LifeCal
User Manual

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Contents

1 Introduction

LifeCal is the tool used to create calibration files for Life Racing ECUs.
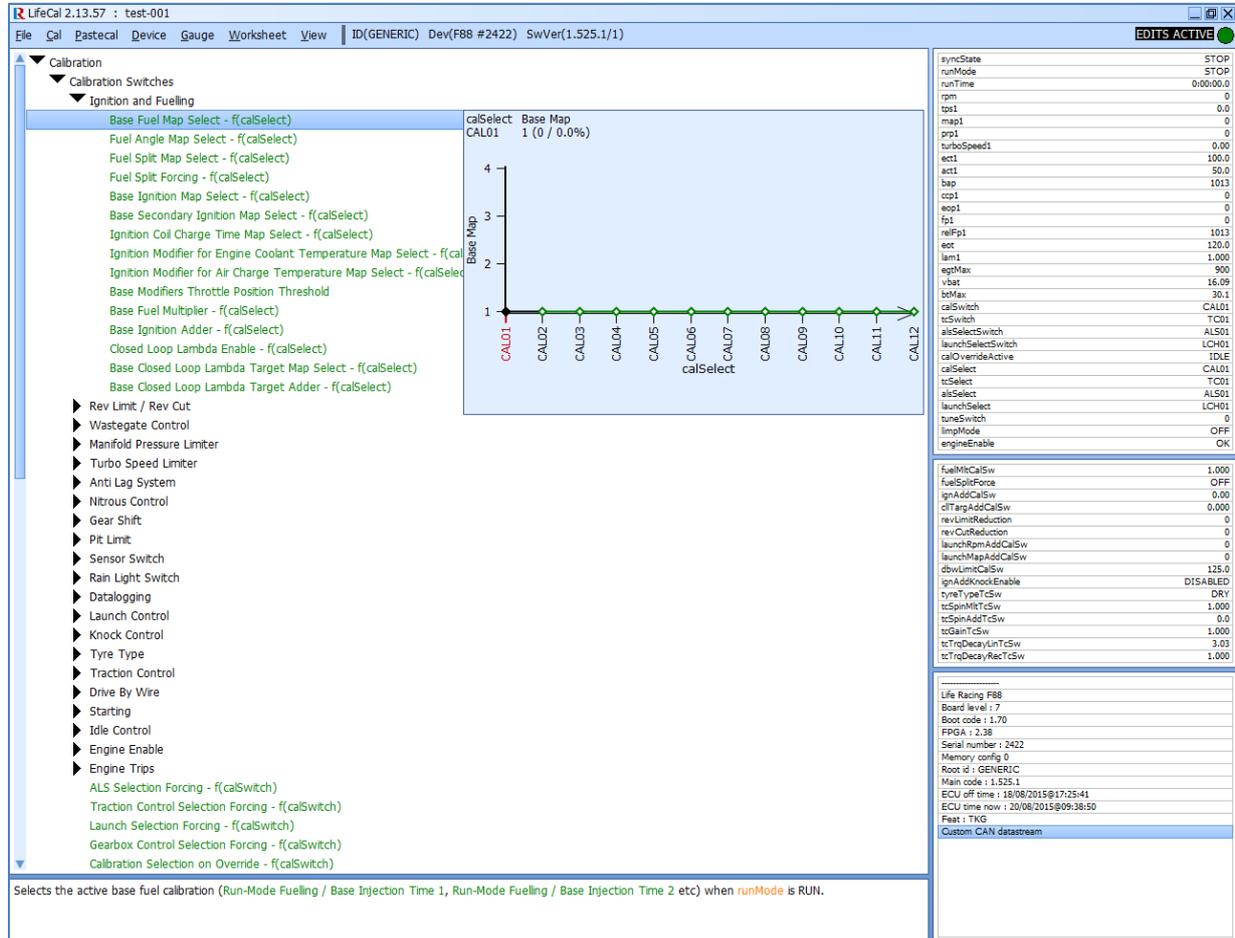
This is an application manual for LifeCal only. It is **not** a strategy manual.

Due to continuous development, some features may change and this manual will update periodically. Please ensure you have the latest version dated on the cover page of this document.

Menu Shortcuts

Life Racing applications are intended for quick operation without the use of a mouse for improved usability in the pit lane. All menu buttons can therefore be reached using keyboard shortcuts. Each option has an underlined letter, identifying its shortcut key or the shortcut displayed to the left. Dialogue boxes can be navigated with the arrow keys. The <Spacebar> can be used to select while <Enter> and <Esc> are used as OK and CANCEL respectively.

2 File

2.1 Cal

New/Load

Select *File, New* and select the ECU software version to create a new calibration. The software version of a calibration must match the version of the ECU. Calibration version can also be later changed under *Cal, change software Version.* A list of any previously used profiles will be available. These profiles are created whenever a calibration of that level is loaded or accessed from an ECU. Load a previously saved calibration by selecting *File, Load*. Shortcuts exist to quickly access the desktop, working directory or recent files.

Build

Select *File, Build Calibration* to stitch together or import multiple partial calibrations contained in a build list. A build list must be manually created as a text file with the top line reserved for comments and each line after containing a single calibration file location. Save this file with the extension '**.LRB**'. Partial calibrations are created when any map is flagged as invalid. Files are loaded in order so if any calibrations share a valid map, the last loaded file will overwrite the previous one.
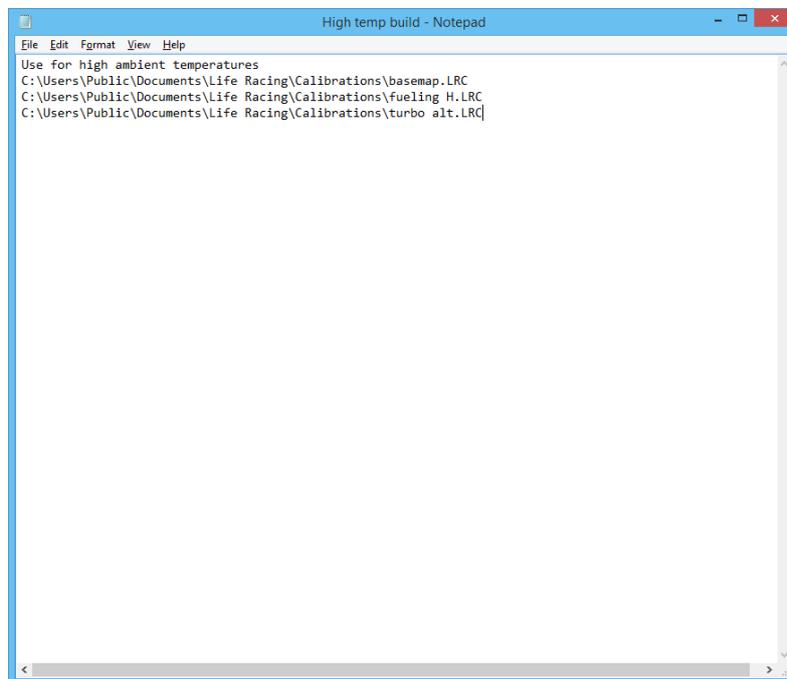
Save/Quicksave

Save the calibration to the current location or the working directory if new with *File, Save.* Save to a different location with *File, saveTo*.
Quicksaving a calibration will save it to the same folder as the original with a numerical suffix that is automatically updated with each save. A quicksave will also give the option

of programming the connected ECU at the same time. To perform a quicksave select *File, QuickSave* or use the <F12> key.

Device

Connect to an ECU with Device, Connect. This will retrieve the current calibration and ECU information as well as begin monitoring live item values. Most map items allow live changes that will take effect while the device is connected. To store these or other changes, the calibration must be programmed to the ECU by selecting *Device, Program*.

Comment

Add a comment to the calibration file with *Cal, Comment*. This will also be programmed to the ECU and will be visible to any PC that connects.

Logbook

LifeCal can be used to view logbook files in ECUs. To view these select *Device, Logbook* with an ECU connected. Comments can only be added to a logbook whilst it remains in an ECU. This can therefore only be done when connected in LifeCal or LifeData.

Select *Export* to save a text file containing the currently displayed information.
Select *Clear* to clear the values in the logbook from the ECU and start fresh.
Selecting *change Units* will change the units of the entire unit group. Note that this change will affect all Life Racing PC applications.

2.2 Security

Settings for custom security are available to root users only and are configured in LifeCal. For more details contact Life Racing and ask for the Security manual.

Generic users can add a passphrase to a calibration or logbook that will be required when either opening the file or retrieving from an ECU. This can be done under *Cal, PassPhrase.* When creating a passphrase for the first time leave the OLD PassPhrase box empty.

