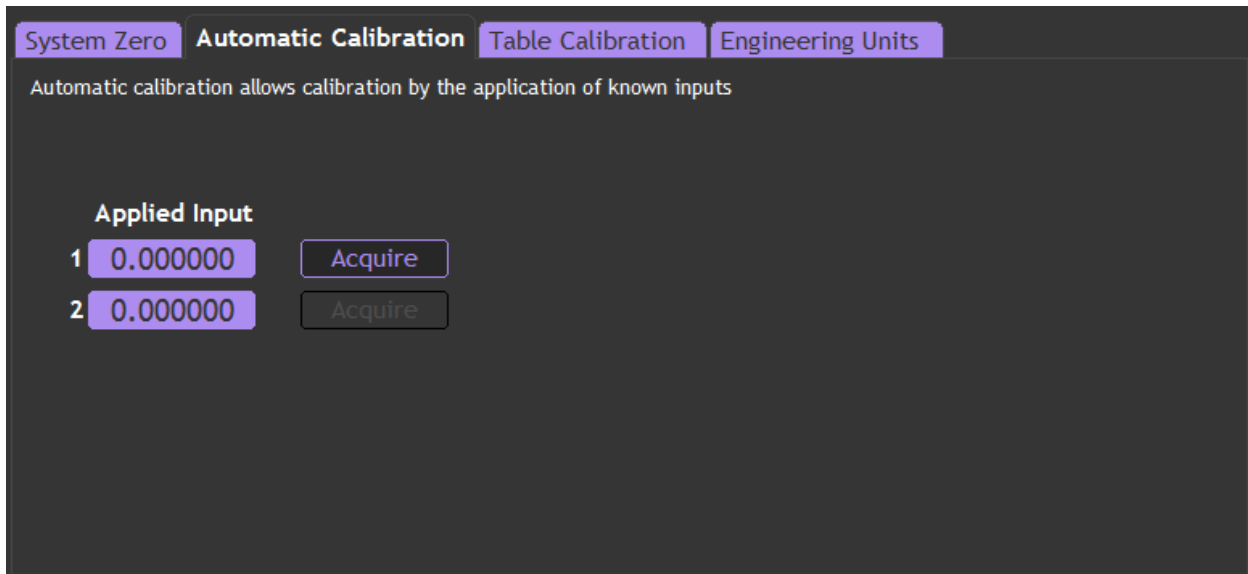
System Zero is used to remove permanent values from an installed system such as the weight of a vessel or weighing platform to give a zero Gross value.

The value shown on this page is subtracted from the measured value.

You can either type a value in manually or click the **Zero Now** button to automatically fill in the value to give a zero reading based on the current input.

This feature can be hidden on the [Lock Page](#).

## 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 higher input. After another settle time click the second '**Acquire**' button and the calibration is complete.

## Table Calibration

	mV/V	Engineering Units
1	0.000000	0.000000
2	0.000000	0.000000

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

Choose 2 points from the load cell 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.

## Engineering Units

Units

kilograms (kg) [Mass]


Choose the engineering units of the current calibration. Changing units will not change the current calibration but just acts as the reference for any future conversions using the display units.

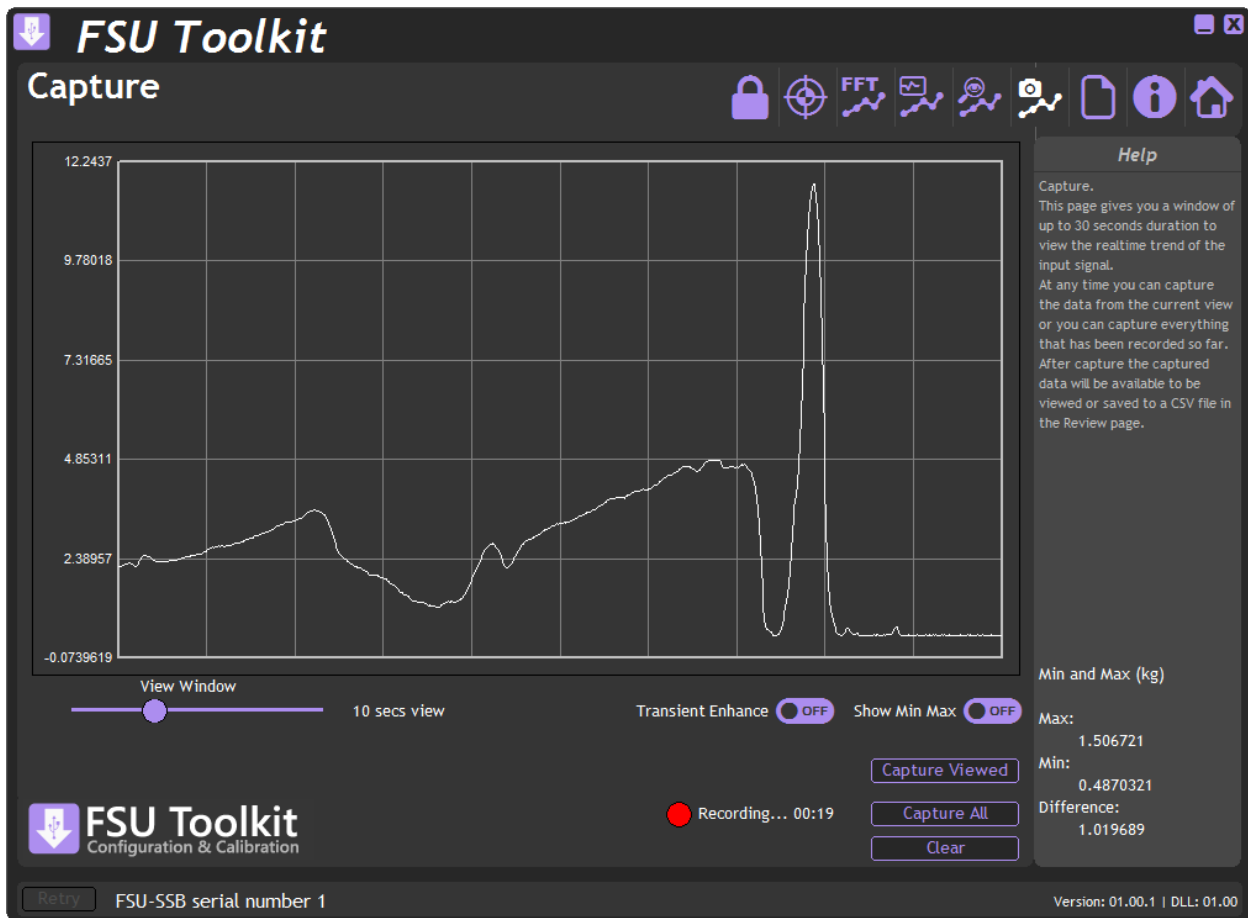
This allows you to specify the engineering units that the module was calibrated in. Changing this does not affect the calibration. It simply assigns the engineering units to the calibrated value so that later the user can select different engineering units and the module output value will be automatically converted to the selected units.

