LCD20 User Manual

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LCD20

Load Cell Amplifier In DIN Rail Format

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Advanced Intelligent Instrumentation

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LCD20 User Manual

Overview

The LCD20 In-Line Intelligent Strain Gauge Amplifier is a compact microprocessor-based unit specifically designed to control and monitor weighing applications. Its flexibility of design allows for the connection of most load cells and pressure or strain gauges over a wide range of sensitivities. Housed in a DIN rail module.

The basic unit offers the following facilities:-
A simple auto calibration of the highest and lowest weights required, an easy auto tare setting and a peak hold and valley facility. A menu password protects the configuration parameters.

DC analogue outputs of 4-20mA and 0-10V are standard with full scaling over any desired range and the ability to invert these outputs if required.

Gain sensitivity is available in two ranges, 0.5 to 3.7mV/V and 3.7 to 7.8mV/V.

Offers two relay set points which can be inverted and/or latched. Hysteresis can be applied to both set points together with individual In-Flight compensation. Both the relay and the Analogue Output have a high level of electrical isolation.

Internal parameters can be set digitally in real engineering terms by means of an optional plug-in programmer unit or LC Toolkit software.

The load cell input design has also taken advantage of new technology in the form of the delta-sigma 20 bit ADC. This device has a built-in low temperature drift, low noise amplification stage with switchable gain. The appropriate range is selected from either the optional programmer keypad or via the Toolkit software and PC communications cable removing the need to gain access to the electronics.

The LCD20 is factory calibrated in mV/V terms to within 0.05% FS, this allows table entry of calibration data straight from a load cell test certificate. An advantage of a factory calibration is that units can be swapped in the field by copying across the calibration from one unit to another with calibration accuracy maintained at 0.05%FS

How to Use This Manual

There are two ways you may want to use the LCD20 and this manual has been arranged to best allow the information required to be presented without having to read irrelevant information.

The two ways to interact with the LCD20 are as follows:

- Handheld programmer/display (LP2)
- LC Toolkit software (With PGM1 cable)

It may be that only one of the above methods is used or it may be possible that you will need to refer to more than one section.

Using the Handheld Programmer/Display (LP2)

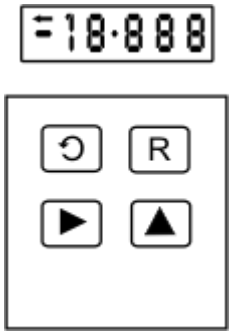
Keypad and Display

The Programmer Unit - Is a small hand held unit together with a 2 metre connection lead known as **LP2** which plugs into an FFC68 socket accessed under the front panel door.

All user controls, displays and indicators are mounted on the front panel which comprises a 4.5 digit LCD display and four flush mounted keys.

A flashing '⬅' symbol in the top left hand corner of the display indicates programming mode. This symbol is also used to indicate there is a load cell integrity issue or that Shunt-Cal is switched on.

Unit Panel Layout



Keys

The LCD20 has a multilevel menu system. The parameters available are dependent on the password level that has been entered.

Used to scroll through the menu items available at the current menu level. When a level has been entered that holds parameters then this key scrolls through the parameters available. At this point if the scroll key is not pressed for 3 seconds then the current value of the parameter is displayed.

Initially used to enter into the next menu level. When displaying a parameter value then this key selects the display digit to be modified. The selected digit will flash together with the program indicator.
When in programming mode it should be noted that the first digit in the display may not be visible, but the program indicator '⬅' will flash to indicate that the instrument is in programming mode even though no digits can be seen to be flashing.

Used to move up a menu level. If already at the highest menu level **PASS** then the menu system will be exited returning to displaying the input variable.
When displaying a parameter value this key increments each selected display digit 0-9. Pressing the ▲ key under programming conditions will display the leading digit as 1, -1, - or a blank display for zero.

Additionally, for items that can be selected from a list such as the digital input function **DIP1,** then this key cycles through the available options. The currently set value is the first shown data value.

Resets the display to the input variable and enters new data in the LCD20 non-volatile memory. If, during the programming sequence no key is pressed the display will revert to showing the input variable after 2 minutes and any changes made will not be saved

ⓘ **I**f on pressing the ↺ or R keys after a new value has been entered that is outside the allowed range for that parameter then **Err** will be displayed until the ↺ or R keys is pressed again. Pressing the R key will exit the menu restoring the last good value to the parameter. Pressing the ↺ key will show the parameters mnemonic again followed by the last good value.

Menus

The LCD20 menu system operates with multiple levels to allow easier navigation round the parameters. Different levels and parameters being made available depending on the password level entered. There are 3 password levels which can be considered as Operator, Engineer and Configurator/Calibrator.

Password Protection

To enter the menu a 4 digit password number must be entered when 'PASS' is displayed. The factory set number, 1111 allows access to the most common parameters.
Additional passwords are required to gain access to the remaining two levels.

Menu Tables

In the table below the hierarchal level of menu items is indicated by a prefix dot.

Item	*Pass Level*	*Range*	*Default*	*Description*
PASS	1	1111		Security Password. Correct value required to proceed further.
VALS	1			Values. View generated live values
GroS	1	-	-	Gross
nEt	1	-	-	Net
PEAK	1	-	-	Peak
VALY	1	-	-	Valley
SNAP	1	-	-	Snap (Held Value)
mVV	2	-	-	mV/V
CALV	2	-	-	Calibrated Value. Gross value before System zero, Zero-Tracking
rLYS	1			Relay Menu
rLY1	1			Relay 1 Menu
SP1	1	±19999	0000	Desired Set Point trip value for Relay 1
IF1	1	±19999	0000	In-Flight compensation for SP1. Relay 1 operates at = (SP1 - IF1)
HYS1	1	0-19999	0000	Hysteresis amount applied to SP1
InV1	1		No	Invert SP1 *Selection value* / *Description* **Yes** – Inverted SP1 operation **No** – Normal SP1 operation

Item	Pass Level	Range	Default	Description
Ltc1	1		No	Latch SP1 **Selection value** / **Description** **Yes** – Latching SP1 operation **No** – Normal SP1 operation
rLS1	2		nEt	Relay 1 source taken from **Selection value** / **Description** **nEt** – Net Value **GroS** – Gross Value **PEAK** – Peak Value **VALY** – Valley Value **SNAP** – Snap (Held) value
rLY2	1	±19999	0000	Relay 2 Menu
SP2	1	±19999	0000	Desired Set Point trip value for Relay 2
IF2	1	±19999	0000	In-Flight compensation for SP2. Relay 2 operates at = (SP2 – IF2)
HYS2	1	0-19999	0000	Hysteresis amount applied to SP2
InV2	1		No	Invert SP2 **Selection value** / **Description** **Yes** – Inverted SP2 operation **No** – Normal SP2 operation
Ltc2	1		No	Latch SP2 **Selection value** / **Description** **Yes** – Latching SP2 operation **No** – Normal SP2 operation
rLS2	2		nEt	Relay 2 source taken from **Selection value** / **Description** **nEt** – Net Value **GroS** – Gross Value **PEAK** – Peak Value **VALY** – Valley Value **SNAP** – Snap (Held) value
AnOP				Analogue Output Menu
OPL	1	±19999	0000	Output Low: display point for minimum Analogue Output
OPH	1	±19999	0000	Output High: display point for maximum Analogue Output

<table>
<tr><th>Item</th><th>Pass Level</th><th>Range</th><th>Default</th><th>Description</th></tr>
<tr><td>AnOP</td><td>2</td><td></td><td>nEt</td><td>Sets what Value the Analogue Output operates from<table><tr><th>Selection value</th><th>Description</th></tr><tr><td>nEt</td><td>Net Value</td></tr><tr><td>GroS</td><td>Gross Value</td></tr><tr><td>PEAK</td><td>Peak Value</td></tr><tr><td>VALY</td><td>Valley Value</td></tr><tr><td>SNAP</td><td>Snap (Held) value</td></tr></table></td></tr>
<tr><td>AOPS</td><td>2</td><td></td><td>4-20</td><td>Selects Analogue Output, current or voltage.<table><tr><th>Selection value</th><th>Description</th></tr><tr><td>4-20</td><td>4-20mA current output</td></tr><tr><td>0-10</td><td>0-10V voltage output</td></tr></table></td></tr>
<tr><td>InV</td><td>2</td><td></td><td>No</td><td>Invert Analogue output. Note this can also be achieved by using OPL greater than OPH.<table><tr><th>Selection value</th><th>Description</th></tr><tr><td>Yes</td><td>Inverted analogue output</td></tr><tr><td>No</td><td>Normal analogue output</td></tr></table></td></tr>
<tr><td>Adj</td><td>3</td><td></td><td></td><td>Adjustment of Analogue output values Menu</td></tr>
<tr><td>4.20G</td><td>3</td><td>0.9 to 1.025</td><td>1.0</td><td>User adjustment for 4-20mA gain. Replace function of the LCA15 gain potentiometer. Unit gain = 1.0</td></tr>
<tr><td>4.20o</td><td>3</td><td>-1000 to 1000</td><td>0</td><td>User adjustment for 4-20mA offset. Replace function of the LCA15 offset potentiometer. Note the value is in PWM counts not mA</td></tr>
<tr><td>0.10G</td><td>3</td><td>0.9-1.025</td><td>1.0</td><td>User adjustment for 0-10V gain. Replace function of the gain LCA15 potentiometer. Unit gain = 1.0</td></tr>
<tr><td>0.10o</td><td>3</td><td>-1000 to 1000</td><td>0</td><td>User adjustment for 0-10V offset. Replace function of the LCA15 offset potentiometer. Note the value is in PWM counts not V</td></tr>
</table>

<table>
<tr><td>diSP</td><td>1</td><td></td><td></td><td>Display parameters Menu</td></tr>
<tr><td>dA</td><td>1</td><td></td><td>0000</td><td>Display Averaging. Number of reading to block average.
Resultant samples per second dependant on rATE setting.
If rATE is set to 10 samples per second
<table>
<tr><th>Selection Value</th><th>Description</th></tr>
<tr><td>0</td><td>2.5 samples per second</td></tr>
<tr><td>1</td><td>1.25 samples per second</td></tr>
<tr><td>2</td><td>1.6 seconds per sample</td></tr>
<tr><td>3</td><td>3.2 seconds per sample</td></tr>
<tr><td>4</td><td>6.4 seconds per sample</td></tr>
<tr><td>5</td><td>12.8 seconds per sample</td></tr>
<tr><td>6</td><td>25.6 seconds per sample</td></tr>
<tr><td>7</td><td>10 samples per second</td></tr>
</table>
If rATE is set to 80 samples per second
<table>
<tr><th>Selection Value</th><th>Description</th></tr>
<tr><td>0</td><td>20 samples per second</td></tr>
<tr><td>1</td><td>10 samples per second</td></tr>
<tr><td>2</td><td>5 samples per second</td></tr>
<tr><td>3</td><td>2.5 samples per second</td></tr>
<tr><td>4</td><td>1.25 samples per second</td></tr>
<tr><td>5</td><td>1.6 seconds per sample</td></tr>
<tr><td>6</td><td>3.2 seconds per sample</td></tr>
<tr><td>7</td><td>80 samples per second</td></tr>
</table></td></tr>
<tr><td>dP</td><td>1</td><td>0-5</td><td>0002</td><td>Decimal point position</td></tr>
<tr><td>rS</td><td>1</td><td>0-19999</td><td>0000</td><td>Display Resolution</td></tr>
<tr><td>ddiS</td><td>2</td><td></td><td>nEt</td><td>Selects Defaults display source from
<table>
<tr><th>Selection value</th><th>Description</th></tr>
<tr><td>nEt</td><td>Net Value</td></tr>
<tr><td>GroS</td><td>Gross Value</td></tr>
<tr><td>PEAK</td><td>Peak Value</td></tr>
<tr><td>VALY</td><td>Valley Value</td></tr>
<tr><td>SNAP</td><td>Snap (Held) value</td></tr>
</table></td></tr>
<tr><td>PEAk</td><td>2</td><td></td><td>nEt</td><td>SelectsPeak value source
<table>
<tr><th>Selection value</th><th>Description</th></tr>
<tr><td>nEt</td><td>Net Value</td></tr>
<tr><td>GroS</td><td>Gross Value</td></tr>
</table></td></tr>
</table>

VALY	2		nEt	Selects Valley value source ***Selection value*** / ***Description*** **nEt** – Net Value **GroS** – Gross Value
SNAP	2		nEt	Selects Snap value source. ***Selection value*** / ***Description*** **nEt** – Net Value **GroS** – Gross Value
OVrV	3	±19999	19999	Over-range value. The Value at which the display will indicate a Positive over-range condition and force the relays and analogue output to behave accordingly. (Display shows +1)
undV	3	±19999	19999	Over-range value. The Value at which the display will indicate a Negative under-range condition and force the relays and analogue output to behave accordingly. (Display shows -1)
LCiP	1			Load cell configuration menu
FSTP	1	0-255	0000	Low-pass Filter Steps
FLVL	1	0-19999	0000	Low-pass Filter Dynamic Level
SEnS	2		0.5-3	Load cell sensitivity ***Selection value*** / ***Description*** **0.5-3** – 0.5 to 3.7 mV/V range **3.7-7** – 3.7 to 7.8 mV/V range
rATE	2		10S	Measurement rate 10SPS and 80SPS ***Selection value*** / ***Description*** **10S** – 10 samples per second **80S** – 80 samples per second
ACAL	2			Analogue Input Calibration Menu
AdCL	3	±7.8	0000	mV/V Value captured for low calibration point CALL
AdCH	3	±7.8	0000	mV/V Value captured for high calibration point CALH
CALL	2	±19999	0000	Calibration Low: display value for low calibration point
CALH	2	±19999	0000	Calibration High: display value for high calibration point
At	2	±19999	0000	Auto Tare value. Value **added** to **Gross** to give **Net**
trbd	2	±19999	0000	Zero Tracking Band
ZEro	2	±19999	0000	System Zero
dIPS	2			Digital input menu

dIP1 | 2 | | Prnt

Digital Input 1 function

Selection value	*Description*
At	Perform Tare
Lr	Latch Relay Reset
Prnt	Do Print
dEFt	Display Default display set by “ddiS”
GroS	Display Gross value
nEt	Display Net value
PEAK	Display Peak value
VALY	Display Valley value
SNAP	Display Snap (Held) value
PV-r	Peak & Valley Reset
SCon	Shunt-Cal On
SCoF	Shunt-Cal Off
SCtG	Shunt-Cal Toggle on/off
dSnP	Do Snap (Hold current value)

dIP2 | 2 | | Lr

Digital Input 2 function.

Selection value	*Description*
At	Perform Tare
Lr	Latch Relay Reset
Prnt	Do Print
dEFt	Display Default display set by “ddiS”
GroS	Display Gross value
nEt	Display Net value
PEAK	Display Peak value
VALY	Display Valley value
SNAP	Display Snap (Held) value
PV-r	Peak & Valley Reset
SCon	Shunt-Cal On
SCoF	Shunt-Cal Off
SCtG	Shunt-Cal Toggle on/off
dSnP	Do Snap (Hold current value)

Auto Calibration

Using the Keypad; a simple two point calibration can be performed. Auto-calibration captures live load cell input values in mV/V terms and relates them to required engineering unit's values. The input can be acquired by loading the load cells with known weights or by injecting known mV levels for the required engineering values. These known mV/V levels may be taken from a load cell calibration sheet or by measurement.
The two calibration points should be near the required lowest point (typically an unloaded structure reading zero weight) and at least 75% of the highest point. This will help provide an accurate extrapolation over the desired calibrated range.

The sequence of calibration is not confined to capturing the Low calibration point **CALL** first. This is useful if a vessel already has a ***known*** amount of product in and it is not practical to empty the vessel before starting the calibration procedure.

For example: the calibration procedure can be initiated by capturing **CALH** with a full hopper if the weight is ***known*** and **CALL** captured at a later date when the hopper is empty.

Please note that the LCD20 may not display the correct weight until the second data point is acquired.

> ⓘ The Sensitivity **SEnS** and Decimal Point position **dP must** be set before calibration takes place.

Procedure

> ⓘ Allow a warm up period of 20 minutes before carrying out the calibration procedure.
>
> ⓘ If It is intended that the calibration is permanent then please ensure the EEPROM has not been disabled by the communications port. See Communications Protocols chapter.
>
> ⓘ The accuracy of the calibration depends upon the input being settled and stable.

This procedure is written assuming the low calibration point **CALL** is followed by the high calibration point **CALH** but note that **CALH** could be done first.

1. With the load cells connected and the load cells settled at the low calibration point (this could be the empty vessel) Press the ↻ key until **PASS** appears.
2. Enter Level 2 password using ▶ and ▲ keys, then press ↻ key.
3. Press the ↻ key several times until A**CAL** appears. Press the ▶ key to select and **CALL** appears.

> ⓘ If **CALL** does not appear your LCD20 may be locked from calibration by your supplier!

4. Press the ▶ key and check that the program symbol '⬅' flashes.

Always ensure that the programmer indicator is flashing, even though the displayed value may not need to change.

5. If the required value for **CALL** is already displayed then move onto to the next step else enter the desired value that the input on the current load cells represents.
6. Ensure that the Strain Gauge has remained settled and is free from disturbance and press the ↻ key to capture and calibrate the **CALL** value.
7. If the **CALH** calibration point is to be done at a later date then the R can be pressed and the values for **CALL** will be committed to memory. Else proceed to calibration high point **CALH** by pressing the ↻.
8. Apply the input to the load cells that represents the calibration high point **CALH** and allow to settle.
9. Press the ▶ key and check that the program symbol '⬅' flashes.

Always ensure that the programmer indicator is flashing, even though the displayed value may not need to change.

10. If the required value for **CALH** is already displayed then move onto to the next step else enter the desired value that the input on the current load cells represents.
11. Ensure that the Strain Gauge has remained settled and is free from disturbance and press the R key to capture and calibrate the **CALH** value and also commit these the values to memory.
12. On the display returning to indicating the load cell value and assuming the load has not changed on the load cells the display will now be showing the required values.

Notes on Auto calibration

- If **CALH** is set to zero then the display value will be mV/V with decimal point position being that set by **dP**.
- **CALL** can be greater than **CALH**. This will have the effect of for an increasing load cell input a decreasing displayed value.
- The calibration can be manually adjusted by changing the mV/V values stored in **AdCL** and **AdCH.** Care must be taken with changing these values and the resolution of entry is limited to 0.001mV/V.

Using the LC Toolkit Software

The LC Toolkit software for Windows will allow a connection with the LCD20 via an optional programming cable **PGM1**.

What Can It Do?

The toolkit allows all aspects of the LCD20 to be configured. Everything that can be achieved with the plug-in programmer/display can be achieved with the toolkit plus a great deal more.
You can:

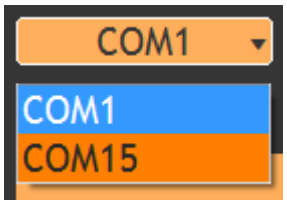
- Configure settings
- Save and restore settings to a file
- Calibrate load cell
- Calibrate analogue outputs
- Log data to a CSV file
- View data on a chart
- Use as a large display

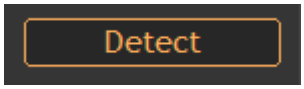
Using the Software

These items just display data and you cannot interact with them.

These items are editable in place. Click on them to be able to change the contents.

These items are dropdown lists. Click on them to drop down a selection of items that can be clicked to select as shown below:





These are buttons. They will change colour dramatically when your mouse passes over them and look like this:

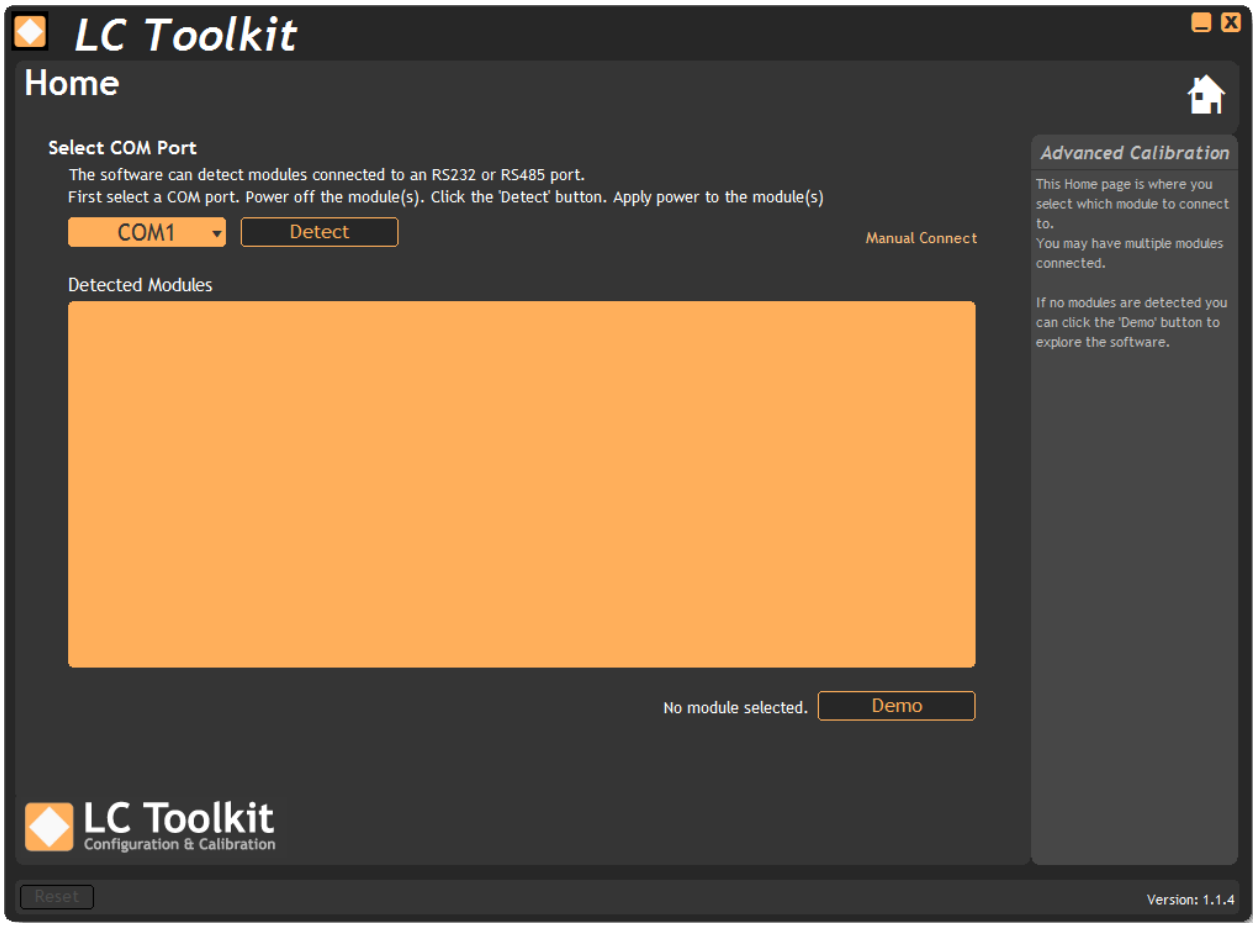
Click to activate.

These items are tabs. The selected tab is not orange but you can click on the other tabs to select them. Different tabs will show different control items when clicked.

Home Page

This is the first page shown after the software launches.

> ⓘ Some of the pages shown here may not be available if your module has been locked by the supplier.