Calibration Passphrase

Enter OLD PassPhrase

Enter New PassPhrase

Retype New PassPhrase

OK   Cancel
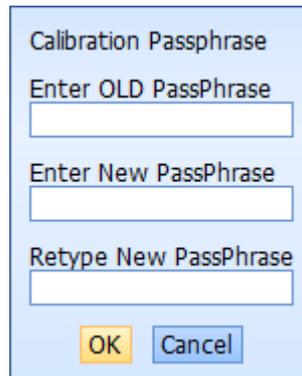
2.3 Working Directory

The working directory is maintained across all Life Racing applications and can be edited in LifeCal, LifeCfg, LifeData, LifeView and PduSetup. To change the current working directory select *Working directory* under *File*. Use *CREATE* to create a new folder in the current location. Use *SELECT* to select the current location as the new working directory. If the location has not been used before, a .CFG file will be created. Selecting *Working Dir Behaviour* allows editing of the .CFG file.

C:\Users\Public\Example Data\

Known Devices   Add   Remove   Edit   Import

1001, "Example", "Car #01"

☐ Reverse folder order

Session Sub Directory
○
◉ Use Date

Downloaded Data
☒ Use directory per session
☐ Use directory per device

Calibrations
☒ Use directory per session
☐ Use directory per device

Logging Setup
☒ Use directory per session
☐ Use directory per device

OK   Cancel

Devices that have been previously connected to are automatically added to the known devices list. They can also be manually added or imported from another working directory with the appropriate buttons. The ECU name will be used as a folder name if device directory is used. The suffix is included in file names.

Directories can be altered individually for calibrations, downloaded data and logging setup files. Tick *Use directory per device* to separate files by ECU. Tick *Use directory per session* to use either the date sub directory or a custom sub directory. A date sub directory will automatically update and add folders when new data is downloaded.

Calibrations
☐ Use directory per session
☐ Use directory per device

Working Directory	Calibrations	.LRC
	Dash	
	DownloadedData	
	LoggingSetup	
	PDUSetup	

Calibrations
☐ Use directory per session
☒ Use directory per device

Working Directory	Calibrations	ECU #1	.LRC
	Dash	ECU #2	.LRC
	DownloadedData		
	LoggingSetup		
	PDUSetup		

Calibrations
☒ Use directory per session
☐ Use directory per device

☐ Reverse folder order

Calibrations
☒ Use directory per session
☒ Use directory per device

⊠ Reverse folder order

Calibrations
⊠ Use directory per device
⊠ Use directory per session
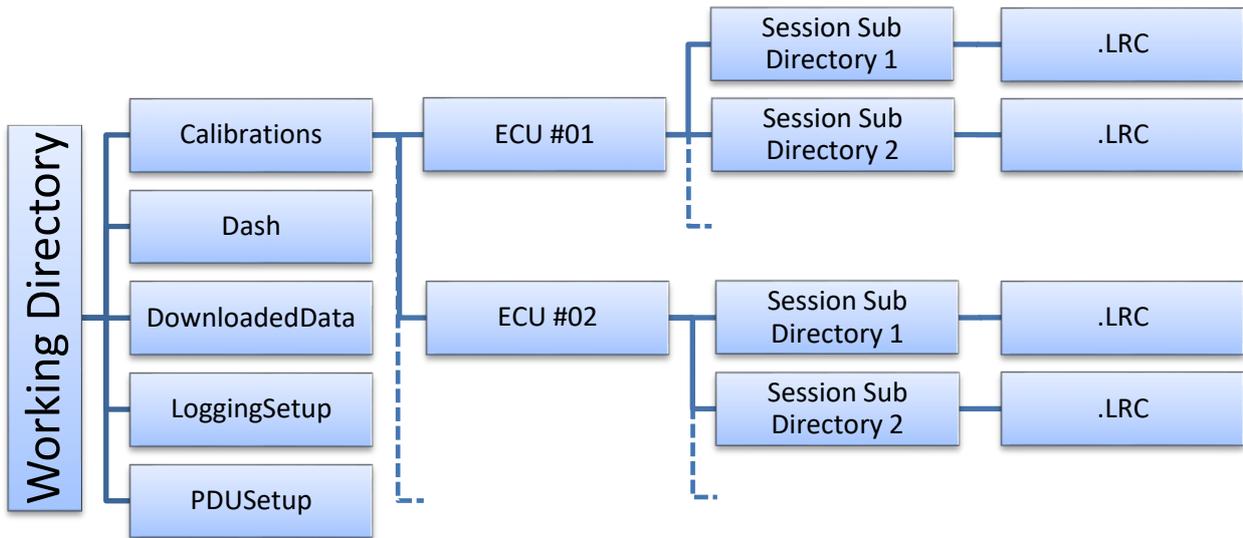
3 Calibration

3.1 Interface
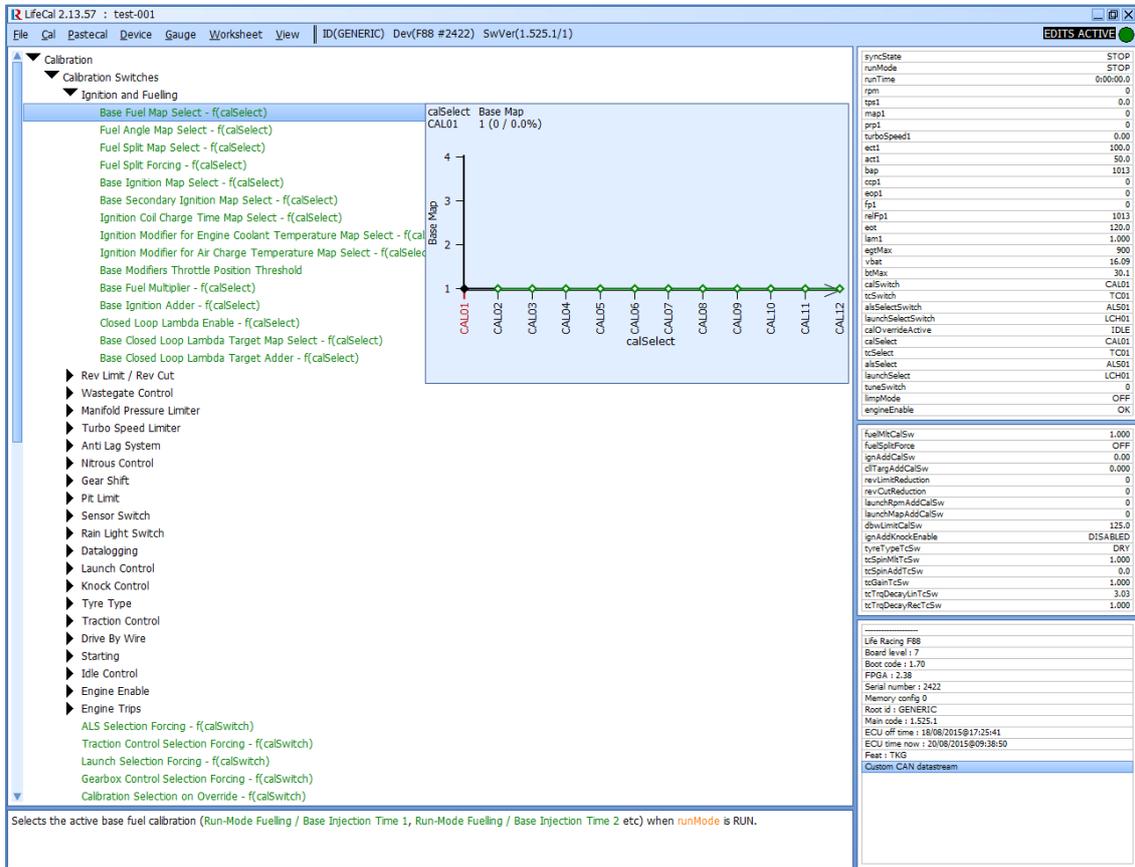
The main tree lists all configurable maps for the software level selected or the ECU profile and features if connected. Use the <Up> and <Down> keys to navigate and <Enter> to expand or collapse a branch or to open the highlighted strategy. When highlighted, a preview screen can be displayed that will show the current state of that strategy. This option can be toggled under *V*iew, map *P*review windows. An asterisk (*) is used to mark when this is active.

Maps displayed in green are "Patchable," allowing live changes to be made to a connected ECU. New values will be applied immediately but will not be remembered unless properly programmed. Maps displayed in blue will require a manual programme to take effect.

