



USER MANUAL

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1 INTRODUCTION

With over 25 years of automotive knowledge, MoTeC has developed its next generation of ECUs with modern vehicles and controlled category racing at its core. Advances in technology have increased the demands on a vehicle's components, especially the ECU. This demand has reached a point where managing the intricate details of each installation become vital in providing the ultimate in performance.

The M1 series was conceived to provide highly optimised targeted firmware for each unique installation. M1 is a platform where operational efficiency, advanced features and flexibility are its primary objectives. At its core, M1 provides the ability to develop a suite of flexible and tailored solutions (packages), making it ideal for any application (however complex) and category management.

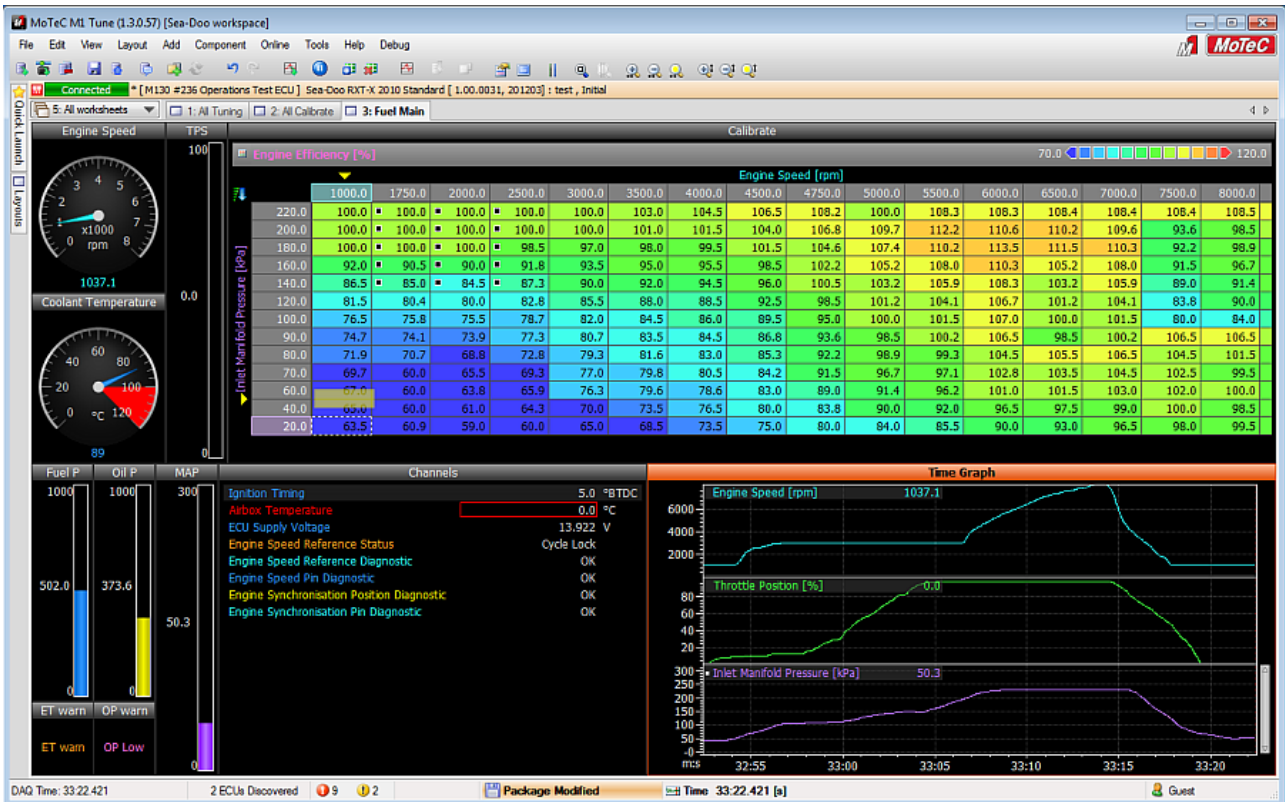
This new approach to engine management systems introduces new concepts, terminology and workflows - though much of this will be familiar to experienced Engine tuners. The M1 Tune software is the link between an M1 Packages and an M1 ECU.

Some basic M1 concepts & terminology will help you get started:

- An M1 ECU is configured using a "Package"
- An M1 Package is a collection of data for M1 firmware that primarily consists of:
 - A copy of the appropriate M1 firmware and help text
 - Calibration (tuning) data for the version of firmware
 - Data logging configuration
 - Workbooks (screen layouts for M1 Tune).
- Each M1 Package is targeted to a specific M1 ECU model (M130, M150 etc.)
- Each M1 Package includes help specific to its intended application
- Packages can be upgraded to new versions of the firmware as they become available
- M1 Tune is generic and can be used with any M1 Package or M1 ECU model

M1 Tune has the same look and feel as MoTeC's i2 analysis software and is used for the configuration, analysis and calibration of M1 firmware. The application allows creation of customizable screen layouts that make engine calibration easier and faster. The ability to add and configure individual components allows Worksheets to be customised for each application.

Example Worksheet window showing a number of components



2 SYSTEM REQUIREMENTS

The system requirements for effective use of the M1 Tune application are listed here.

Operating system:	Windows XP, Vista, Win7 (32 and 64 bit)
Minimum screen resolution:	1024 x 768
Recommended screen resolution:	1600 x 1200 or greater The higher the resolution the greater the screen layout options
Communications port:	Ethernet port
Communication protocol:	IPV6

3 INSTALLING THE M1 TUNE APPLICATION

Important: If during installation, you are prompted to allow the M1 software to make changes to your PC, **always allow**; otherwise PC communications will not work.

The M1 Tune software is available as a download from the MoTeC website at <http://www.motec.com.au/software/latestreleases/>

To install the software, the user must have a high enough level of access for the installation software to be able to make the appropriate updates to the PC. This may require the software to be installed by an administrator.

Once the software is installed, the M1 Tune icon is available from the desktop. Use this icon to start the M1 Tune software.

3.1 CHECKING AND INSTALLING THE LATEST VERSION

M1 Tune is constantly evolving. It is recommended to keep the software up-to-date. Check and update your version as follows.

1. Select **Help »About** and take note the version you are using.
2. Go to <http://www.motec.com.au/software/latestreleases/> and check the latest release version.
3. If a newer version is available, download and install the new version.

4 CONNECTING THE M1 ECU TO THE PC

Important: If, during installation or application start-up, you are prompted to allow the M1 software to make changes to your PC, **always allow**; otherwise PC communications will not work.

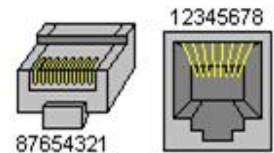
The MoTeC M1 ECU uses an Ethernet connection for communication between the ECU and M1 Tune. This ECU to PC connection uses a standard Ethernet cable, wiring and protocols.

When producing M1 wiring, all Ethernet communications cables must comply with Category 5 cable specifications. This includes wiring used to connect to the M1 ECU connector. MoTeC have panel mount category 5 Ethernet cables available that are suitable for this application.

Note: It is recommended that Ethernet cables are wired as crossover from the ECU to the loom side socket. By doing this, a standard (non crossover) Ethernet cable can then be used for all communications between the ECU and the PC.

4.1 PIN-OUT INFORMATION FOR ECU COMMUNICATIONS

All M1 ECU to PC communications take place using the standard IPV6 communications protocol via an Ethernet cable.



The Ethernet connector pin-out is shown in the following table.

Pin	Function
1	Ethernet RX +
2	Ethernet RX -
3	Ethernet TX +
6	Ethernet TX -

4.2 ESTABLISHING ECU COMMUNICATIONS

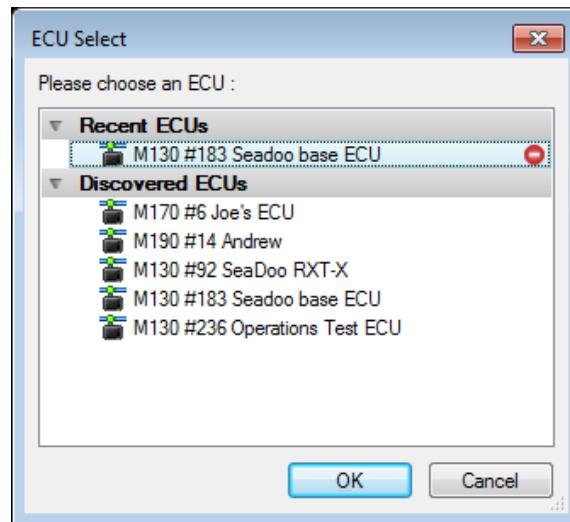
The IPV6 protocol used by M1 Tune is the same method that is used in some internet communications. Accordingly, some anti-virus and firewall applications will treat M1 PC communications in the same way as other internet traffic. In most instances, this will have no effect, but some anti-virus applications may block the M1 to PC communication.

To communicate from the PC to the ECU:

1. Power up the ECU.
2. Connect the Ethernet cable to the ECU and the PC.
3. Start M1 Tune. See [STARTING M1 TUNE](#).

► *The connected ECU should display in the **Quick Launch** fly-out or the **ECU Select** window.*

Example ECU Select window



Note: If M1 Tune does not discover the ECU, see [Resolving undiscovered ECU problems](#).

4. Select the required ECU from the list of available ECUs.

4.2.1 Resolving undiscovered ECU problems

When the ECU starts communicating, you will see it appear automatically in the list of connected ECUs on the **Quick Launch** fly-out or the **ECU Select** window.

If your ECU does not appear in the list, follow the steps below to resolve the cause of the communication problem.

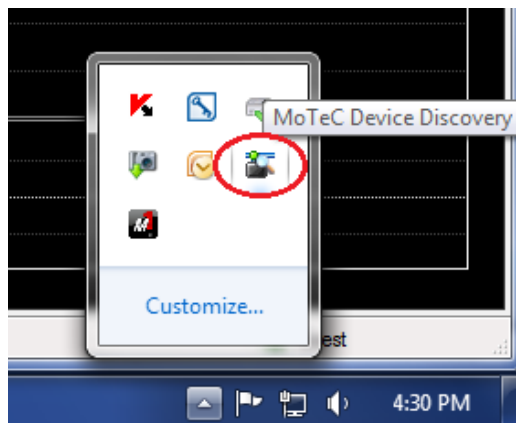
1. Ethernet ports normally include LED indicator lights. Check if they are lit (they normally flicker, indicating data traffic on the cable) when the ECU is plugged in and powered ON. On some PCs and notebooks, rather than individual LEDs, the Ethernet connector is lit at the PC end.

Example Ethernet port lights on a PC



► If the ECU is powered ON and they stay OFF, it most likely indicates an Ethernet wiring issue.

2. Where Ethernet wiring is confirmed as correct and there is still no communication:
 - a) Temporarily disable, turn off, or uninstall any anti-virus applications.
 - b) Close M1 Tune and ensure that the MoTeC Device Discovery service is also stopped. To check if MoTeC Device Discovery is running, display the active services as shown in the following image. If the MoTeC Device Discovery icon is shown (as circled below), right-click on it and select **Exit**.