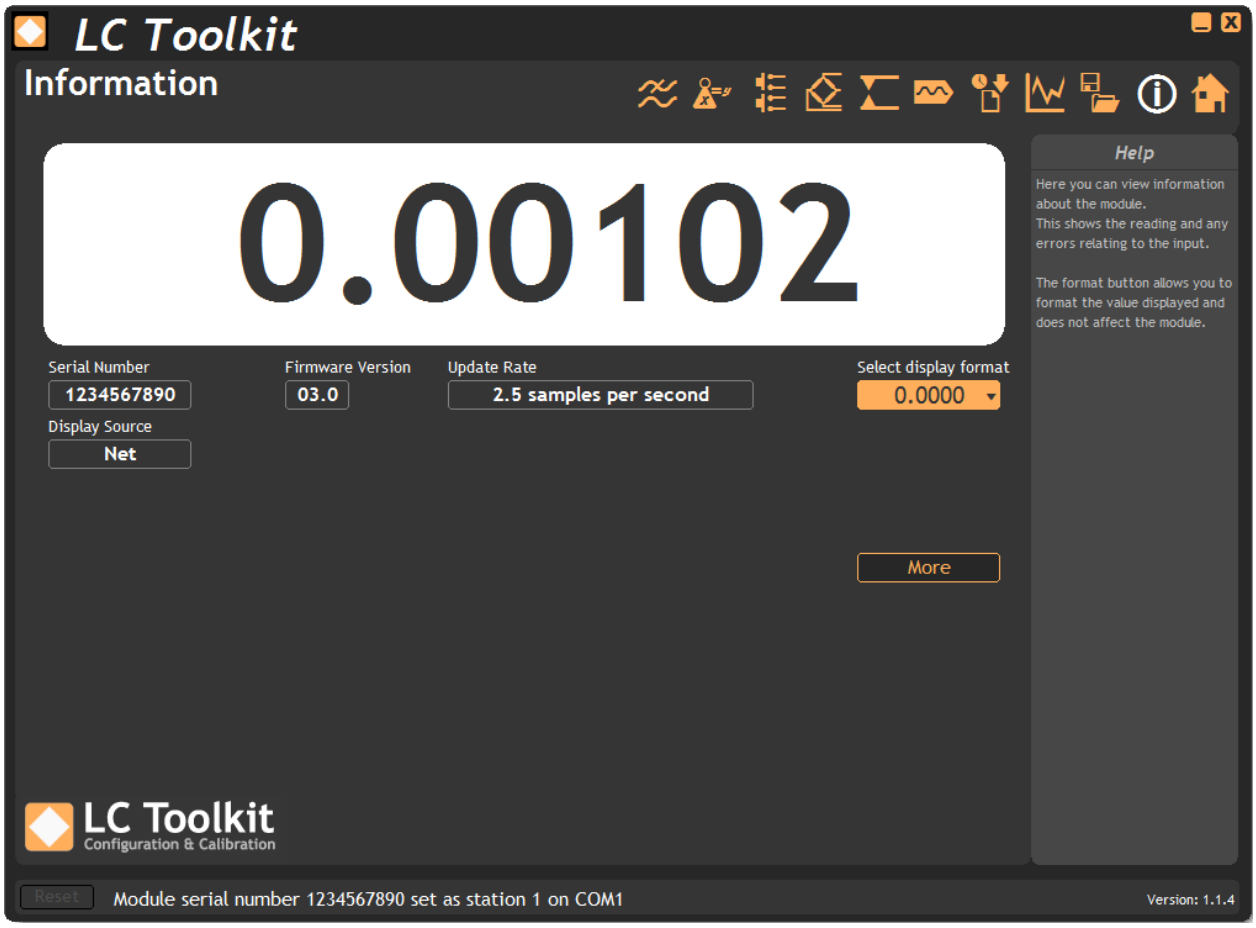
The serial ports (COM ports) on the computer are detected and added to the drop down list on the top left of the page. Clicking the drop down list will automatically re-detect available COM ports.
To detect the connected module:

- Connect the PGM1 cable to the LCD20. Plug the USB cable into the PC. (You may have to wait for the drivers to install the first time this is plugged in).
- Power up the LCD20.
- Select the COM port that your PGM1 is allocated and click the **Detect** button.
- Press the Detect button on the LCD20 (Hold for 1 second). See Installation | Push Switch SW for more information.)

> ⓘ If you cannot get physical access to the LCD20, to power cycle or to push the button, you can connect manually by clicking the 'Manual Connect' text on this page. See Appendix G – Manual Connect.

Information ⓘ

The Information page shows useful information about the module. The large display may prove useful in simple monitoring projects.



Main Display – Displays the module value. If units have been specified at calibration then the units will be shown.

Serial Number – Shows the serial number of the module.

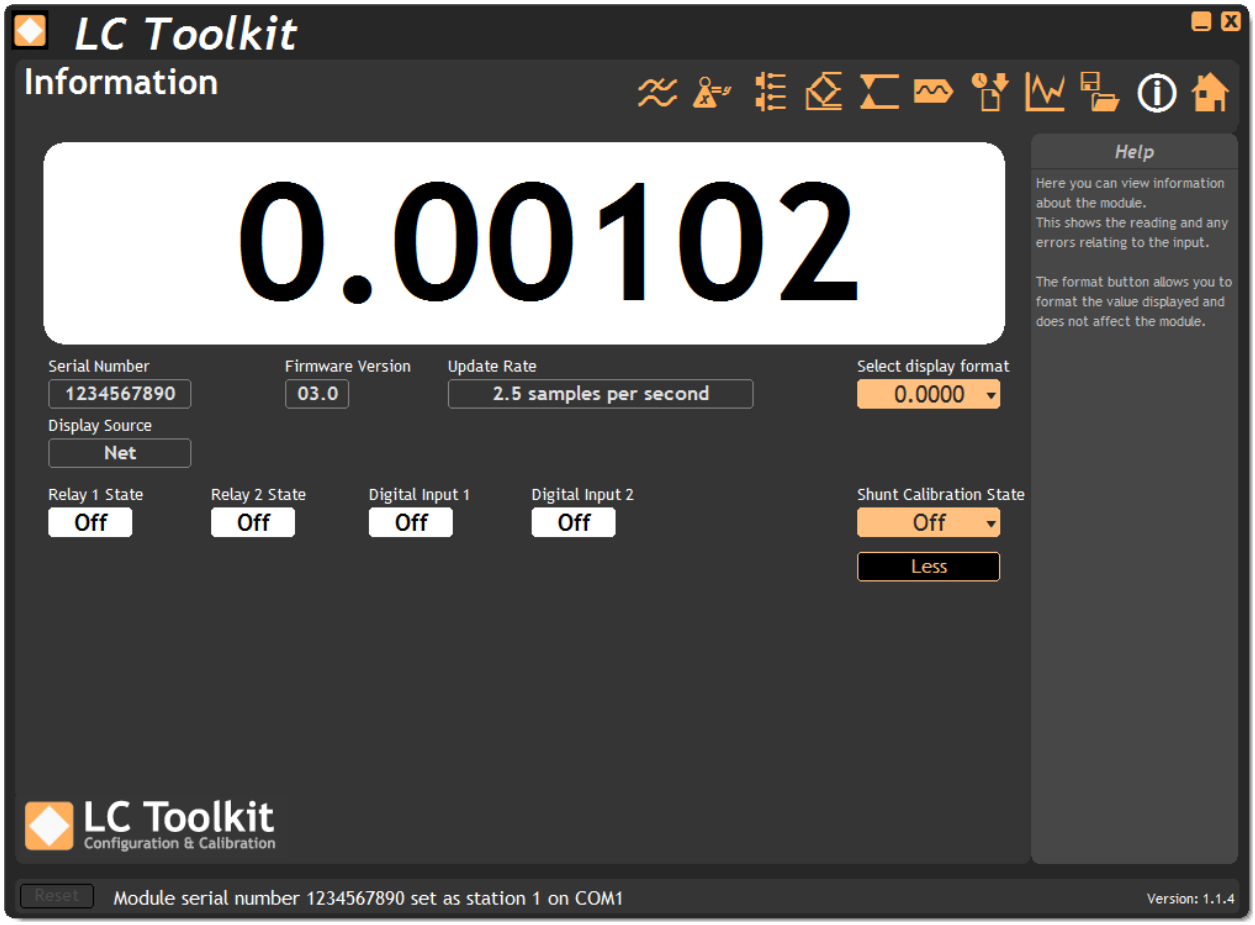
Firmware Version – Shows the module firmware version.

Display Source – Indicates where the display (Parameter and LCD where fitted) gets its value.

Update Rate – Indicates the update rate of the module. This is the rate at which a new value is generated.

Select Display Format – Drop down the list and select a display format for this software only. This does not change any module settings.

More - Clicking this button displays more information as shown in the following screenshot.



Relay 1 State – Indicates whether relay 1 is on or off.

Relay 2 State - Indicates whether relay 2 is on or off.

Digital Input 1 - Indicates whether digital input 1 is activated or not.

Digital Input 2 - Indicates whether digital input 2 is activated or not.

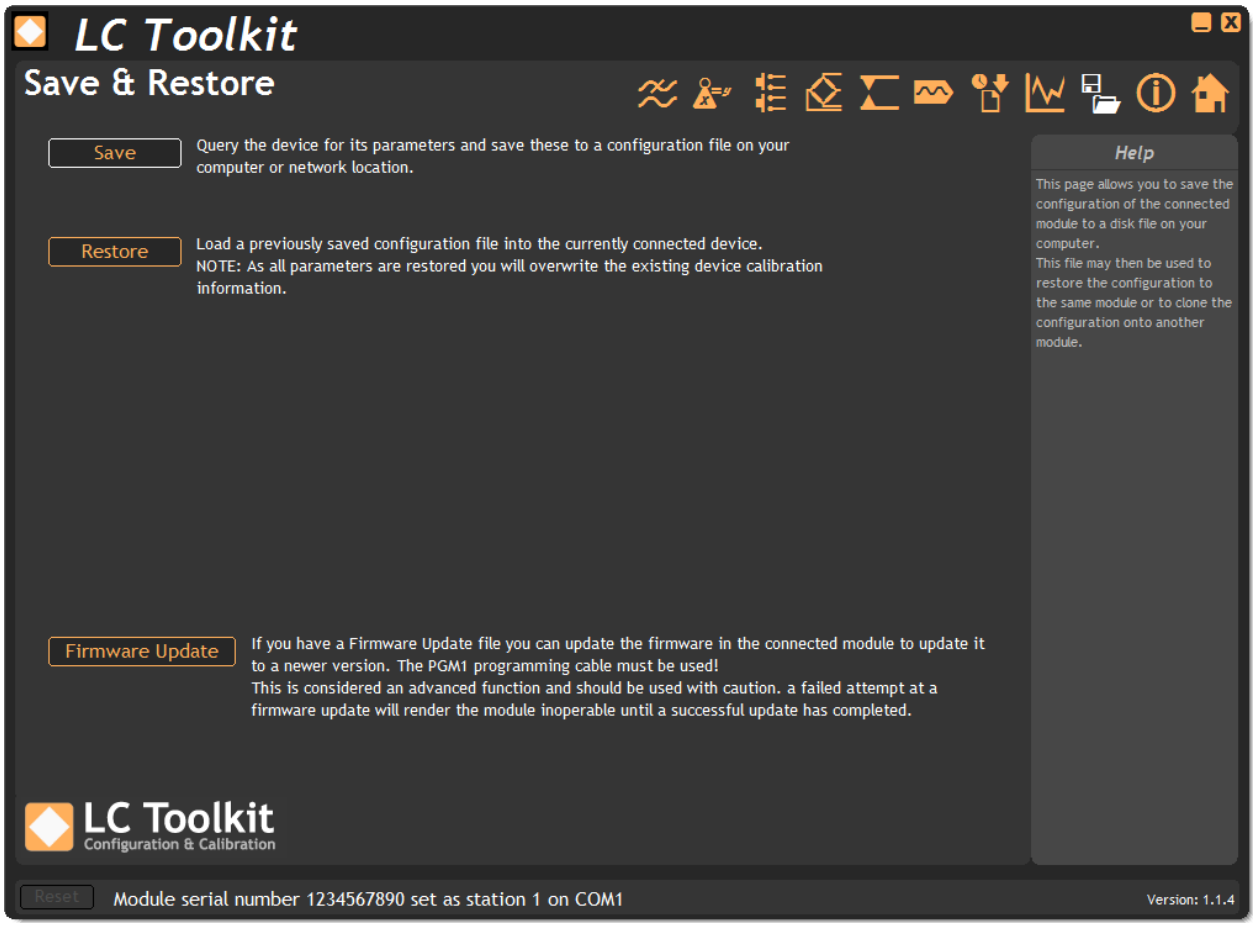
Shunt Calibration State – Allow the shunt calibration function to be activated.

Less – Clicking this button hides this extra information again.

See Also – Appendix A – Calibration | Shunt Calibration

Save & Restore

This page allows the configuration of the module to be saved to a file for later restoration.



Save – Save the module configuration to a file on the computer.

Restore – Restore a previously saved configuration file to the connected module.

Firmware Update – If you have a firmware hex file you can click this to select the file and update the firmware in the module.

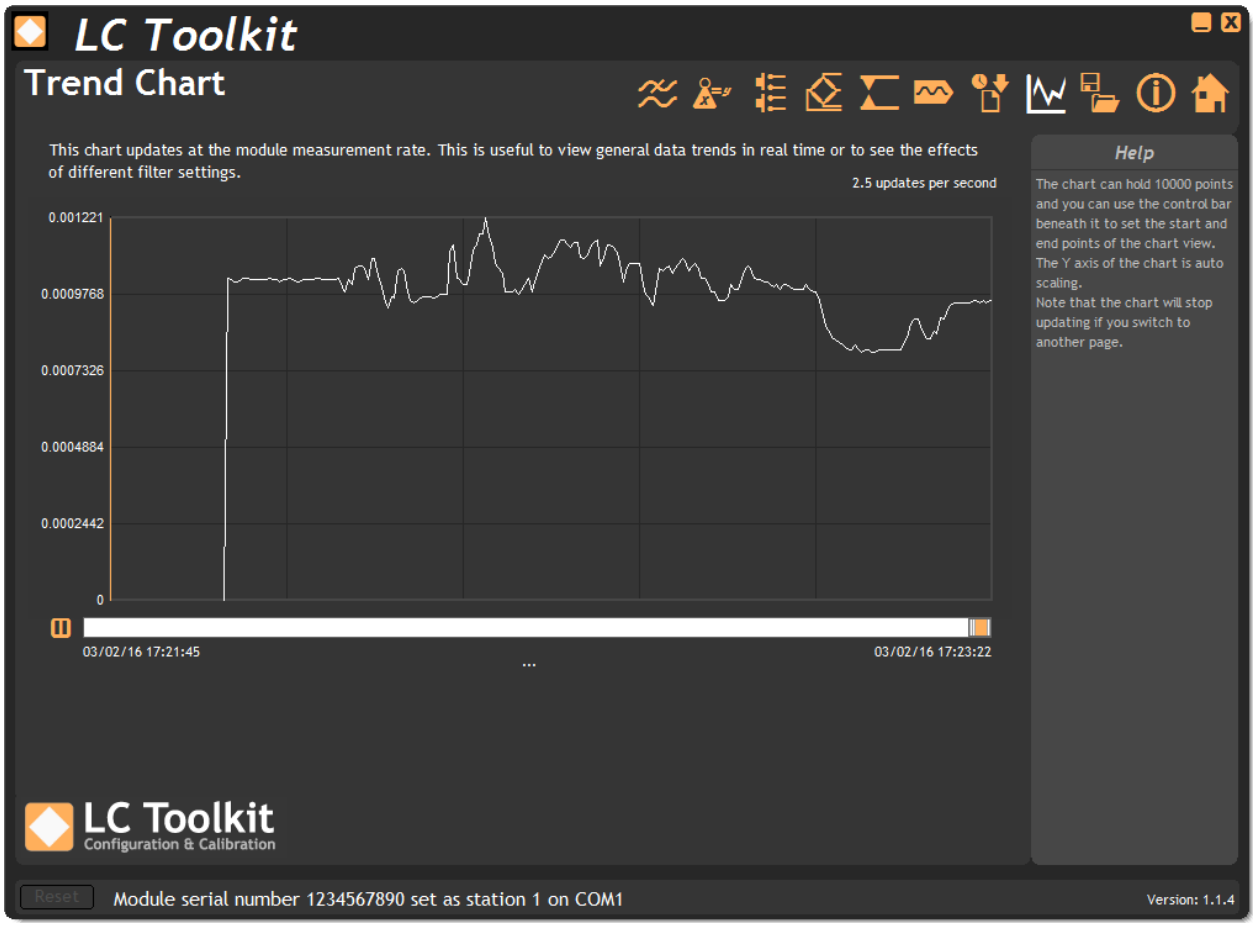
Warning - A failed attempt at a firmware update will render the module inoperable until a valid firmware update has been achieved.

Trend Chart

This page allows you to view the module value on a scrolling chart. The chart will hold 10,000 points of data and is updated at the update rate of the module (Displayed at the top right of the chart). This is determined by the settings on the Filters page.

The chart Y axis is auto scaling but you can select the view into a stored history of 10,000 data points. Just drag the handles of the range scrollbar under the chart to define the start and end point of the view.

The date and time of the first and last point on the chart are displayed in the lower left and right area under the chart. By clicking in the chart you can display a cursor and the date and time at the point of the cursor, also the data point value will be displayed underneath the chart.



Pause Button – Pauses the chart. During a pause no more data will be added to the chart. You can use the range scrollbar to change the view or click and drag on the chart to move the cursor. The time and value of the data under the cursor will be displayed under the chart.

Range Scrollbar – By dragging the orange 'thumb' you can view different areas of the data history. By dragging the left or right side of the 'thumb' you can increase or decrease the amount of data shown thus zoom in and out.

Right Click Menu – Right clicking the chart will display a pop-up menu with three options:

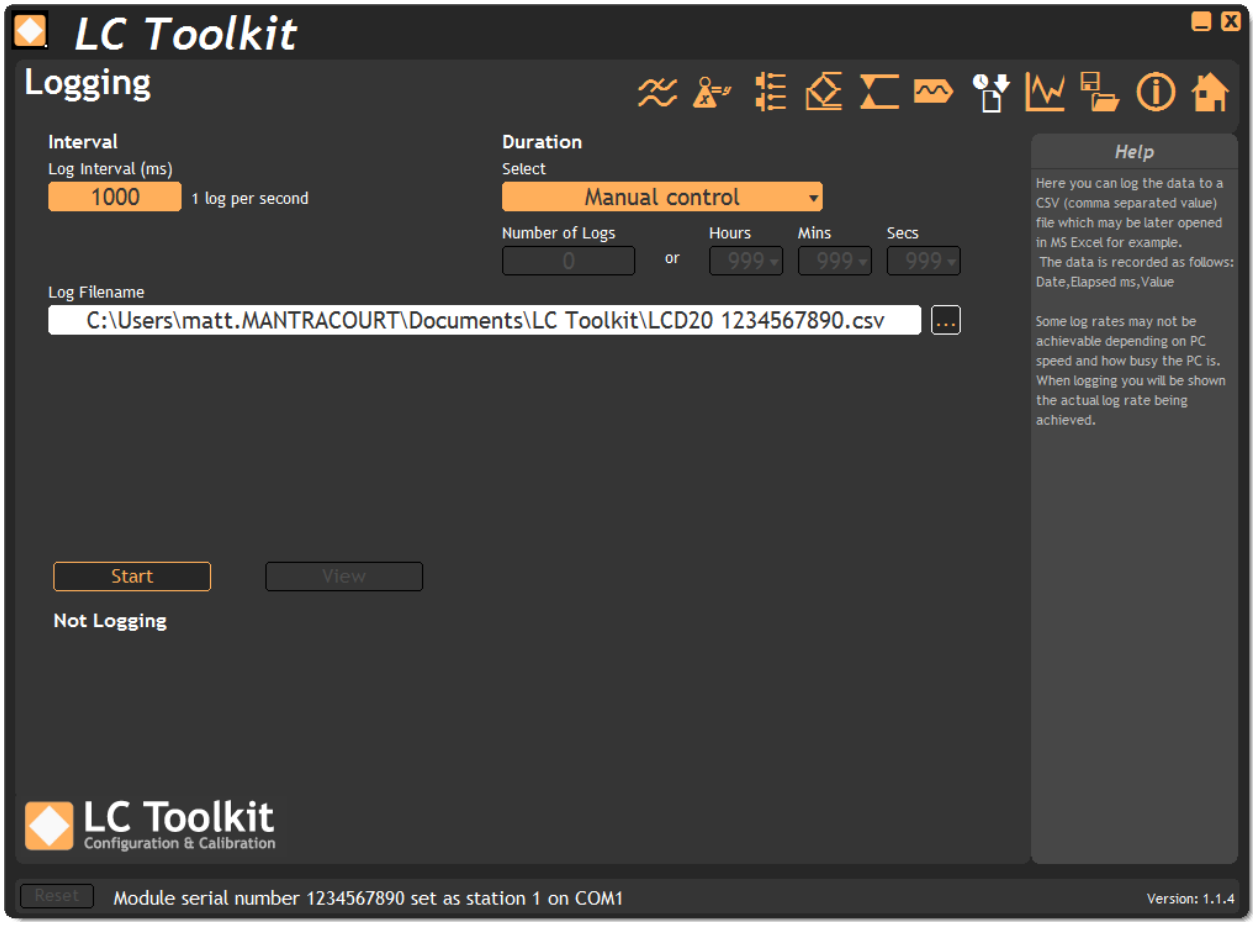
Copy Chart Image – Copy a bitmap image of the chart to the clipboard.

Copy Chart Data – Copy tab separated chart data to the clipboard in a suitable format for pasting into MS Excel.

Clear Chart – Clear all data from the chart.

Logging

The toolkit allows you to log data to a CSV (Comma Separated Value) file. This file can be opened for analysis in various applications including MS Excel.
The logging session can be manually controlled or automatically stopped after a duration/number of logs limit.



Interval

Log Interval - Choose a Log Interval in milliseconds between 12 and 32000. For example 20mS will enable a log at 50Hz.

Duration

Select – Choose whether you want **Manual control,** so you can click the **Start/Stop** button whenever you want, or choose **Based on number of logs** or **Based on timed duration**.

If you choose either of the last two options you can define the length of the log by entering either a number of logs to record or the time to record in hours, minutes and seconds.

Number of Logs – if you choose **Based on number of logs** then you can enter the number of logs here. The hours, minutes and seconds will update to show the actual duration based on the number of logs and the log interval.

Hours:Minutes:Seconds - if you choose **Based on timed duration** then you can choose the hours, minutes and seconds here. The number of logs will update based on the duration and the log interval.

Log Filename - Select a file to log to.

Each time the log starts it will erase any data already in the file.

Start - Clicking this button will start the log.

Stop - Clicking this button will stop the log.

View - When a log has just been stopped this button will launch the application associated with CSV files.