To the right of the screen are the Dash Panels. The General Dash is shown at the top and contains vital monitoring items that will always be visible. In the middle is the Operating Mode Dash which contains monitoring items that are relevant to the current map. At the bottom is the Message Panel. This displays ECU messages including ECU firmware details and any errors with the calibration. These panels cannot be hidden however they can be resized by dragging the boarders for easier viewing.

In the top right hand corner is the connection status.

OFFLINE ○	No devices connected
CONNECTED ●	Connected successfully
EDITS ACTIVE ●	Connected successfully, live changes are active
CONNECTED (not in sync) ●	Connected with error
DISCONNECTED ●	Connection lost
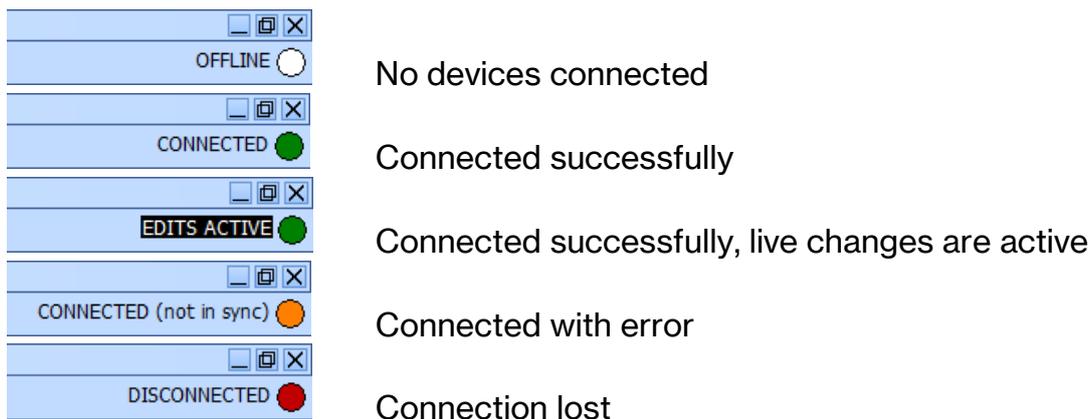
At the bottom of the screen is the Help Panel. This panel will provide strategy explanations for the highlighted map. Any maps referenced (displayed in blue or green) in this explanation can be accessed by selecting it. Referenced monitoring items (displayed in yellow) are added as gauges when selected. The Help Panel can be toggled with the <F1> key or resized by dragging the border.

3.1.1 Navigation

Use the arrow keys or the mouse to navigate the tree. <PageUp>, <PageDown>, <Home> and <End> can all also be used in the traditional Windows fashion. Double click or press <Enter> to expand or collapse branches. +/- can also be used to expand or collapse the entire tree.

Double click or press <Enter> to access a map. <z> and <x> can be used as BACK and FORWARD in the same way as an internet browser to switch between maps.

Create user shortcuts to specific maps with *Cal, edit Shortcuts* or select <SHIFT> and any unassigned F# key (F2-F8) with the map selected. With shortcuts set, press the assigned F# key to instantly access that map.

Specific maps can be searched for with *Cal, Goto.* The full list of maps will be displayed. Begin typing to narrow down the list and select *OK* when the required map is found. This will expand the required trees and highlight the selected map.

3.1.2 Warning Flags

Any single map or branch can be flagged by selecting *Cal, Warnings Menu* or by right clicking. A solid flag indicates all maps under that branch are flagged. A transparent flag indicates that only some have been flagged. The following flags can be assigned:

🛑 Invalid

This flag sets the selected map as invalid to indicate no value. This is most useful when performing an import as only the valid maps will be imported. A calibration saved with invalid maps is known as a "partial calibration". Invalid maps can be hidden under *View, hide Invalid maps.*

Programming a partial calibration into an ECU will prevent the ECU from running, even if the invalid maps are in an inactive strategy.

🛡️ Restricted

When using more than one root identity, this flag can be used as a security feature to hide map values from someone with full calibration access whilst keeping the strategy functional. The flag can be cleared and the restriction removed but this reverts the restricted maps to their default values.

🔒 Locked

A locked map cannot be edited whilst it is locked however, it can be unlock and edited at any time. The lock is intended as a reminder that a particular map is not expected to be changed without extra consideration. The lock flag is also a useful method of hiding unused maps when *hide Locked maps* is active in the *View* menu.

❓ Warning (user)

This flag is a visual marker only and has no other effect. It is generally used as a reminder to revisit a map. Use *View, hide Untagged maps* to display only maps marked with a warning for speed of review.

ⓘ Warning (automatic tag)

This flag cannot be manually set. It is used as a visual marker only during a software level update or a calibration import. It marks maps that were not successfully imported or are new. It is cleared in the same way as a user warning. Use *View, hide Untagged maps* to display only maps marked with a warning for speed of review.

Warning Menu

Additional options can be found under *Cal, Warnings Menu.*

remove all Warnings – Clear the warning flag (auto and user) from all maps.

Invalidate all non tagged cals – Mark all maps without a user warning as invalid. Useful for quick creation of partial calibrations.

Change import warnings to user warnings – Change automatic warnings from imports and software changes into user warnings.

3.2 Defined Maps

3.2.1 Map Variants

All strategies in LifeCal are graphically represented by default. Most maps also have a textual view that can be toggled under *Options*.

Single dimension maps represent a single value or state for a single item. Use +/- to increase or decrease values. This will also cycle text options. Press <Enter> to type a value or select an option form a list.

Breakpoint maps set breakpoint values for another 2D or 3D map axis. Use arrows to highlight a value (hold shift for multiple values) and +/- to increase/decrease value or use <Enter> to type a value.
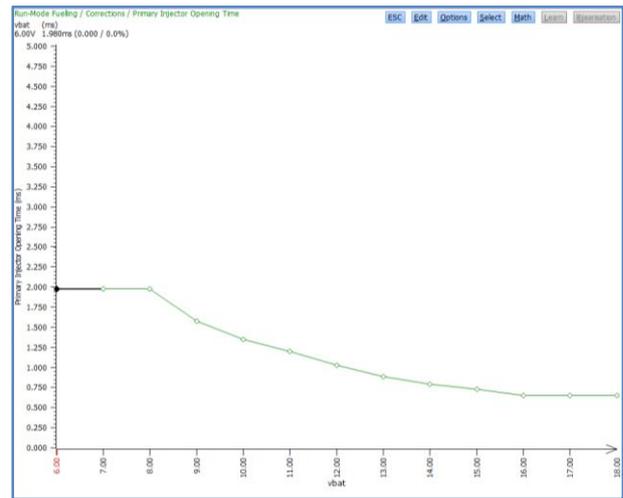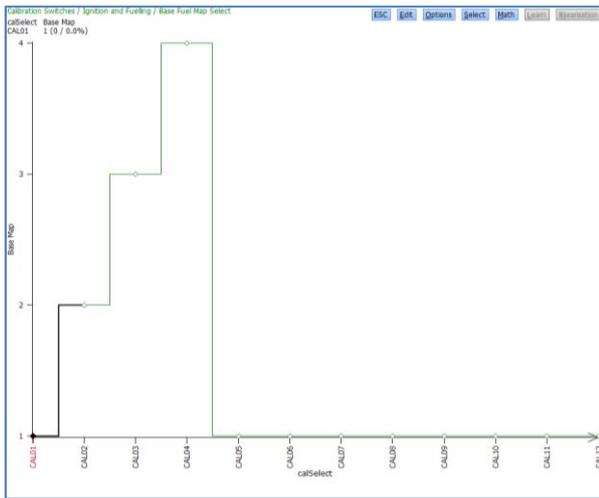
Two dimensional maps allow the vertical axis value to be dependent on a single variable. Use arrows to highlight a value on the x-axis (hold shift for multiple values) and +/- to increase/decrease the y-axis value or use <Enter> to type a value.
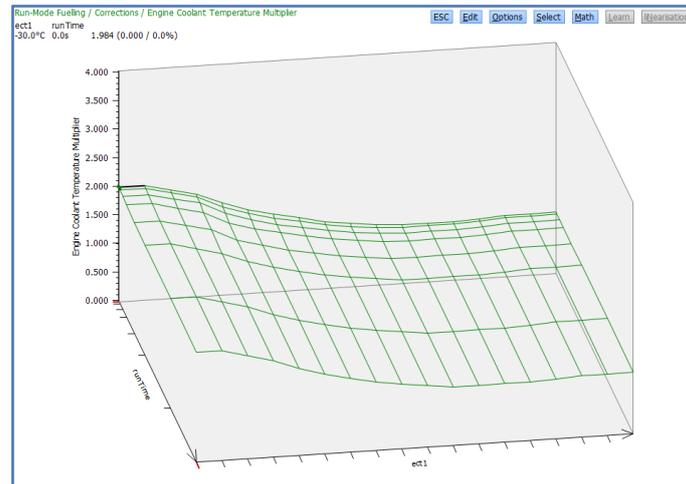
Three dimensional maps add a third axis allowing the vertical axis value to be dependent on two variables. Use arrows to highlight a value on the z-plane (hold shift for multiple values) and **+/-** to increase/decrease the z-axis value or use <Enter> to type a value. Use **</>** to rotate and **[/]** to scale the z-axis. A short z-axis allows a top viewing angle whereas a long z-axis allows a side view.