- c) Restart M1 Tune and attempt to establish communications with the ECU.

Note: If turning off or uninstalling your anti-virus or firewall fixes the problem, then your anti-virus or firewall application must be configured to allow the MoTeC ECU to communicate normally.

If you have removed all anti-virus and firewall applications, and there is still no PC communication with the ECU, continue with the following steps.

3. Ensure that the IPV6 communications protocol is installed on the PC (this is only an issue with some Windows XP software).
 - a) Once any communication protocol issues are corrected, restart M1 Tune and attempt to establish communications with the ECU, see [ESTABLISHING ECU COMMUNICATIONS](#).
4. If all the above are addressed and there is still no communication, contact MoTeC support – <http://www.motec.com.au/support/technicalsupportAU/>

5 STARTING M1 TUNE

Important: If, during start-up, you are prompted to allow the M1 software to make changes to your PC, **always allow**; otherwise PC communications will not work.

When the software is started, the **Quick Launch** window will fly out from the left hand side.

From **Quick Launch** you can connect to an ECU, or open a Package offline. The **Quick Launch** images below provide examples “with” and “without” ECUs available for connection.

<p>This example indicates that there are available online ECUs for connection, as well as a number of recent Packages that are available to be opened offline.</p>	<p>This example indicates that there are no ECUs that M1 Tune is able to connect to, but there are a number of recent Package that are available to be opened offline.</p>
<p>The screenshot shows the 'Quick Launch' window with the 'Getting Started' dropdown menu. Under 'Open an ECU', there are four ECU icons with labels: 'M170 #6 Joe's ECU', 'M190 #23 M1', 'M130 #183 Seadoo base ECU', and 'M130 #236 Operations Test ECU'. Under 'Open a recent Package', there are four package cards: 'test' (Sea-Doo RXT-X 2010 Standard [1.00.0031, 201203]), 'Testing' (Sea-Doo RXT-X 2010 Standard [1.00.0031, 201203]), 'Bench' (RB Engine Basic [1.00.0006, Input Modules]), and 'testi' (Seadoo RXT-X 2010 Standard [1.00.0030, Testing]). At the bottom, there is a 'Useful Links' section with four buttons: 'Retrieve Logged Data from an ECU', 'Browse ECU's', 'Browse Packages', and 'Find out more about M1 Tune'.</p>	<p>The screenshot shows the 'Quick Launch' window with the 'Getting Started' dropdown menu. Under 'Open an ECU', there is a red message: 'No Devices are available. Please connect your ECU and power it on'. Under 'Open a recent Package', there are four package cards: 'test' (Sea-Doo RXT-X 2010 Standard [1.00.0031, 201203]), 'Testing' (Sea-Doo RXT-X 2010 Standard [1.00.0031, 201203]), 'Bench' (RB Engine Basic [1.00.0006, Input Modules]), and 'testi' (Seadoo RXT-X 2010 Standard [1.00.0030, Testing]). At the bottom, there is a 'Useful Links' section with four buttons: 'Retrieve Logged Data from an ECU', 'Browse ECU's', 'Browse Packages', and 'Find out more about M1 Tune'.</p>

Other options available from Quick Launch provide the ability to retrieve logged data (an M1 ECU needs to be connected for this option to work), browse available ECUs, browse offline Packages, or help on M1 Tune.

6 OVERVIEW OF PACKAGES AND LAYOUTS

Within the M1 environment, a Package is the name used to describe the complete set of data for an application.

Layouts refer to how data is laid and displayed in the M1 Tune graphical user interface.

Note: An M1 ECU can contain only one Package.

If a new Package is sent to the ECU, it completely replaces all content that might have been part of a previous Package.

A Package on an ECU connected to M1 Tune can be worked on directly (online). Packages stored on the PC are known as Offline Packages.

6.1 PACKAGE CONTENTS

A Package contains the following:

- System Firmware
- Tune Data (similar to an M800 Configuration)
- Security information
- A layout, that is, a Workspace containing base Workbooks and Worksheets, see [LAYOUTS](#). Each M1 Tune Package contains three objects that are used for controlling the behaviour of the ECU; they are Channels, Parameters and Tables.

Object	Package Segment	Definition
Channels	Firmware	A Channel is a system variable which is updated in the ECU firmware upon execution. Channels cannot be modified by the user. An example of a channel is a sensor value, such as throttle position.
Parameters	Firmware (for definition) Tune Data (for value)	A defined value which may be altered by the user in M1 Tune. These are the values that the end user modifies to setup things such as re/sync mode, gear ratios, RPM limit Etc.
Tables	Firmware (for definition) Tune Data (for value)	Tables are a basic component of many control strategies such as fuel and ignition delivery, and gearbox control. The table is made up of a number of pre-configured axis types. From within M1 Tune these axes can be turned on and off, the axis sites changed, and the contents of tables modified. This is one of the main ways to configure the M1 ECU. The number of axes and the number of set points are defined in build, as are the input components and output units.

6.2 LAYOUTS

A Package layout consists of:

- A Workspace
- Workbook(s)
- Worksheets
- Worksheet components

Using a book analogy a Workspace is the library, Workbooks are the book and Worksheets are pages in the book. Worksheet components are the contents of a page.

6.2.1 Workspace

A Workspace is the name given to the entire collection of an M1 Tune layout, and is simply a file that contains the layout elements defined for a particular Workspace.

Note: A Package can contain only one Workspace, see [Default Package Layout](#). The Workspace (layout) provided as part of the Package cannot be changed. However, the data in the Package does not have to be displayed within the provided Workspace. Any number of Workspaces can be created in M1 Tune and saved to the PC. The Package data can be displayed in any Workspace selected by the user.

User created Workspaces are populated with user configured and customised Workbooks, Worksheets and Worksheet components such as graphs, gauges, channel reports and alike. Commonly, this customisation is made to suit a particular application.

Workspaces can be created, modified, exported and emailed from **File »Workspaces**

Example of the need for a different Workspace

A Package was created to work as a gearbox controller only, and not an engine management system. In this instance the Workspace containing the Workbooks, Worksheets and settings would only show the items to suit monitoring, setting up and calibrating a gearbox.

When that same PC was used with the M1 ECU as an engine management system, the workbook layout, the worksheets, gauges and settings would need to be completely different. By creating a different Workspace, work on each of these two applications is easier.

6.2.2 Workbooks

Once a user created Workspace is available, it is possible to create new Workbooks. Workbooks can be used to separate different functions. An example of this would be to create a book called "Fuel", one called "Ignition", one called "Dyno tuning" and another called "Traction Control". Any number of these Workbooks can be created.

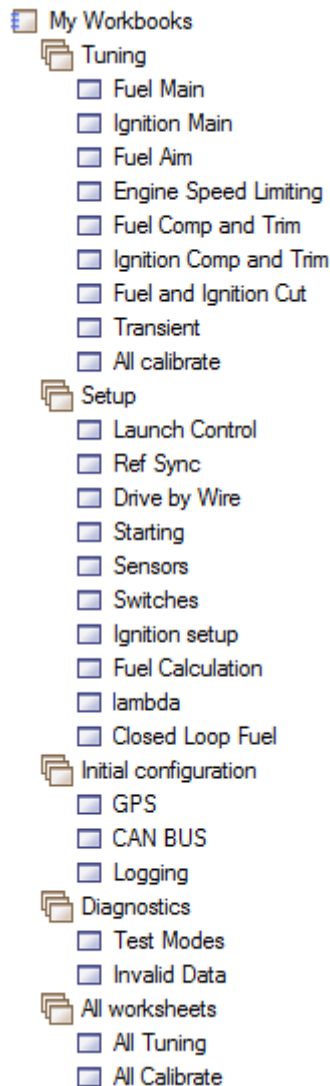
Note: Keeping functional areas separate is the recommended method for using M1 Tune. This allows easy identification of a functional area when work in that area of the Package is needed.

6.2.3 Worksheets

A Worksheet can be considered as a page of the Workbook. To realise the benefits of this relationship, all Worksheets should be tightly related to the name of the Workbook.

For example, a Workbook called Fuel could have Worksheets related to fuel injector setup, fuel pump control, fuel used calibration, fuel transient setup, fuel tuning, fuel pressure control, Etc. In an ignition Workbook, appropriate Worksheets could relate to dwell, ignition timing, ignition compensations, ignition cut, individual cylinder ignition compensations, Etc.

Example of Workbooks and Worksheets laid out in a structured fashion



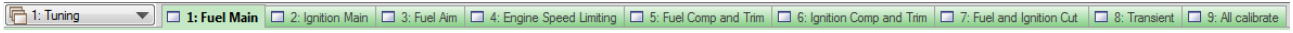
6.2.4 Default Package Layout

A default layout is specifically designed to make using the Package as easy as possible.

When a Package is created, the developer of the Package has the option to create a default layout. Once the layout is created, the whole Package can be saved so that this default layout is immediately available in M1 Tune.

Default layouts are distinguished from user created and customised layouts by the green Worksheet tabs and window surround.

Example of default layouts



These default Worksheets are fixed in their layout and location and cannot be modified by the end user.

In M1 Tune, the user can use the default layout provided with the Package or configure their own layouts.

7 OPENING OFFLINE PACKAGES

The **Open Package** window provides information and access to package details, filtering and history. Packages saved on the PC can be opened as follows:

1. Select **File »Open Package**, or select **Browse Pages** from the **Quick Launch** fly-out.

► *The Open Package window displays.*

Example Open Package window

The screenshot shows the 'Open Package' window with the following components:

- Quick Filter:** A sidebar on the left with filters for 'Imported Date/Time', 'Firmware', 'Recently Imported', 'Recently Modified', 'By Firmware', 'By Hardware', 'By ECU', and 'By Vehicle ID'. The 'Imported Date/Time' filter is active, showing a list of packages from 1/05/2012 to 2/04/2012.
- Main Table:** A table with columns: State, Vehicle ID, Serial #, Comment, and Firmware. The table contains multiple rows of package data, including 'test', 'Sonata', 'Bench', 'Daytona', and 'Carxxx'.
- Summary Panel:** A panel on the right displaying details for the selected package: 'Sea-Doo RXT-X 2010 Standard'. Fields include Firmware Version Name (201203), Firmware Version (01.00.0031), Product (M130), System Version (01.03.12.0001), Licence (MoTeC bench test.AU operations), Author (MoTeC Application Engineering), Company (MoTeC), Contact No (+61 3 9761 5050), Address (121 Merrindale Drive, Croydon South, Victoria 3136, Australia), Email (support@motec.com.au), Support (http://www.motec.com), Copyright (MoTeC), Build Version (1.3.0.49), Built (19/04/2012 1:28:46 PM), Comment (Simmo Migration to 1.00.0031), and Vehicled (Testing).
- State Key:** A legend at the bottom left showing color-coded boxes for Unknown (yellow), Auto Saved (light blue), Tuned (blue), Matched ECU (green), Migrated (orange), Merged (purple), and Partial Merge (red).
- Buttons:** 'Open', 'Cancel', and 'Help' buttons are located at the bottom right.