The format of the log file is as follows:

```
DateTime, Elapsed, Value
```

Where:

DateTime is the date and time in long format

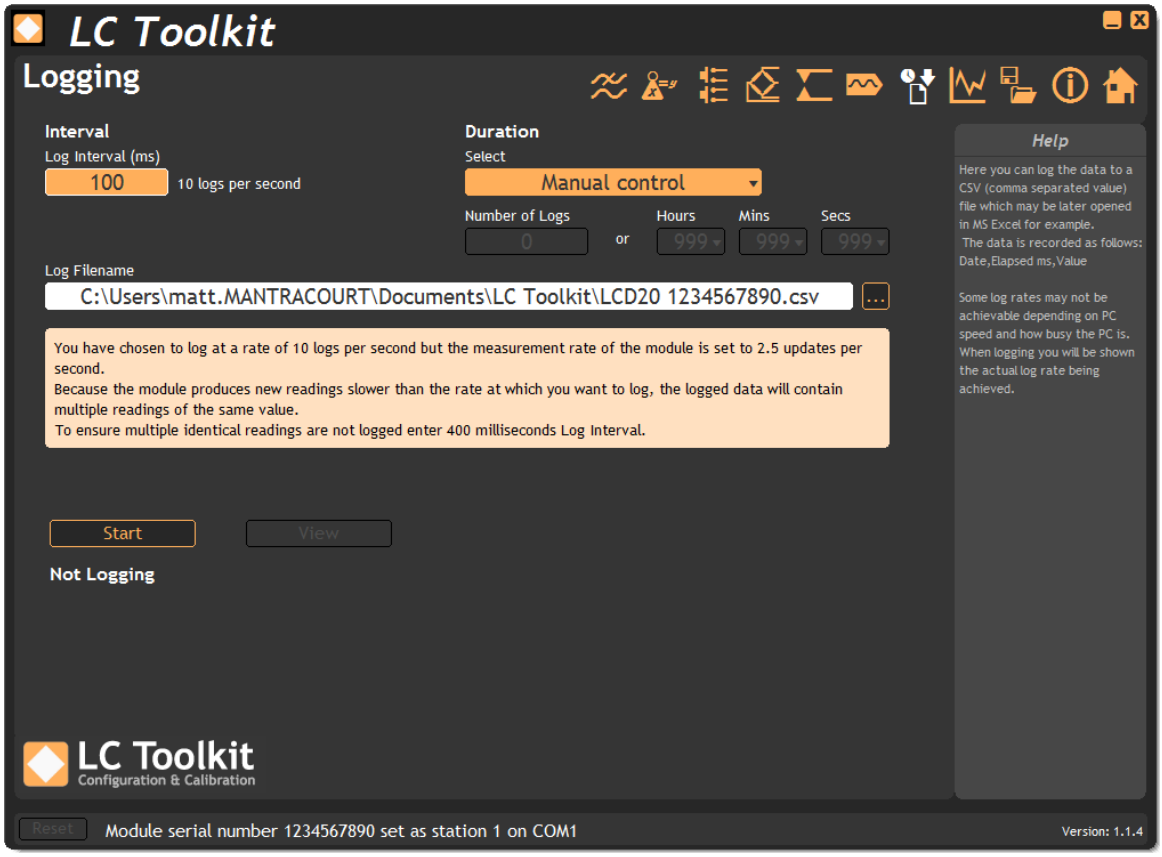
Elapsed is the time elapsed in milliseconds since the start of the log

Value is the numeric value logged

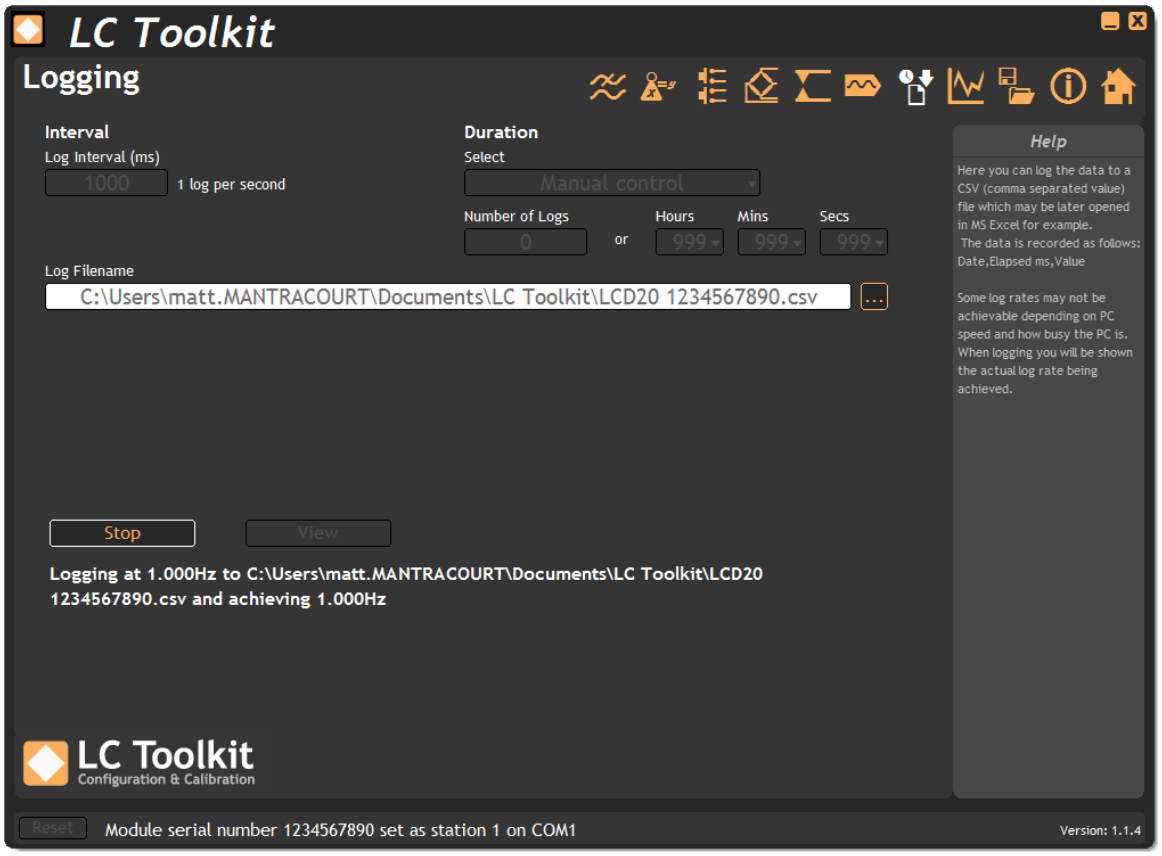
Example:

```
08/06/2009 15:41:08,0,-3.253001E-03
08/06/2009 15:41:08,10,-3.253001E-03
08/06/2009 15:41:08,43,-3.253001E-03
08/06/2009 15:41:08,60,-3.253001E-03
```

If the measurement rate of the module is less than the rate at which you have chosen to log you will be informed with a message as shown below.
Either reduce the **Log Interval** or reduce the **Measurement Rate.**

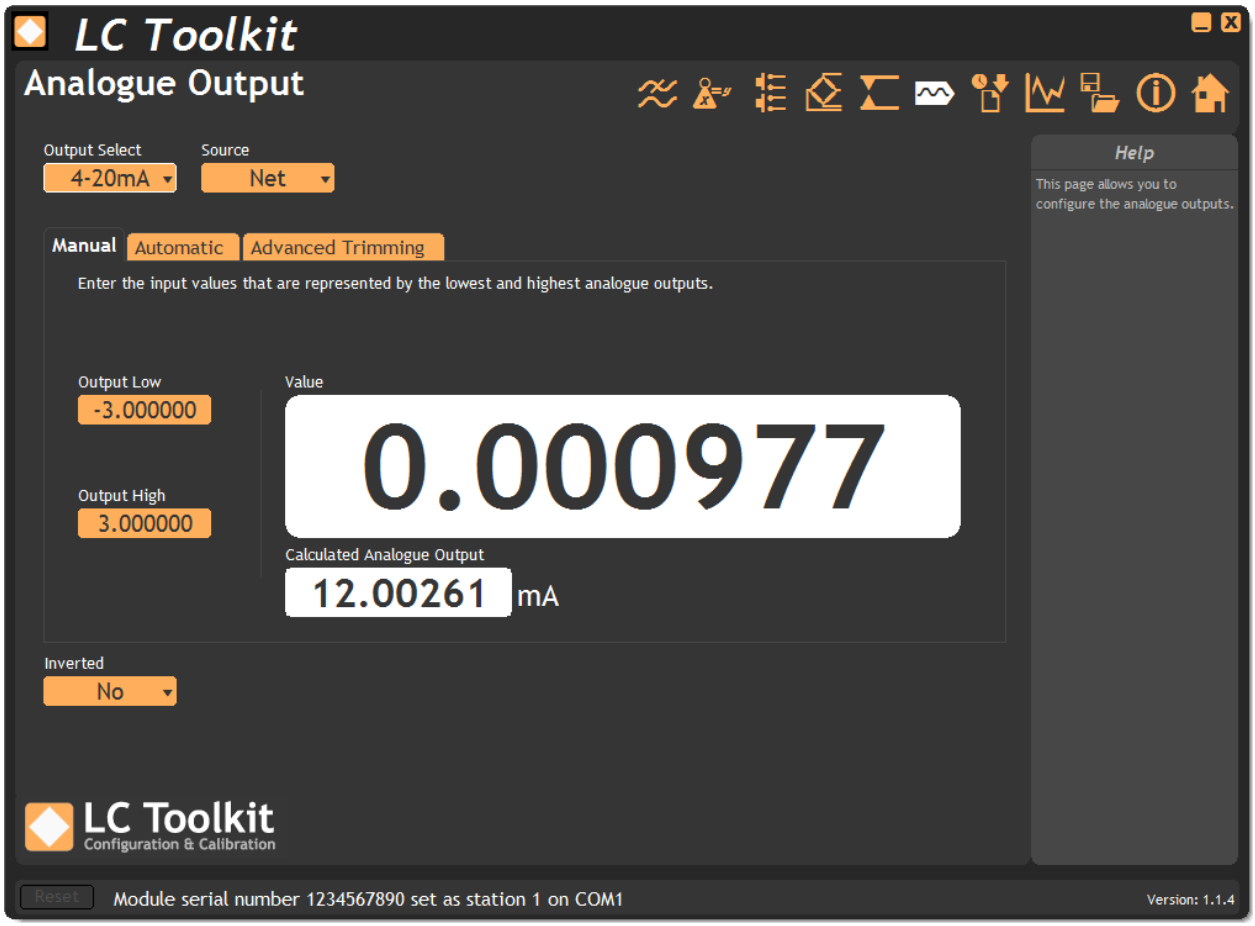


Once the logging starts the actual achieved log rate will be displayed at the bottom of the window. This is useful for diagnostics such as when a heavily burdened PC is slowing the log rate.



Analogue Outputs

This page allows the configuration and calibration of the analogue outputs.



Output Select – Choose between 4-20mA current output or 0-10V voltage output.

Source – Select the source value that the analogue output is based on.

Inverted – Select this to invert the output. The original LCA15 did not allow Output Low to be higher than Output High so this option had the same effect as entering a higher value for Output Low than for Output High. This new module will allow you to do this in both modes so this option is for backwards compatibility.

Manual Tab – This tab allows you to manually specify the values that relate to the minimum and maximum analogue output levels.

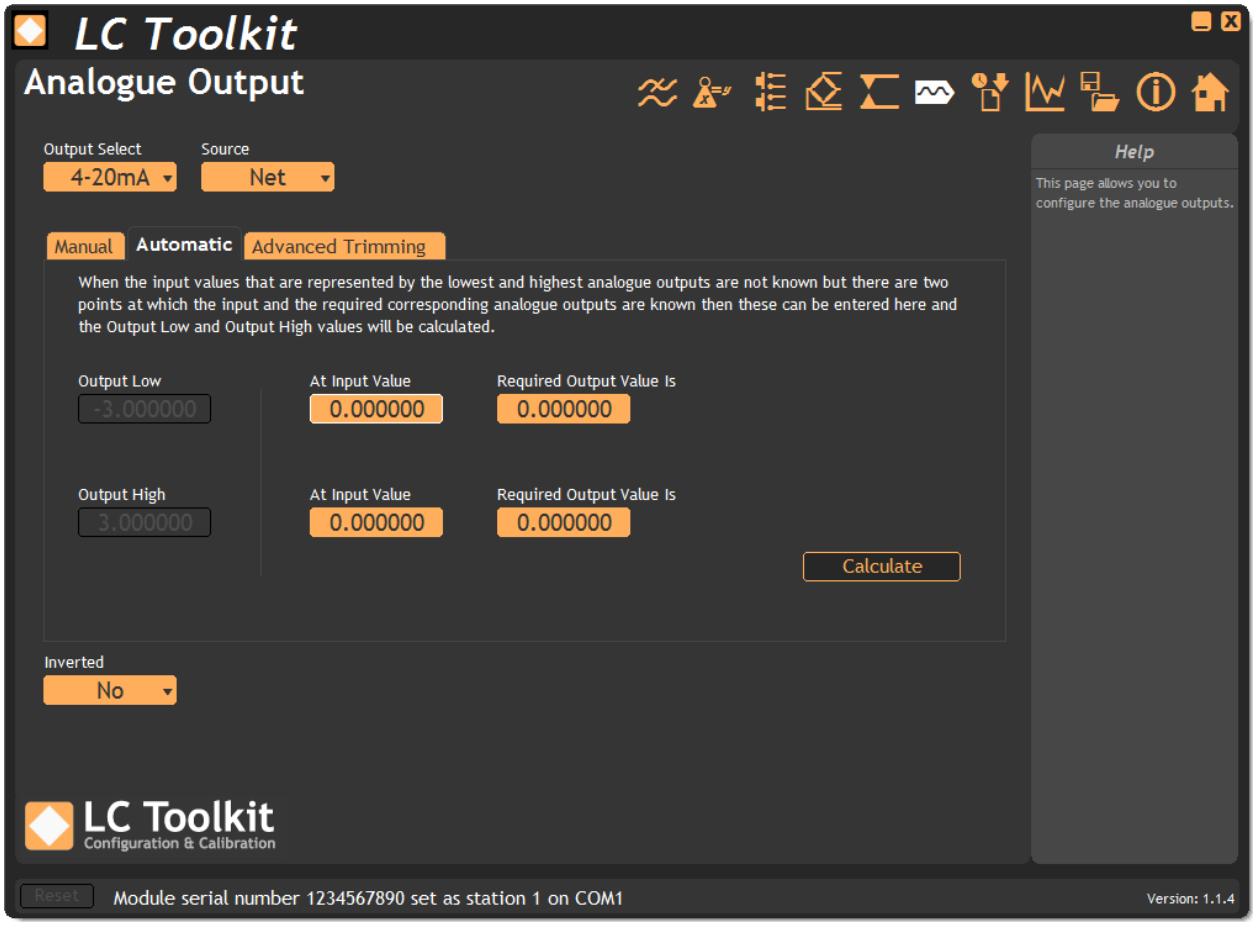
Output Low – Enter the value (of the source selected above) at which the analogue output will be at the minimum level (4mA or 0V).

Output High – Enter the value (of the source selected above) at which the analogue output will be at the maximum level (20mA or 10V).

Value – This shows the current selected source value.

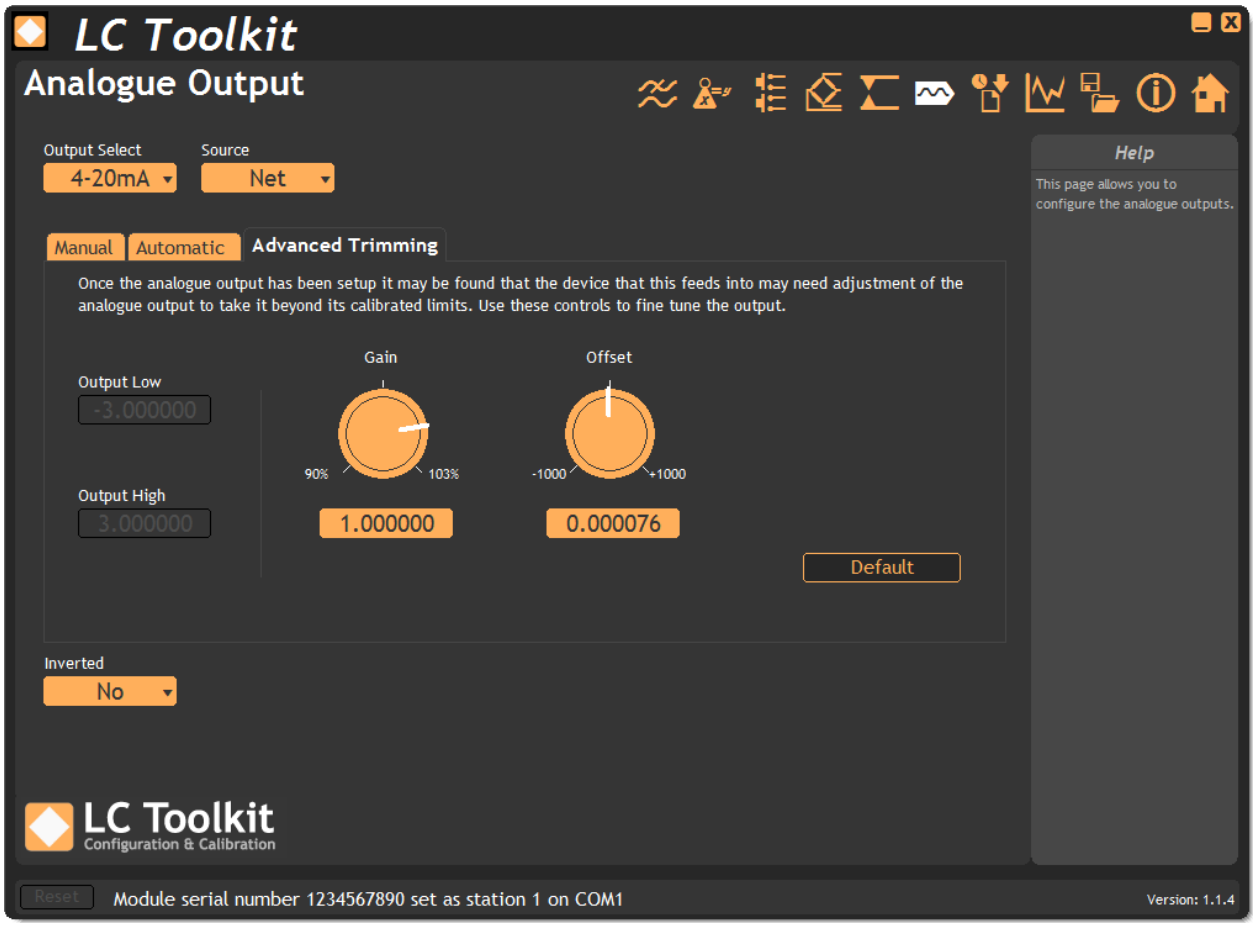
Calculated Analogue Output – Shows the calculated analogue output for the current input value. Note that this calculated value may be beyond what the output is capable of providing.

Automatic Tab – If you do not know what input value relate exactly to the minimum and maximum analogue output levels but you do know the input values for other output values use this tab.



Output Low – Shows the new **Output Low** value after you click the **Calculate** button.
Output High – Shows the new **Output High** value after you click the **Calculate** button.
At Input Value – Enter an input value that you know the required analogue output value for. There are one of these for the low level and one for the high level.
Required Output Value Is - Enter the required analogue output value for the input value you have specified. There are one of these for the low level and one for the high level.
Calculate – Click this button to calculate new **Output Low** and **Output High** values based on the information you have entered.

Advanced Trimming Tab – Sometimes when the analogue outputs are correct the device you are feeding the analogue output into does not (because of inaccuracies in that device) read the correct value. The gain and offset virtual knobs allow you to tweak the gain and offset of the analogue output to achieve fine control rather than perform measurements and recalculate Output Low and Output High Values. Also tweaking the gain and offset is the only way to push the analogue output past the min and max values (0V, 4mA and 10V, 20mA).



Gain – Alter the analogue output gain by clicking and dragging the pointer on the virtual knob.

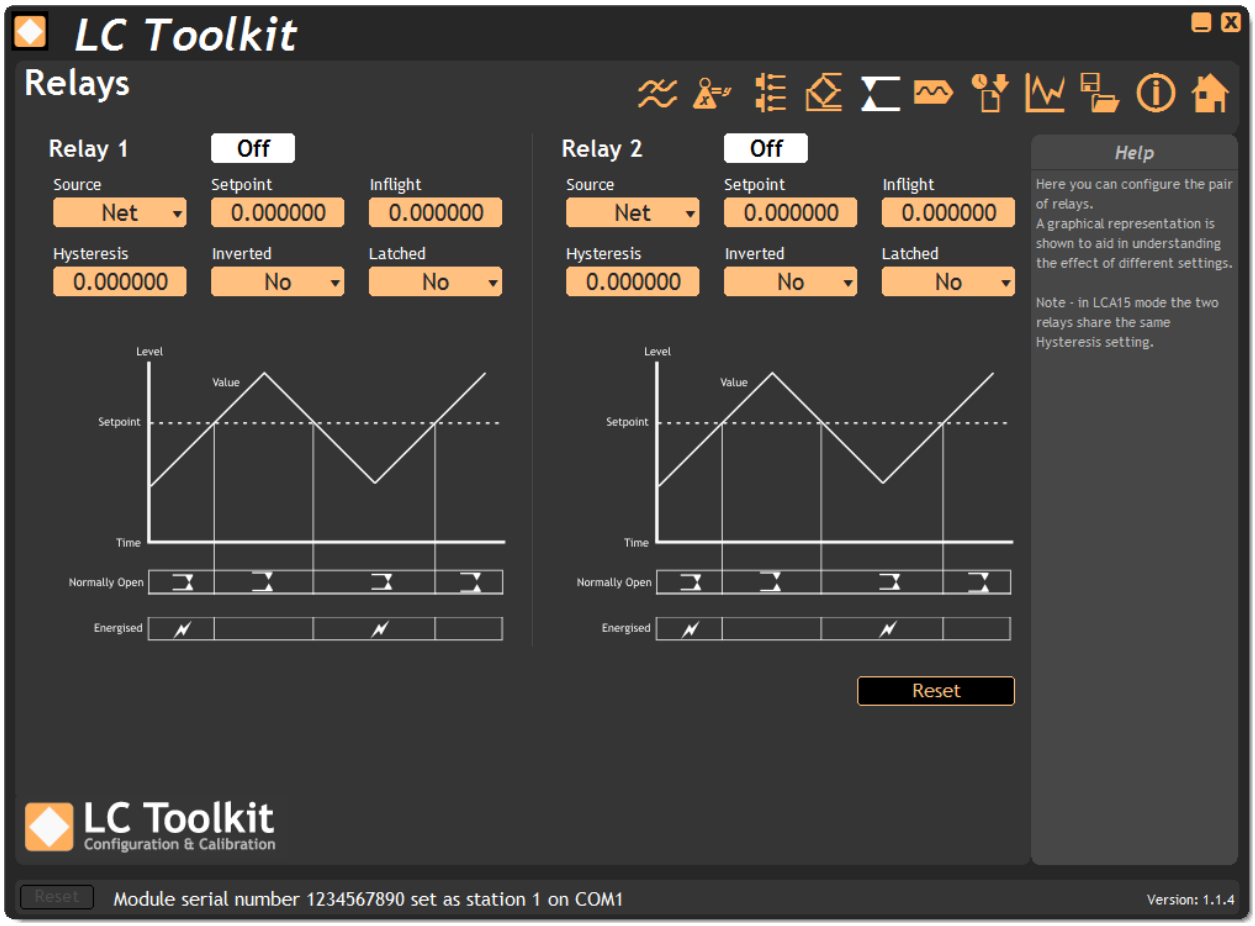
Offset – Alter the analogue output offset by clicking and dragging the pointer on the virtual knob.

Default – Clicking this button will return the gain and offset to default values.

ⓘ The gain and offset are interactive. You may need to alternate between the adjustments to achieve the desired effect.

Relays

This page allows you to configure the relays.



Source – Select the source of the value that the relays will act upon.

Setpoint – The target value at which the relay operation will function. The actual point at which contacts may changeover may be affected by Inflight and hysteresis value.

Inflight – Compensates for amount of delivered product still falling even after valves are closed.

Hysteresis – This is used to stop relay chatter and affects the actual point that relay contact changeover occurs.

Inverted – Whether the operation of the relay is inverted.