If you do not want the user changing the units you can hide access to that feature on the [Lock Page](#).

If you do not want to display any engineering units then select Undefined from the list and no units will be displayed next to the value on the Information Page and the user will not be able to select or change the displayed engineering units.

## Capture Page

Click on the  icon to open the Capture page.



This page helps you to see what is happening in real-time to the input of the module. All the other pages offer you the options of Capture All to capture and review everything recorded so far. *This* page allows you to capture shorter durations and to see the state of the input for those times when you can identify when to capture the input data.

### View Window

Select the viewing window into the real-time data by selecting between 1 and 30 seconds using the slider. The input data is displayed on the chart.

### Transient Enhance

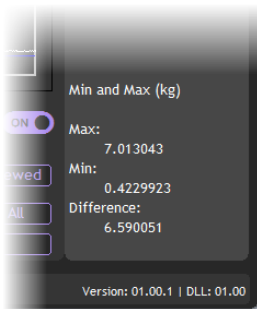
Selecting this option will enhance the display to better identify fast transient peaks. Because of the way a large amount of data is subsampled to enable it to fit on the chart, fast peaks may not appear or may flash in and out of visibility as the data flows past the chart. This feature will have the side effect of creating a slightly fuzzy edge on slower moving data. This does not affect the way data is recorded, only the way it is shown on the chart. When used in conjunction with the Show Min Max feature this can help stabilize the view of data.

### Show Min Max

By default the chart auto scales as the data moves across it which means that if a transient occurs the chart will rescale but once that transient leaves the viewport the chart will autoscale again based on the lower magnitude data that follows. By selecting this feature the chart scaling will be locked to the minimum and maximum values detected while the feature is active.

Also, when activated, the values of the detected min and max along with the difference between the two are displayed in the lower right of the window in the Help pane.





To deactivate the Min Max function set the switch to off. Next time it is switched on the min and max values will be reset.


### **Capture Viewed**

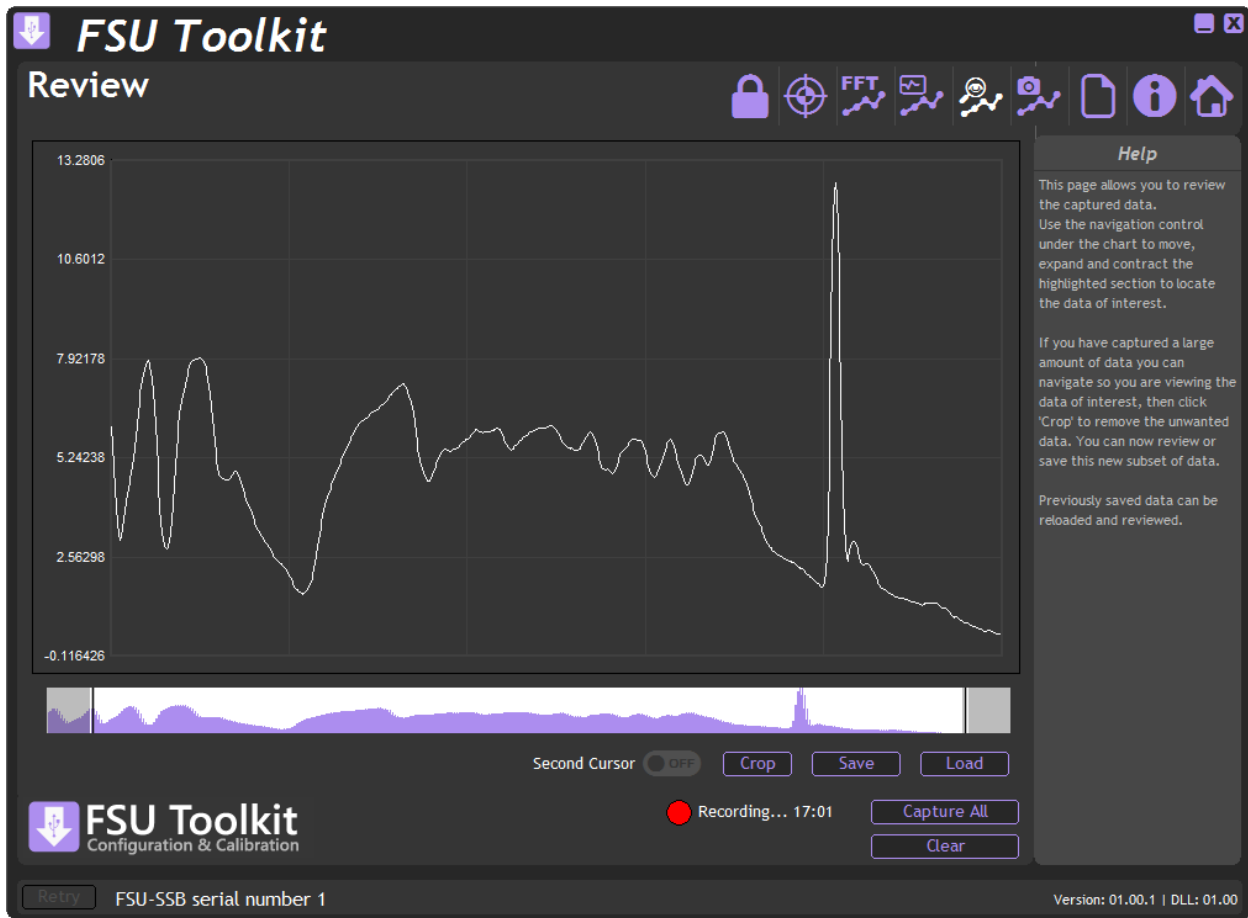
Although you are always able to Capture All data recorded so far, this Capture Viewed button gives you the options of capturing only the data currently visible on the chart. Sometimes the data you are interested in can be recognised from the chart so this avoids having to capture and review all of the recorded data which may be up to 30 minutes worth.