2. Identify and select the required Package using the Package details, filtering and history information available from this window.

3. Select the **Open** button.

► *The selected Package opens.*

7.1 ABOUT PACKAGE DETAILS

The **Open Package** window displays a list of offline Packages. The details about each of the offline Packages is shown, these are defined in the following table. Also see, [ABOUT THE PACKAGE FILTERING OPTIONS](#) and [ABOUT THE PACKAGE HISTORY](#).

Details	Definition
State	Icons indicating ...
Vehicle ID	A unique identifier of the vehicle in which the package is used. The vehicle ID is a useful way to find Package(s) for a particular vehicle.
Serial #	The serial number field records the ECU number with which the package is associated. Whenever a package is sent to an ECU, M1 Tune will attempt to send it to the matching ECU. If the package is to go into a different ECU, then the serial number must be changed to the serial number of the receiving ECU.
Comment	Comments are used to keep track of changes to the Package over time. This is the recommended method to use for recording the sequence of changes made to a Package. This field assists in selecting the correct Package.
Firmware	The firmware property is the name of the firmware group.
Firmware Version Name	Used to describe the specific version of the firmware.
Firmware Version	An incrementing number that uniquely represents each unique build of the package.
Hardware	This field identifies for which M1 ECU model the package was built. Each M1 Package is built to work with a particular M1 model. A package built for an M170 will have a different pin allocation to a package for an M190.
Modified Date/Time	This field records the last time that this particular package was modified.
Imported Date/Time	This field records the date and time that the package was imported onto the PC.

7.2 ABOUT THE PACKAGE FILTERING OPTIONS

The filtering options provided down the left hand side of the **Open Package** window can be very useful in helping to find specific Packages.

Note: When working on a Package, update the Vehicle ID and the Description as you go so that the most benefit can be realised when the filtering feature is later used. This is important to make it easy to find and sort Package versions.

The result of using each of the filtering options is defined in the following table.

Filter option	Result
All	Shows all packages on the PC (no filtering)
Recently imported	Lists all packages grouped by imported date, sorted by the most recently imported into Tune
Recently Modified	Lists all packages grouped by Modified date, sorted by the most recently modified from within Tune
By Firmware	Shows all packages grouped by firmware name, then sorted alphabetically
By Hardware	Shows all packages, grouped by the M1 hardware model, then sorted alphabetically
By ECU	Shows all packages grouped by ECU type and ECU number, then sorted alphabetically
By Vehicle Id	Shows all packages grouped by the Package vehicle ID, then sorted alphabetically

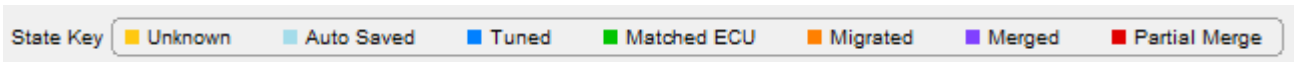
7.3 ABOUT THE PACKAGE HISTORY

The Open Package window shows the history of each Package. This history is displayed using a graphical State tree.

This State tree uses coloured boxes to denote the state of a Package, and connecting lines to indicate the lineage of the Package.

Using these lines it is possible to determine from where a particular version of a Package originated.

Displayed along the bottom of the Open Package window are the seven possible states.



The Package states as indicated by the coloured keys are defined as follows.

State	Definition	Example State Tree
Light Orange - Unknown	M1 Tune cannot determine the source of this Package.	
Cyan - Auto Saved	A modified Package that was never saved by the user, M1 Tune auto saves Packages every minute.	
Blue - Tuned	A Package that has been changed offline but not sent to an ECU.	
Green - Matched ECU	A Package that matches exactly to a tune that has been seen in an ECU.	
Dark Orange - Migrated	A Package that has been changed based on another Package.	
Purple - Merged	This scenario occurs when there are multiple people working on a single ECU. If two people are working in different parts of the Package, but sending to the same ECU, it means that changes have been applied "on top of" (or merged) into a package that was different to the original package (since one user updates the ECU sometime between the other user opening the Package and sending changes).	
Red - Partial Merge	In some cases a full merge cannot fully succeed since two users changed the same part of the package (causing a conflict that cannot be automatically resolved); but some of the data was merged.	

8 COPYING, MOVING AND DELETING PACKAGES

Moving M1 Package files via Windows Explorer is not recommended.

MoTeC M1 Packages are not intended to be copied, added, deleted or moved by use of the standard Windows file system. It is recommended that when moving Package files the Import, Export and Export Mail functions are used, these are available from the **Open Package** window, see [OPENING OFFLINE PACKAGES](#).

Use the Import and Export functions when a package needs to be moved from one PC to another.

8.1 ARCHIVE FILES

MoTeC has implemented a new method of adding and moving files within the M1 system. The new file type is called an **M1 Archive file**. Its purpose is to remove the need for users to manually find their way around the file system when moving or adding files.

The **M1 Archive** may contain multiple files and complete directory structures, it is similar to a self extracting ZIP file. The locations are automatically determined when the file is extracted, requiring no input from the user.

The archives used within M1 Tune are described in this table.

Archive file extension	Purpose
.m1pkg-archive	Files required to add a new package to M1
.m1prj-archive	All files required for an entire M1 project
.m1lic-archive	M1 licence file
.m1wsp-archive	Files required to install a new workspace configuration in M1 Tune

8.2 EXPORTING PACKAGES

To export packages:

1. Open the **Open Package** window from the **Quick Launch** fly out, or the menu option **File »Open Package**.
2. Using filters and searches as necessary, find and select the Package to copy.
3. Select the **Export File** button to export the archive to a USB stick or drive, or the **Export Mail** button to attach the archive to an email.

► *The file created has an extension of **.m1pkg-archive**. The filename is a combination of the Firmware, Hardware, Vehicle ID fields.*

4. Distribute the Package archive file as required.

8.3 IMPORTING PACKAGES

Once a Package archive is received, there are two options for installing (importing) the package; using the Import function as described below, or by double-clicking on the archive filename.

Both methods result in the package being unpacked and files added to the correct locations so that the Package becomes available in the **Open Package** window.

1. Open the **Open Package** window from the **Quick Launch** fly out, or by selecting menu option **File »Open Package**.
2. Select the **Import File** button.
3. Browse to the location of the archive file, select it and click **Open**.

8.4 DELETING PACKAGES

To delete Packages:

1. Open the **Open Package** window from the **Quick Launch** fly out, or by selecting menu option **File »Open Package**.
2. Select the Package to delete (Multiple Packages may also be selected) and right click on the selection.
► The right-click menu displays.
3. From the right-click menu, select **Delete**.

9 CREATING WORKBOOKS

To create Workbooks:

1. Select menu option **Layout »New Workbook**.
 - ▶ *A prompt to enter a Workbook name displays.*
2. Name the new Workbook.
 - ▶ *A new empty Workbook is created.*
3. Add Worksheets and components as required.

10 WORKSHEET COMPONENTS

A new Worksheet is created blank. The user can then populate the Worksheet with a variety of components that can be placed anywhere on the Worksheet to create a customised layout that suits the application. The components themselves can be moved, resized, and customised so that they are appropriate to the worksheet.

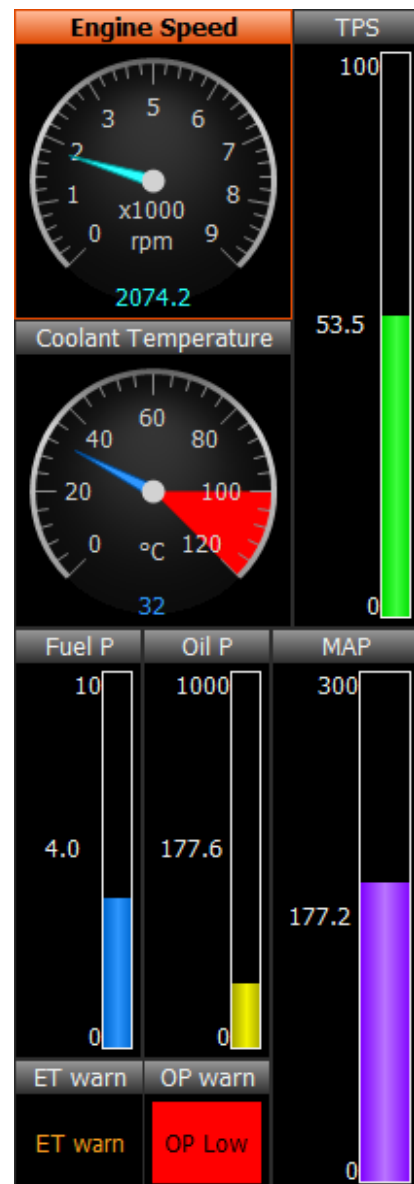
Every component has a unique set of properties specific to that component type. These properties determine how the component looks and behaves. The property values are set within M1 Tune for tuning of the M1 ECU.

Note: The same component type can be used on multiple Worksheets. However, the property values are specific to that one component instance; they are not shared with other instances of that component type in other places.

The component types that are available include:

- Calibrate
- Table Target
- Channel List
- Time Graph
- Scatter Plot
- Histogram
- Colour Graph
- Notes
- Gauges

Examples of gauge type components.



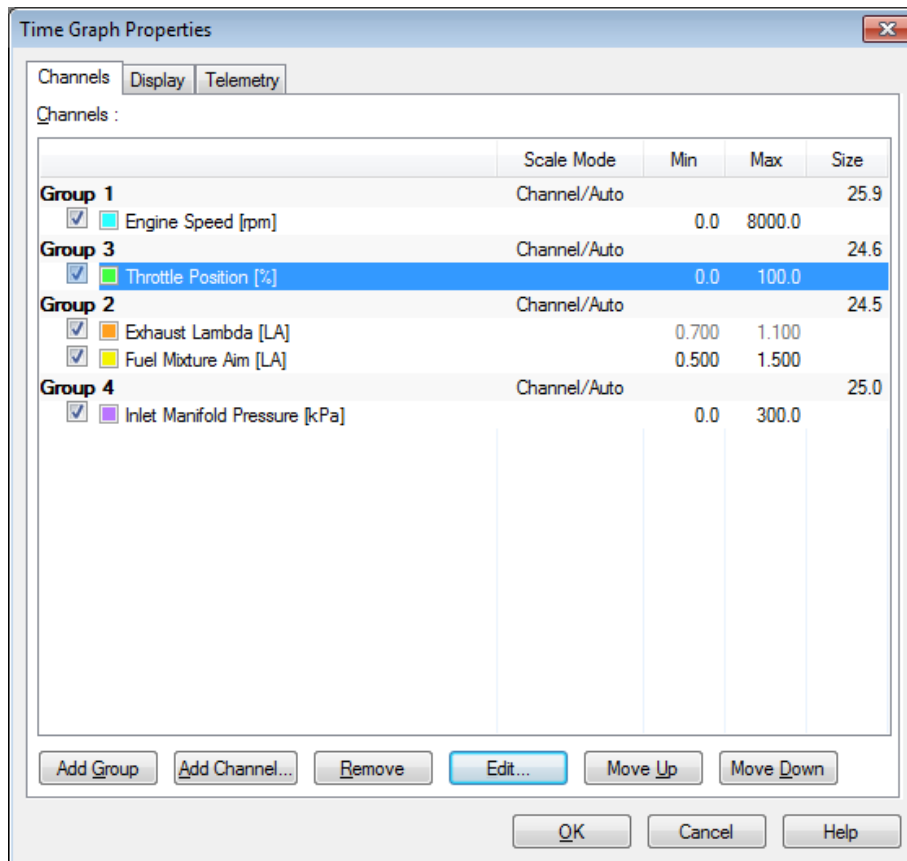
10.1 ACCESSING COMPONENT PROPERTIES

To access the properties of individual components:

1. Highlight the component, and press **F5**, or right-click on a component and select **Properties...** from the menu list.