Four dimensional maps apply a 3D map to each of the points in a second map, allowing three variables. The fourth dimension is navigated using the <PageUp> and <PageDown> keys.

3.2.2 Map Menu

ESC	Return to tree. The <Esc> key can also be used.

Edit

Undo	Undo last edit
Copy	Copy highlighted value(s)
Paste	Paste copied value(s)
Breakpoints	Open breakpoint maps in a dialogue box. Additional options to add or remove points can be found under *Point*.
breakpoint Label	Change axis names

Options	Includes display toggle options. Active options are marked with an asterisk (*).
Inc Fine/Course	Toggle increment change size between fine and course.
Graphical View	Show only graphical representation.
Textual View	Show only textual representation.
Both Views	Show both graphical and textual representation.
Wide Lines	Toggle thick lines between points.
Smooth Lines	Toggle antialiasing to lines.
3d Highlights	Toggle highlighting multiple points displaying in 3D.
Auto Scaling	Auto scale vertical axis to min and max values.
Toggle Delta View	Delta view displays how much a value has changed rather than its new value.

Toggle Delta <u>H</u>otSpots	Apply colouring to represent where changes have been applied and by what magnitude.
Toggle <u>L</u>ive Lock	Toggle moving the selected cell to that which is closest to the live position. When this is switched off, F9 may be used to quickly select the live cell.
T<u>r</u>ailing Live Position	Show live position path history.
change <u>U</u>nits	Change units of vertical axis and all associated items across all Life Racing applications.
<u>P</u>rint	Print the current map.

<u>S</u>elect	**Selection shortcuts.**
<u>A</u>ll	Highlight all data points.
<u>R</u>ow	Highlight all data points in the current row.
<u>C</u>olumn	Highlight all data points in the current column.

|	
<u>M</u>ath	**Apply functions to alter map values.**
<u>M</u>ultiply	Multiply the highlighted points by any given value.
<u>D</u>ivide	Divide the highlighted points by any given value.
<u>A</u>dd	Add any given value to the highlighted points.
<u>S</u>ubtract	Subtract any given value to the highlighted points.
<u>I</u>nterpolate	Interpolate across highlighted values in a specified direction.
<u>F</u>lip	Flip highlighted values in specified direction.
s<u>W</u>eep	Copy values across highlighted data points in a specified direction.
Set to <u>R</u>eference	Set highlighted points to values at the point of opening the map.
Set to Default (0)	Set highlighted points to their default values.
<u>E</u>dit Expression	Create a custom expression that can be applied to the highlighted cell values.
Set to Expression (F10)	Apply a previously defined expression to the highlighted cells.
Set to <u>P</u>asteCal	Set the highlighted points only to the PasteCal values.
<u>L</u>earn	
<u>A</u>pply	Add the learned correction values to the base map values.
<u>R</u>eset	Reset the current learn map to 0 across all points.
<u>V</u>iew learn/base map	Toggle between viewing the base and learn maps.

li<u>N</u>earisation	**Used to apply linearisation to sensors.**
<u>S</u>elect Type	Select linearisation type:

INTERPOLATE   EXTRAPOLATE
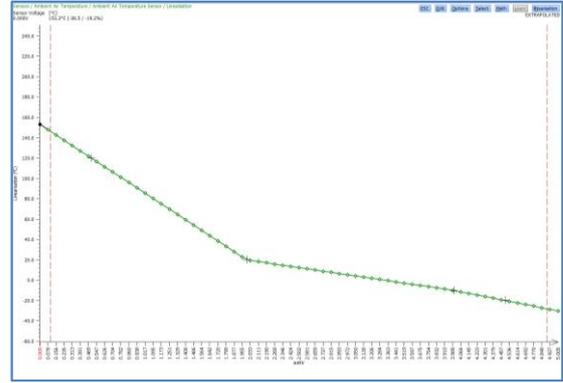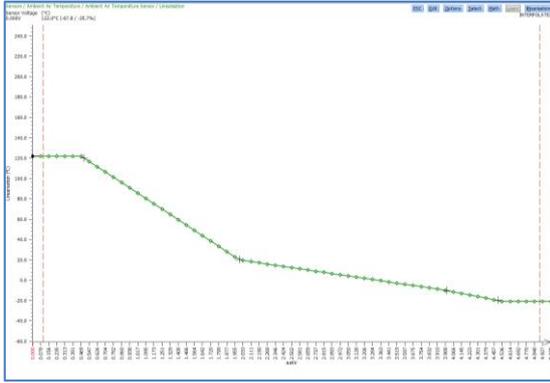
GEAR
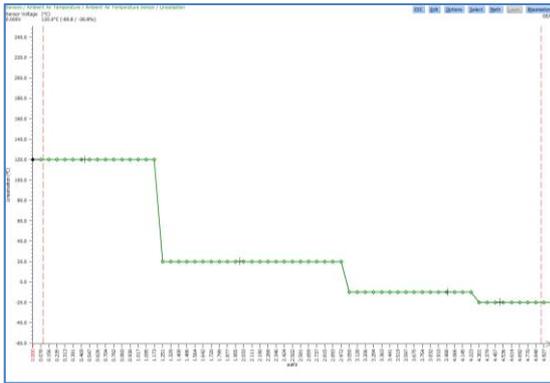
LINEFIT
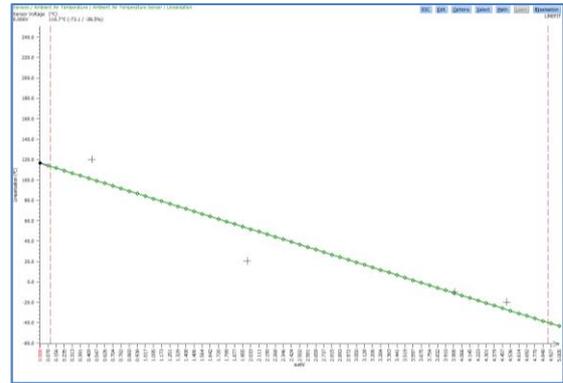
CURVEFIT
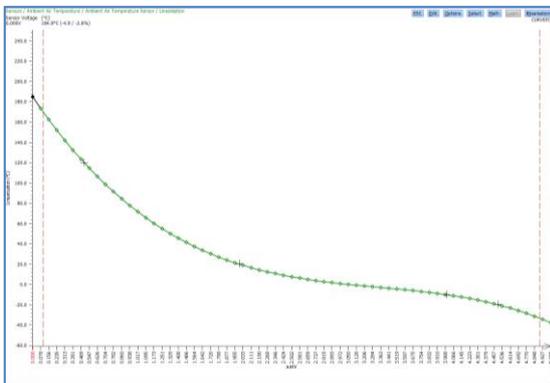
EXPRESSION
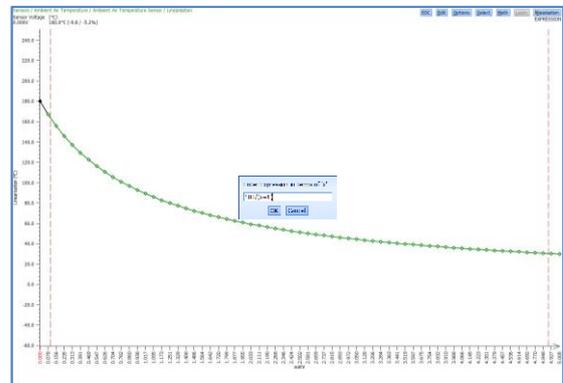
Add <u>L</u>ive Point	Add a point at the current sensor voltage when an ECU is connected.
Add <u>P</u>oint	Add points manually.
<u>E</u>dit Points	Edit existing points. Also allows copy and pasting from other maps.
<u>R</u>emove all Points	Clear all saved points.
<u>T</u>oggle show Points	Hide/show linearisation points.
<u>A</u>pply	Apply the selected linearisation type to the added points.
sensor<u>D</u>b	Save a linearisation with *Save sensor* or load a previously saved linearisation with *Load sensor*. The sensor database can be found in the main Life Racing folder.