### **Copy Chart Image**

This feature is available by right-clicking on the chart and copies the chart image to the clipboard enabling pasting into other applications.

## Review Page

Click on the  icon to open the Review page.



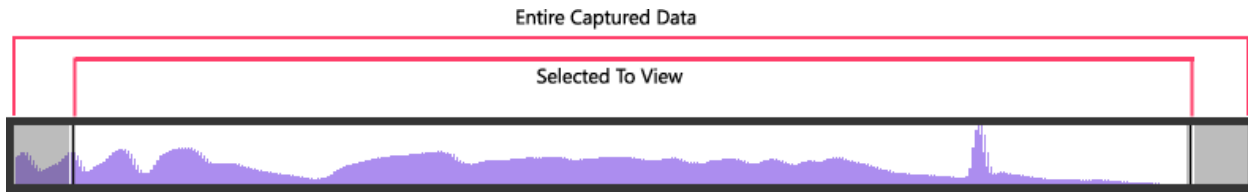
This page can be selected by clicking the  icon or it can be shown automatically by clicking the **Capture All** button or the **Capture Viewed** button (Only available on the Capture Page).

This is where you can navigate through all the captured data, optionally discard unwanted data, view cursors and load and save data).

The chart automatically enhances transient peaks so that there is no chance of missing important features in the data. Once you have zoomed in enough so you can identify individual data points the enhancement is turned off automatically.

## Navigation

The data navigation bar sits under the chart. The entire set of captured data is represented in the background coloured purple. The lighter highlighted part shows the selected portion that is currently being displayed in the chart. Thus the navigation control allows you to zoom in and out of the data as well as pan along through the data at the current zoom level.



You can change the viewed data by dragging the highlighted portion as follows:

Expand or contract the highlight by clicking and dragging the cursor at the left-hand side of the highlight or anywhere to the left of the highlight.



Expand or contract the highlight by clicking and dragging the cursor at the right-hand side of the highlight or anywhere to the right of the highlight.

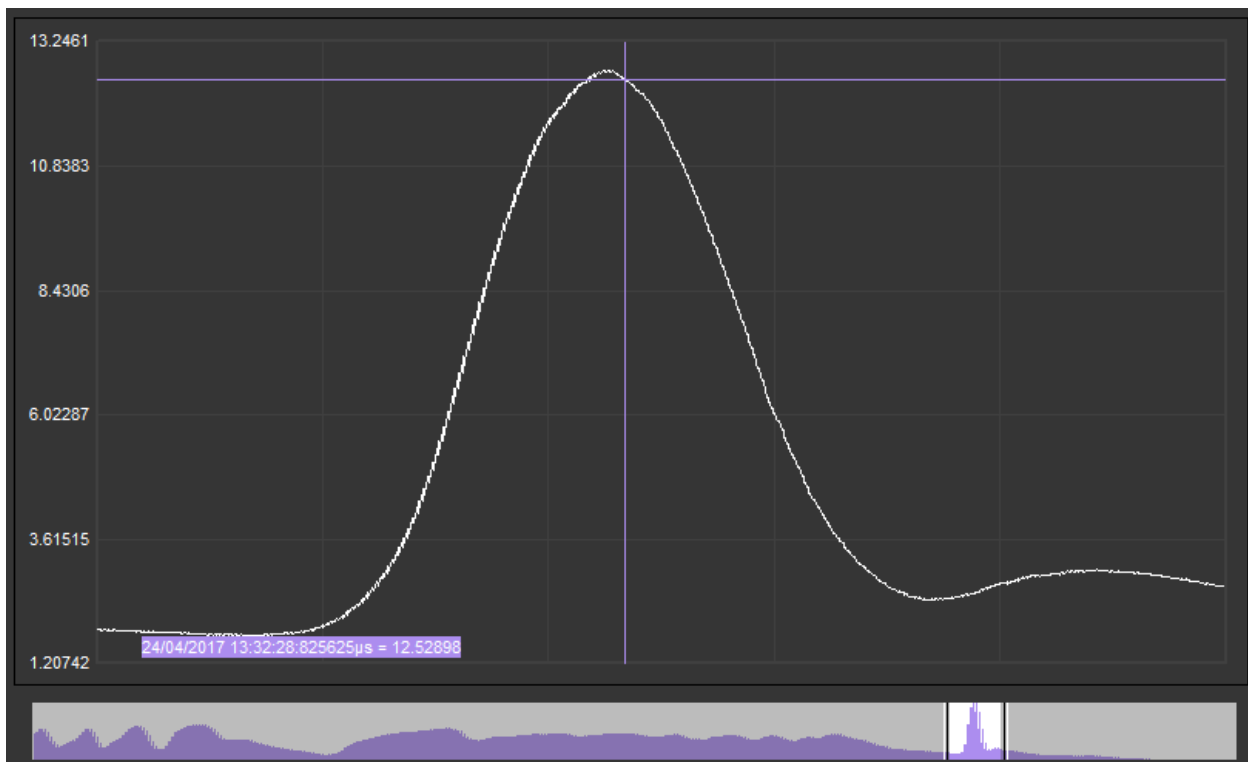


Or you can pan the highlight left and right by clicking and dragging in the middle of it.



## Cursors

Left clicking on the chart will display the first cursor. The cursor snaps to the nearest data point and displays the data and time and value of the data point in a box in the lower left of the chart.