► *The relevant properties window displays.*

Example of the properties window for a Time Graph component



10.2 CALIBRATE COMPONENT

For those intending to make changes to their Package, the calibrate component is the most important component in M1 Tune, it is an all in one place to view and modify tables and parameters. If you want to see the value of any item in M1 Tune, it can be found in the Calibrate component.

Calibrate also allows quick functions for lambda tuning and sensor calibration readings.

It consists of two main parts:

- The Calibrate list, which displays the value of channels. See [Calibrate List](#)
- Calibrate table and/or graph. When tuning a vehicle, the calibrate table and graph are generally the most important components used. To make the best use of the available screen space, the graph and table can be cycled between three views:
 - Table and graph
 - Table only
 - Graph only

See [Changing Calibrate Display Options](#).

It is also possible to zoom in so that the Calibrate component uses the whole screen area.

See [Calibrate Component Properties](#) or information on configuring what is displayed in the Calibrate component.

Example Calibrate window



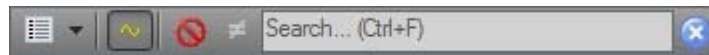
10.2.1 Calibrate List

The Calibrate list contains channels and their values and is displayed on the left-hand side of the Calibrate component.





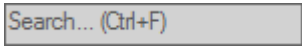
Note: What channels are displayed in this list is governed by the list type selected in the Calibrate properties. See [Calibrate Component Properties](#).

How the list displays information can be adjusted using the Calibrate list toolbar (located at the top of the list) as defined below.

Calibrate List Toolbar



Each option in the toolbar operates as described below.

	Select in what manner the list is displayed - a flat list, compact tree or full tree. The full tree mode is very useful as it reduces the visible list to a more manageable size by grouping the contents, this grouping relationship is as the items were organised by the application developer in M1 Build.
	Toggles the channel values on and off. When on, the list includes the current live values of any channel that match the current Calibrate list type.
	Limits the list to show only items that are currently invalid. Invalid items are tables or channels that contain values that do not meet their validation criteria. These items should normally be corrected before running an engine.
	When you are in comparison mode (comparing one Package with another), the Calibrate List indicates what is the same and what is different between the two Packages, and by how much. Selecting this option limits the list to only show items that are different.
	Search input area that will search through the current list for any items that match both the current Calibrate list type, and the search value.

10.2.2 Calibrate Component Properties

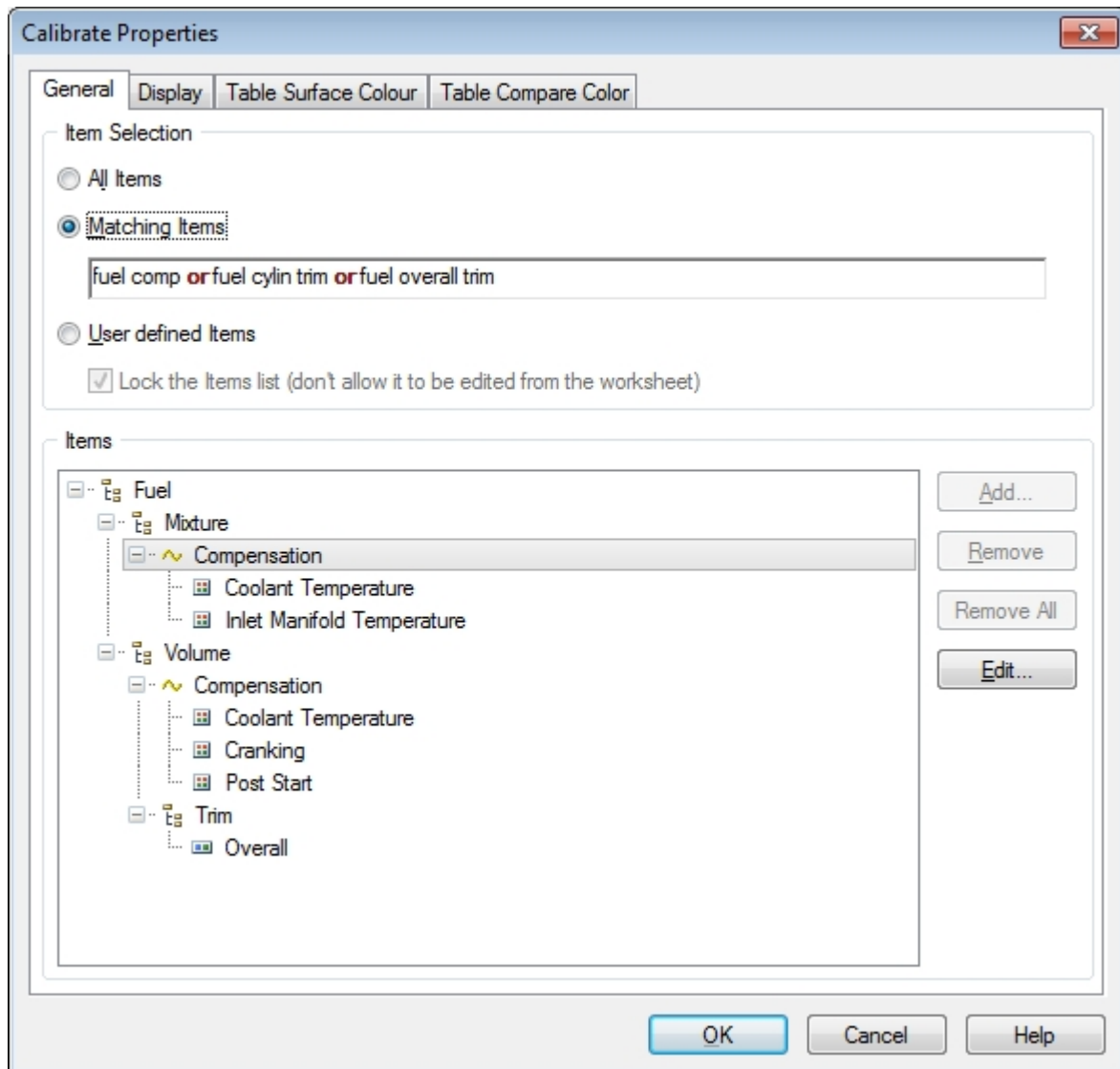
The Calibrate (component) Properties is used to configure the contents of the Calibrate component.

The Item Selection in the Calibrate Properties window functions as follows.

Item Selection - All Items	Show all items (everything in the entire M1 Package)
Item Selection - Matching Items	Limits the items in the Calibrate list by matching a specified keyword. For example, limiting items displayed by the keyword "Fuel" focuses the list on the application and makes the component easier to use.
Item Selection - User defined Items	Limits the items in the Calibrate list by displaying only user defined items in the list.

The colours, ranges and other display settings can also be configured.

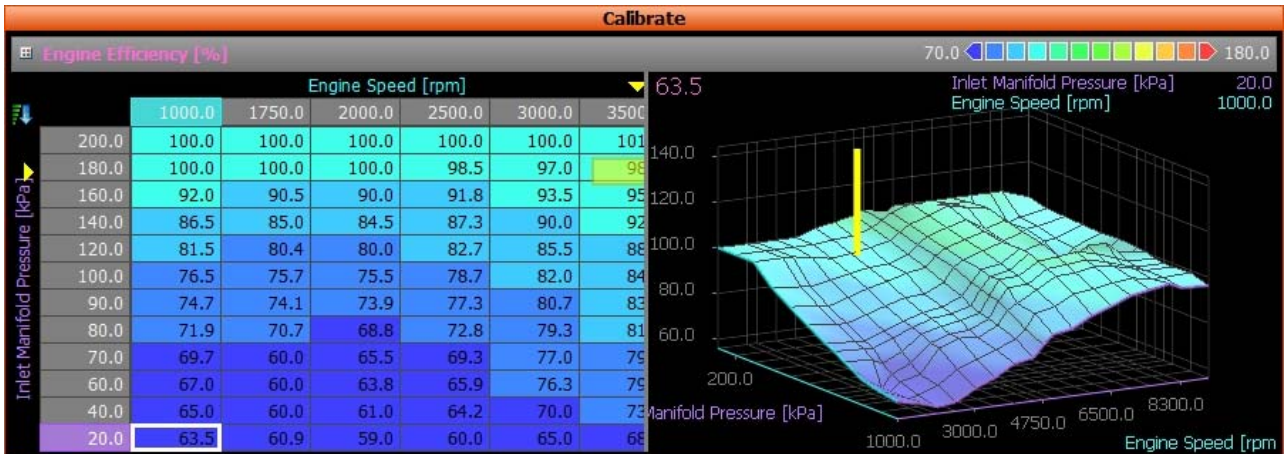
Example Calibrate Properties window

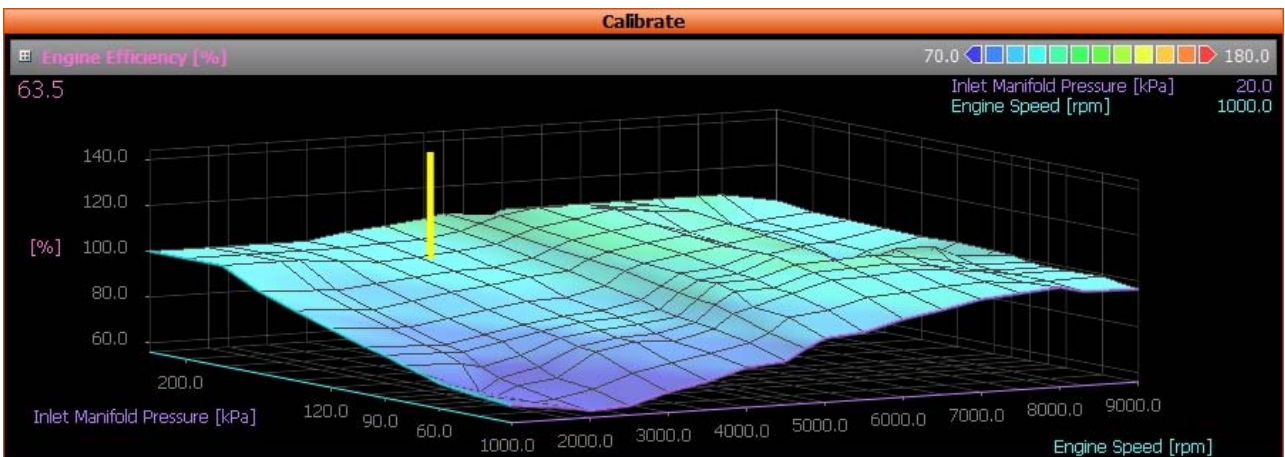


10.2.3 Changing Calibrate Display Options

To cycle between views and to zoom.