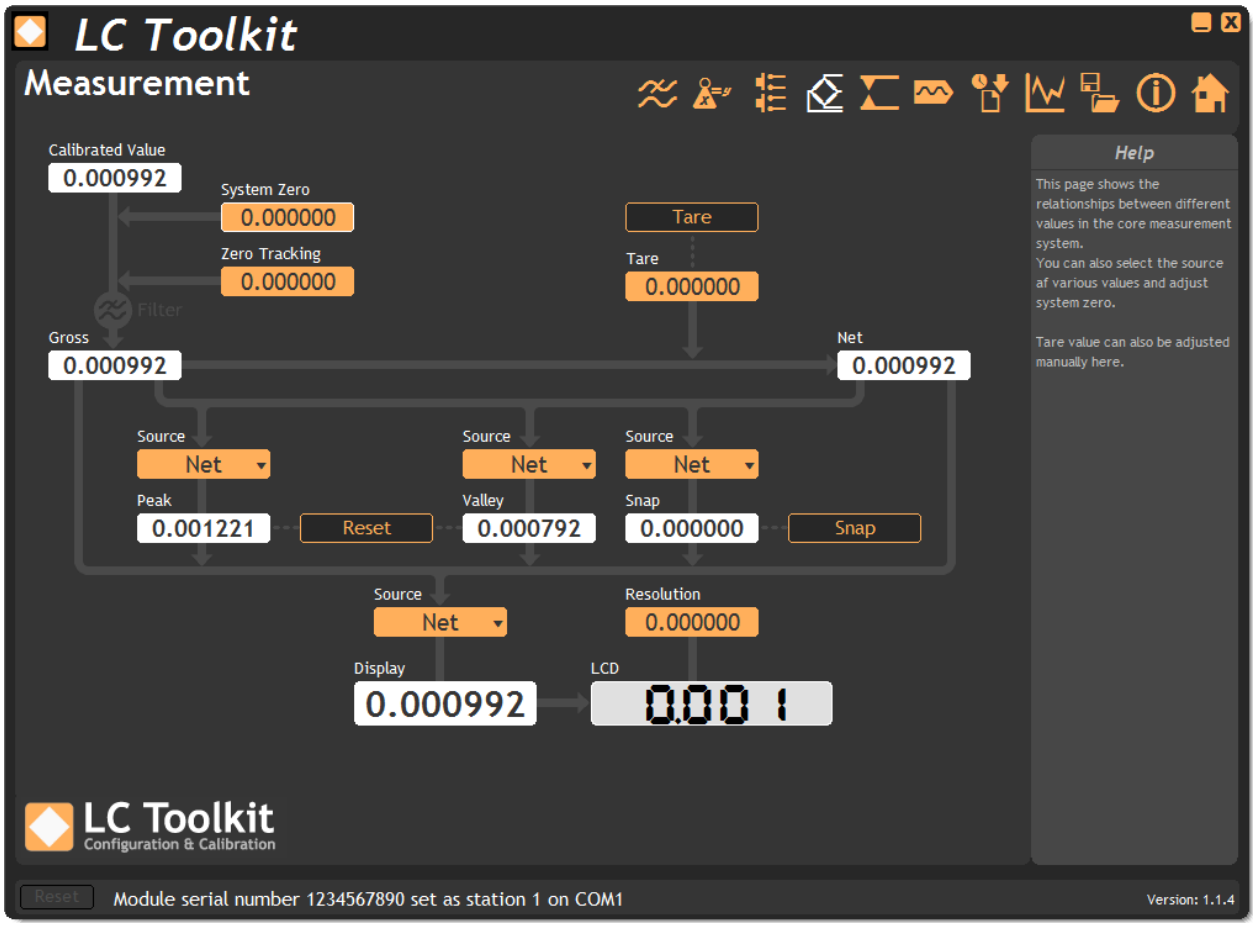
Latched – Once contacts have changed this option can be used to latch the relays. A serial command or digital input is then required to reset the relay contacts. Relays only latch in deactivated state.

Reset – Click this button to reset any latched relays.

See Also – Appendix C - Relays for more information.

Measurement

This page shows how the core measurement values relate to each other.



Calibrated Value – Shows the calibrated value. Calibration turns the input mV/V value into this value.

System Zero – Enter a value here that is added to the **Calibrated Value** to produce the **Gross** value. 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.

Zero Tracking – Zero tracking is applied after the system zero and compensates for small changes in the input to allow for a zero Gross value. See Appendix B – Zero Tracking for more information.

Gross – The Gross value of the system.

Net – The Net value of the system is generated from the Gross value plus the Tare value.

Tare – The Tare value is added to the Gross value to generate the Net value.

Peak – Indicates the highest value measured since power up or last Peak/Valley Reset.

Peak Source – Select which source the peak value is based on.

Valley – Indicates the lowest value measured since power up or last Peak/Valley Reset.

Valley Source – Select which source the valley value is based on.

Reset Button – Reset the peak and valley values to the current source value.

Snap – Shows the last snap value recorded.

Snap Source – Select which source the snap value is based on.

Snap Button – Perform a snap recording now. (This control is included for demonstrating the function. Snap would normally be triggered by a digital input to 'Hold' a value.

Display – Shows the main value that is indicated on the optional display. Note that the actual value shown on the LCD may differ from this floating point value due to the **Resolution** parameter setting.

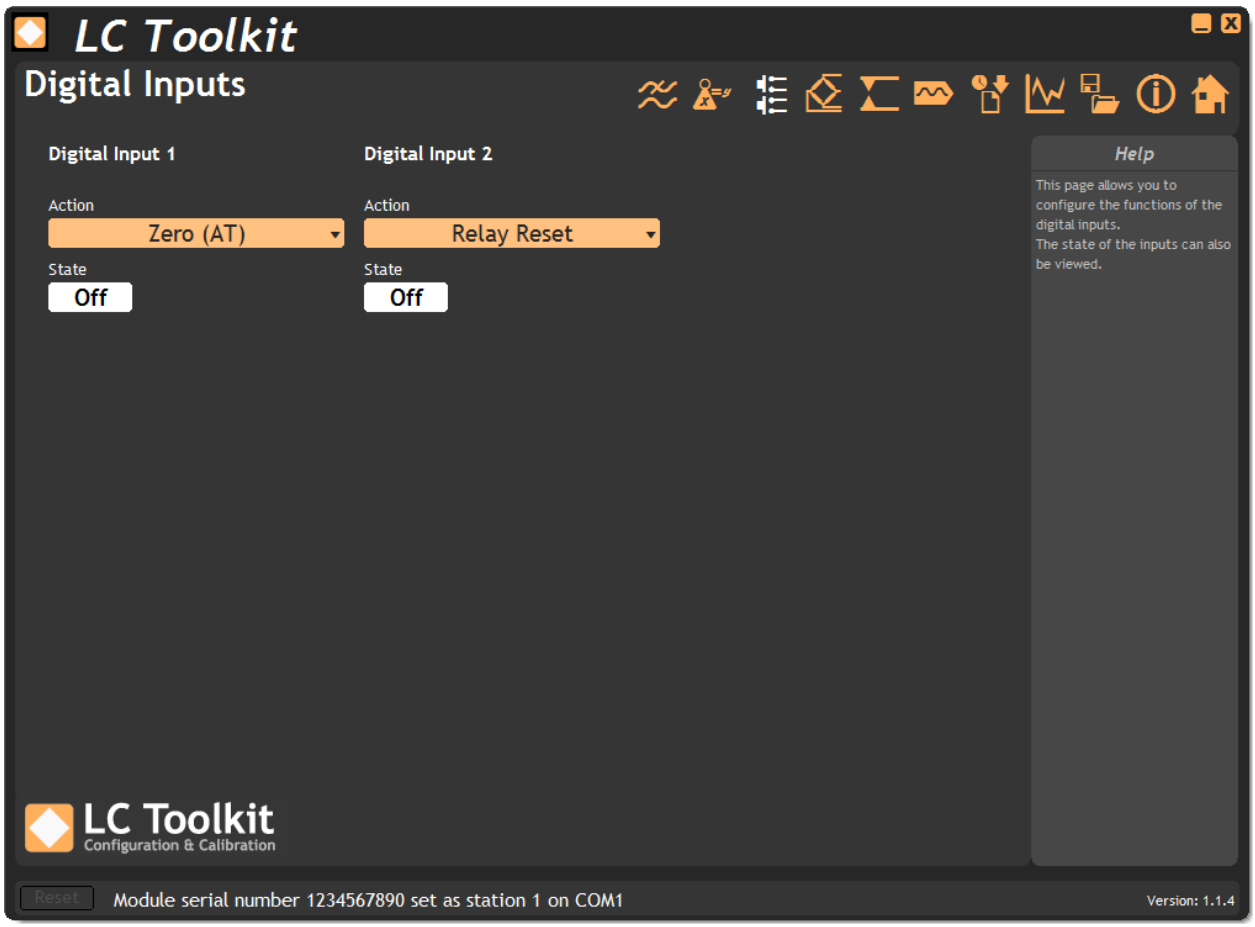
Display Source – Select the source for the display value.

LCD – Mimics the actual display that would be shown on the optional LCD display.

Resolution – This parameter value sets the block size that the optional LCD display will increment and decrement by. This setting does not affect anything other than the LCD display.

Digital Inputs

Allows the function of digital inputs to be set and indicates the current state of the inputs.



For each of the three digital inputs the following settings are available:

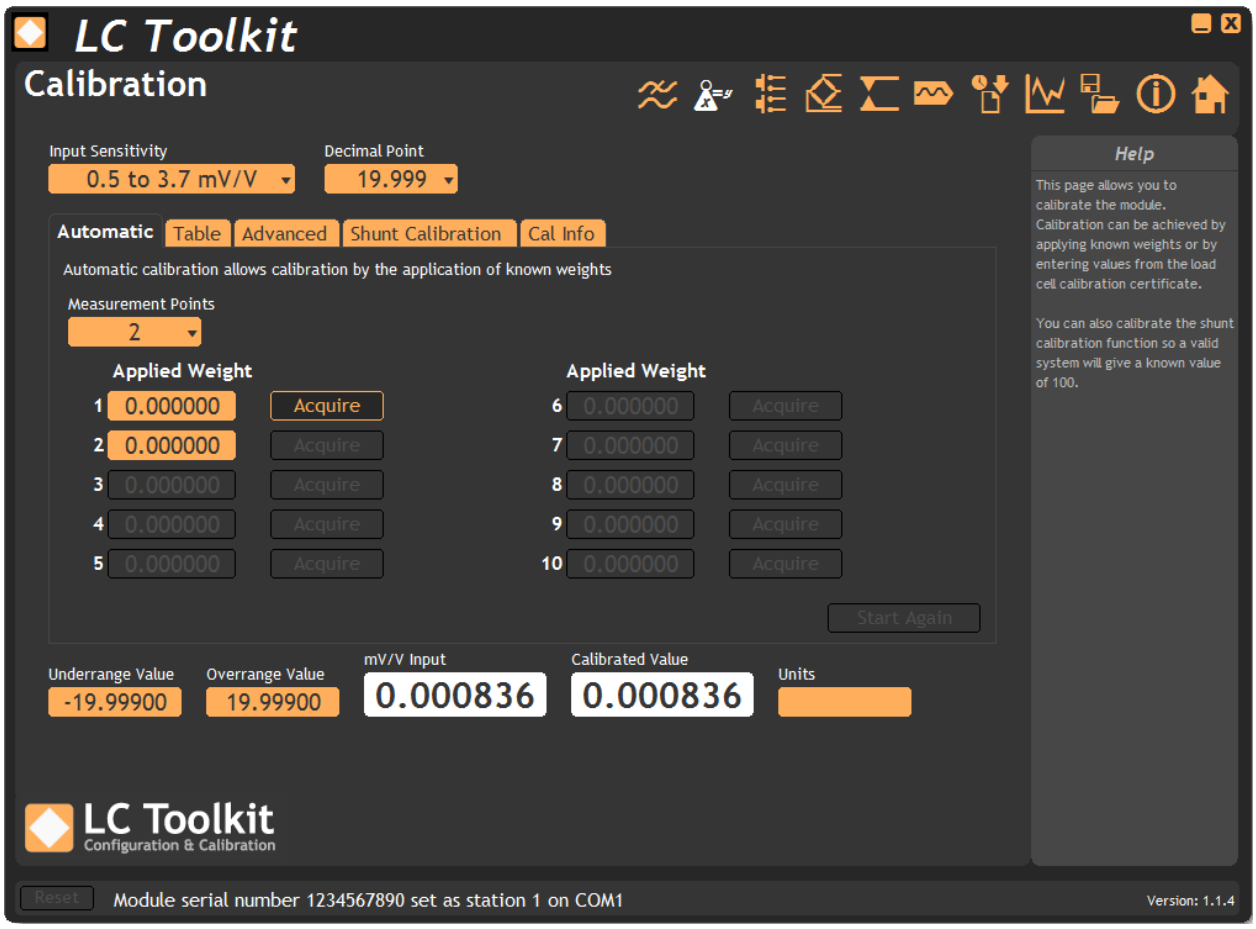
Action – Select the action to execute when the digital input is activated.

State – Indicates the current state of the digital input.

See Also – Appendix E - Digital Inputs for more information.

Calibration

The calibration page offers three ways to calibrate the module and also allows configuration of shunt calibration.



The **Input Sensitivity** and **Decimal Point** parameters should be decided on before calibration takes place. Changing either after calibration may void that calibration.

Input Sensitivity – Choose the appropriate range for the load cell sensitivity that is connected.

Decimal Point – This setting determines the maximum range of the engineering units for the module. ***This must be selected to allow for the maximum value likely to be encountered.***

Underrange Value – Enter the engineering unit value of the **Gross** value below which the underrange flags will be set. The output value will change to -20001 with the decimal point as defined above. The optional LCD display will show -1 with no other digits shown.

Overrange Value – Enter the engineering unit value of the **Gross** value above which the overrange flags will be set. The output value will change to +20001 with the decimal point as defined above. The optional LCD display will show +1 with no other digits shown.

mV/V Input – The mV/V value measured at the input.

Calibrated Value – The mV/V value after having the calibration applied.

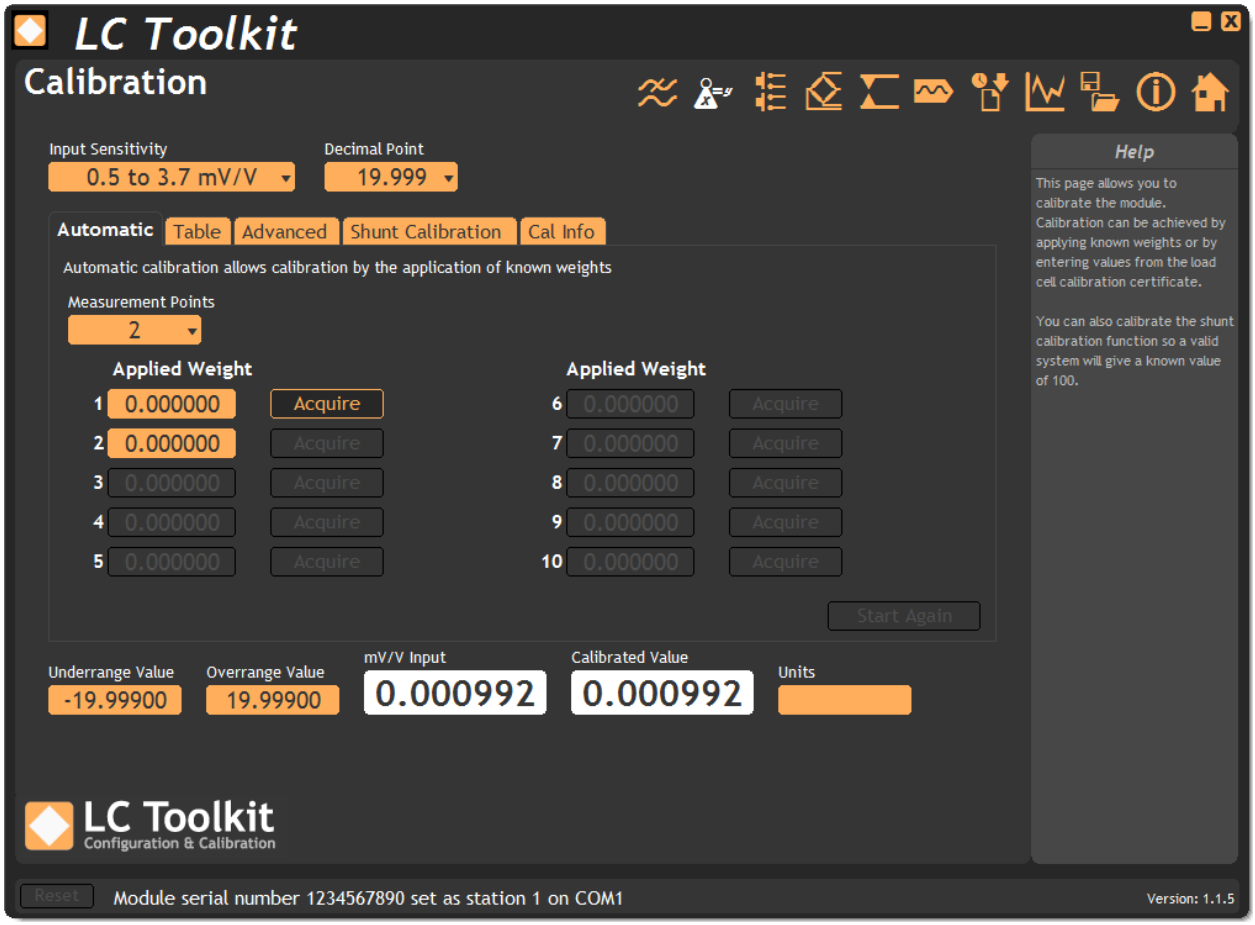
Units – Optional 6 characters of units that will be displayed on the main Information page.

The following sections will deal with each of the tabs available on the calibration page.

Automatic Tab

Select this tab to calibrate the module by applying known loads.

> ⓘ Each time you enter this page it will hold the last data entered or will be blank ready to accept values. i.e. The page is used to generate the calibration data seen in the Advanced Tab but does not reflect any data held in the module.



Measurement Points – Enter between 2 and 10 measurement points. These are the points at which weights will be applied. This process will linearise as it calibrates.

The following pair of controls will be available for the number of measurement points selected.

Applied Weight – Enter the known weight applied at this measurement point. The weights must be applied in ascending order.

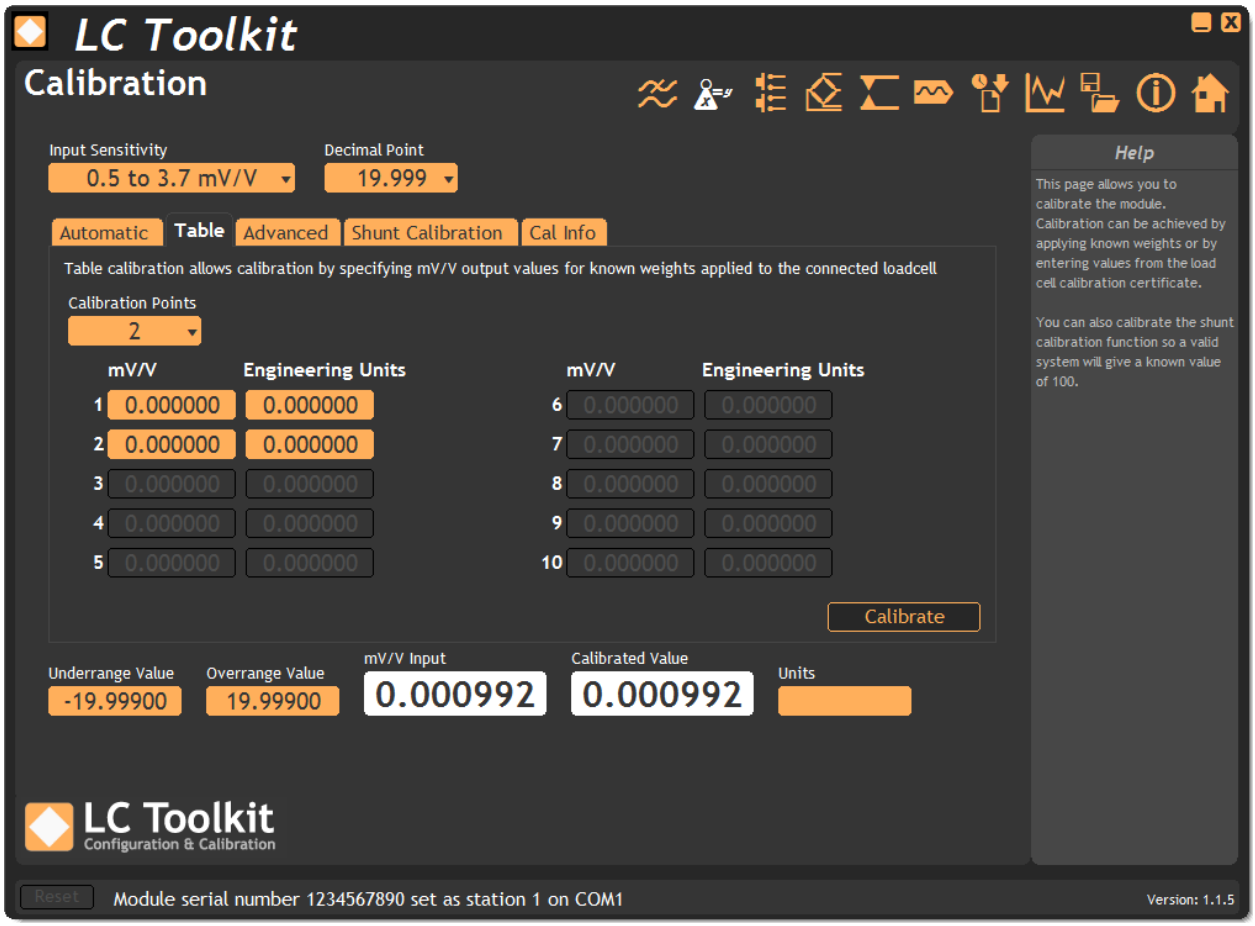
Acquire Button – Once the input has been given enough time to settle click this button to acquire the point and start calculating calibration values. You can then redo the calibration at this point again or move on to the next calibration point.

Start Again – Click this button to restart the calibration process.

Table Tab

Select this tab if the mV/V input values are known for 2 or more known weights. This can be used to calibrate based on load cell manufacturer certificates and there is no need to apply actual weights.

> ⓘ Each time you enter this page it will hold the last data entered or will be blank ready to accept values. i.e. The page is used to generate the calibration data seen in the Advanced Tab but does not reflect any data held in the module.



Calibration Points – Enter the number of known mV/V and engineering unit value pairs.

The following pair of controls are repeated for each calibration point.

mV/V – Starting from the lowest mV/V value enter the known value for this point.

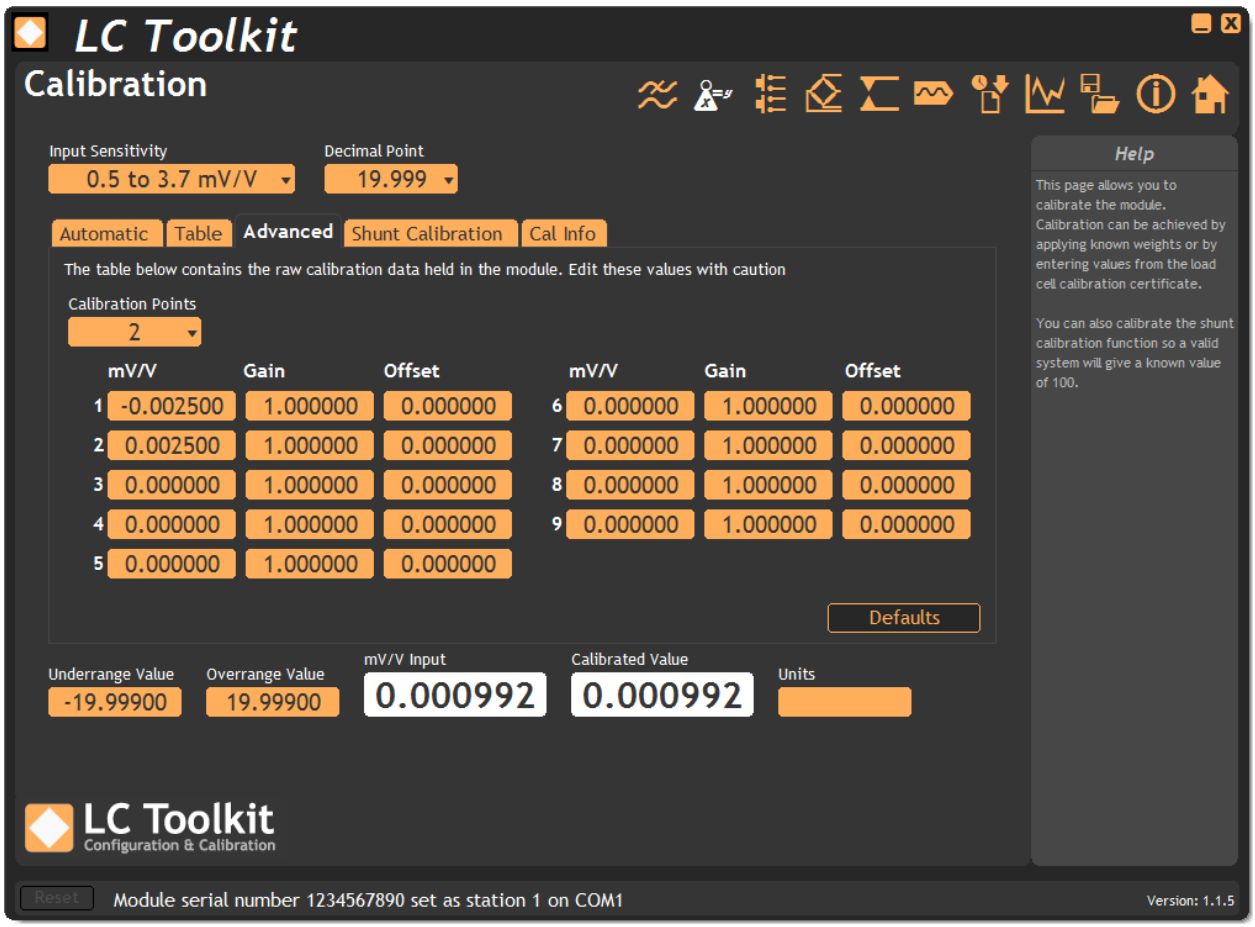
Engineering Units – Enter the known engineering unit weight for the stated mV/V value.