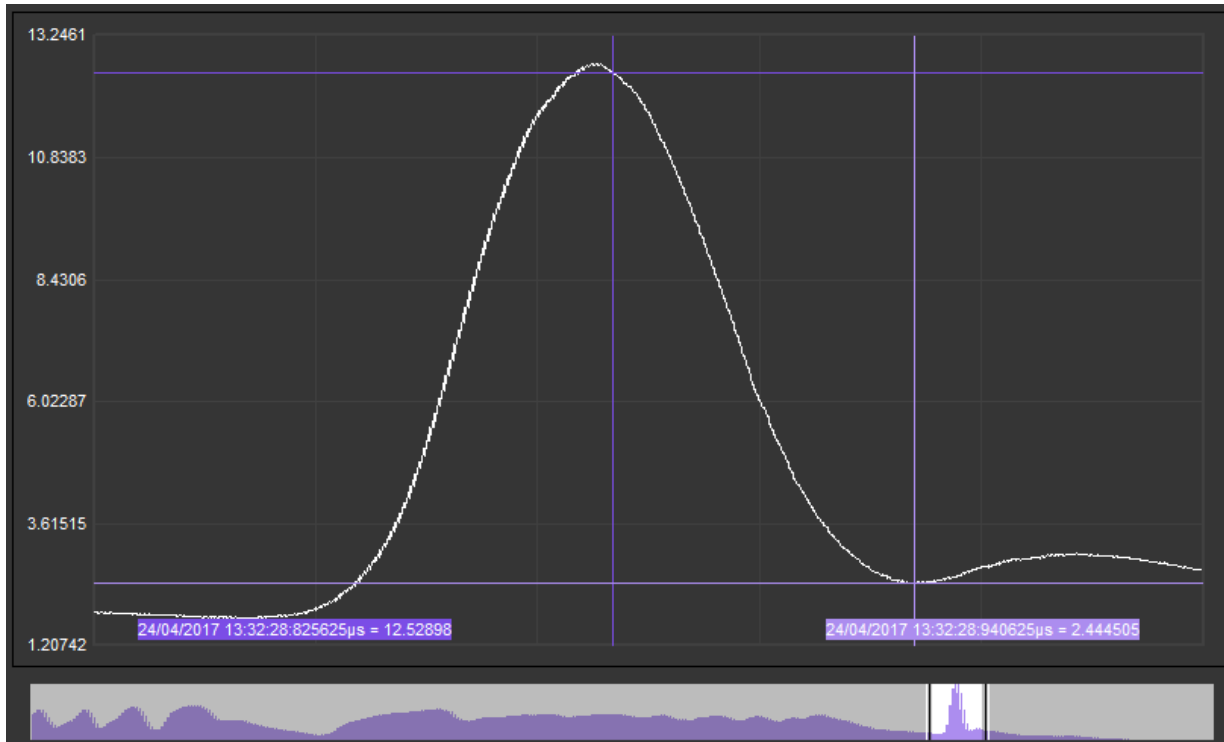


The date is followed by the time in HH:MM:SS:microseconds format then the value.

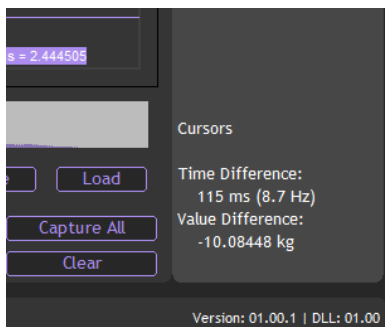
Cursors are turned off once the navigation control is used.

## Second Cursor

Turning this feature on will display a second cursor that can be positioned on the chart.



There is also some extra information displayed in the lower right of the window in the Help panel.



This displays the time difference between the two cursors (Plus the frequency if you had placed the cursors on two adjacent features in a wave based signal) and the value difference.

Cursors are cleared once the navigation control is used.

## Crop

When displaying large amounts of data (30 minutes of data equates to over 8.6 million data points) it is often only a small portion that contains the actual data of interest. The crop button discards data that falls outside of the currently viewed portion of the entire data set and resets the chart and navigation control to focus only on this data.

The newly focussed data can then be navigated, saved or again zoomed and cropped.

If a mistake is made during cropping, the entire data can be captured again.

## Save

Save the entire data set to a CSV file. The file can be loaded again to be reviewed or loaded into a 3<sup>rd</sup> party program for analysis. See [CSV File Specification](#).


## Load

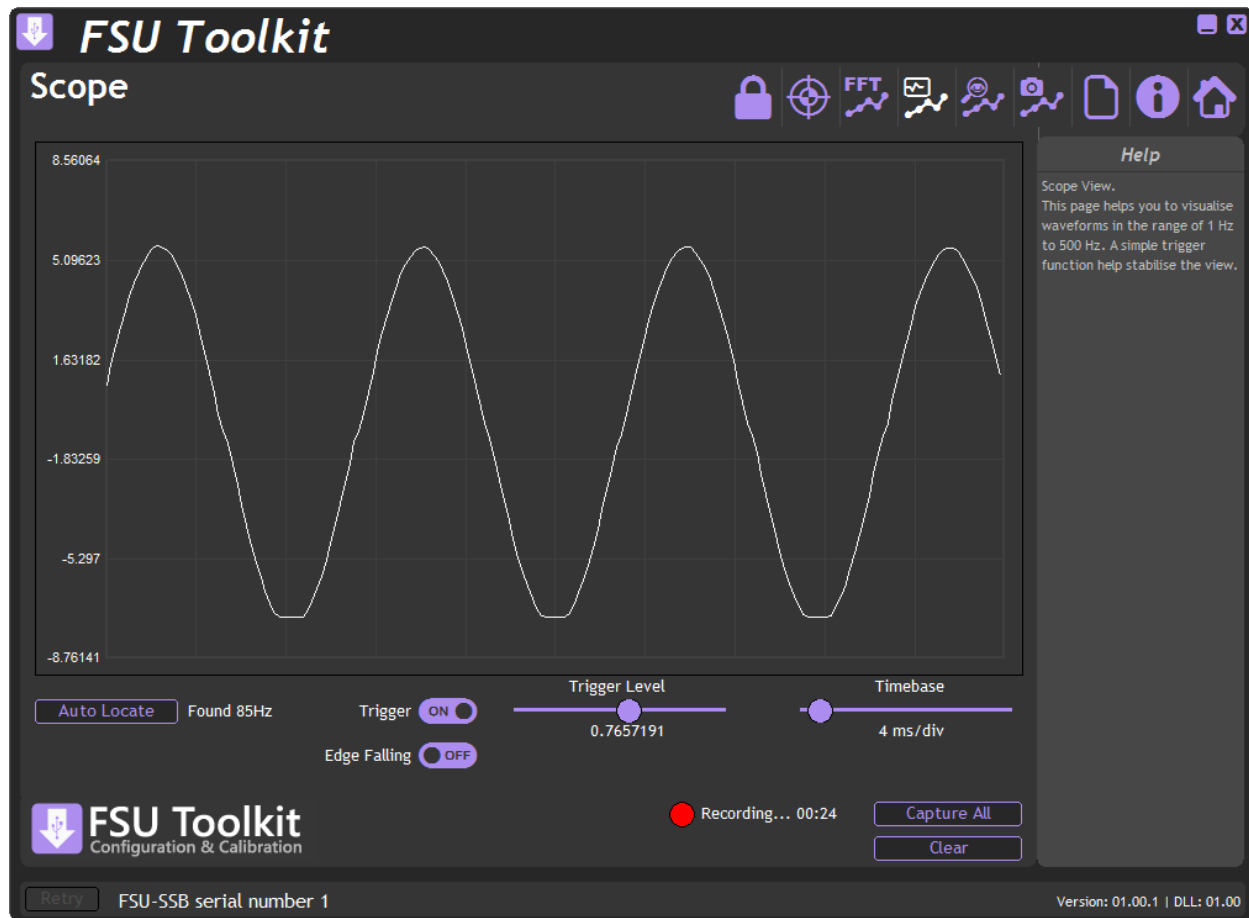
Load a previously saved CSV data file back into the Toolkit for navigation and analysis.