1. Select the Calibrate component.
2. Press **G** to cycle through the three views.
3. To zoom into the current view press **F6**.
 - ▶ *The Calibrate component occupies the whole screen.*
4. To leave zoom mode press **F6** again, or move to another Worksheet.

Example Table and Graph

Example Table Only

Example Graph Only


10.2.4 About Calibrate Tables

The calibrate table is the most important part of the M1 Tune application.

There are three fundamental aspects of tables:

- Table axes
- Table interpolation
- Table values - entering, importing and exporting.

10.2.5 Table Axis

Each table in the Calibrate component can have up to three axes. These Axis channels are pre-configured when the Package is built and cannot be changed.

It is possible to:

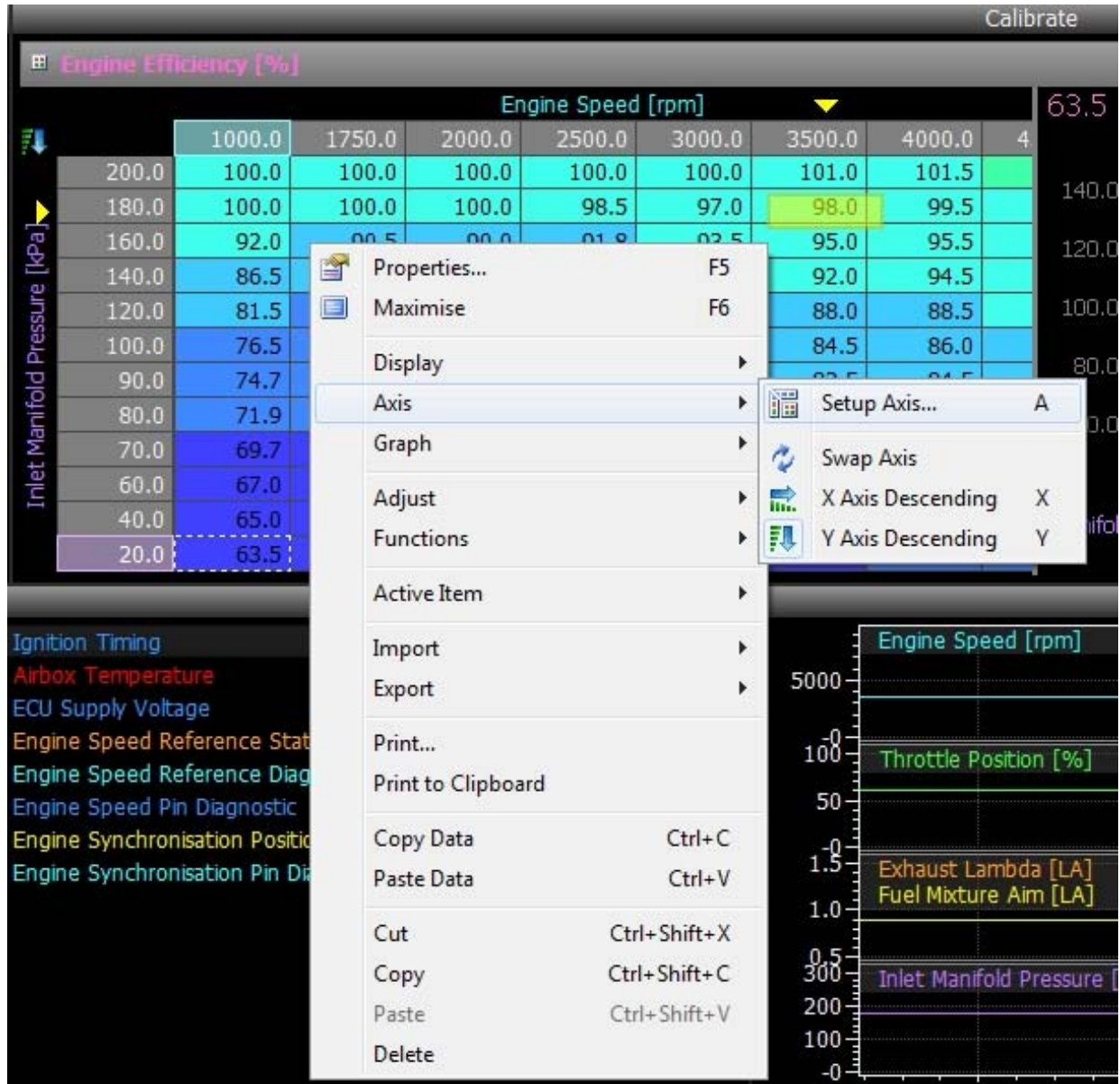
- Add, remove and adjust sites and values
- Turn on any, all or none of the axes
- Swap axes
- Reverse the sort order.

10.2.5.1 Table Axis Display Options

To adjust how axes are displayed.

1. Right click on the table and from the right click menu select **Axis**.

► *The axis options display.*



2. Select the relevant option.

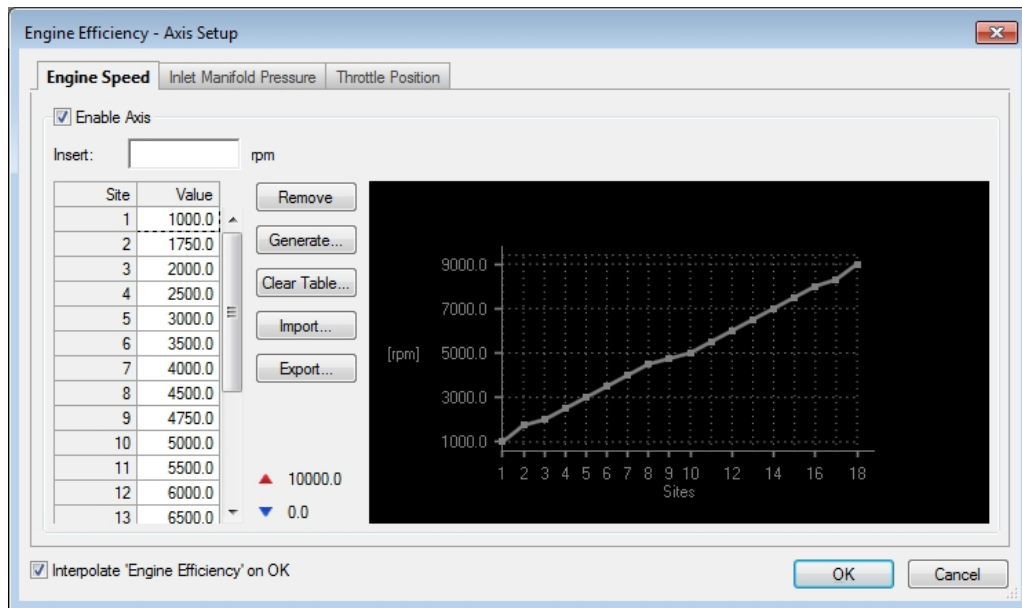
10.2.5.2 Table Axis Setup

To adjust axis sites and values.

1. Highlight the table and press **A**, or right click on the table and select **Axis »Setup Axis**.

► *The Axis Setup window displays.*

Example Axis Setup window



10.3 Table Interpolation

The M1 Tune Calibrate component has enhanced interpolation functionality to make building and smoothing tables easier.

Note: Sites marked as tuned are not modified by the interpolate function. See [Marking Sites as Tuned](#).

Interpolate (bi-linear)	Takes the corner values from the selected area and interpolates across then down from there. This is followed by a horizontal interpolate across each row in the block.
Interpolate Vertically	Takes the top and bottom values and evenly distributes the values in the middle.
Interpolate Horizontally	Takes the left and right values and evenly distributes the values in the middle.
Smooth	When a single row is selected, the smooth function performs the smooth from the values left and right of each point. A block smooth will take each value in the block and perform a weighted smooth from each surrounding sites. More weight is given to the vertical and horizontal values, less to the corners.

See [Applying Interpolation](#).

10.3.1 Applying Interpolation

To apply interpolation:

1. Select the required area (sites).
2. Right-click on the selection.
 - ▶ *The Right Click menu displays.*
3. Select **Adjust »[required option]**

The screenshot shows the 'Calibrate' window in MoTeC software. The main data table is for 'Inlet Manifold Pressure [kPa]' versus 'Engine Speed [rpm]'. The table has columns for 1000.0, 1750.0, 2000.0, 2500.0, 3000.0, 3500.0, 4000.0, 4500.0, 4750.0, 5000.0, 5500.0, 6000.0, and 6500.0 rpm. The rows represent pressure values from 220.0 to 40.0 kPa. A context menu is open over the table, and the 'Interpolate' option is selected. The menu also shows options for 'Adjust', 'Functions', 'Active Item', 'Import', 'Export', 'Print...', 'Print to Clipboard', 'Copy Data', 'Paste Data', 'Cut', 'Copy', 'Paste', 'Delete', 'Interpolate Vertically', 'Interpolate Horizontally', and 'Smooth'.

Engine Speed [rpm]	1000.0	1750.0	2000.0	2500.0	3000.0	3500.0	4000.0	4500.0	4750.0	5000.0	5500.0	6000.0	6500.0
220.0	100.0	100.0	100.0	100.0					108.2	100.0	108.3	108.3	108.3
200.0	100.0	100.0	100.0	100.0					106.8	109.7	112.2	110.6	110.6
180.0	100.0	100.0	100.0	100.0	98.5				104.6	107.4	110.2	113.5	111.1
160.0	92.0	90.5	90.0	91.8					102.2	105.2	108.0	110.3	105.5
140.0	86.5	85.0	84.5	87.3					100.5	103.2	105.9	108.3	103.3
120.0	81.5	80.4	80.0	82.7					98.5	101.2	104.1	106.7	101.1
100.0	76.5	75.7	75.5	78.7									
90.0	74.7	74.1	73.9	77.3									
80.0	71.9	70.7	68.8	72.8									
70.0	69.7	60.0	65.5	69.3									
60.0	67.0	60.0	63.8	65.9									
40.0	65.0	60.0	61.0	64.2									

10.4 Marking Sites as Tuned

It is possible to mark a site or range as 'Tuned'. As the value is considered tuned, any interpolate function will not modify these values.

1. Select the table values.
2. Press **Backspace**.

► The sites are marked with a red square and the values are considered to be tuned.