Calibrate – Click the Calibrate button to calculate the calibration settings based on the information entered.

Advanced Tab

This gives access to the internal gain and offset values. This is considered advanced and care should be taken in this tab.

> The data shown on this page is the actual calibration data held in the module. Use with caution!



Calibration Points – Shows the number of calibration points in the calibration.

The following triplets of controls are repeated for each calibration point.

mV/V – Between this mV/V value and the next the following gain and offset will be used to convert the value to the Calibrated Value.

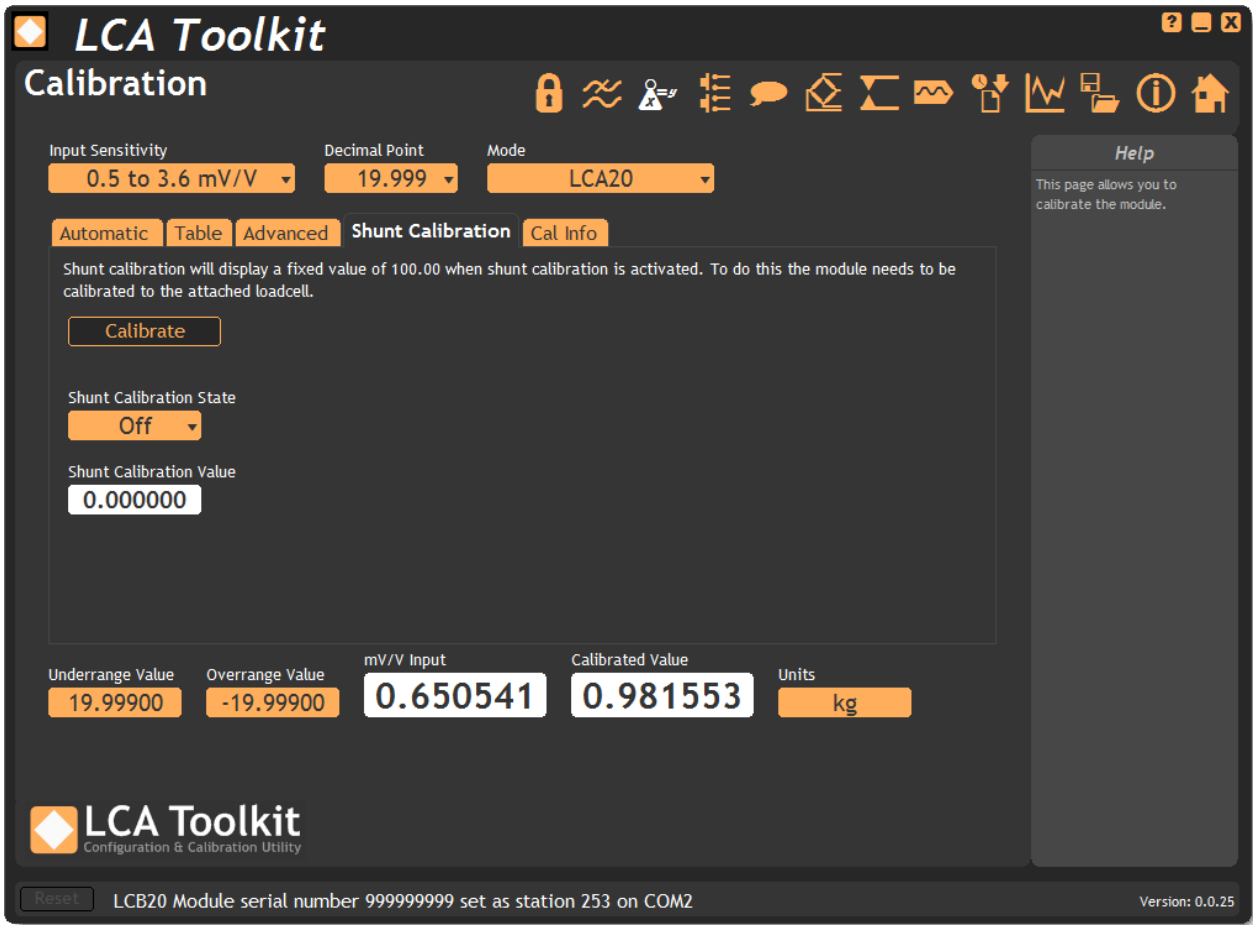
Gain – The gain (multiplication factor) applied to the mV/V value.

Offset – The offset added to the mV/V * Gain value to give the Calibrated Value.

Defaults – Click this button to revert all calibration data to factory defaults. The Calibrated Value will then be mV/V.

Shunt Calibration Tab

This tab allows the calibrating of the shunt calibration function. After a load cell has been connected to the module and all wiring and connectors have been finalised the Shunt Calibration can be calibrated so that the Shunt Calibration output always indicates 100.00 if nothing has changed on the load cell or wiring. This value will indicate 100.0 regardless of the weight on the load cell at the time the shunt calibration is activated. This allows very quick checking of calibration and hardware integrity.



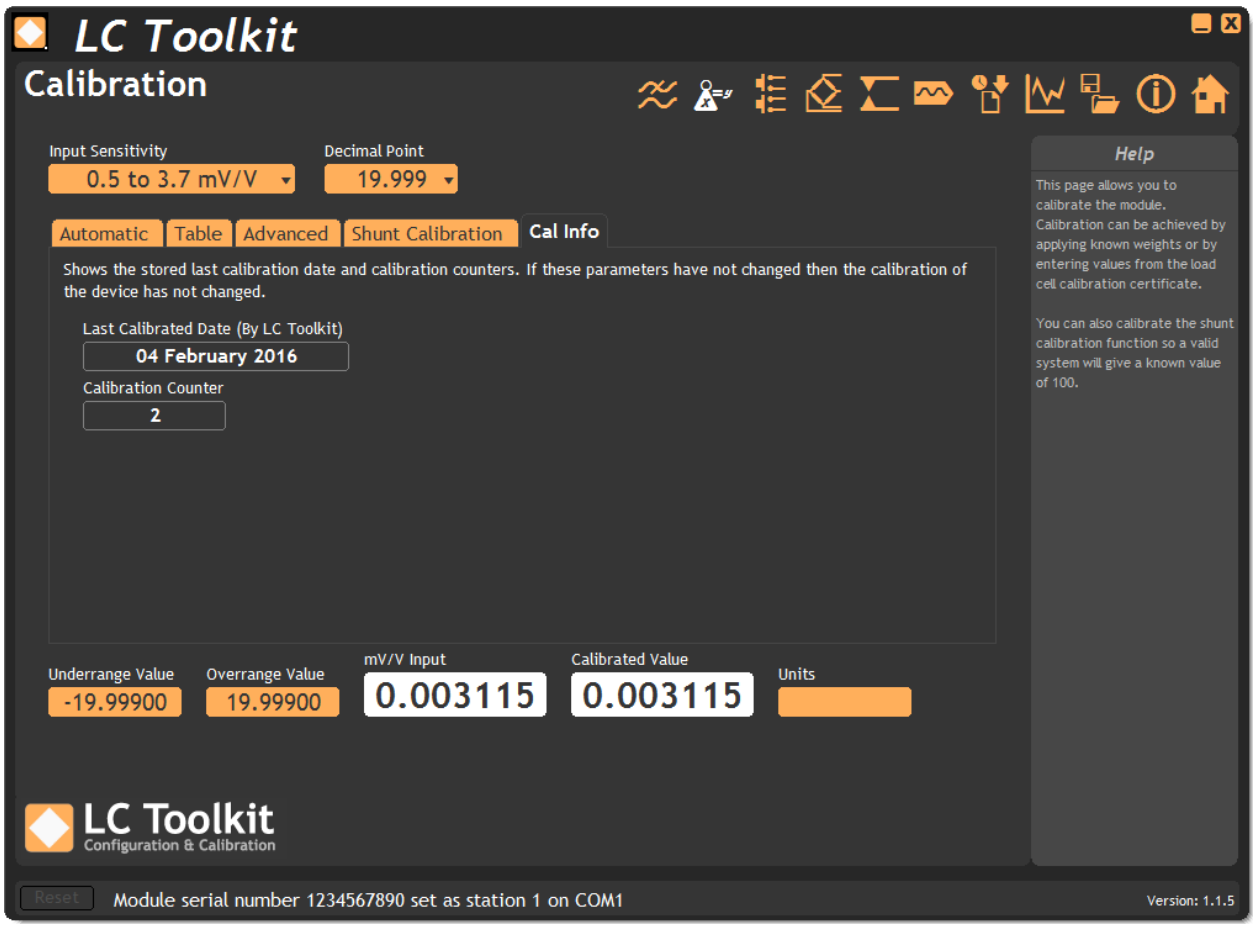
Calibrate – Click this button to calibrate the shunt to the current load cell attached.

Shunt Calibration State – Allows the control of switching on or off the shunt calibration.

Shunt Calibration Value – This is the special shunt calibration value that should read 100.0 when shunt calibration is activated and the integrity of the calibration and hardware is correct.

Cal Info Tab

This tab shows the last date the Toolkit was used to perform calibration and shows the Calibration Counter parameter that the module increments whenever a calibration related parameter is written to.

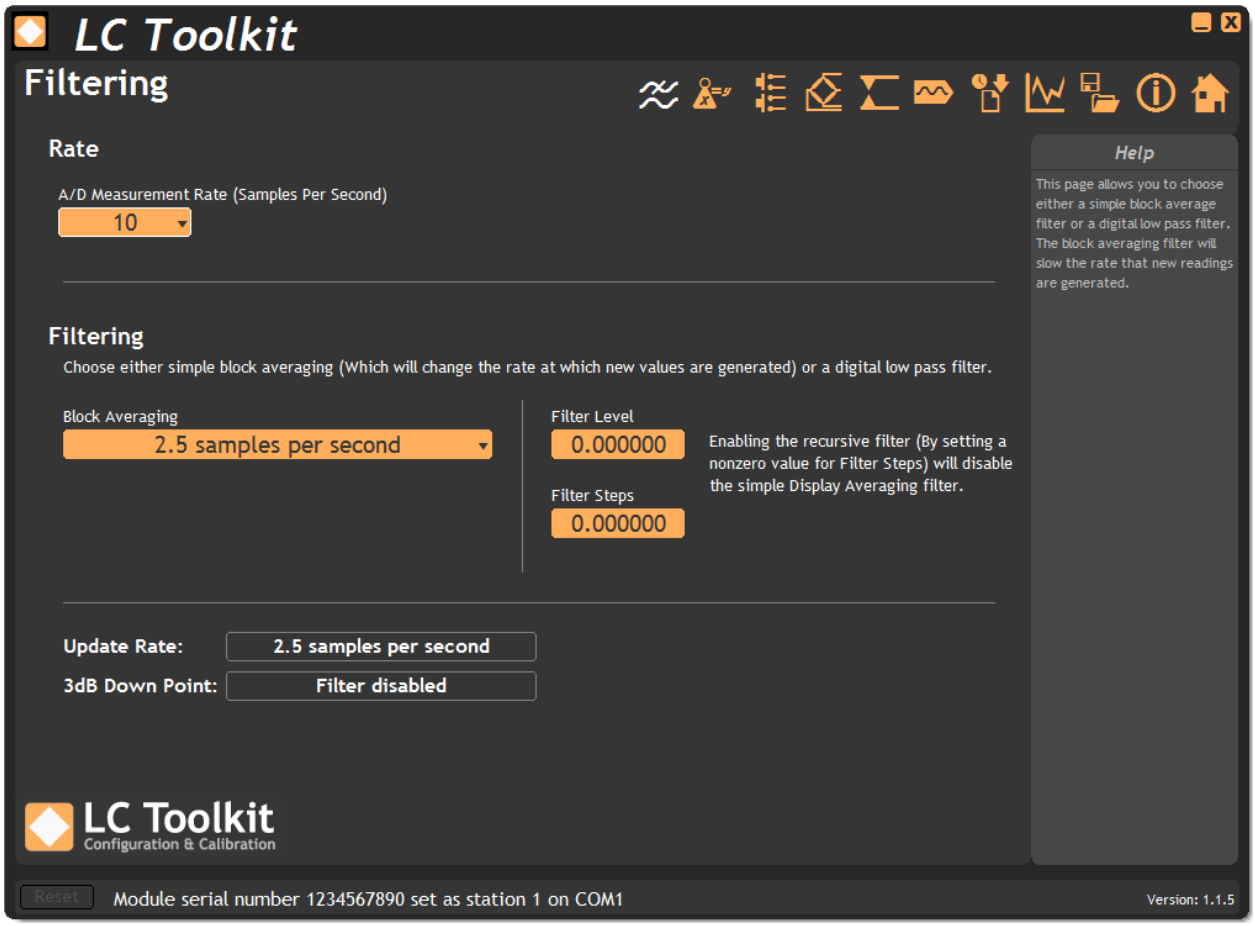


Last Calibrated Date – Indicates the last date that calibration was performed by the Toolkit.

Calibration Counter – Shows the internal calibration counter.

Filters

This page allows the selection of filter settings that are applied to generate the **Gross value**.



Rate – Here the basic selection of A/D measurement rate can be selected. The slower rate will have an improved noise free resolution.

Filtering – This section allows the choice between simple block averaging or digital low pass filtering. Choosing block averaging will slow down the generation of new values which will be noticeable on the optional display or via the communications bus.
The digital low pass filter will result in new values being generated at the A/D measurement rate.

> **Block Averaging** – Select the required rate at which new readings are generated. This is in the form of samples per second or seconds per sample.
>
> **Filter Level** – If the difference between the newest unfiltered value and the previous filtered value is greater than this filter level value then the filter is bypassed and the gross will jump straight to the unfiltered value. If the difference is less than the filter level value then the filter will be operational.
>
> **Filter Steps** – Set the fractional part of the difference between the newest and previous values that is added to the previous value to generate the next gross. i.e. if filter steps is 10 then only a 10^{th} of the change is applied to the gross value.

Update Rate – This indicates the samples per second or rate at which new values are generated.

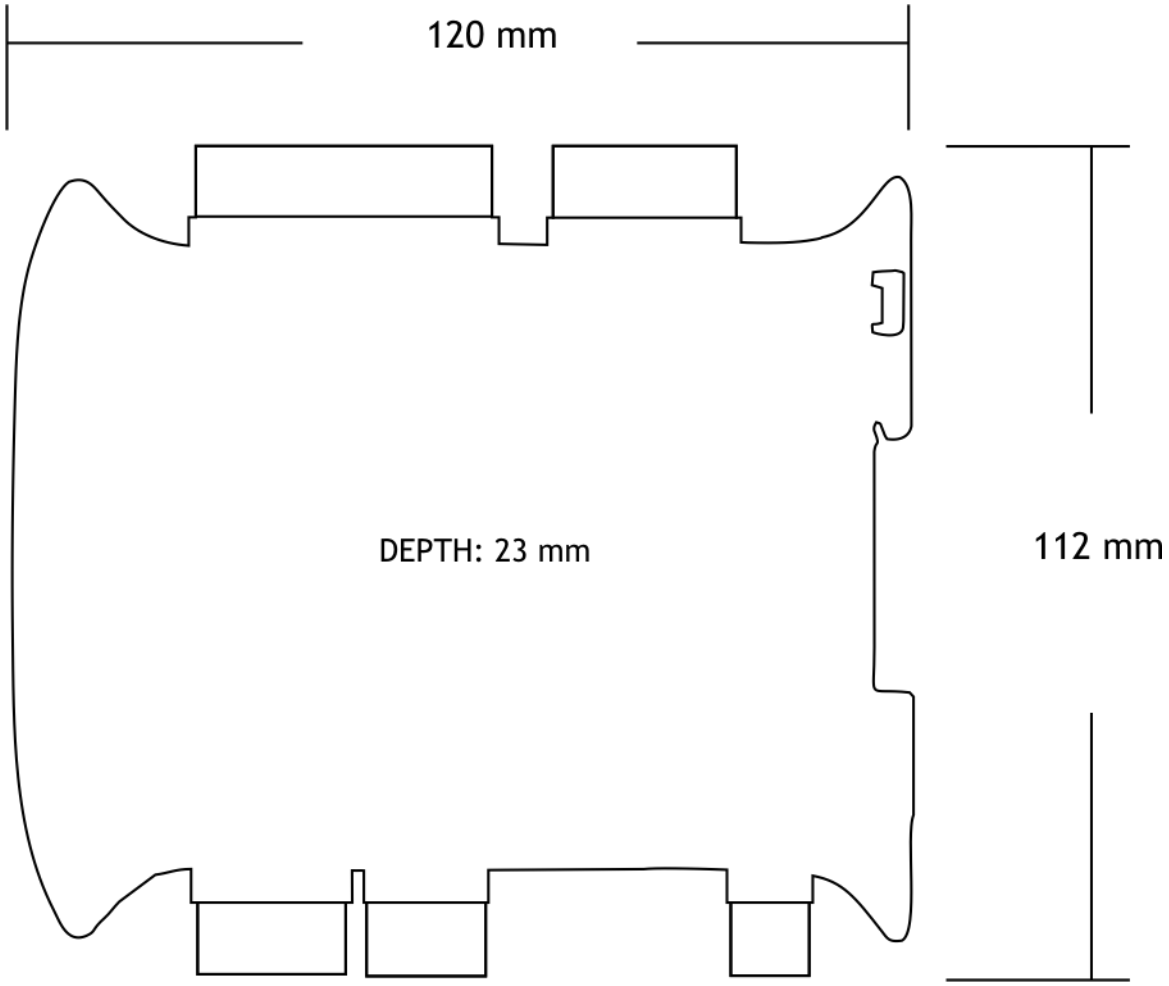
3db Down Point – When using the digital low pass filter there is an attenuation of higher frequency components on the input signal. This indicates the frequency at which the output value would be half of what it would be at a fixed level.

See Also – Appendix B – Measurement | Filters for more information.

Installation

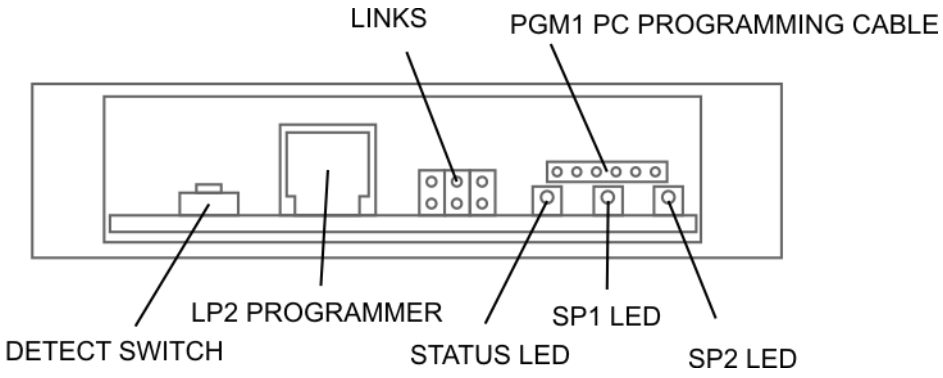
Mechanical

The LCD20 is designed to connect to a 'Top Hat' DIN rail.

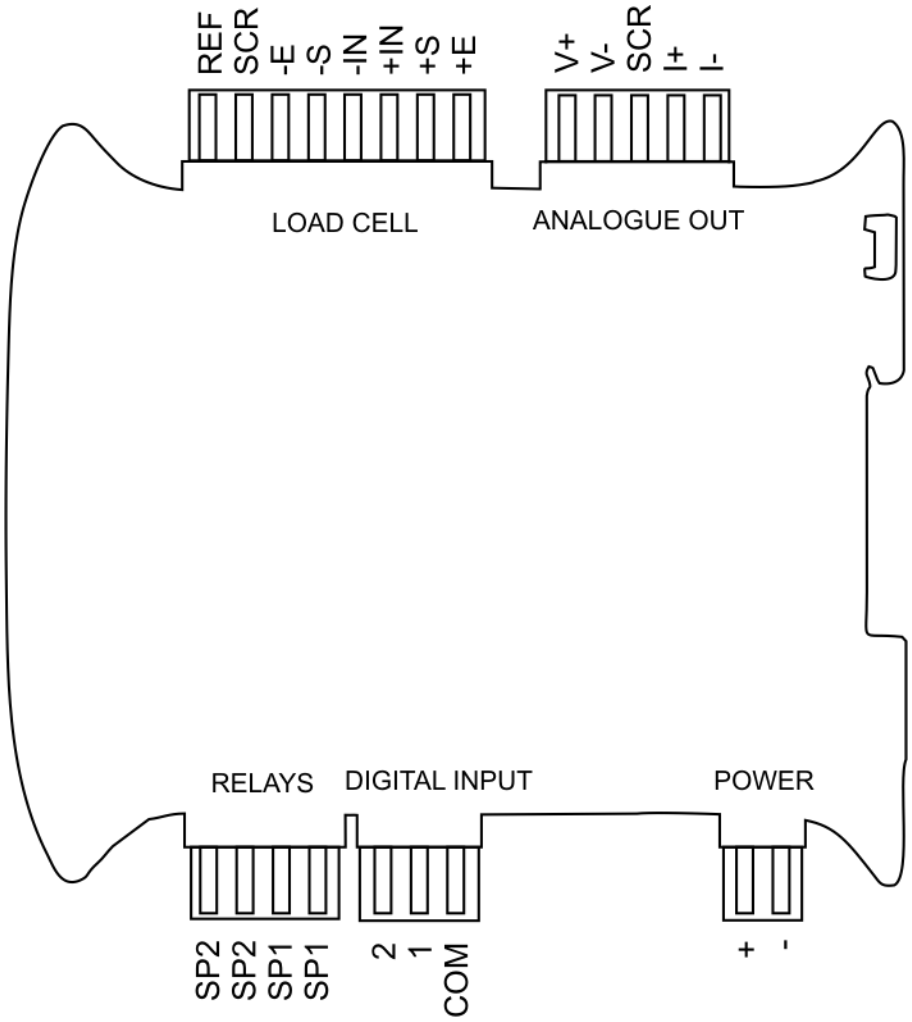


Front Panel

Access to various connectors and buttons is gained by opening the front panel door. This is hinged at the opposite side to the LEDs.



Connections



Load cell Connections

The LCD20 offers a direct connection to a range of low level (foil) strain gauge sensors.

Gain sensitivity is optimised for two ranges, 0.5 to 3.7mV/V and 3.7 to 7.8mV/V selected by the **Sensitivity** parameter in the menu.

A stable 5VDC excitation supply at 150mA is provided which is sufficient to power up to **four** 350 ohm load cells connected in parallel.

Ratiometric strain gauge measurements are taken which cancel out errors caused by changes or drift in Excitation voltage. The LCD20 facilitates 6 wire measurement which allows for voltage drops caused by long cable lengths between the LCD20 and the load cells, where barriers are used or if the load cells are powered from another source. Where possible, use 6-wire connections to the load cells.