## Copy Chart Image

This feature is available by right-clicking on the chart and copies the chart image to the clipboard enabling pasting into other applications.

## Scope Page

Click on the  icon to open the Scope page.



This page offers a simple oscilloscope view of wave based input signal to help visualise what is happening.

From this page you have the ability to Clear the current recording or click Capture All to capture the entire recording and display it in the Review page.

This page best allows viewing of frequencies of between 1 Hz and 500 Hz. You can view waveforms up to around 2 kHz but there will not be enough samples in the captured data to represent the proper waveform.

### Auto Locate

Click this button to automatically select the best settings to view the current input waveform.

### Trigger level

This selects the trigger level which is the value at which the left-hand side of the scope starts to draw the waveform.

### Trigger

Turns the trigger on or off.


### Edge Falling

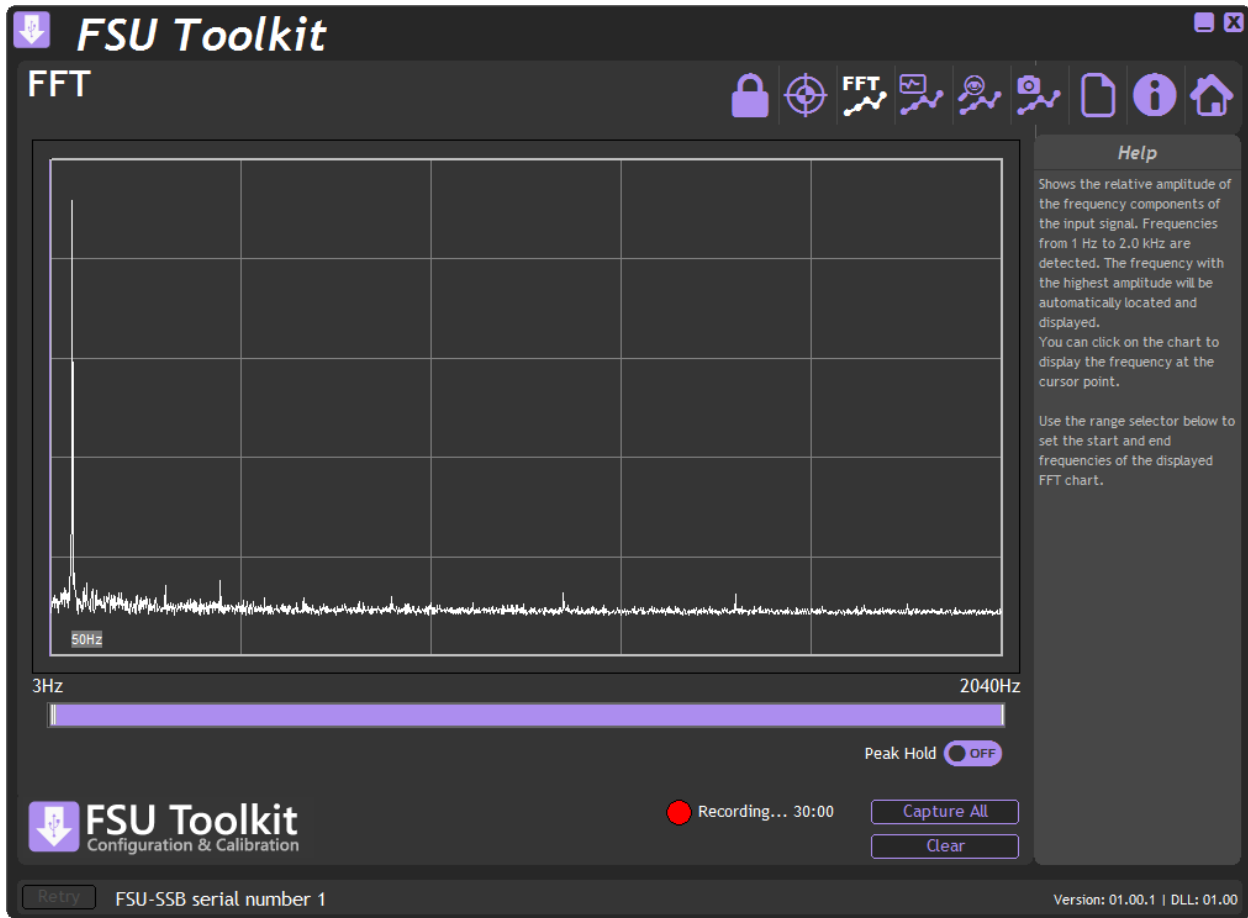
Normally the trigger is set to detect a rising edge. Turn Edge Falling to On to detect the falling edge of the waveform.

### Copy Scope Image

This feature is available by right-clicking on the chart and copies the chart image to the clipboard enabling pasting into other applications.