Calibrate														
Engine Efficiency [%]														
70.0 ◀ ◀ ◀ ◀ ◀ ▶ 120.0														
Engine Speed [rpm]														
	1000.0	1750.0	2000.0	2500.0	3000.0	3500.0	4000.0	4500.0	4750.0	5000.0	5500.0	6000.0	6500.0	
Inlet Manifold Pressure [kPa]	220.0	100.0	100.0	100.0	100.0	100.0	103.0	104.5	106.5	108.2	100.0	108.3	108.3	108
200.0	100.0	100.0	100.0	100.0	100.0	101.0	101.5	104.0	106.8	109.7	112.2	110.6	110.6	110
180.0	100.0	100.0	100.0	98.5	97.0	98.0	99.5	101.5	104.6	107.4	110.2	113.5	111	111
160.0	92.0	90.5	90.0	91.8	93.5	95.0	95.5	98.5	102.2	105.2	108.0	110.3	105	105
140.0	86.5	85.0	84.5	87.3	90.0	92.0	94.5	96.0	100.5	103.2	105.9	108.3	103	103
120.0	81.5	80.4	80.0	82.7	85.5	88.0	88.5	92.5	98.5	101.2	104.1	106.7	101	101
100.0	76.5	75.7	75.5	78.7	82.0	84.5	86.0	89.5	95.0	100.0	101.5	107.0	100	100
90.0	74.7	74.1	73.9	77.3	80.7	83.5	84.5	86.8	93.6	98.5	100.2	106.5	98	98
80.0	71.9	70.7	68.8	72.8	79.3	81.6	83.0	85.3	92.2	98.9	99.3	104.5	105	105
70.0	69.7	60.0	65.5	69.3	77.0	79.8	80.5	84.2	91.5	96.7	97.1	102.8	103	103
60.0	67.0	60.0	63.8	65.9	76.3	79.6	78.6	83.0	89.0	91.4	96.2	101.0	101	101
40.0	65.0	60.0	61.0	64.2	70.0	73.5	76.5	80.0	83.8	90.0	92.0	96.5	97	97

See [Unmarking Sites as Tuned](#).

10.5 Unmarking Sites as Tuned

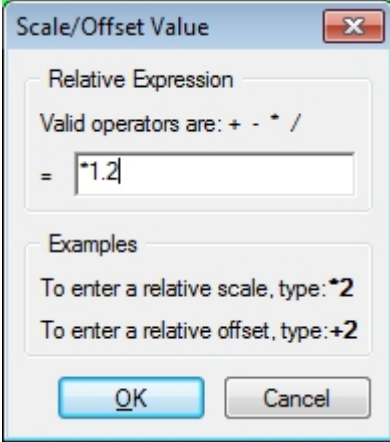
To unmark sites as tuned:

1. Select the site(s).
2. Press **Delete**.

► The sites are unmarked and the red square is removed. The value(s) are considered to be untuned.

10.6 Entering Table Values

When a table is selected, there are a few options on how to enter values.

Direct entry	<ol style="list-style-type: none"> 1. Select the site. 2. Type in the number and press Enter. <i>Press Escape to cancel the entry.</i>
Increment / Decrement the table value	<ol style="list-style-type: none"> 1. Select the site or region. 2. Press Page Up to increase the values in the selection in medium steps, or Press Page Down to decrease the values.
Increment / Decrement the table value fast	As for Increment / Decrement the table value. However, use CTRL Page Up to change values in larger steps.
Increment / Decrement the table value Slow	As for Increment / Decrement the table value. However, use CTRL Page Up to change values in smaller steps.
Scale or Offset	<ol style="list-style-type: none"> 1. Select the site or region. 2. Press = to display a maths expression window. 3. Enter an expression to perform on the selection. For example: 

10.7 Importing and Exporting Tables

When using the M1 Tune application, there can be a large number of items to fill in a table. To make this task faster, and more accurate, it is possible to export and import values into M1 tables; there are a number of methods available.

Each method is selectable from the **Component** menu or from the **Right Click** menu.

<p>Export »Entire Table »To File...</p> <p>OR</p> <p>Import »Entire Table »From File...</p>	<p>Export or import the complete table, its axes and axis values. These tables are in a format that cannot be edited outside of the M1.</p> <p>Note: This is the only way to copy a 3 axis table in one step, and is the preferred method for copying a table from one Package to another.</p>
<p>Export »Current View »To CSV File...</p> <p>OR</p> <p>Export »Current View »To Clipboard</p>	<p>Exports only the current 2 viewable layers (axes) of a 3 axis table, or the entire table for 2 and 1 axis tables. This data can be exported to clipboard for a fast copy, or to a CSV file if it is to be sent or edited outside of M1 Tune.</p>
<p>Import »Current View »From CSV File...</p> <p>OR</p> <p>Import »Current View »From Clipboard</p>	<p>Imports table layers (axes) exported using the export current view function.</p>

See [Copying and Pasting Table Data](#).

10.7.1 Copying and Pasting Table Data

When using the M1 Tune application, there may be a need to copy and paste part of a table's data. These functions are **Copy Data** and **Paste Data**.

Note: This is the only method available for copying and pasting selections of table data. The Cut, Copy and Paste functions will not operate for table data, they are designed to only act at the component level. For example: even if part of a table is selected and Copy chosen, then the whole Calibrate component is copied.

Each function is selectable from the **Component** menu or from the **Right Click** menu.

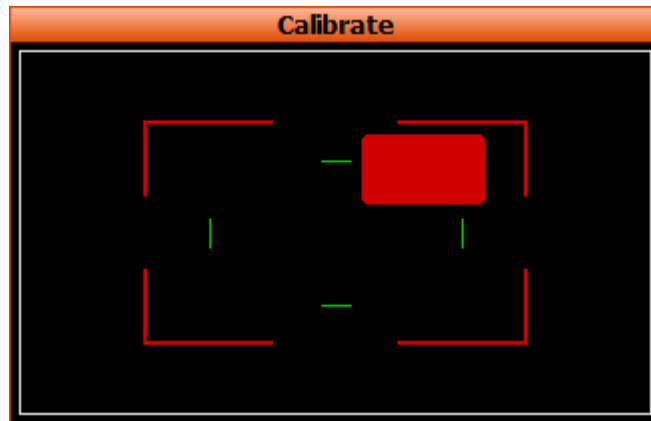
<p>Copy Data</p>	<p>Copies only the selected table values, it does not copy the axes or any other table information.</p>
<p>Paste Data</p>	<p>Pastes the data copied using the Copy Data function.</p>

See [Importing and Exporting Tables](#).

10.8 TABLE TARGET COMPONENT

The Table Target component is commonly used when tuning an engine. The whole component box represents the currently selected table. The floating red square shows where the live channel values sit, compared to the currently selected table site.

Example Table Target



The most common use of the Table Target is when tuning an engine on the dyno. The tuner would select the site that they would like to tune. The engine would then be adjusted in throttle or load so as to position the square in the middle of the Table Target component box. When the square is in the middle of the target, the engine live value is the same as the selected site value.

Once the engine live value and the site match, any changes made to that site value will correspondingly be made to the running engine live value.

10.9 CHANNEL LIST COMPONENT

The Channel List component displays a filtered and sorted list of channels, and their live values.

Example Channel List

Channels	
Ignition Timing	36.8 °BTDC
Airbox Temperature	0.0 °C
ECU Supply Voltage	13.934 V
Engine Speed Reference Status	Cycle Lock
Engine Speed Reference Diagnostic	OK
Engine Speed Pin Diagnostic	OK
Engine Synchronisation Position Diagnostic	OK
Engine Synchronisation Pin Diagnostic	OK

The list can be filtered via the Channels Properties window and the Search bar. If not visible, the Search bar can be set to display on the Display tab of the Channels Properties window.

The Channels Properties window controls the following:

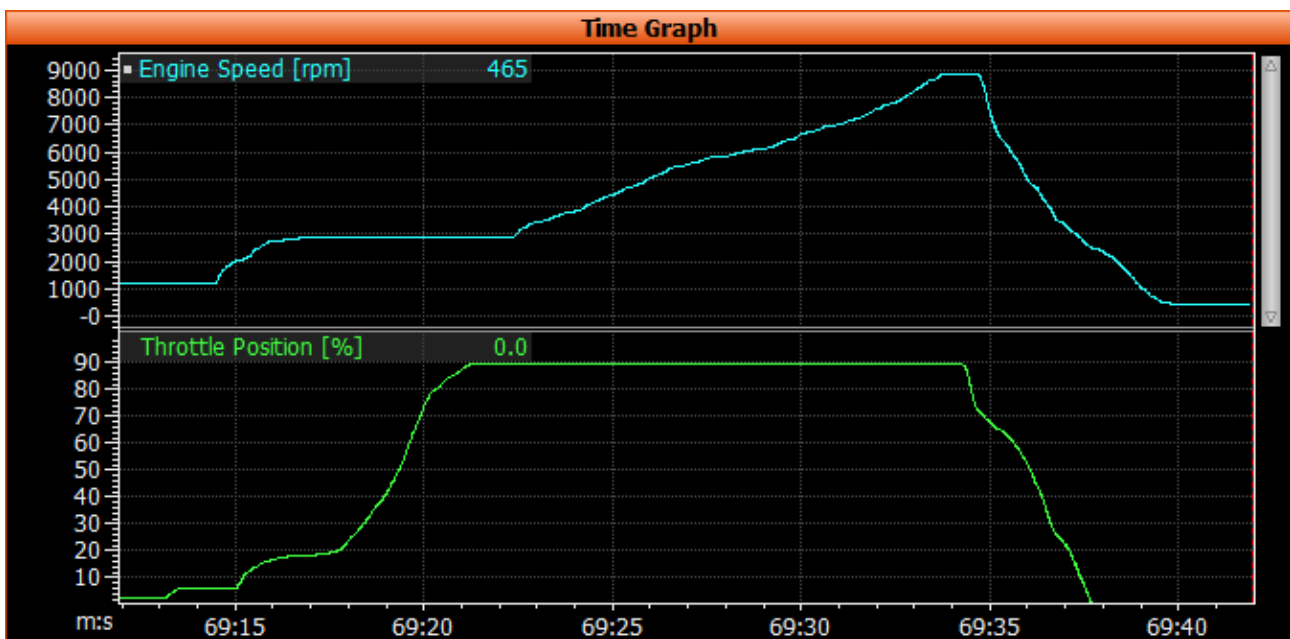
- Which channels to display
- The caption of the component
- Whether the context help is displayed, and if so, to the left or right of the component
- Whether the Search Toolbar is shown or hidden.

Note: Channel lists display the live values, so the values themselves cannot be modified.

10.10 TIME GRAPH COMPONENT

A Time Graph component tracks and displays the live values for the selected channels.

Example Time Graph



The graph uses time as the X axis, and the individual channel range for each channel group on the Y axis.

It is possible to pause and restart the time graph (T), see [LIVE DATA CONTROL](#) for more details.