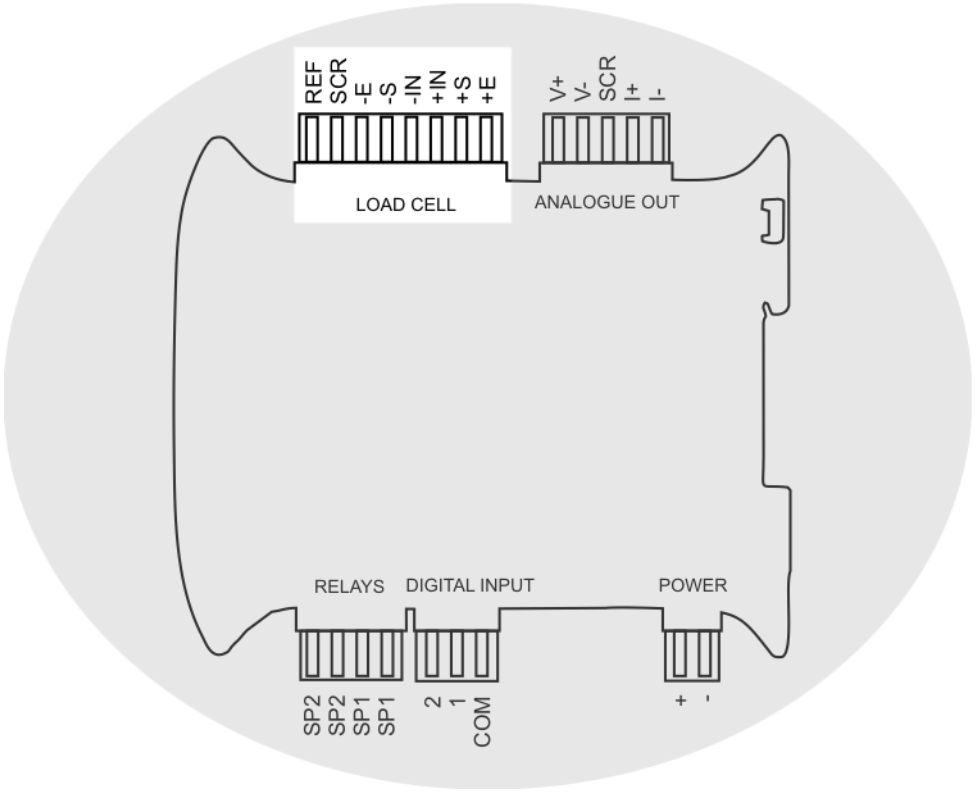
For load cell connections we recommend the use of 3 pairs of twin twisted pair cable such as Alpha Wire 5123C SL005 available from Farnell 130-2249.

The pairs should be arranged as follows:

Excitation	pins 1 & 6
Sense	pins 2 & 5
Signal	pins 3 & 4

ⓘ Terminate all screens at 'SCR'. The screens should not be connected at the transducer end of the cables. However, if the transducer has an EMC gland then the screen should be connected there and not at 'SCR' on the LCD20.

Connector Location

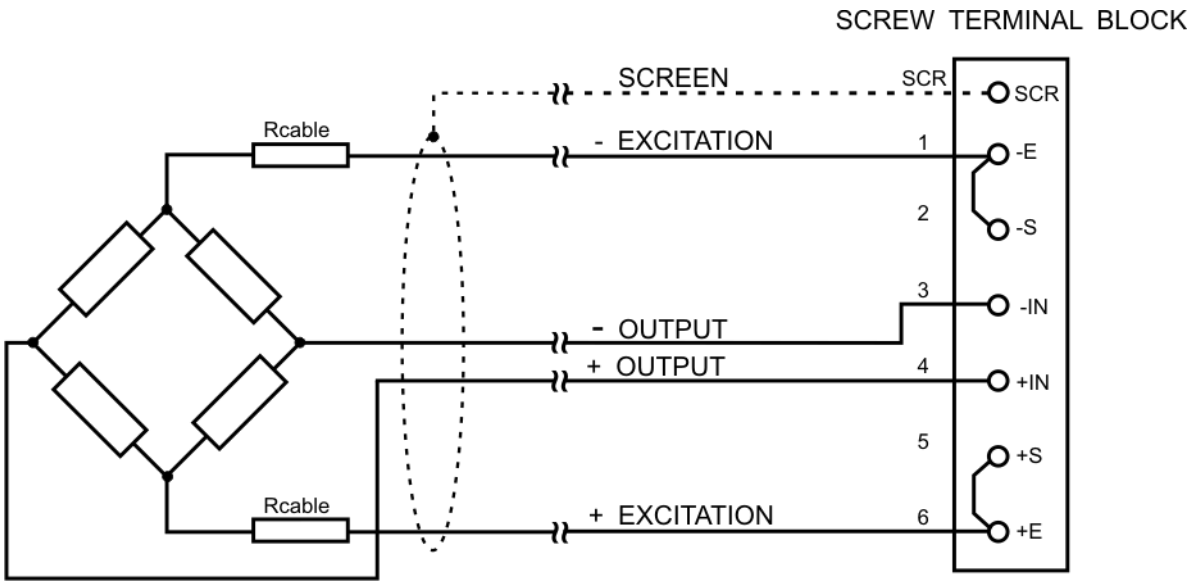


4 Wire

If the load cell is supplied with a 4 wire cable and long cable lengths are required it is recommended that any extension cabling required is 6 wire to compensate for voltage drops along the cable.
Once a 4-wire system is calibrated any changes to the cable length will require that the system is re-calibrated.

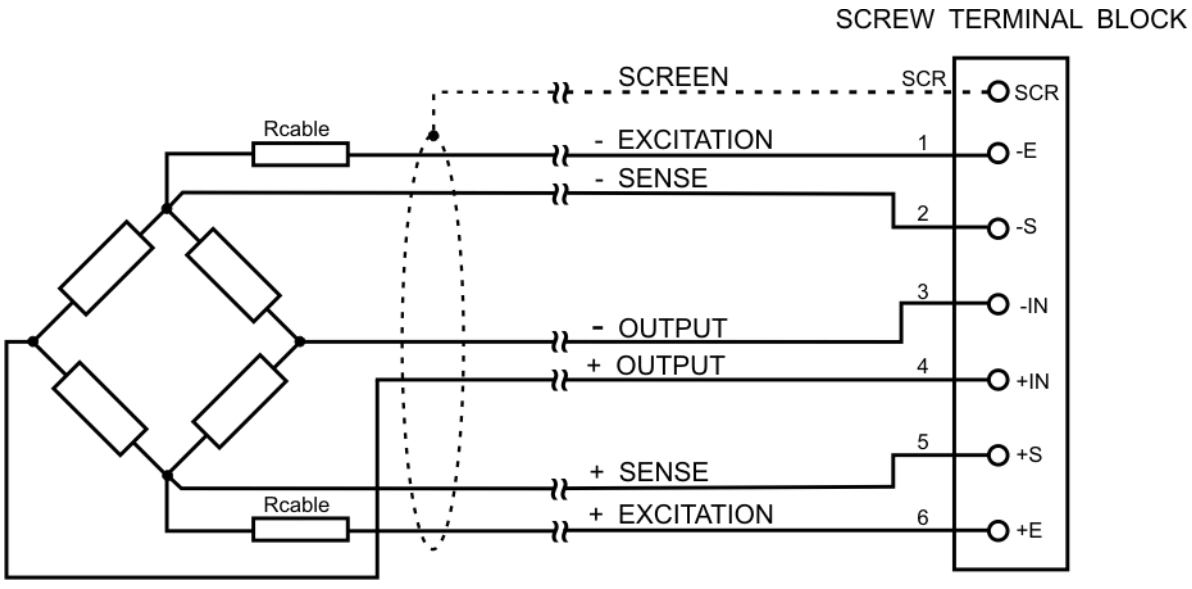
Please refer to load cell manufacturer's instructions.

When 4-wire connectivity is used it is important that the respective Excitation and Sense connections are linked together.



6 Wire

Where load cells are provided with 6 wires then it is recommended to continue the 6 wires connectivity throughout the system.

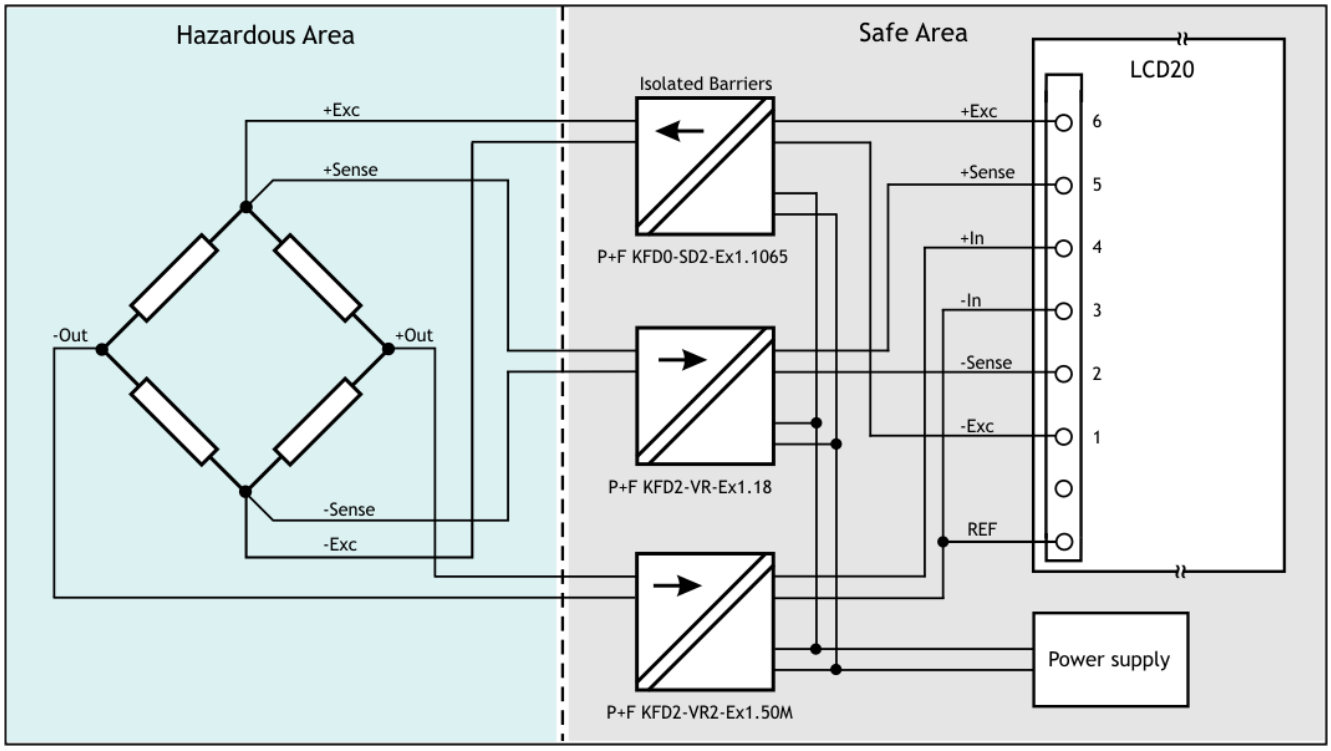


Barriers

The LCD20 can be used with isolating barriers. This allows the load cells to be situated in the hazardous area whilst the LCB is in the safe area.
6 wire connectivity must be used.

The example below uses Pepperl + Fuchs isolated barriers.

KFD2-VR2-Ex1.50M is used to isolate the Output signal from the load cell.
KFD2-VR-Ex1.18 is used to isolate the Sense connections.
KFD0-SD2-EX1.1065 used to provide excitation for up to 4 350 ohm load cells.



Because the barriers are fully isolated, the **REF** connection **MUST** be made to ensure that the LCD20 input stage is biased correctly.

If galvanic isolation is **NOT** required, passive non-isolated barriers such as the MTL77xx series can be used instead. In this case the **REF** connection should **NOT** be made.

Digital Inputs

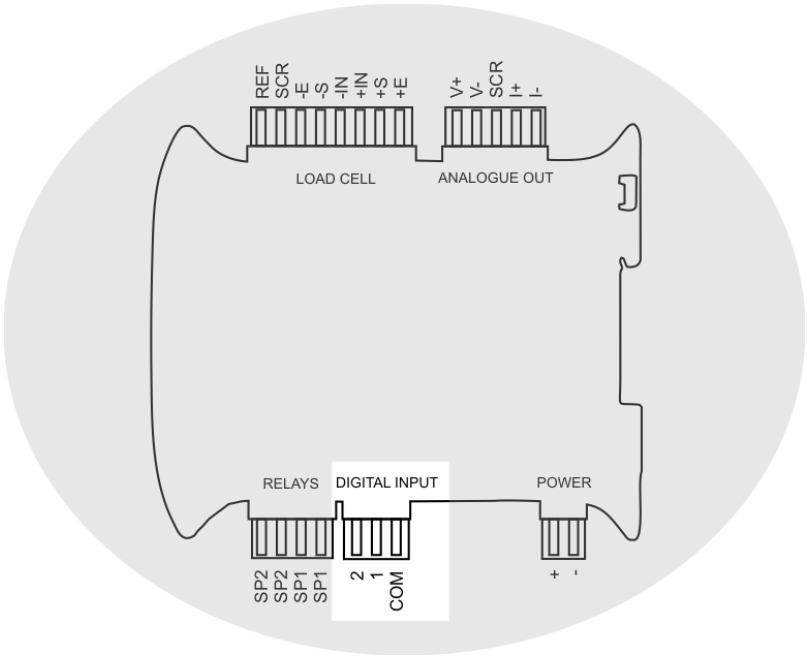
The digital inputs are for switch contacts or volt free transducers such as relays. Another common type that is suitable for the LCD20 digital inputs is a NPN open-collector transistor.

The digital input internal circuitry has 1k ohm pull-up with a 300ms de-bounce filter.
The common of the digital input marked '0V' has a 47 ohm series resistor.

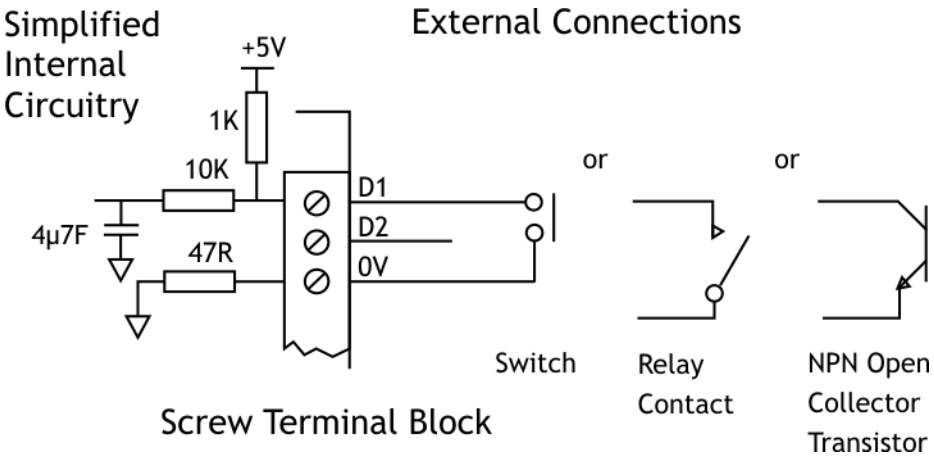
ⓘ The Digital Inputs are not isolated from the load cell input

ⓘ Do not apply voltages to these digital inputs

Connector Location



Connections



Analogue Output

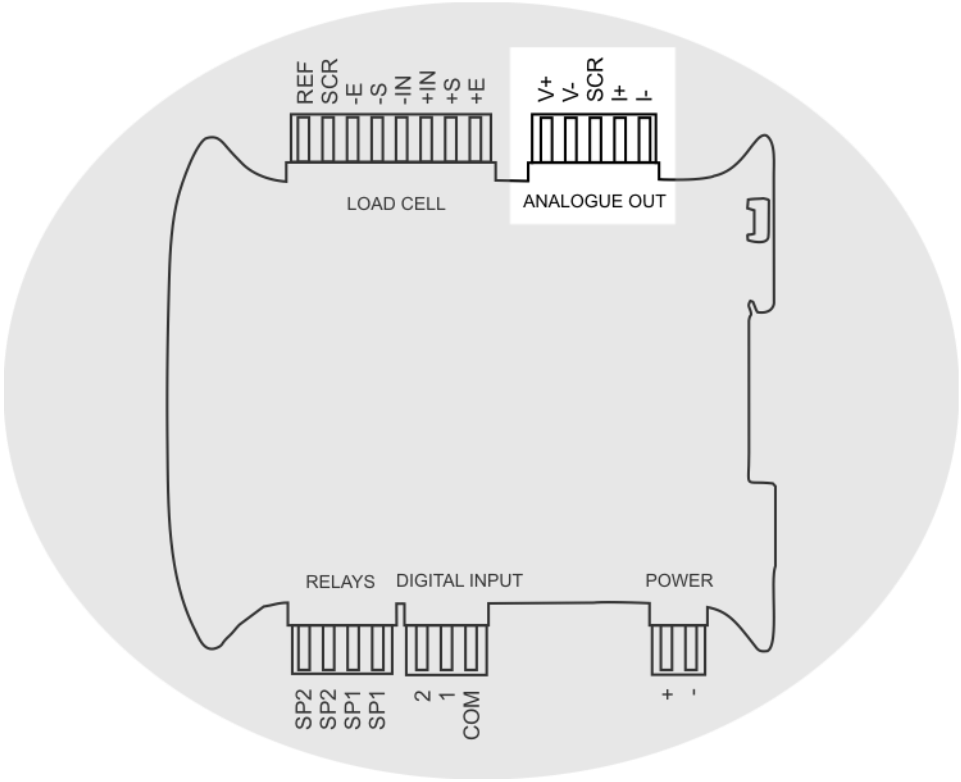
There are two analogue output available on the LCD20, a 0-10V voltage and a 4-20mA current. They are both driven from a single Pulse Width Modulated (PWM) source meaning they track each other and use the same scaling factors.

The analogue outputs are isolated from the load cells, digital inputs and power source but are common to each other.

We recommend using a cable with a screened twisted pair such as ALPHA WIRE - 5121C available from Farnell stock code 130-2298.

The screen should be connected at either the LCD20 or the remote device but not both thus avoiding ground loops.

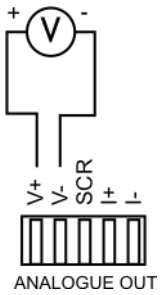
Connector Locations



Voltage

For voltage output the cable lengths should be kept to less than 20m. Voltage outputs are more susceptible to electrical interference so where long cable lengths are required the current output should be used.
If the screen is to be connected at the LCD20 then it should connect to the terminal marked SCR.

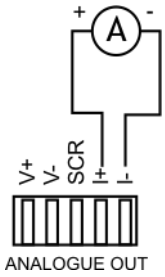
Minimum load impedance for the voltage output is 5k ohms



Current

The current is suitable for driving long cable lengths and in areas where higher electrical interference is likely.
If the screen is to be connected at the LCD20 then it should connect to the terminal marked SCR.

The maximum load impedance for the current output is 1k ohm

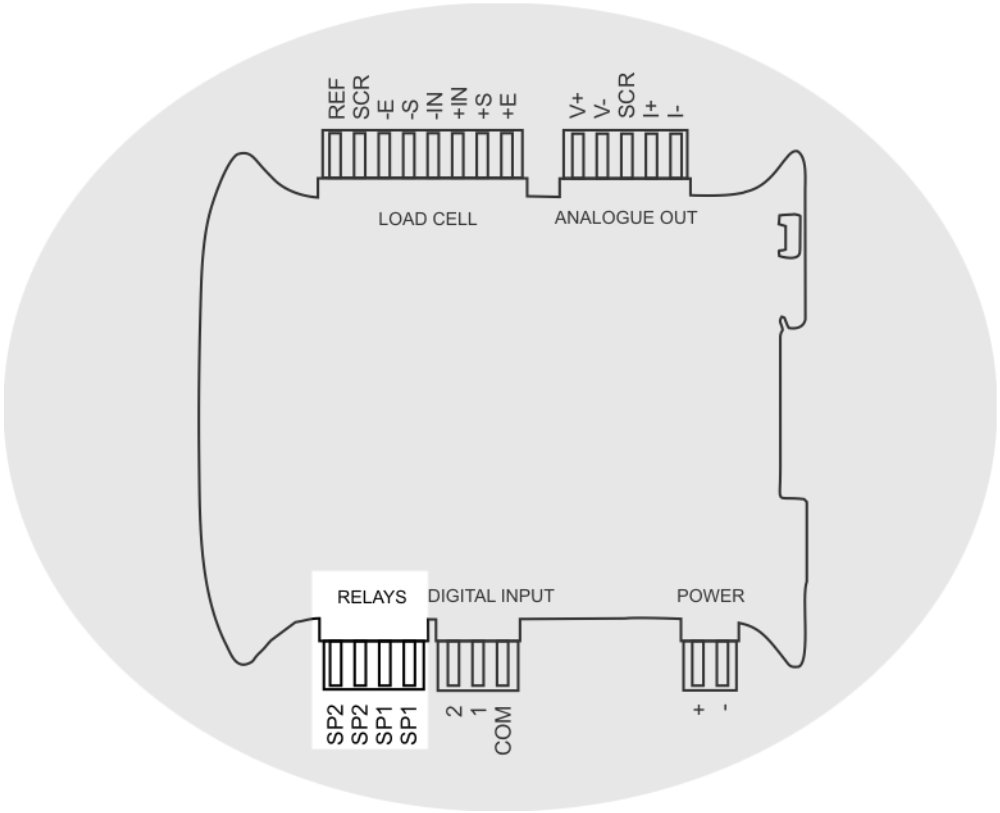


Relays

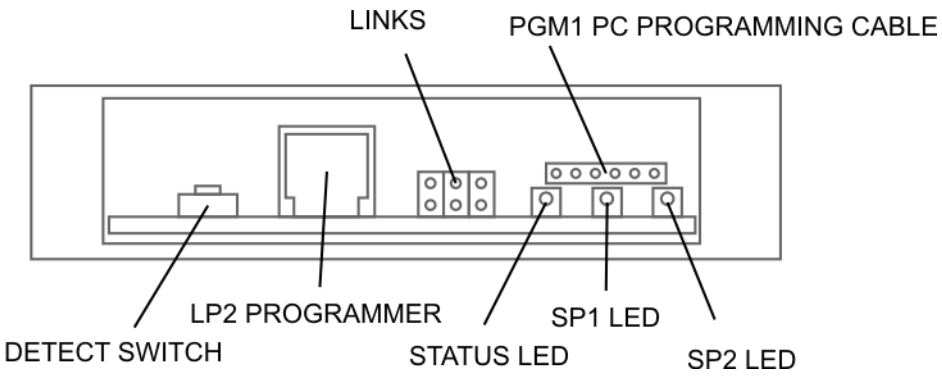
The Relays provide for 3 A switching at 240 VAC or 3 A switching at 30 Vdc. Suitable cable for the installation should be selected.

> Care should be taken as any connections already made by the installer may be at mains potential.

Contact Connections



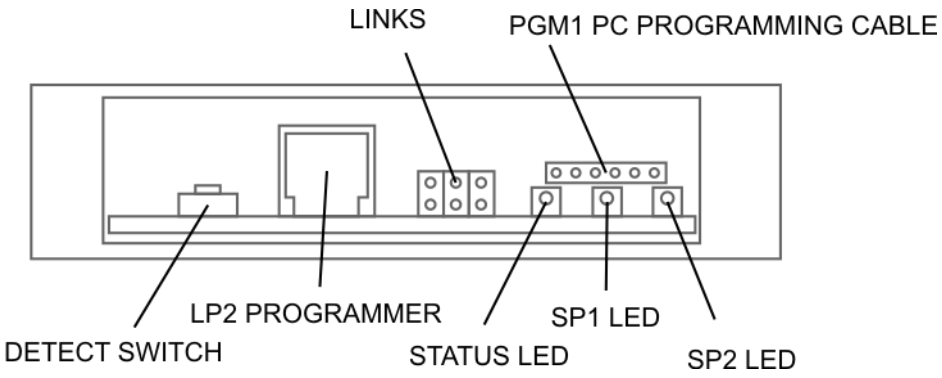
The LEDs marked SP1 and SP2 will illuminate when the relay is energised.