## FFT Page

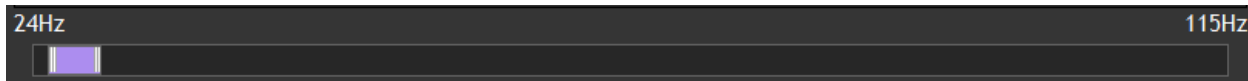
Click on the  icon to open the FFT page.



This page shows the relative magnitude of the frequency components of the input signal from 1 Hz to 2040 Hz. A grey annotation will be displayed under the largest magnitude frequency detected. The above screenshot shows 50Hz detected.

### Navigation

You can drag the thumbs at each end of the purple navigation bar to zoom into the frequency range of interest.



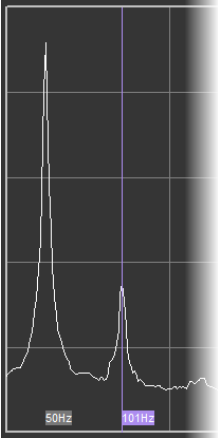
The purple bar can be panned as well as resized.

### Peak Hold

When activated this simply holds the maximum for each frequency displayed until the feature is turned off.

### Cursor

Click the chart to display the cursor. This can be dragged around the chart and displays the frequency of the point under the cursor.



### **Copy Chart Image**

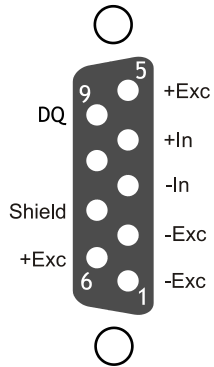
This feature is available by right-clicking on the chart and copies the chart image to the clipboard enabling pasting into other applications.

## Chapter 3 Installation

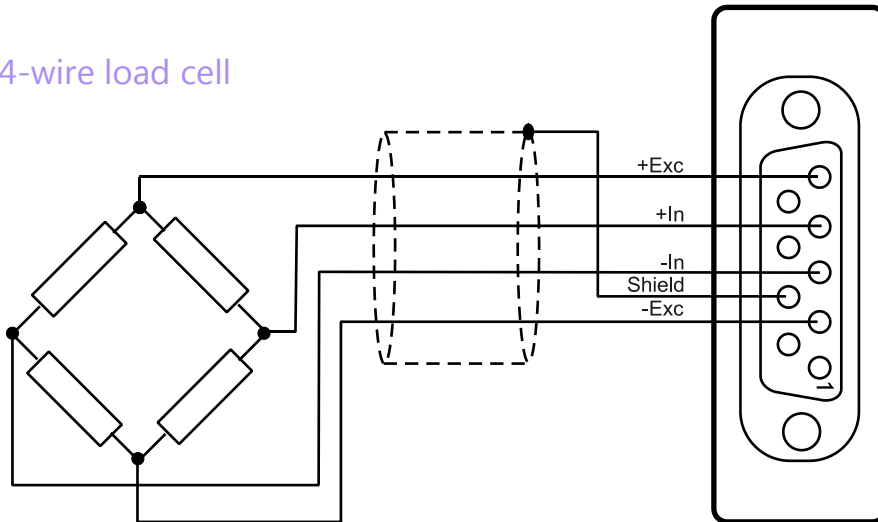
This chapter gives detailed information on integrating the FSU into a production system – including mounting, protection, adjustments, wiring and electrical requirements.

### Identifying Strain Gauge Connections

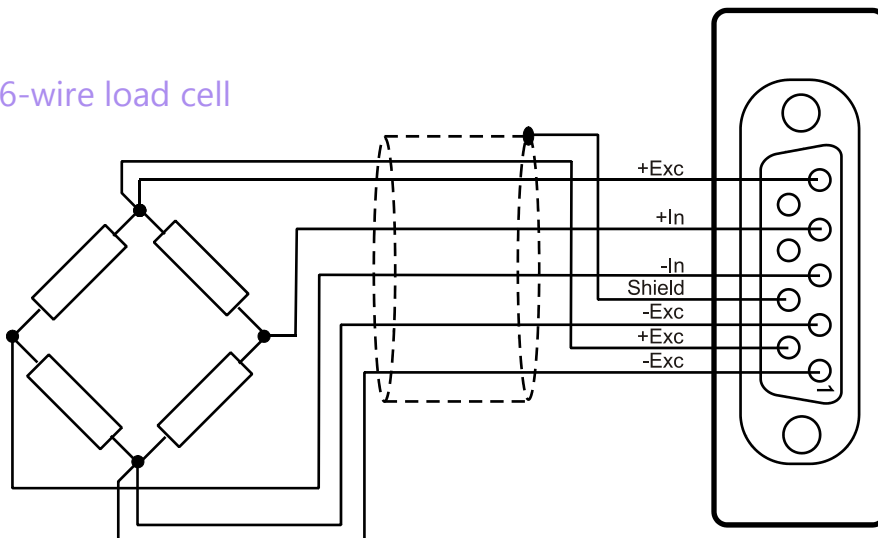
#### 9 way D Connector Pin-outs



#### 4-wire load cell



#### 6-wire load cell





## Chapter 4 Specifications

### Technical Specifications

Parameter	Min	Typical	Max	Units
Strain Gauge Measurement	4 Wire			
Strain Gauge Excitation Voltage	4.5	5	5.25	VDC
Strain Gauge Drive Capability	80	-	5000	Ohms
Strain Gauge Sensitivity	-3	2.5	3	mV/V
Offset Temperature Stability		1	4	ppm/°C
Gain Temperature Stability		3	5	ppm/°C
Offset Stability with Time		20	90	ppm of FR <b>(1)</b>
Gain Stability with Time			30	ppm of FR <b>(2)</b>
Non Linearity before Linearization		5	25	ppm of FR
Internal Resolution		16 Million		Counts/divs
Resolution @ 4.8kHz readings (Noise stable) over 1s		8192		Counts/divs
Resolution @ 4.8kHz readings (Noise stable) over 1s		13		Bits
Measurement Sample Rate		4800		Per Second <b>(3)</b>
Measurement Sample Rate Accuracy		±0.5	±1.1	%

Electrical	Min	Typical	Max	Units
Power Supply voltage	4.25	5	5.5	V dc
Power Supply current (350 Ohm Bridge)		68	75	mA

Data transmission	Min	Typical	Max	Units
Output cable length			5	m

Environmental	Min	Typical	Max	Units
Operating temperature range	-40		+85	°C
Storage temperature	-40		+85	°C
Humidity	0		95	%RH
Protection	IP50			

Dimensions	
Cased version	70.5 x 51 x 20mm excluding 9-way 'D' type socket connector. 74.5 x 51 x 20mm including connector.