3.2.3 Pin Assignments

The pin assignment map is unique from the normal variants and is used to assign all of the useable I/O items to their physical pins. Selecting an input or output will display a list of compatible pins in the ECU and available CAN frames. Selecting a pin or frame from this list will assign it to the chosen input or output.
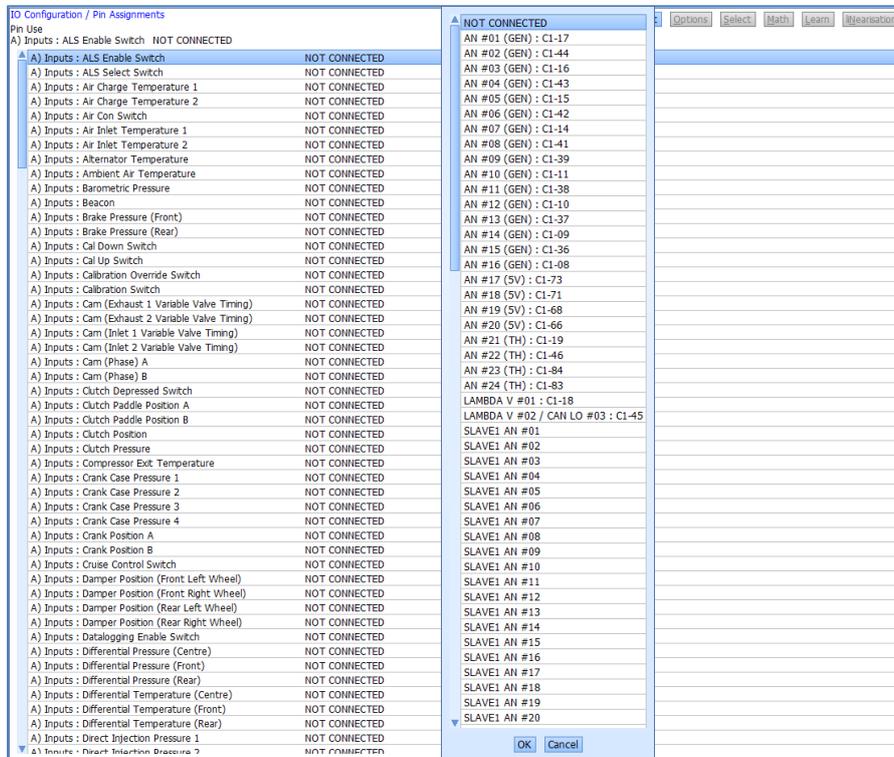
The *Edit* menu provides options for alternative viewing modes:

View All	View the entire I/O available
View Assigned	View assigned I/O only
View Undefined	View undefined I/O only (caused by software level changes)
View Not-Connected	View unassigned I/O only

Also available under the *Edit* menu is the option to export the current pinout as a text file by selecting *Save Pinout*.

I/O coloured red share a pin and cannot be successfully programed. Those coloured yellow also share a pin but are compatible.

Claiming a full bridge (using two half bridges together for DBW etc) is done by claiming the first of an aligned pair (ie HB01 gets you HB01+HB02, HB03 gets you HB03+HB04, you cannot use HB02+HB03) and setting the output type to full bridge in the claiming strategy. The other pin is claimed automatically.

Input Type

If an ECU is connected, the input type will be displayed in the pin choices. Without an ECU connection, the list defaults to a full F88 or F90RX depending on the calibration profile.

5V	0-5v input	Generally for three pin sensors (5v, sig, GND)
TH	Thermistor	Internal pull up resistor. Most commonly used for thermistors or two pin sensors (sig, GND)
BI	Bipolar	Allows negative voltages. Typically used for inductive sensors
FREQ	Frequency	Supports high speed inputs such as crank, cam and wheel speed sensors
GEN	Generic	Supports all of the above (software selectable)

Slaves

Slave inputs and outputs can be assigned when available but function will depend on the device used as a slave.

Slave I/O	X10	F88	PDUx
SLAVE1 AN #01	INPUT #01	INPUT #01	INPUT #01
SLAVE1 AN #02	INPUT #02	INPUT #02	INPUT #02
SLAVE1 AN #03	INPUT #03	INPUT #03	INPUT #03
SLAVE1 AN #04	INPUT #04	INPUT #04	INPUT #04
SLAVE1 AN #05	INPUT #05	INPUT #05	INPUT #05
SLAVE1 AN #06	INPUT #06	INPUT #06	INPUT #06
SLAVE1 AN #07	INPUT #07	INPUT #07	INPUT #07
SLAVE1 AN #08	INPUT #08	INPUT #08	INPUT #08
SLAVE1 AN #09	INPUT #09*	INPUT #09	INPUT #09
SLAVE1 AN #10	INPUT #10*	INPUT #10	INPUT #10
SLAVE1 AN #11		INPUT #11	INPUT #11
SLAVE1 AN #12		INPUT #12	INPUT #12
SLAVE1 AN #13		INPUT #13	INPUT #13
SLAVE1 AN #14		INPUT #14	INPUT #14
SLAVE1 AN #15		INPUT #15	INPUT #15
SLAVE1 AN #16		INPUT #16	INPUT #16
SLAVE1 AN #17		INPUT #17	
SLAVE1 AN #18		INPUT #18	
SLAVE1 AN #19		INPUT #19	
SLAVE1 AN #20		INPUT #20	
SLAVE1 AN #21		INPUT #21	
SLAVE1 AN #22		INPUT #22	
SLAVE1 AN #23		INPUT #23	
SLAVE1 AN #24		INPUT #24	
SLAVE1 LAMBDA V #01		LAMBDA V #01	
SLAVE1 LAMBDA V #02		LAMBDA V #02	
SLAVE1 THERMO+ #01		THERMO+ #01	
SLAVE1 THERMO+ #02		THERMO+ #02	
SLAVE1 OUT #01	PWM #01	FUEL #01	PWM/H-Bridge #01
SLAVE1 OUT #02	PWM #02	FUEL #02	PWM/H-Bridge #02
SLAVE1 OUT #03	PWM #03	FUEL #03	PWM/H-Bridge #03
SLAVE1 OUT #04	PWM #04	FUEL #04	PWM/H-Bridge #04
SLAVE1 OUT #05	PWM #05	FUEL #05	PWM/H-Bridge #05
SLAVE1 OUT #06	PWM #06	FUEL #06	PWM/H-Bridge #06

SLAVE1 OUT #07	PWM #07	FUEL #07	PWM/H-Bridge #07
SLAVE1 OUT #08	PWM #08	FUEL #08	PWM/H-Bridge #08
SLAVE1 OUT #09	PWM #09	FUEL #09	PWM/H-Bridge #09
SLAVE1 OUT #10	PWM #10	FUEL #10	PWM/H-Bridge #10
SLAVE1 OUT #11	H-BRIDGE #01	FUEL #11	PWM #11
SLAVE1 OUT #12	H-BRIDGE #02	FUEL #12	PWM #12
SLAVE1 OUT #13	H-BRIDGE #03*	FUEL #13	PWM #13
SLAVE1 OUT #14	H-BRIDGE #04*	FUEL #14	PWM #14
SLAVE1 OUT #15		FUEL #15	
SLAVE1 OUT #16		FUEL #16	
SLAVE1 OUT #17		IGNITION #01	
SLAVE1 OUT #18		IGNITION #02	
SLAVE1 OUT #19		IGNITION #03	
SLAVE1 OUT #20		IGNITION #04	
SLAVE1 OUT #21		IGNITION #05	
SLAVE1 OUT #22		IGNITION #06	
SLAVE1 OUT #23		IGNITION #07	
SLAVE1 OUT #24		IGNITION #08	
SLAVE1 OUT #25		H-BRIDGE #01	
SLAVE1 OUT #26		H-BRIDGE #02	
SLAVE1 OUT #27		H-BRIDGE #03	
SLAVE1 OUT #28		H-BRIDGE #04	

*The Master ECU is not aware of pin sharing on a Slave device. Therefore if, for example, both H-Bridge 3 and Input 9 are assigned on an X10, the Master will not know there is an issue but the Slave will not operate.

Claiming an input as 5V/TH/BI/FREQ is done as if the pin is in the Master and is fully checked against the connected slave's capability at run time. Claiming a lambda or thermocouple only works if you set the requested input type to 5V and set the linearisation curve manually.