Programmer Module

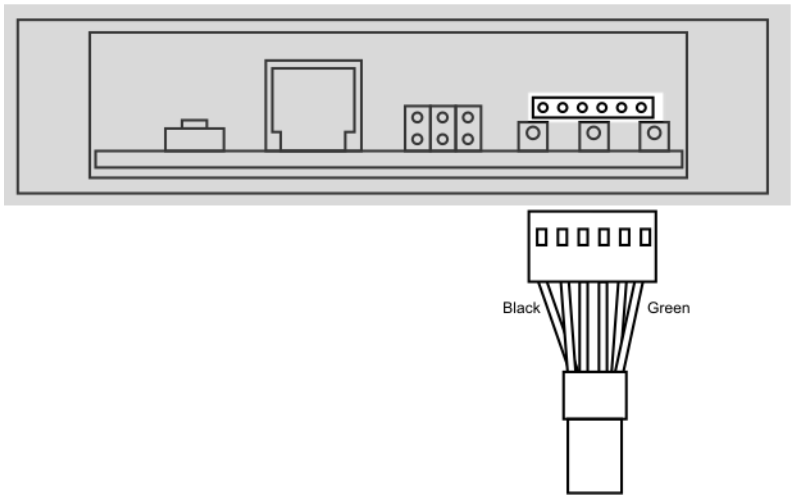
LP2

The handheld programmer comes with 2m of cable. Power should be switched off before the connector is inserted or removed.



Programming Cable PGM1

For communicating with the module using the LC Toolkit for configuration or firmware updates using the PGM1 programming cable.
The programming cable plugs into a 6 way row of pins above the LEDs on the LCD20 module and the other end into the PC USB socket.



Please ensure correct orientation as marked by colour coding above.

This will appear as a virtual RS232 port (COM port) on the PC.

The PGM1 cable is available from Mantracourt or can be purchased from Farnell or RS. Please see the following information:

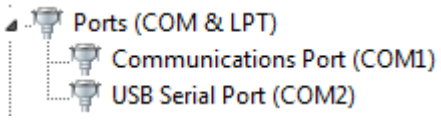
Manufacturer: FTDI Chip. http:/ftdichip.com Part number TTL-232R-5V
Supplier: RS 687-7770
Driver: http://www.ftdichip.com/Drivers/VCP.htm (Select the **Virtual COM Port Drivers**)

A driver may need to be installed for the PGM1 cable to work correctly. This will create a virtual RS232 serial port (COM Port) which your own software or the LC Toolkit will connect to.

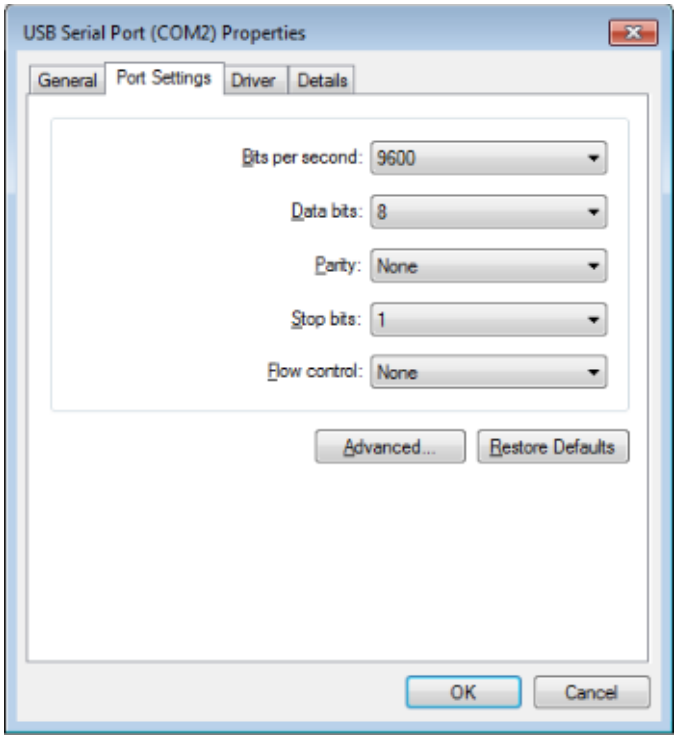
Driver Settings

If you are using the communications to read or log data at high speed (This includes viewing the Trend Chart using the LCD20 Toolkit) you may find the desired speed is unachievable even with high baud rates. This could be due to the default settings of the **Latency Timer**. Open the **Control Panel** and launch the **Device Manager**.

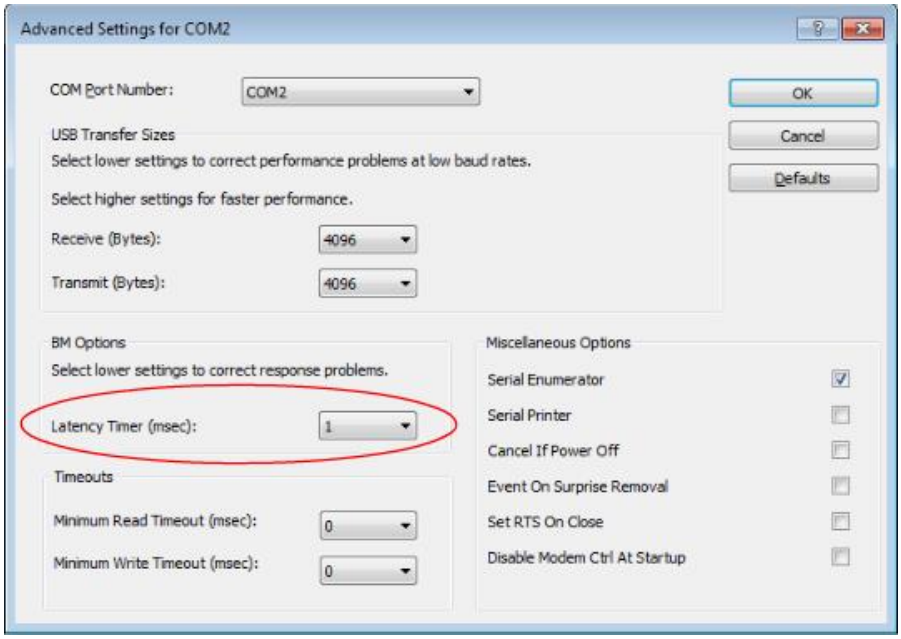
Once **Device Manager** is open you need to locate the virtual COM port assigned to this interface. This will be listed under the **Ports (COM & LPT)** section of the hardware tree. You may need to unplug and re-attach the interface cable from the computer to identify which entry to use.



Double click the item to open the **Serial Port Properties** dialog window.



Click the **Advanced** button to display the **Advanced Settings**

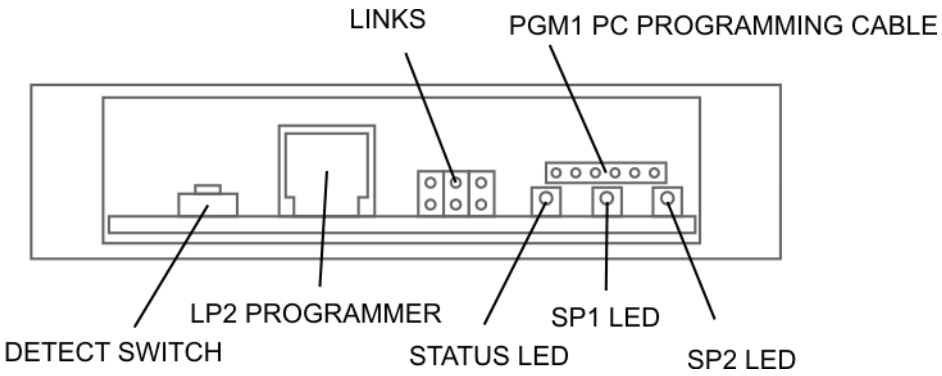


You need to ensure that the **Latency Timer** setting is set to **1**.

LED Indicator

Status LED

The red LED is used to indicate a number of functions.

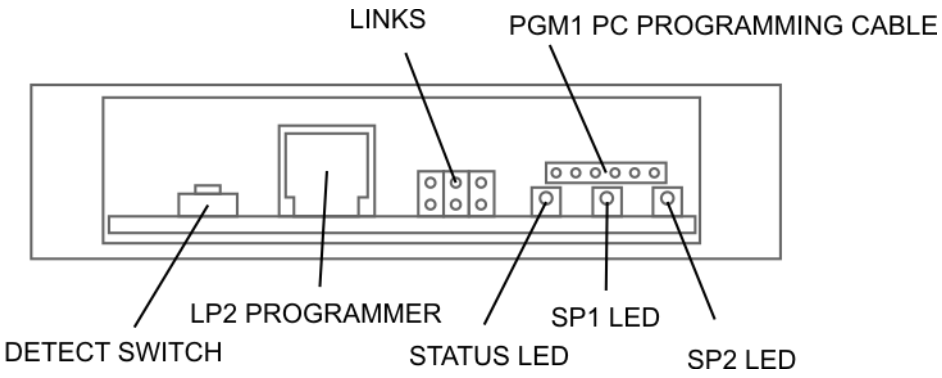


- Under normal healthy operating conditions the red LED should be OFF flashing ON every second.
- If the LED is ON Flashing OFF every second then this indicates that an error condition exists and the reasons for this are as follows:
    - There is a Load cell integrity problem
    - The Shunt-calibration has been activated.
    - An Over-range or under-range condition exists.
    - The unit has had a 'watch-dog' reset. Cleared only by power cycling.
- The LED is permanently ON indicates the unit is either attempting to connect with the toolkit or already in communications with the Toolkit.
- Led Flashing approximately 10 times a second indicates the unit is in boot-loader mode either waiting to be re-flashed or because an incorrect or no Flash file exists in the processor.

See Also – Using The LC Toolkit Software | Save & Restore for more information regarding updating the firmware.

Detect Switch

This switch is used to connect to the LC Toolkit without the need to power cycle. See Using The LC Toolkit Software section for operation. The LC Toolkit software searches for modules connected to the selected serial port. Push the switch for 1 second after selecting 'Detect' in the LC Toolkit.



ⓘ The button needs to be held in for at least 1 second.

Appendix A – Calibration

Best practices

- Before calibrating the LCD20 it is advised that the device be powered on for 20 minutes to allow the electronics and load cells to stabilise.
- Set the Sensitivity and Decimal Point Parameters before calibrating
- For multi-point linearization / calibration we recommend the use of the toolkit as this simplifies the process.
- The best calibration is achieved by using the complete system using actual known weights.
- When using the multi-point linearization load the complete system in increments that allow a graph of non-linearity to be plotted. From this graph the best point can be determined for the calibration points.
- When multiple load cells are connected together in parallel ensure that they have equal mV/V outputs. Alternatively use an Active Junction module such as a JBA.

Table Calibration Method

If the load cell manufacturer's calibration certificate is available then it is possible to calculate gains and offsets that can be entered into the linearization table parameters. A simple way of achieving this is provided by the LC Toolkit.
The LC Toolkit's Calibration Advanced Tab is where you can view the actual linearization table parameters from either the Auto-Cal or Table calibration methods.

Shunt Calibration

The LCD20 is fitted with a 100k ohm resistor which, when commanded from a digital input or over the communications port, is placed across the Load Cell Negative Input and the Excitation Negative. This has the effect of changing the mV/V by a fixed amount in the positive direction.

The change in mV/V can be calculated as follows

$$\Delta mV/V = 1000Rg / (4Rs + 2Rg)$$

Where Rg is the Load Cell impedance
And Rs is the Shunt Calibration Resistor impedance.

> ⓘ The Shunt Calibration is for indication and integrity purposes and should not be used to perform calibrations from.

Using Shunt Calibration

The Shunt Calibration facility allows a known value to be displayed thus allowing the integrity of the LCD20, load cell wiring and load cell to be checked. The load cell input should be constant before and during this Integrity check.
The Shunt Calibration can be switched on, off or toggled by a digital input. It can also be commanded on and off from the communications port. When Shunt Calibration is switched on the Status parameter will flag this and also flag that a Load Cell Integrity condition exists. The LCD display will indicate this by the PGM Arrow segment being on.

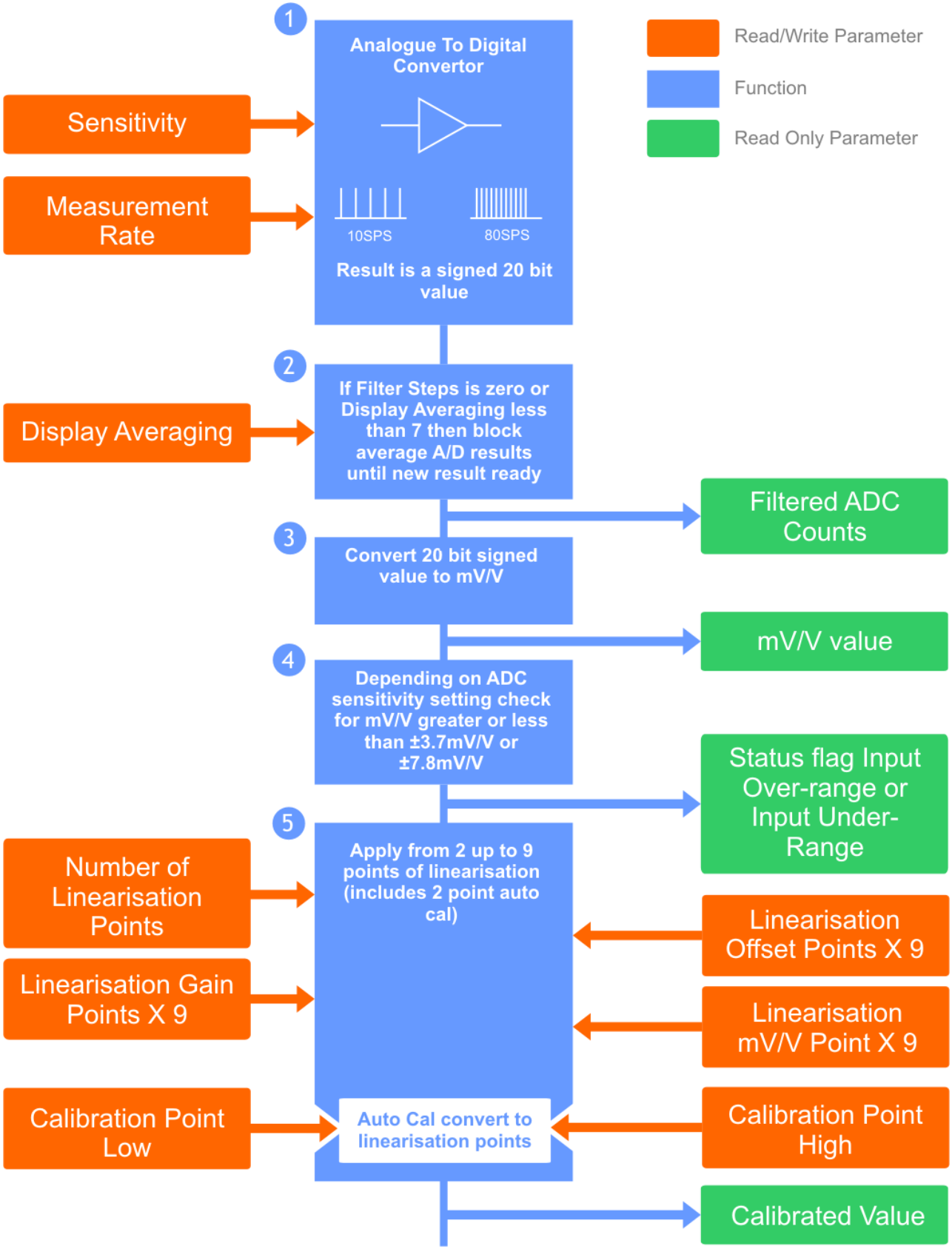
When the Shunt Calibration is commanded to switch on; but before the Shunt Calibration resistor is placed across the load cell; the current mV/V value is recorded in a Pre Shunt Calibration Value parameter. This is used when calculating the Shunt Calibration Scaling factor parameter see following.

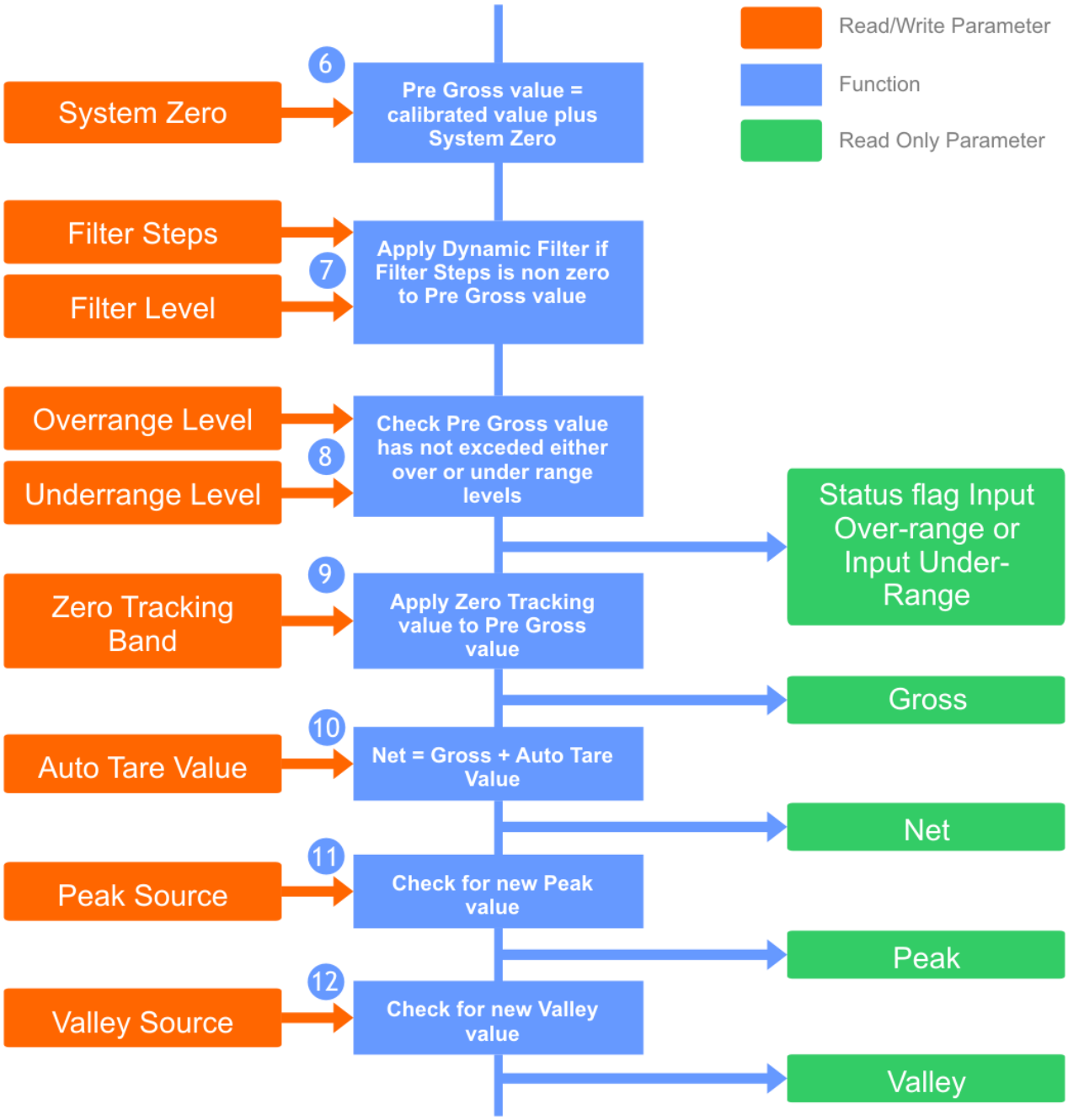
$$Shunt\ Calibration\ Scaling\ Parameter = \left(\frac{Required\ known\ value}{Post\ Shunt\ Calibration\ mV/V\ - \\ Pre\ Shunt\ Calibration\ Value\ parameter} \right) * 10$$

Note: When Shunt Calibration is switched on the LCD20 values such as Gross, Net, Peak, Valley ETC are also affected. Consequently the Analogue out and relays are also affected.

Appendix B – Measurement

Overview





1. The measurement process starts by converting the load cell analogue values to digital values. The Analogue to Digital Converter (ADC) has a bipolar input allowing for load cells to be used in both tension and compression.
   The ADC measures the 5V excitation voltage using the sense inputs and through an amplifier the output of the load cells from these two measurements the mV/V output from the load cells is calculated.
   This amplifier has two gain settings allowing for two ranges, ±3.7mV/V and ±7.8mV/V. These gains setting are selected by the Sensitivity parameter.
   The ADC can also take measurements at two different rates, 10 samples per second (sps) and

80sps, selected by the Rate parameter. The output from the ADC is a signed 20bit result in ADC counts terms.

2. When a new ADC result is available; which is determined by the Rate parameter; the process is checked to see if block averaging is required. This is determined by the value set in the Display Averaging parameter and the digital low pass filter parameter Filter Steps. The block averaging is bypassed if Display Averaging parameter is set to 7 or the Filter Steps parameters is non zero. Block averaging simply adds a number of results together then divide the result by the number of results added (known as the mean). For Display Averaging values of 0-6 the number of result to average is calculated as….

   `2 to the power of (Display Average + 2)`

   Once a new block average value is ready the Filtered ADC Counts value is updated and the process continues.

3. The Filtered ADC Counts Value is then converted using the factory calibration to a mV/V value to within 0.05% accuracy.

4. This mV/V value is then tested to see if in fact the input has been over or under ranged and if so an internal input over or under range flag is set that is checked later in the process (see 8).

5. The current mV/V value is then converted into the user desired engineering units using the 9 point linearization programme. This programme searches the mV/V levels for each point to find what Gain and Offset values to apply. The number of points to search through is set by the Number of Calibration Points parameter. If the current mV/V is above or below the last or first mV/V table level then the gain and offset values to be used are extrapolated from the last or first two points.
   When the 2 point Auto-Calibration routine is used the same principle applies. The auto-cal calculates the values for the first two points in the table using the mV/V values captured for Calibration Low and Calibration High parameters.
   The output from this process is termed the Calibrated Value.

6. The **System Zero** parameter is then added to the Calibrated value to give an intermediate internal value known as Pre-Gross Value.

7. If block average has not been selected as determined in (2) above and the Filter Steps parameter is non-zero then the Low Pass Filter algorithm is implemented. This is covered in Appendix B – Measurement | Filters. The Pre-Gross value is updated with the result of the Low Pass Filter.

8. The Pre Gross Value is checked against the Over and Under Range parameters and if exceeded or if the internal input over or under range flag is set then the Status and Flag Parameter is updated accordingly. The Flag parameter being a non-volatile latched flag requiring user intervention using the communications port to be reset.
   The Gross and Net values are set to over or under range values also. This ensures that the display, relays, analogue output and communication ports all detect and recognise this error condition.

9. Pre Gross Value is now adjusted with the Zero Tracking value. Zero Tracking is enabled when the Zero Tracking Band parameter is non-zero.

10. Net is calculated by adding the Auto-Tare parameter to the Gross.

11. The Peak value is checked against the source selected by the Peak Selection parameter which could select either Gross or Net values.

12. The Valley value is checked against the source selected by the Valley Selection parameter which could select either Gross or Net values.

Zero Tracking

Zero tracking is applied to the Gross value.
A Tracking Band parameter sets a band about the Pre Gross absolute zero value. If a Tracking Band parameter has a value of 10.0 then the band is calculated as between + 10.0 and -10.0. If the Pre Gross value is in between these two calculated values for more than 1 second then the value of Pre Gross is stored as the new zero tracking value.
This Zero Tracking value is then subtracted from the Pre Gross value to give a Gross value of zero.
Zero Tracking can be disabled by setting the Tracking Band Parameter to zero. The Zero tracking value is volatile therefore reset to zero on power up.

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 **System Zero** parameter is then added to the Calibrated value to give an intermediate internal value known as Pre-Gross Value.

Auto Tare

The Auto Tare facility enables the generation of the Net value. The Net Value is calculated as the Gross value added to the value set in the Auto Tare parameter. An update of the Auto Tare value can be commanded from a digital input or from the communications port. Additionally an Auto Tare value

can be entered into this parameter from the keypad or again using the communication port. The Auto Tare parameter is non-volatile and is therefore saved through power fail.