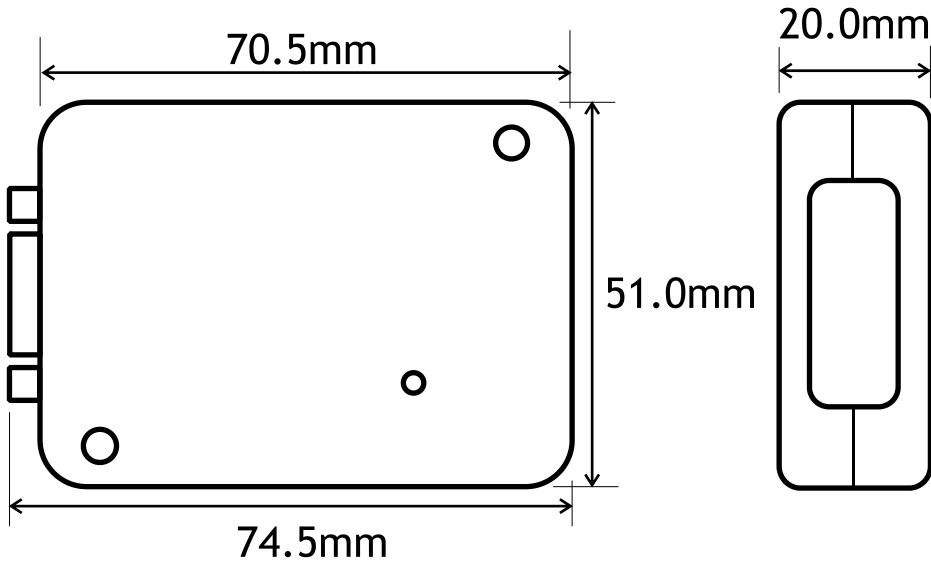
Notes.

1. From original offset at any time
2. 1st Year
3. Contains no anti-aliasing analogue filter

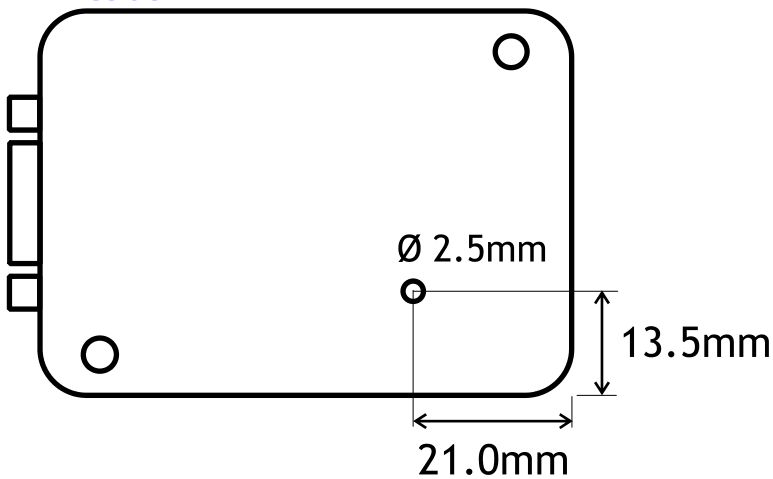
## Dimensions & Mounting

The following diagrams show the case dimensions and mounting holes and optional DIN rail mounting kit.