X:CAN RECEIVE
Custom CAN receive items must also be defined as part of the I/O by assigning the desired input to a specific slot in either an A frame (16bit) or a B frame (8bit). These slots and frames are configured under *Datastreams, Generic CAN Receive*. More information can be found in the CAN documentation.

X:PDU CONTROL
Outputs can be configured to be directly transmitted to an LR PDU over 16 slots in 2 dedicated frames rather than using Custom CAN transmission. These are received by the PDU as soft inputs that can then be used in the PDU schematic. More information can be found in the CAN documentation.

3.3 Customisable Maps and Sensors

A number of sensors and strategies can be customised. The customisation options are hidden in normal use but can be accessed by selecting *View, show Customising options.* Here options such as selectable control sensors and renaming of Cal switches are available.

On changing any custom option, a list of affected maps is given. After reviewing, changes can be confirmed with *Proceed* or cancelled with *Undo change*. Use *Proceed & Tag* to also place a flag next to the affected maps in normal view.

3.3.1 Output Functions

Specific output functions can be customised for different uses:

Basic PWM outputs 01 and 02 (bbw1/2 by default) can be used as PWM, H-Bridge or Full bridge outputs.

Fans 1-8 can be used as On/Off strategies or as PWM.

Variable frequency (formally 'test output') is dependent on the two chosen variables.

Name, abbreviation and variables can be customised in this view. Output behaviour is defined in the normal view under *Output functions*.

3.3.2 Sensors

Calibration switches can be renamed under *Sensors, Defined Sensors and Trip Setups. Give* the switch a new name under 'Use.' This name will be displayed throughout the Life Racing applications.
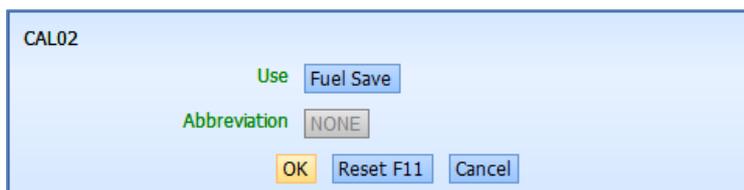
Twenty-five sensors are available as user defined sensors. These can be fully customised and can be used in custom strategies or as monitoring sensors. Select *Sensors, User Definable Sensors* and *Redefine* under the desired sensor to open the dialogue box below.
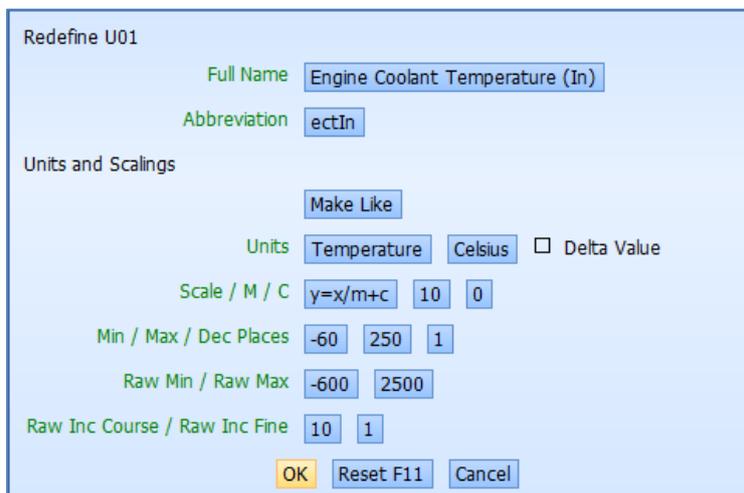
Full Name	Visible in sensor branch.
Abbreviation	Used on axis, gauges, logging config and analysis channels.
Make Like	Select *Make Like* to base the custom sensor on another predefined or definable one. This will change all the below options to match the chosen sensor.
Units	Select unit type and raw value units.
Delta Value	Toggle absolute or delta values (critical for unit conversion)
Scale / M / C	Scale the raw sensor values into engineering units, i.e. including decimal places and offsets.
Min / Max / Dec Places	Set minimum and maximum values as well as the number of decimal places displayed when monitoring or analysing the sensor. Automatically changed when Raw Min / Raw Max edited.
Raw Min / Raw Max	Set minimum and maximum raw values. Automatically changed when Min / Max edited.
Raw Inc Course / Raw Inc Fine	Set the increment size when using the +/- keys. Increments use raw values so scale these for actual unit values.
Reset F11	Reset all options to the default example sensor values.

3.3.3 Configurable Purpose Maps

All configurable purpose maps can be assigned as an adder or multiplier for any of the custom output functions or specific predefined strategies such as global ignition and fuel values. When given a 'Use,' configurable maps will appear under that specified tree in normal view with the variables specified as well as under the dedicated 'Configurable Purpose Maps' branch. Changes can be made in either location. Map 'Use' and axis are defined in Custom Options. The number of breakpoints and breakpoint values can be changed in normal viewing.
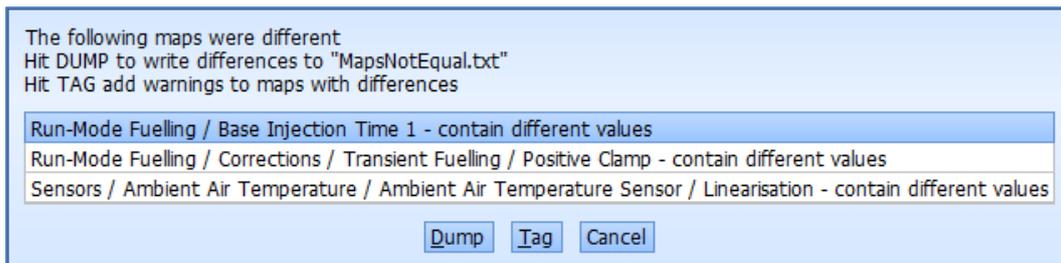
3.3.4 Custom Items in LifeCfg

Creating a new logging configuration will display the default names of the user definable items (sensor and custom map terms). To display the custom names, the config must be taken from the ECU before being worked on. A config can be set to the ECU without this step if the User Definable numbers are remembered and the naming will still be correct.

4 Calibration Comparison

4.1 Compare

The open calibration can be compared with another in order to find differences between them. Select *File, compare* to choose the comparison file. A dialogue box will list any differences and give the options of dumping the list to a text file or tagging the different maps in the open calibration.

The following maps were different
Hit DUMP to write differences to "MapsNotEqual.txt"
Hit TAG add warnings to maps with differences

Run-Mode Fuelling / Base Injection Time 1 - contain different values
Run-Mode Fuelling / Corrections / Transient Fuelling / Positive Clamp - contain different values
Sensors / Ambient Air Temperature / Ambient Air Temperature Sensor / Linearisation - contain different values
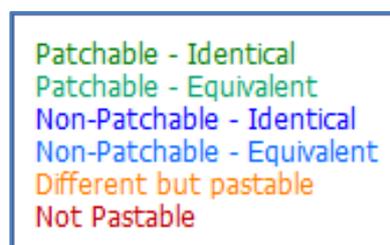
Dump Tag Cancel

4.2 Import

The import tool, found under *File, Import*, allows values from another calibration file to be copied into the open calibration. This will copy all valid maps so is most useful for importing partial calibrations (contains maps marked as invalid) or values from a different level of software.

4.3 PasteCal

The PasteCal tool allows individual map comparison and importation. Select *Pastecal, Load* to select a file to compare to the open calibration. Details of the pastecal file can be found by selecting *Pastecal, Description*. Maps will become coloured depending on the differences between files. Equivalent maps hold the same values but use different breakpoints. Patchable maps will be applied instantly to a connected ECU. Non-Patchable maps will require a manual program.

Patchable - Identical
Patchable - Equivalent
Non-Patchable - Identical
Non-Patchable - Equivalent
Different but pastable
Not Pastable

Maps or entire branches can be individually imported by highlighting the map or branch and selecting *Pastecal, Import map/branch* or importing and tag the change with *Pastecal, import map/branch and Tag*.

Import a different named map into the highlighted map with *import Other* and select the alternative from the list of valid maps. Begin typing a map name to reduce the list size.

Map differences can be stored in a text file or tagged in the original calibration with warning flags by selecting *Pastecal, Compare*.

5 Gauges

Gauges can be added to the display in LifeCal and work in a similar way to LifeMon to monitor live values from a device. Use the <Spacebar> to freeze current values. When gauges are frozen, the right hand menu will appear blue. The mouse may then be used to look at trace values at any visible point.