Filters

Overview

The least significant digits of the display or values over the communications port may change excessively in certain applications due to vibration or 'noise' on the input. Filtering can be applied to smooth the display by two methods.
The simple block average filter uses averaging and therefore generates new values at the **Measurement Rate** which is slower than the **A/D Measurement Rate**.
The dynamic digital low pass filter uses software to generate new values at the **A/D Measurement Rate.**

Simple Block Averaging

Block averaging delays the generation of a new output value until a number of new values generated at the **A/D Measurement Rate** have been averaged. This provides a very steady display or output but at the expense of a slow update rate. The range of choices of the final update rate is dependent on the selected **A/D Measurement Rate**.

A/D Measurement Rate is set to **10** samples per second	**A/D Measurement Rate** is set to **80** samples per second
10 samples per second	80 samples per second
2.5 samples per second	20 samples per second
1.25 samples per second	10 samples per second
1.6 seconds per sample	5 samples per second
3.2 seconds per sample	2.5 samples per second
6.4 seconds per sample	1.25 samples per second
12.8 seconds per sample	1.6 seconds per sample
25.6 seconds per sample	3.2 seconds per sample

Dynamic Digital Low Pass Filter

The dynamic filter is a digital low pass filter implemented in software which behaves like an electronic 'RC' circuit. It has two user settings, a **Filter Level** set in the calibrated engineering units and the maximum number of steps, **Filter Steps** 1 to 255. To bypass the dynamic filter set **Filter Steps** to 0.

Instead of outputting every new value, a fraction of the *difference* between the new input value and the current filtered value is added to the current filtered value to produce the filtering action.

If this difference is less than the value set in **Filter Level** then the fractional amount added each time is decremented until it reaches the minimum level set by **Filter Steps** i.e. **Filter Steps** is the *limit* of the divisor.

Example: if **Filter Steps** = 4, initially the whole difference between the new value and the current filtered value is added to the current filtered value. The next value displayed is the result of adding one half of the difference. The following update adds one third while subsequent updates continue to add one quarter of the difference, the limit of the divisor having been reached
i.e. 1/ **Filter Steps** = 1/4.
If **Filter Steps** were increased to 10, the process would loop for ten times then continue to add just 10% of the difference resulting in a longer settling time but deeper filtering effect.

If a rapid or step change in the input causes the difference between the new input value and the current filtered value to exceed the amount set in **Filter Level**, the filter acquires the new value immediately by resetting the divisor to 1. The filtering process repeats as above on subsequent updates by adding one half of the difference, one third, one quarter etc. until 1/ **Filter Steps** is reached. This allows the Filter to respond rapidly to fast moving input signals but still retain its smoothing characteristic as the input settles.

When a step change occurs which does not exceed **Filter Level**, the new filtered value is calculated as follows:

$$New\ Filter\ OutputValue = Current\ Filter\ OutputValue + \left(\frac{(InputValue - Current\ Filter\ OutputValue)}{Filter\ Steps} \right)$$

Note: To retain the filtering effect but defeat the step change response set **Filter Steps** appropriately and **Filter Level** to 0.

The time taken to reach 63% of a step change input (which is less than **Filter Level**) depends on the rate at which values are passed to the dynamic filter, set in **A/D Measurement Rate** (10 or 80 samples per second (SPS)), multiplied by **Filter Steps**.

The table below gives an indication of the response to a step input which is less than **Filter Level**.

% of Final Value	**Time To settle**
63%	Measurement Period * **Filter Steps**
99%	Measurement Period * **Filter Steps** * 5
99.9%	Measurement Period * **Filter Steps** * 7

For example, if **A/D Measurement Rate** is set to 80 samples per second (12.5ms period) and **Filter Steps** is set to 30 then the time taken to reach a percentage of the step change value is as follows:

% Of Final Value	**Time To settle**
63%	0.0125 x 30 = 0.375 seconds
99%	0.0125 x 30 x 5 = 1.875 seconds
99.9%	0.0125 x 30 x 7 = 2.625 seconds

Frequency Response:

For a sinusoidal input the -3dB point, i.e. the frequency where the output is 0.71 of the input is given by:

$$Frequency = \left(\left(\frac{SampleRate(SPS)}{Filter\ Steps} \right) \times \frac{1}{6.3} \right)$$

To calculate the number of steps for a -3dB frequency point use:

$$Filter\ Steps = \left(\frac{SampleRate(SPS)}{(Frequency \times 6.3)} \right)$$

Peak and Valley Values

The LCD20 incorporates a Peak/Valley function which continuously monitors the Gross or Net value, selected by the Peak and Valley Selection Parameter, and stores the minimum (valley) and maximum (peak) values. These values are volatile and reset on power up.

Peak and Valley values can be used as the default display value, analogue output and relay source values. That is to say, the display can be set to show Peak value, Relay 1 source value could be Peak, Relay 2 could be Valley and the analogue output source value also set for Peak.
Peak and Valley values can also be selected to view by using the digital inputs. For example Digital input 1 could be used to display Gross value, Digital input 2 to display Peak value.
Peak and Valley values can be reset from a digital input or from the LC Toolkit.

Appendix C – Relays

Overview

The relays provide output control signals which can be used for switching functions such as ON/OFF control and alarm indications. The relays are activated by the values programmed for the Set Points.

Relay Functions

The LCD20 can be programmed so that the relay output module reacts to all or any of the following functions:

- Source for relay such as Gross, Net, Peak, Valley and Snap
- Setpoints
- Inflight compensation
- Hysteresis
- Relay inversion
- Relay latching

The two relays provide Single Pole Change-Over (SPCO) contacts and are rated at 240 VAC at 3 A or 30 Vdc at 3 A.

Source

For LCD20 mode the source value for each relay can be selected from the following values; Net, Gross, Peak, Valley and Snap.

Setpoints

Setpoints are used to produce relay signals at any required value so that the operation of the monitored process can be maintained to pre-set levels. Any excursion beyond the **Setpoint**(s) will normally activate the relay or relays to provide an alarm or initiate control as required.

Two relays can be programmed to suit different applications. The actions of either or both relays can be inverted if required.

For normal operation the relay is energised until the input reaches the **Setpoint** level. In this condition, when the input value is less than the **Setpoint**, the setpoint LED is on and the output relay is energised producing a closed circuit on a normally open contact. When the **Setpoint** value is reached, the setpoint LED turns off and the relay is de-energised producing an open circuit on a normally open contact.

For an **Inverted** operation the reverse operations apply.

Normal and inverted action is determined by the direction of the input value as it changes.

A High-High operation allows for a rising input value to operate on two relays to define an acceptable quantity, weight or band of operation.

A Low-Low operation operates on a falling value.

A High-Low operation will operate on a rising or falling value, setting a 'band' by one relay operating normally and the other being inverted.

Inflights

The setting of an **Inflight** value causes the relays to automatically adjust to control the flow of the material being weighed.
For example, if a relay is used to control a flow, a certain amount of product will be **'Inflight'** between the supply point and receiving point causing a positive error when the required weight is reached. The **Inflight** compensation value is adjusted by the user to reduce the **Setpoint** value to prematurely stop the flow, allowing the **Inflight** amount to make up the required total set by the associated **Setpoint**.

Hysteresis

When **Hysteresis** is applied to relays with normal output action, the input is allowed to rise to the **Setpoint** value and the relay is then turned off. The relay is held off until the input value has dropped to the **Setpoint** minus the **Hysteresis** value.
For inverted action the input drops to the **Setpoint** and the relay goes off and comes on again when the input rises to the **Setpoint** plus the **Hysteresis** value.

For LCA15 mode **Hysteresis** will be applied to both **Setpoint** values. It is effective for both normal and **Inverted** action.

Inversion

A normal, non-inverted relay is defined as being in the energised state when the source value is below the resultant setpoint.

An inverted relay is defined as being in the energised state when the source value is above the resultant setpoint.

Note the SP1 and SP2 LED's visible on the front panel denote whether a relay is energised or de-energised. The LED is ON for an energised relay.

Latching

The latching facility allows the relay module output to be held until reset externally via the digital input or via the communications port. Latching is applied to the 'off' status of the relay.
Latched relays are reset by operating a closing contact connected between 'LR' terminal and '0' volts, on the field terminals (this assumes that Digital Input 2 is set to its default function 'LR'

See Also – Appendix E - Digital Inputs for more information.

Appendix D – Analogue Output

Overview

Two analogue outputs are available offering a DC current range (4 to 20mA) and a DC voltage range (0 to 10V).
They are fully scalable, optically isolated and both generated from a single selected variable (see source below)
Both outputs are pre-calibrated to an accuracy of 0.15% FR and have a resolution of approximately 13 bits or 1 part in 8000.

> WARNING:
> Maximum load on voltage modules is 2mA
> Maximum drive voltage available for the current range is 15V

Source

The value the selected analogue output, 4-20mA or 0-10V, calculates its output from can be sourced from Net, Gross, Peak, Valley or Snap values.

Scaling

Output scaling factors are set by the user and determine the display range over which the analogue module operates.
Output Low - This sets the displayed value at the analogue outputs minimum i.e. 4mA or 0V.
Output High - This sets the displayed value at analogue outputs maximum output i.e. 20mA or 10V

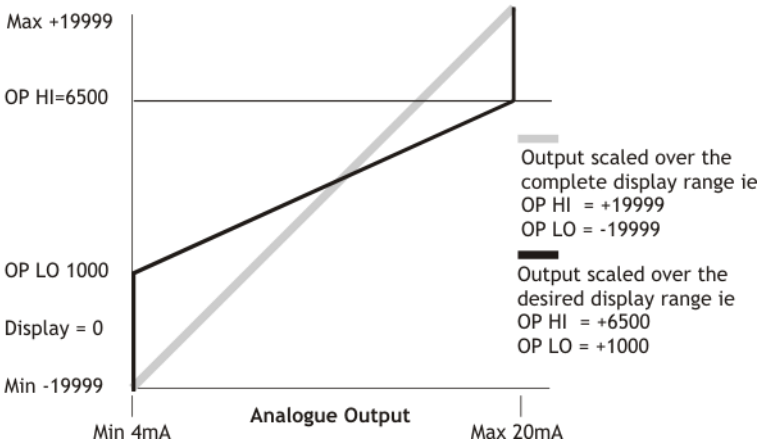
If the display is outside the range defined by **Output Low** and **Output High** scale factors the analogue output will remain constant at its minimum or maximum output value.

So for example, if the 4-20mA output is selected and **Output Low** scale factor is set to 00.00 whilst the **Output High** scale factor is set to 100.00 then if the source value is at 00.00 or less the 4-20mA output will be at 4mA level and consequently if the source value is 100.00 or greater the 4-20mA output would be at 20mA.

Inversion of the analogue output can be set by the Output Action parameter or transposing **Output Low** and **Output High** scale factors.

Calculating the Scale Factors
Example: Assume a 4-20mA output module is required to provide an output of 4mA for 1000Kg and 20mA for 6500Kg.
Set **Output Low** to 1000 and Output High to 6500

It will be necessary to determine **Output Low** and **Output High** scale factors by graphical or mathematical means if the known source values do not coincide with the minimum and/or maximum analogue output.



Method of Calculating **Output Low** & **Output High** from known output values

$$Output\ Low = Low\ Display - \left(\frac{Display\ Span * (Low\ Output - Min\ Output)}{(High\ Output - Low\ Output)} \right)$$

$$Output\ High = High\ Display + \left(\frac{Display\ Span * (Max\ Output - High\ Output)}{(High\ Output - Low\ Output)} \right)$$

Where:

Low Output	Required analogue output at low display value
High Output	Required analogue output at high display value
Min Output	Lowest value of analogue output (4mA or 0V)
Max Output	Highest value of analogue output (20mA or 10V)
Display Span	Required High display value minus required Low display value.

Example

To scale the output from 6mA at a display value of 400 to 18mA at a display value of 1100:

$$Display\ Span = (1100 - 400) = 700$$

$$Output\ Low = 400 - \left(\frac{700 * (6 - 4)}{(18 - 6)} \right)$$

$$Output\ Low = 400 - \left(\frac{1400}{12} \right) = (400 - 116.66)$$

$$\underline{Output\ Low = 283.33}$$

$$OutputHigh = 1100 + \left(\frac{700 * (20 - 18)}{(18 - 6)} \right)$$

$$OutputHigh = 1100 + \left(\frac{1400}{12} \right) = (1100 + 116.66)$$

$$\underline{OutputHigh = 1216.66}$$

Note 1: The output can be inverted by setting **Output Low** more positive than **Output High**.
Note 2: If **Output Low** or **Output High** is greater than ± 19999 then divide both **Output Low** and **Output High** by 10, this will give less resolution.

User Adjustment

The LCD20 has no Potentiometers for trimming the 4-20mA and 0-10V outputs as did its predecessor. Instead the output can be 'trimmed' digitally using parameters that can adjust both the 4-20mA and the 0-10V outputs for gain and offset. This is useful for when the input of the device that the LCD20 is connected to is not accurately calibrated itself or, in the case of the voltage output, to compensate for small voltage drops in the cabling.

As an example, setting the 4-20mA and 0-10V Gain parameters to 0.5 re-scales the analogue outputs to 4-12mA and 0-5V respectively.

An offset can be introduced by entering a value for 4-20mA and 0-10V Offset parameters with one digit nominally representing 2.03uA and 1.254mV respectively.

The factory calibration can be re-instated by resetting the offsets to 0 and the gains to 1.

Appendix E – Digital Inputs

Overview

The LCD20 has 2 digital inputs. These inputs are volt free which require either a contact closure or open collector type output which connects the particular input to the terminal marked '0V'. The input has an internal 1000 Ohm resistor pulling the input to +5Vdc. The input requires to be closed for a minimum of 300mS due to the de-bounce circuitry. Note that these inputs are not isolated from the load cell input.

WARNING - Do not apply voltages to the digital inputs.

The two digital inputs can be individually configured to provide the following functionality.

Digital Input selection table

Description	*Notes*
Perform Tare	Perform a tare action.
Latch Relay Reset	Reset any latched relays.
Display Default display	Switch the display to the original display source value.
Display Gross value	Switch the display to **Gross** value.
Display Net value	Switch the display to **Net** value.
Display Peak value	Switch the display to **Peak** value.
Display Valley value	Switch the display to **Valley** value.
Display Snap value	Switch the display to **Snap** value.
Peak & Valley Reset	Reset the peak and valley capture values.
Shunt-Cal On	Turn Shunt calibration on. The **Shunt Calibration Value** available over the communications bus and optional display will show 100 if integrity of load cell and wiring is OK and the Shunt Calibration value has been calibrated. See Using the LCA Toolkit Software | Calibration | Shunt Calibration section of the manual for more information.
Shunt-Cal Off	Turn off shunt calibration.
Shunt-Cal Toggle on/off	Toggle between shunt calibration on and off.
Do Snap	Store the current value of the snap source to the snap value.

Appendix F – Security Locking

By default the LCD20 arrives from the factory unlocked in terms of requiring changes to hardware to gain access to certain functionality.

Menu Passwords

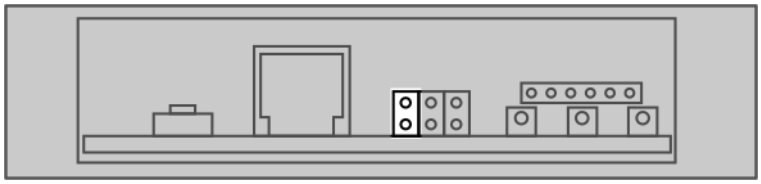
Access to menu sections using the wired handheld programmer/display is controlled by passwords. The user is asked for a password and depending on the password entered gains access to the appropriate section and all sections beneath.
These passwords are fixed as follows:

Level 1 Password	**1111**	**Operator**
Level 2 Password	**2111**	**Engineer**
Level 3 Password	**3111**	**Advanced Calibration / Configure**

Handheld/Display Calibration Lock

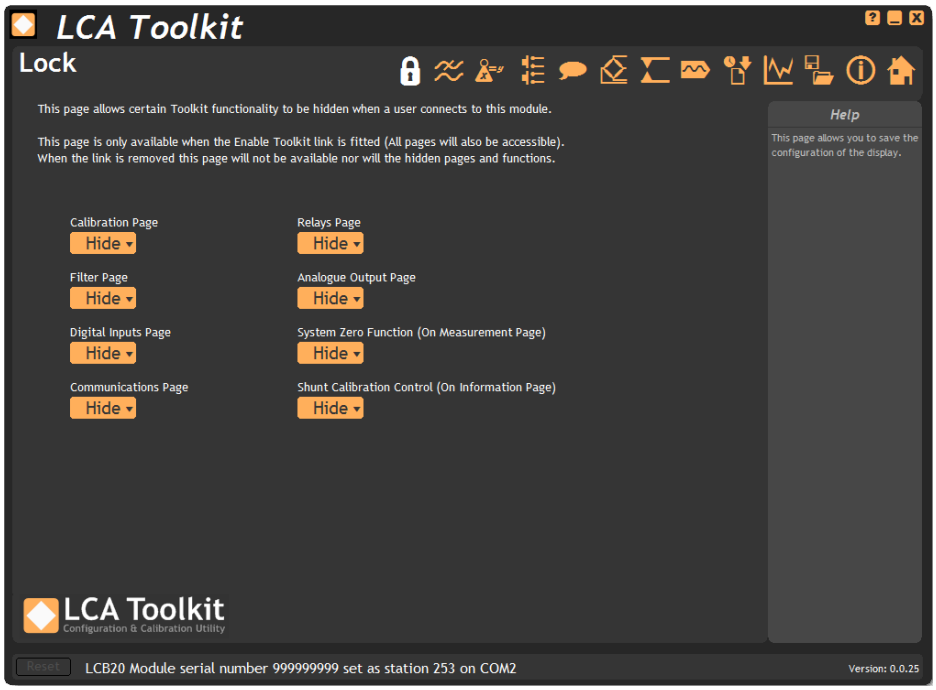
There is also a hardware link on the main board that if removed will hide the CALL, CALH, ADCL, ADCH and SENS parameters from the handheld menu and thus prevent calibration.

LK1 Jumper Link On	**Calibration Visible**
LK1 Jumper Link Off	**Calibration Hidden**



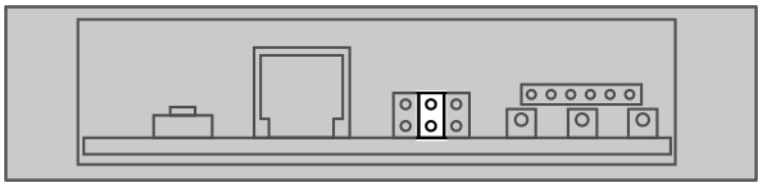
LC Toolkit Lock

LK2 on the main board controls access to the Lock page in the Toolkit. When the jumper link is fitted all pages are visible including this **Lock Page**.



Certain pages and functionality can be hidden or disabled using this page. Once the LK2 jumper link is removed and the module is connected to the LCA Toolkit this page and all other selected pages and functions will be hidden.

LK2 Jumper Link On	**All Pages Visible**
LK2 Jumper Link Off	**Lock Page & Selected Pages Hidden**



Specifications

Electronics

Loadcell Input

Physical Parameter	*Minimum*	*Typical*	*Maximum*	*Units*
Strain Gauge Excitation System		6 Wire		
Strain Gauge Excitation Voltage	4.75	5.0	5.25	V
Strain Gauge Drive Capability	85			ohms
Strain Gauge Sensitivity Range 1			±3.7	mV/V
Strain Gauge Sensitivity Range 2			±7.8	mV/V
Offset Stability @ 2.5mv/V FS		±2		ppm/°C
Gain Stability		±4		ppm/°C
Offset Stability With Time		±3		ppm FR
Gain Stability With Time 1st Year		±6		ppm FR
Integral Non Linearity Before Linearisation		±10		ppm
Internal Resolution		1:1000,000/20		Resolution/Bits
10hz Noise Free Resolution		1:180,000/17.5		Resolution/Bits
80hz Noise Free Resolution		1:130,000/17		Resolution/Bits

Analogue Output

Physical Parameter	*Minimum*	*Typical*	*Maximum*	*Units*
Current Output	4		20	mA
Current Output Drive Capability			1	K Ohm
Voltage Output	0		10	V
Voltage Output Drive Capability	5			K Ohm
Phase Delay – Sine Wave		55		ms
3db Down Point		8.5		Hz
Phase Delay – Step Change		26		ms
Rise/Fall Time (10% To 90% FR)		40		ms
Rise/Fall Time (1% To 99% FR)		85		ms
Zero Stability		0.005	0.01	%FS/°C
Gain Stability		0.005	0.01	%FS/°C
Resolution		1:8000/13		Resolution/Bits
Isolation	±130V RMS or DC to any other port			

Above specification is based on a Measurement Rate of 80 samples per second and no averaging or filtering.

Power Supply

Physical Parameter	Minimum	Typical	Maximum	Units
Supply Voltage (DC) Isolated	9		32	V DC
Power			3	W

Relays

Physical Parameter	Minimum	Typical	Maximum	Units
Contact Type		2 X SPNO		
Contact Rating		240V AC @ 3A or 30 Vdc @ 3 A		

Environmental

Physical Parameter	Minimum	Typical	Maximum	Units
Operating temperature range with four 350 ohm load cells	-20		+70	°C
Operating temperature range with one LCI + four 350 ohm load cells	-20		+60	°C
Storage temperature	-20		+90	°C
Humidity	0		95	%RH
Protection		IP20		

Regulatory

CE Approvals

European EMC Directive

2014/30/EU

BS EN 61326-1:2013

BS EN 61326-2-3:2013

Low Voltage Directive

2014/35/EU

BS EN 61010-1:2010 Rated for Basic Insulation, Normal Condition, Pollution Degree 2, Permanently Connected, Insulation Category lll

Troubleshooting

This chapter is designed to assist in the identification of problems relating to the installation and setting up of the LCD20.

General connection and setup parameters. – No flashing status LED on power up.

- Check supply is present at the LCD20 terminals.
- Remove all other connections to the LCD20 except the power
- If supply is correct contact distributor.

Display shows (-1 or 1) continually, without a weight applied to the Strain Gauge.

- Check input connections to the LCD20 from the Strain Gauge.
- If connecting a 4 wire device ensure terminals 1&2 and 5&6 are linked.
- Check Strain Gauge output between input terminals 3&4 of the LCD20.
- Check that the CALH weight is applied and is not the same or lower than CALL.

Display over ranges (-1 or 1) when, or before, the maximum required weight is applied to the Strain Gauge.

- Check that the **Sensitivity** parameter is set to the appropriate range in the menu.

Display very noisy

- If using a 4 wire device ensure terminals 1&2 & 5&6 are linked.
- Check output voltage of Strain Gauge.

Display operating in wrong direction

- Check connections to input terminals 3&4 are correct way round.
- Check the type of Strain Gauge - compression or tension.

Unit will not auto calibrate

- Check that CALH is not zero and its weight is greater than CALL.
- Check that input is not over-ranged on CALH weight.

Incorrect relay operation

- Check setpoint, in flight and hysteresis values are correct.
- Check latching and inversion settings are correct.
- Check connections to output terminals.

Order Codes

Description	Code
Load Cell Amplifier In DIN Rail Format	LCD20

Accessories

Description	Code
Programming Cable (For Toolkit Software)	PGM1
Handheld Programmer	LP2

Configuration Record Sheet

Product	
Product Code	
Serial No.	
Tag No.	
Date	
Location	
Measurement type, range & engineering units	
Calibration Date	
Calibration Interval	

Parameter	*Value*
PASS	
tYPE	
VALS	
GroS	
nEt	
PEAK	
VALY	
SNAP	
mVV	
CALV	
rLYS	
rLY1	
SP1	
IF1	
HYS1	
InV1	
Ltc1	
rLS1	
rLY2	
SP2	
IF2	
HYS2	
InV2	
Ltc2	
rLS2	

Parameter	*Value*
AnOP	
OPL	
OPH	
AnOP	
AoPS	
InV	
Adj	
4 20G	
4 20o	
0 10G	
0 10o	
diSP	
dA	
dP	
rS	
ddiS	
PEAk	
VALY	
SNAP	
OVrV	
UndV	
LCiP	
FSTP	
FLVL	
SEnS	
rATE	
ACAL	
AdCL	
AdCH	
CALL	
CALH	
AT	
trbd	
ZEro	
diPS	
dIP1	
dIP2	

Warranty

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

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

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