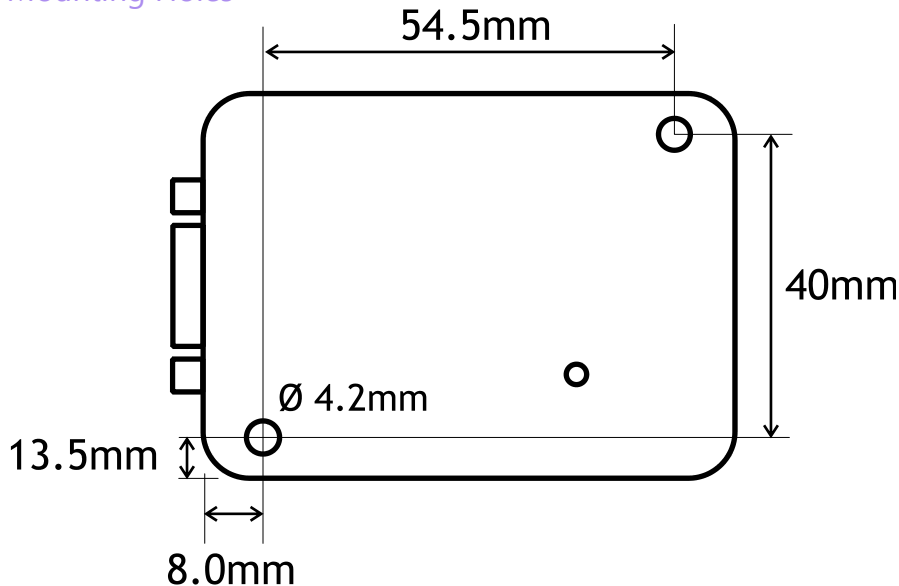
### External Dimensions



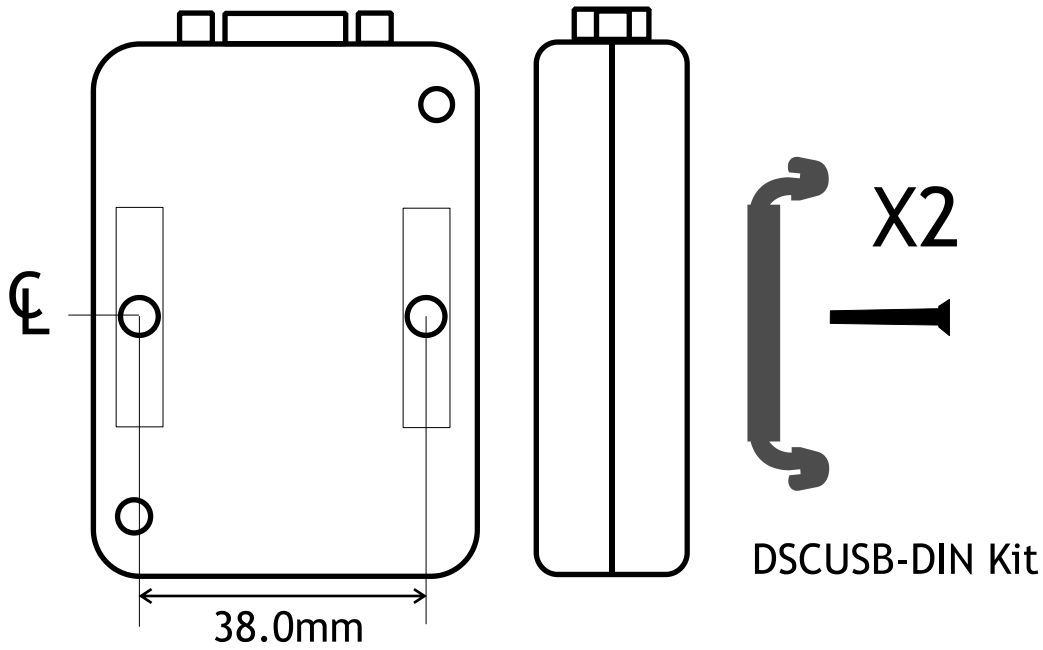
### LED Position



### Mounting Holes



### DIN Rail Mounting (Optional Kit)



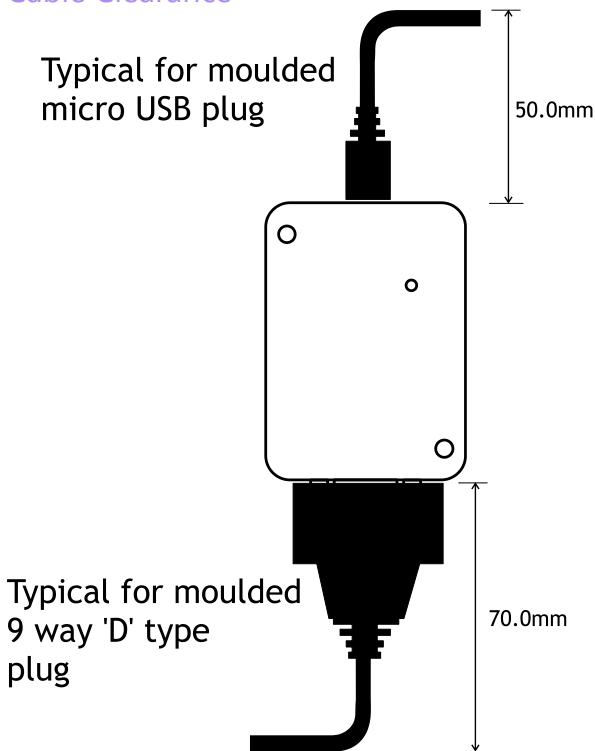
A DIN rail mounting kit is available for top hat DIN rail EN 50022. Optional part DSCUSB-DIN consists of a pair of screws and two DIN rail clips.

Remove the two screws on the rear of the FSU case and replace with the longer screws from the DSCUSB-DIN kit. These longer screws secure the din rail clips which sit in the rectangular depressions around the screw holes.

NOTE: You may want to remove and replace one screw at a time to avoid the case coming apart.

Once fitted the top face of the FSU will be 31.4mm from the surface that the DIN rail is mounted on.

### Cable Clearance



These are typical clearances but smaller mouldings or using a tighter cable radius can reduce this.

## Cable Retention

The 9 way 'D' socket can accept a mating plug that has screw retention functionality. The micro USB socket does not have any form of cable retention and this must be taken into account if mounting the FSU to ensure that the cable cannot disengage accidentally or through vibration.

## CSV File Specification

CSV files can be saved and reloaded from the [Review](#) page.

The CSV file format is.

The first line is a structured time stamp YYYYMMDDHHMMSS.mmmmm

Where YYYY = year

MM = month

DD = date

HH = hour

MM = minute

SS = second

mmmmm = microseconds (This is only present in data that has been saved after cropping)

The following lines are single value readings recorded at 208.333 microsecond intervals (4800 per second  $\pm 1/1\%$ )

### Example

```
20170818154940.625
123.456
123.456
123.456
...
```

### Timestamp Explained

2017	08	18	15	49	40	.625
Year	month	day	hour	minute	second	microseconds

## Environmental Approvals

### CE Approvals

European EMC Directive	2004/108/EC
	BS EN 61326-1:2006
	BS EN 61326-2-3:2006

Output shall not exceed the sum of uncertainties when subjected to an electric field of 10V/m over the frequency range 80 to 600MHz

## Warranty

All FSU products from Mantracourt Electronics Ltd., ('Mantracourt') are warranted against defective material and workmanship for a period of (3) three years from the date of dispatch.

If the 'Mantracourt' product you purchase appears to have a defect in material or workmanship or fails during normal use within the period, please contact your Distributor, who will assist you in resolving the problem. If it is necessary to return the product to 'Mantracourt' please include a note stating name, company, address, phone number and a detailed description of the problem. Also, please indicate if it is a warranty repair. The sender is responsible for shipping charges, freight insurance and proper packaging to prevent breakage in transit.

'Mantracourt' warranty does not apply to defects resulting from action of the buyer such as mishandling, improper interfacing, operation outside of design limits, improper repair or unauthorised modification.

No other warranties are expressed or implied. 'Mantracourt' specifically disclaims any implied warranties of merchantability or fitness for a specific purpose. The remedies outlined above are the buyer's only remedies. 'Mantracourt' will not be liable for direct, indirect, special, incidental or consequential damages whether based on the contract, tort or other legal theory.

Any corrective maintenance required after the warranty period should be performed by 'Mantracourt' approved personnel only.

Document Title: **FSU User Manual**  
Applies To: **FSU Product Range**  
Part Number: **517-941**  
Issue Number: **01.02**  
Dated: **28<sup>th</sup> September 2017**

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



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