The Time Graph Properties window controls the following:

- The caption of the component
- Add and remove channel groups and channels to display
- The order of channel groups and channels
- The layout of channels

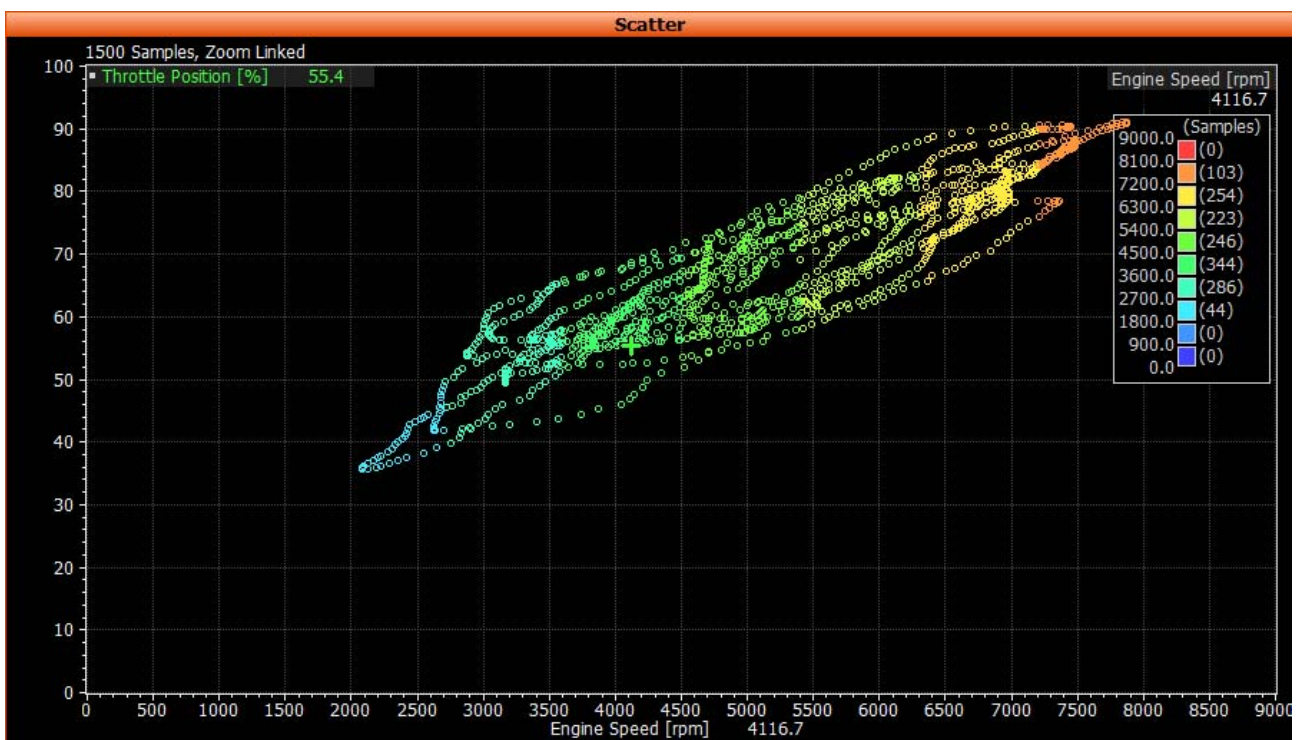
- Various display options such as axis information, ranges and units
- The period of time shown in the graph and other telemetry options

10.11 SCATTER PLOT COMPONENT

The Scatter Plot component is a live updated component that is used to show a trend of two related channels on a plot.

A common use of this sort of chart is to plot the relationship between the boost channel and RPM, or to show how the oil pressure changes with oil temperature.

Example Scatter Plot



The Scatter Plot samples the two selected channels at 50 Hz, and plots the intersection between the two channel values on the chart. Each plotted value will stay displayed on the screen for a configurable length of time.

The Scatter Plot Properties window controls the following:

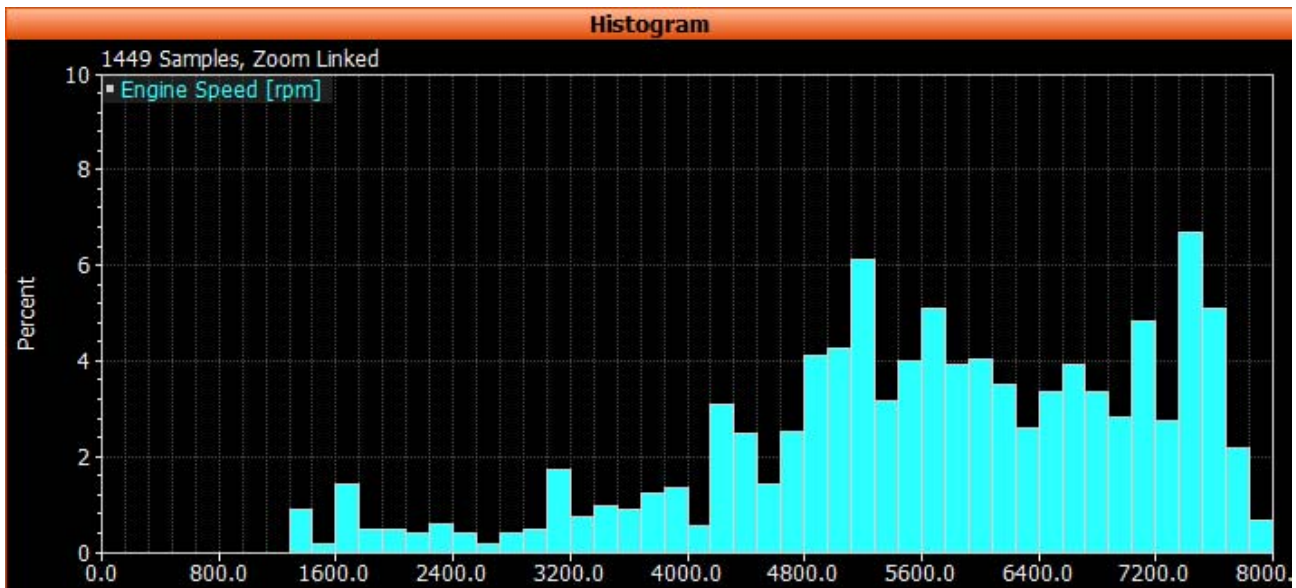
- Channel selection and settings
- Various display options
- The period of time the plot is displayed (via the Telemetry tab).

10.12 HISTOGRAM COMPONENT

The Histogram component provides a graphical representation of the proportion of time that a channel has been within a specific value range. For example, the amount of time that an engine has spent in high boost.

A common histogram shows the amount of time that an engine has spent at particular RPM ranges, as shown in this example histogram.

Example Histogram



The Histogram Properties window controls the following:

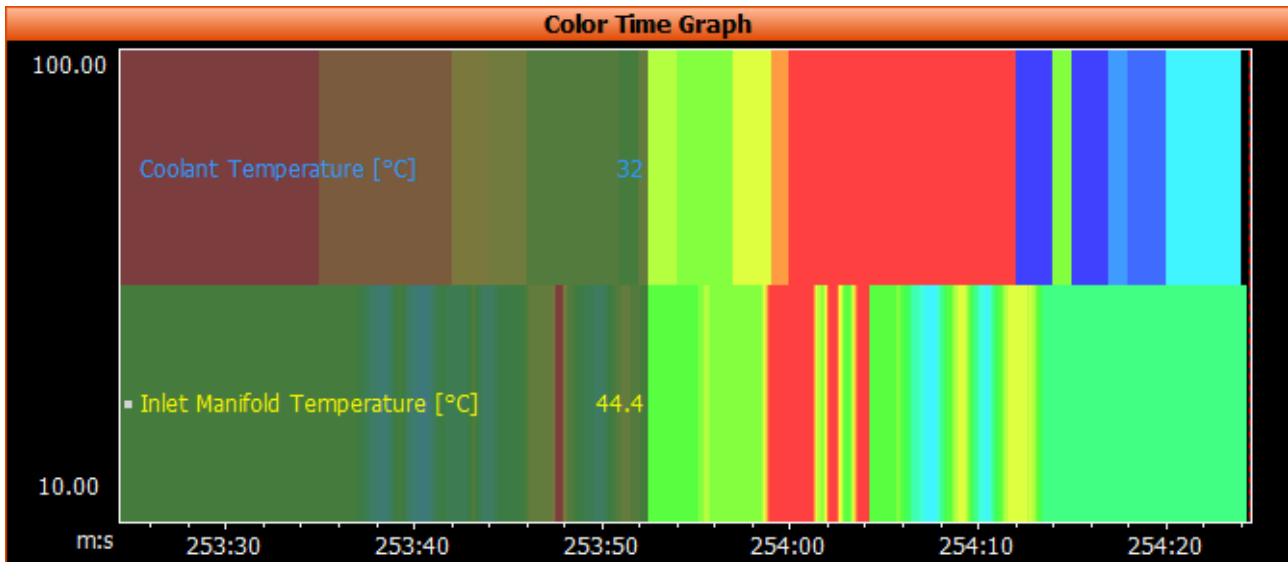
- Channel selection and settings
- Various display options
- The period of time (via the Telemetry tab).

10.13 COLOUR GRAPH COMPONENT

The Colour Graph a component shows a coloured representation of a channel over time.

The example below shows an engine temperature colour graph over time, where the engine starts up cold, warms up, cools down and so on.

Example Colour Graph



This type of graph is useful, such as when comparing multiple exhaust temperatures. If all cylinders are displayed on this graph at once, a visual representation is given showing how each cylinder is climbing in temperature compared with the other cylinders.

The Colour Graph Properties window controls the following:

- Channel selection and settings
- Various display options
- The speed of the time line (via the Telemetry tab).

10.14 NOTES COMPONENT

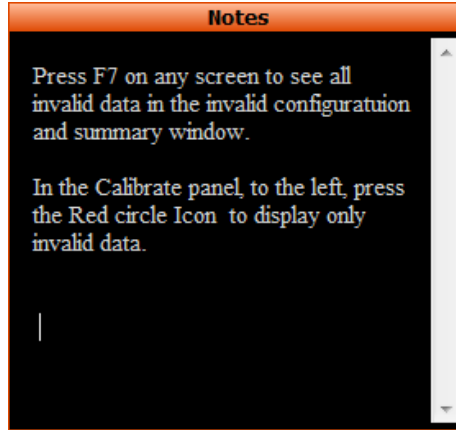
The Notes component is a method that allows either the application developer or the end user to leave informational notes about the Worksheet.

Note: As the same Notes component may be used for multiple Packages, it is important that the Notes component is specific to the Worksheet, not the Package.

When an application developer is creating standardised Worksheets for a Package, this component can be used to provide specific Worksheet information to the end user. As the standardised Worksheets are configured on a per Package basis, the Notes can be tailored to the individual application.

The use of Notes by the end user is also beneficial when creating their own customised Worksheets. The main use of the Notes component is to explain how best to use the Worksheet, and the purpose of each component.

Example Notes



10.15 GAUGES COMPONENT

The Gauges component is provided to display channels in a fast and easy to read manner.

This is extremely important when an engine is on and running. A gauge is often the quickest way to keep an eye on vital engine condition channels.

For example, with one glance it is possible to see engine speed, Inlet air temperature and engine oil pressure.

Gauge types include the following.

Numeric	Bar	Dial	Status Light
A single channel numeric display of a channel value	A vertical or horizontal colored bar graph	A dial type of gauge	Warning light or status light for a particular channel or condition

11 USING M1 TUNE

To make effective use of this application, an understanding about the following elements is essential.