5.1 Add/Remove

A gauge can be added by selecting *Gauge, Add* and choosing from the list. Begin typing an abbreviation to shorten the list. Select the gauge type and frequency at which the item should be monitored. Alternatively, select an item in the dash panels displayed on the right. Double click for a text gauge or right click to use any other.
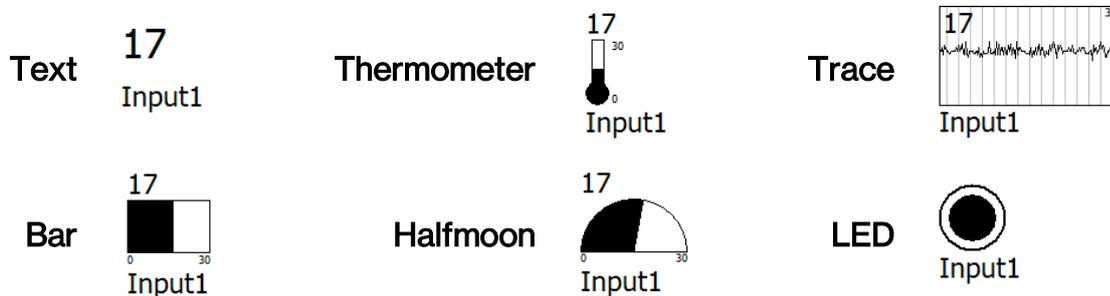
A Text gauge can also display state items. The LED gauge will 'light up' with any non-zero value.

The order of gauges can be changed by dragging them into the desired locations.

Remove a single gauge with *Gauge, Remove* or clear the entire screen with *Gauge, Remove All (X)*.

5.2 Right Click Menu

Right click a gauge to bring up further customisation options.

Duplicate
Create an identical gauge with the same item and visual characteristics.

Remove
Delete the selected gauge.

Edit Math Function
Open the Math window to allow math edits (only available when gauge is displaying a math item).

Change Item
Change which item the gauge is displaying.

Add Item
Overlay a second item on the same gauge. Compatible with trace, halfmoon, bar and thermometer gauges
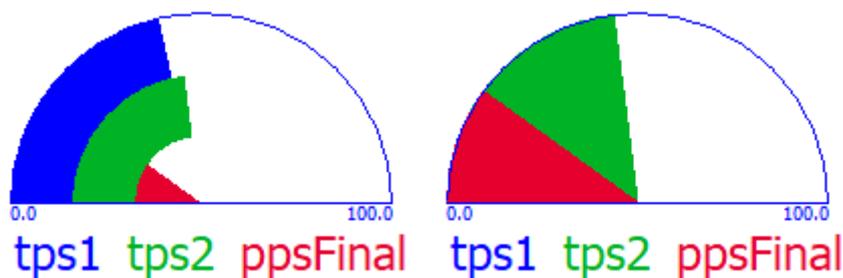
Remove Item
Remove an overlaid item from a multi item gauge.

Order Items
Change the display order of items in a multi item gauge.

Overlay Items toggle
Toggle a halfmoon multi item gauge between separated arcs and full sized overlay.

Change Type
Change the type of gauge.

Change Frequency (#Hz)
Change the frequency at which the item is monitored. For math items, this also changes the sample rate. The number in brackets is the current rate.

Change Scale
Change the minimum and maximum values on graphical displays.

Change Alarm
Change the value limits at which the gauge will flash red if exceeded. Individual alarms can be set for each item in a multi item gauge.

Change Colour
Change the base colour of the gauge graphic and text.

Change Units
Change the units for the item unit group. Units are universal across files and applications.

Naming Scrolling/Normal
With naming scrolling active, the gauge will remain at its default size and any text that exceeds its boundaries will continuously scroll. If naming is normal, the gauge size we be adjusted to accommodate the text.

siZe Compact/Normal
Toggle between small and normal fixed sizes.

Make Resizable (1)
Set a custom size for the graphic. Does not affect text size.

5.3 Layout
Once a layout has been completed, it can be saved by selecting *Device, Save Layout* for a new name or *Device, Overwrite Layout* to replace an existing name. Saved layouts can be found under the same menu with their own numerical shortcuts.

Use *Set Default Layout* to choose a layout to automatically display when a device is connected.

5.4 Preferences
General gauge options can be found under *Gauge, Preferences.*

Name Scrolling
With name scrolling active, the gauge will remain at its default size and any text that exceeds its boundaries will continuously scroll. If not active, the gauge size we be adjusted to accommodate the text.

Compact siZe
Toggle between small and normal fixed sizes.

Panel Scrolling
With Panel Scrolling active, gauges will be distributed along one line only with the ability to scroll to view hidden gauges. When inactive, gauges can be distributed across multiple lines, taking up more space but allowing more gauges to be displayed at once.

6 Worksheets

Worksheets are custom displays that allow multiple maps to be viewed side by side while remaining editable. Create a new, blank worksheet by selecting *Worksheet, New*. Select *Save* to overwrite the current worksheet or *SaveAs (F2)* to store the layout as a new worksheet. When saved, a worksheet can be loaded from the same menu with numerical shortcuts or each worksheet can be listed in tabs below the menu bar by enabling with *Worksheet, enable Tabbed worksheets*. Rename or delete worksheets under *Worksheet, Manage*.
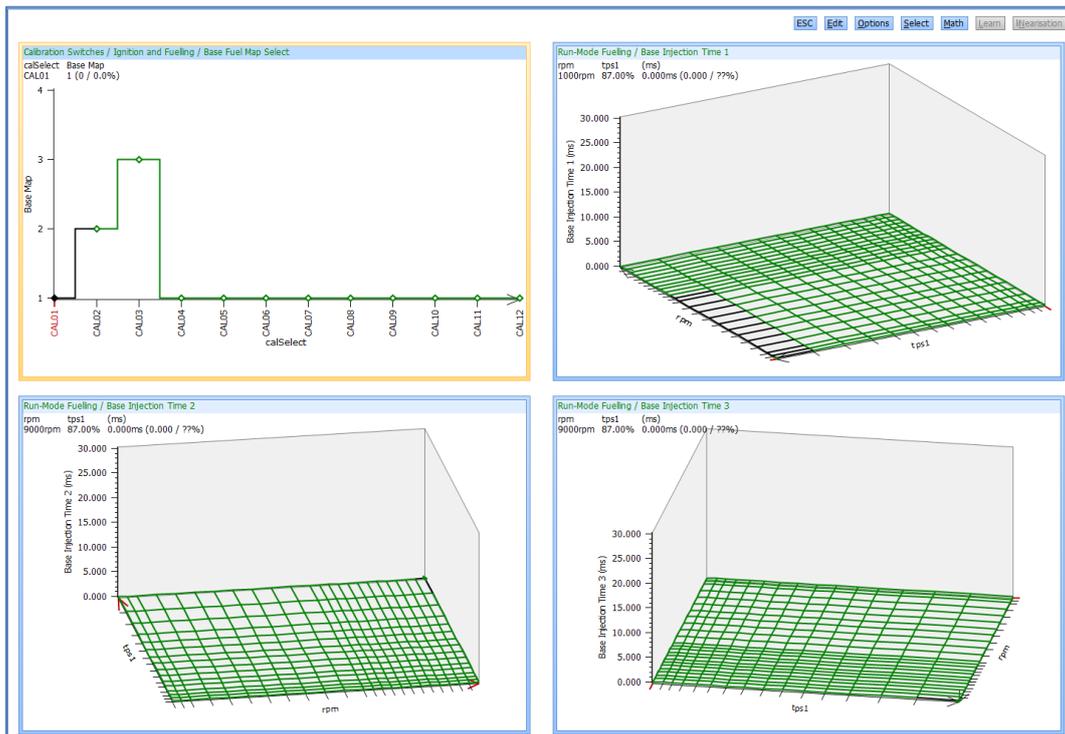
Calibration maps can be added under *Worksheet, Add Cal*. The complete tree will be visible to find and select the desired map to add. Maps can be moved by dragging from the top bar and resized from any edge in the traditional Windows fashion. Remove a map by selecting *Worksheet, Remove Cal.*

7 Tools

7.1 Sync Log
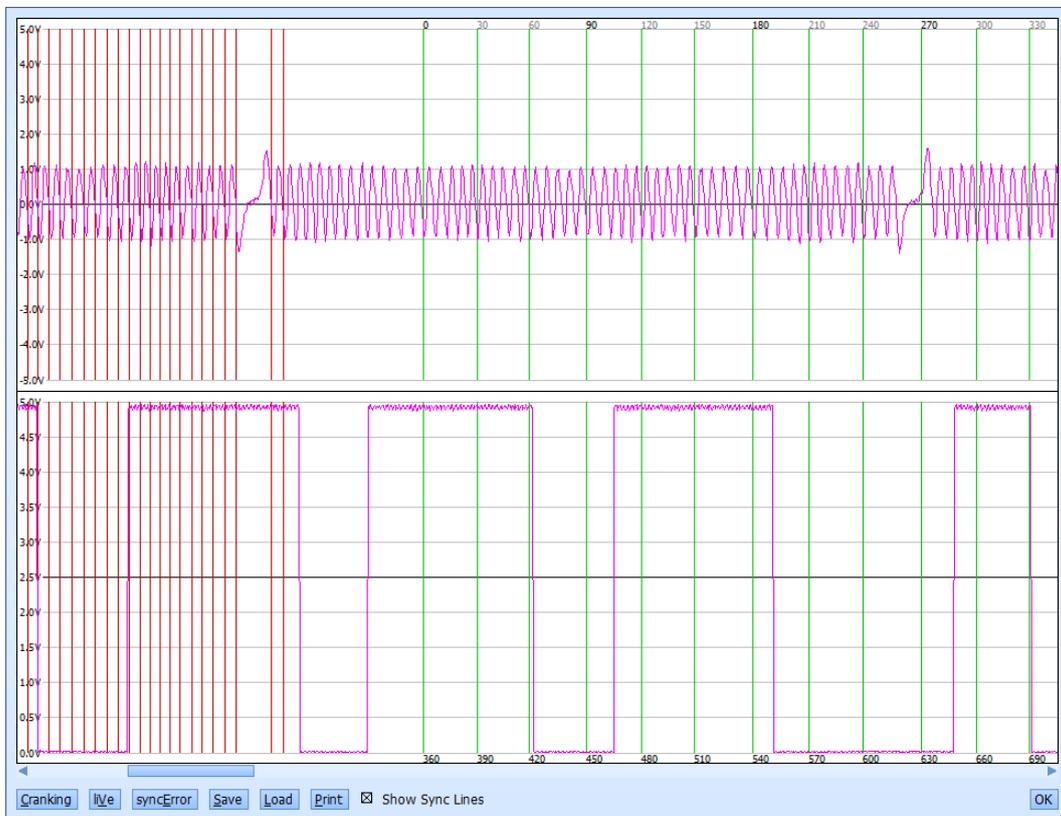
The sync log is used to view cam and crank signals at very high frequencies. It is used to help establish correct settings for engine synchronisation or as a diagnostic tool.
The two pink traces are the crank (top) and cam (bottom) position sensor traces. The vertical lines are "sync lines" displayed in red when un-synced and green when synced. Once synced, the measured angle from cylinder 1 TDC will be displayed along the x-axis.

Select *Cranking* to view the last crank event. When first opened, the sync log displays this by default if an ECU is connected.
Select *liVe* during engine running to view the signal trace at the point of selection.
The ECU automatically stores a sync trace when synchronisation is lost. Select *syncError* to view the last instance of this.
Select *Save* to store the current sample as a text file in the Downloads section of the working directory. This can then be view later with *Load.*
Select *Print* to print the currently visible section of the sync log.
Sync lines can be hidden to improve trace visibility by clearing the Show Sync Lines box.

7.2 Device Tools

Messages
Select *File, Dump Dashs/Msgs to Disk* to save the information displayed in the message screen in the bottom right to a text file in the working directory.

Errors
Any errors will be indicated with a flashing red device menu. Select *Device, Errors* to view the list. Errors will be shown in red and described below the failed item. A number will display how many times the error has occurred. Warnings are displayed in yellow and can be cleared with the *Clear* button. Use the 'Show' buttons to change what items are visible. Use *Refresh* to recheck error status and *Dismiss* to close.
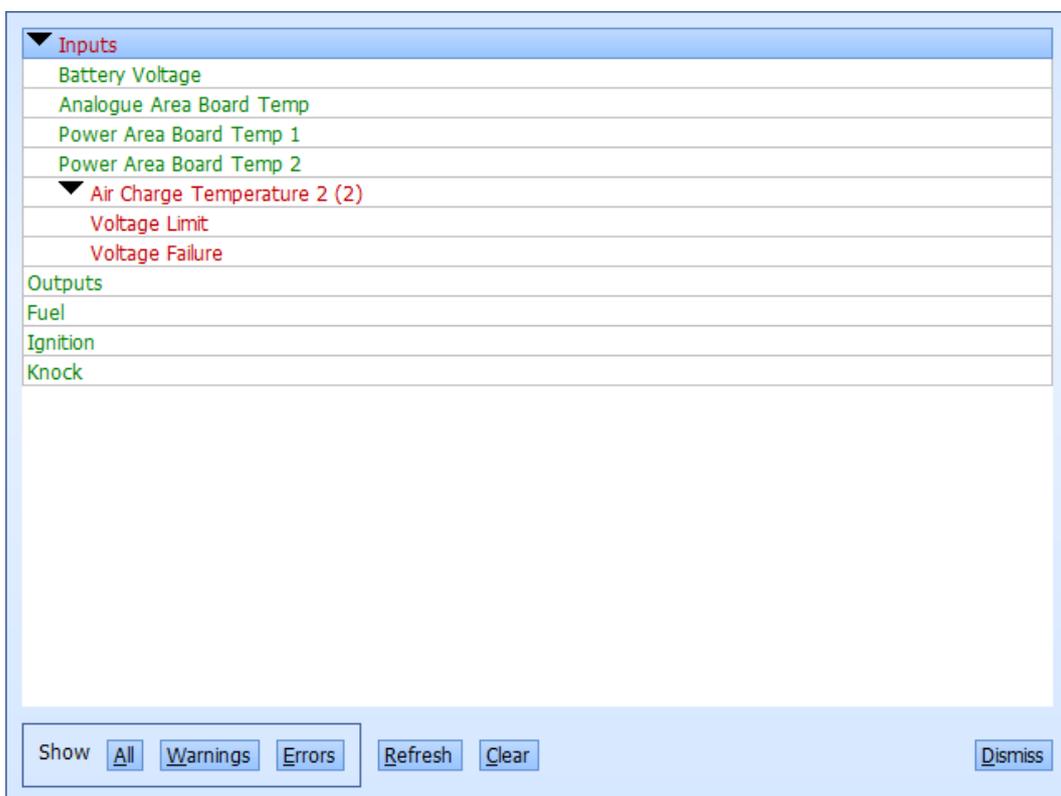
Sensor Zeroing
Use this tool, found under *Device, Sensor Corrections,* to set sensor reference points in the ECU for the sensors displayed in the subsequent list.

Clear Fuel consumption
Clear Fuel consumption information from the ECU by selecting *Device, Clear Fuel Consumption.*

Clear Distance Accumulator
Clear distance accumulator value and number of laps completed from the ECU by selecting *Device, Clear Distance Accumulator.*

Clock

Set the time in the ECU to match the current time on the connected PC with *Device, Real Time Clock, Set Real Time Clock.* The clock will be auto-updated when out of a certain range compared to the connected PC. Define this range under *Device, Real Time Clock, Set RTC Auto-Update Time Difference.*

Reset Learn Maps

Selecting *Cal, reset all Learn maps* will clear all learning from the calibration. Maps can also be individually cleared when accessed.

Reset ECU

An ECU can be factory reset by selecting *Device, Program defaults (ERASE) (Z).* This will clear the ECU of all calibration, logbook and logging data. This cannot be undone. Ensure backups of all required files are stored on a PC before performing a reset.

7.3 Output Testing

The maps found under the *Output Testing* branch enable manual control of the ECU outputs for testing hardware, wiring or timing. Output testing should be used with **extreme caution** as misuse can damage ECU components and vehicle hardware. Read the F1 help carefully for each map to avoid accidental damage.

7.4 Global Options

Global options affect all applications and can be found under *File, Global Options*.

Black-on-White colour scheme

Toggle the colour scheme of all Life Racing applications between a white background and a black background. The best option will be dependent on screen quality, ambient lighting and user preference.

Colour Blind (yellow/green)

Changes fixed yellows to purple to aid with yellow/green confusion.

Reverse Folder Order (in file menu)

Folders are ordered alphabetically in the file menu. Tick this box to reverse this order.

Floating Mouse Focus (in dialogs)

Causes whatever the mouse pointer is hovering over to be highlighted as if it was selected with the keyboard.

8 Document Revision History

2016-01-08	MH V1.0	Initial public release
2017-04-13	MH V2.0	Updated to new format
		Added connection status
		Added slave pinout assignment
		Added new features including GoTo and custom sensors and maps
2019-05-25	MH V2.1	Added additional gauge options including multi item gauges
		Added PDUx slaving