- Using Worksheets
- Configuring channels
- Using live data recording
- Dyno tuning with M1Tune
- Using the "Q" Quick lambda function
- Using the "W" and "L" fuel tuning functions
- Using the "Q" calibrate functions
- Making live data changes to the ECU
- Saving live changes to the ECU
- Viewing live pin values

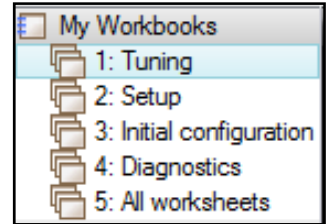
11.1 WHAT TYPE OF WORKSHEET TO USE

The following table provides information about Worksheets and how they should be used.

Supplied Worksheets	When new to M1 Tune, it is worth using the supplied Worksheets. They are configured to show all the main parts of the application, and ensure all required components and channels are configured. These Worksheets also show examples of how you can setup your own.	
Custom Worksheets Worksheets can be customised any way that the user requires, but experience has shown that they are generally configured as a generic or task specific	Generic	A generic Worksheet can contain a single calibrate component. The calibrate list would be set to All, and the search bar displayed. A combination of standard diagnostics gauges such as engine temperature, oil pressure Etc. should also be added. The Search toolbar would be used to find required items (channels). For example, search on "Fuel" will list all like items.
	Task specific	M1 Tune is easiest to use if dedicated Worksheets are created to suit particular tasks. This ensures that when main fuel numbers are to be updated, there is a Worksheet available that is specifically setup for fuel tuning. Configuring Worksheets to suit fuel tuning, ignition timing, compensations, injectors, lambda, and Ref/Sync would make ECU configuration more efficient.

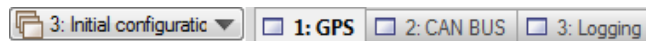
11.2 USING SUPPLIED WORKSHEETS

Using the supplied Worksheets is the easiest way to use M1 Tune for specific tasks. MoTeC have made available sample Worksheets with each Package that make performing these tasks easier. These Worksheets are contained within the Workspace provided with the Package. The Workspace contains three Workbooks, they are Tuning, Setup and Initial Configuration.



11.2.1 Initial Configuration Workbook

Example Worksheets in the Initial Configuration Workbook

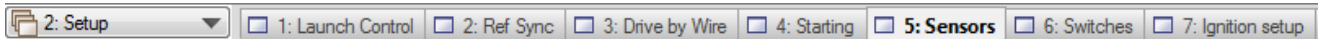


The Initial Configuration Workbook is designed to include Worksheets that are normally be filled in before the ECU is plugged in, or before the engine is started. Among others, this workbook allows the configuration of the Transmission, Cylinder TDC's, Fuel Injectors and CAN information.

Unique to the Configuration Workbook is the Test Modes Worksheet. This sheet contains the settings to allow the testing of auxiliary outputs, run an Ignition timing test, and to complete the DBW step test.

11.2.2 Setup Workbook

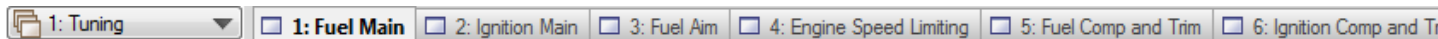
Example Worksheets in the Setup Workbook



The Setup Workbook contains Worksheets that can be used either offline or online, but they should be filled in before starting the engine. After starting the engine, some of these settings may need modifying.

11.2.3 Tune Workbook

Example Worksheets in the Tune Workbook



The Tune Workbook includes sheets that are generally used when tuning the running engine. From ignition and fuel main tables, to trims, starting, transients and closed loop.

Note: These Worksheets are just a starting point for how to configure the ECU. There may be extra or specialised sheets that can be added as required.

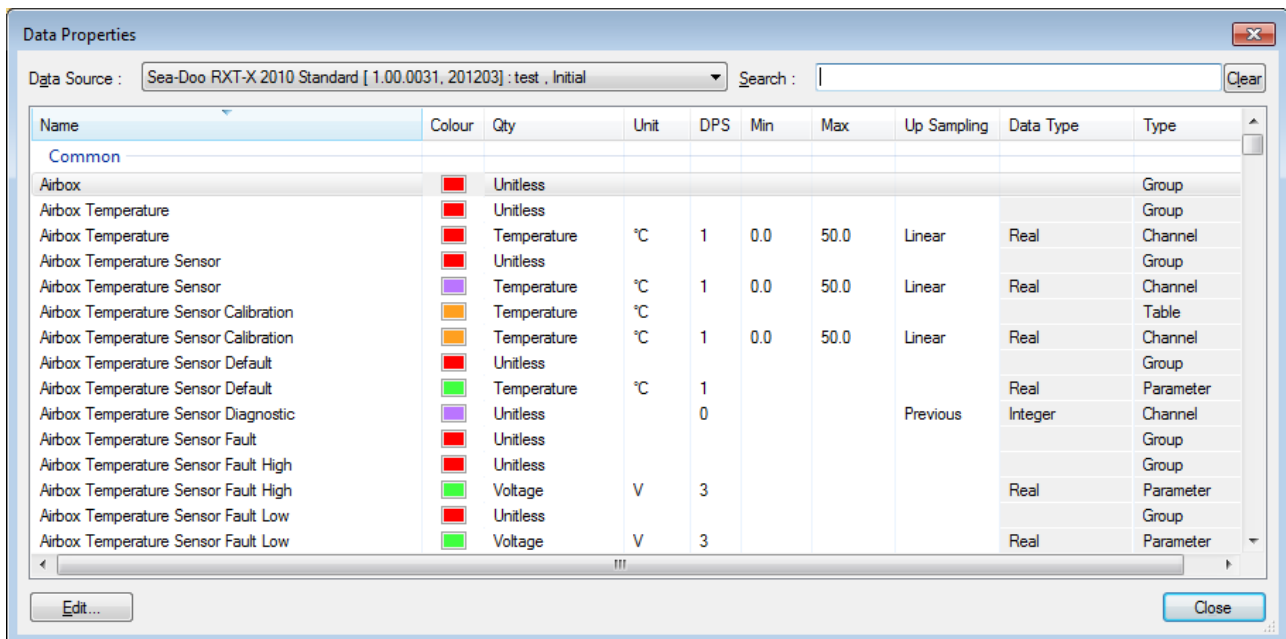
11.3 MANAGING DATA (CHANNEL) PROPERTIES

Within M1 Tune, the user has the option to configure any channel to suit their local requirements.

The Data Properties window shows all channels in use by the current Package, and their property settings.

Note: These channel properties are global, and any change that is made will reflect across the entire application.

Example Data Properties window



11.3.1 Accessing Data Properties

1. Select menu **Tools »Show Data Properties...**

► *The Data Properties window displays. To change the properties of any of the channels, including channel colour, units, decimal places, min/max scaling and warning limits.*

See [Editing Channel Properties](#).

11.3.2 Editing Channel Properties

The channel properties are set in the **Channel Properties** window. There are two methods of accessing this window.

Note: These channel properties are global, and any change that is made will reflect across the entire application.

1. From the **Data Properties** window, see [Accessing Data Properties](#), select **Edit**.
▶ *The **Channel Properties** window displays.*
2. Set the channel properties as required. See [Setting Channel Display Limits](#).

Or

1. From the Channels component, right-click on the required channel and select **Properties**.
▶ *The **Channels Properties** window displays.*
2. Select the **Edit** button.
▶ *The **Channel Properties** window displays.*
3. Set the channel properties as required. See [Setting Channel Display Limits](#).

11.3.3 Setting Channel Display Limits

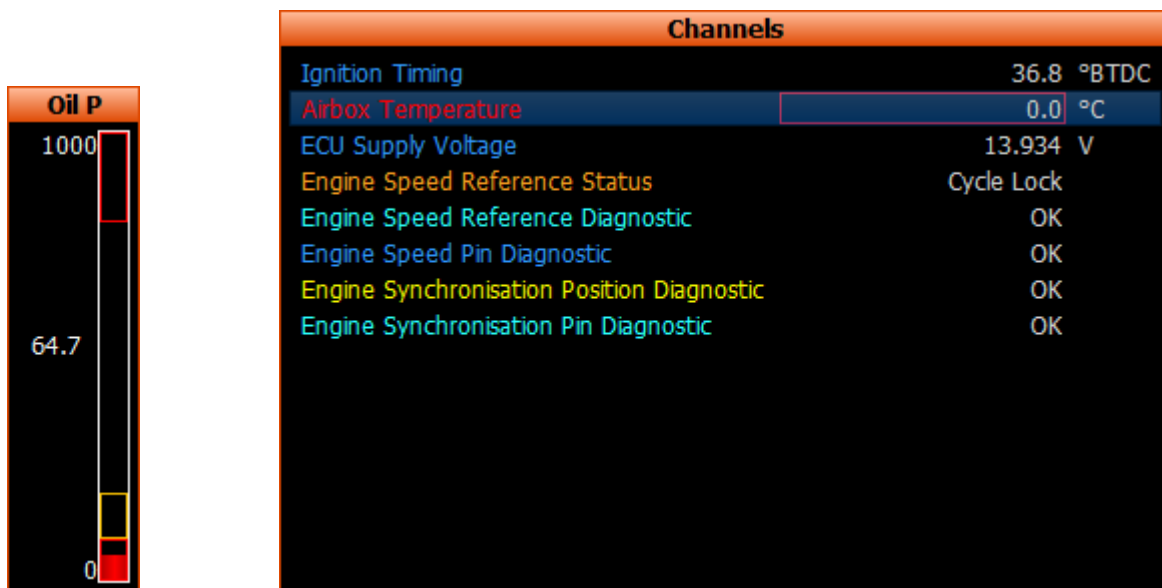
In addition to other settings, the *Channel Properties* window also controls channel limits. Warning limits created for a channel are consistent across the whole application.

Note: These channel display limits are in addition to the high and low parameter limits displayed in the Error Status list, see [ERROR MANAGEMENT AND STATUS LIST](#).

Oil pressure example

If an oil pressure sensor is setup with a low limit of 100kPa, as shown here...

...then in any location within M1 Tune where the oil pressure is shown, the value displays in red rather than in the default color. This is shown below in the oil pressure Bar Graph (for Bar Graphs the bar itself is red rather than the number) and in the Channel List.




11.4 LIVE DATA CHANGES

When modifying the M1 ECU within M1 Tune, any changes made are "Live", meaning the change happens in real time the moment the new value is entered. That is, when an engine is on a site, and the value of that site is changed, the ECU will immediately start using the new value.

Note: Even though the ECU may be operating on new values does not mean they are saved, see [SAVING CHANGES TO ECU DATA](#).

In some instances, a live change is not possible. This occurs where a parameter value has underlying dependencies, requiring simultaneous update of all relevant parameters. In these circumstances the change will require an ECU reset to take effect.

Parameters that require an ECU reset if changed can be identified by the red flag  after their name.

11.5 SAVING CHANGES TO ECU DATA

Although live changes in M1 Tune have an immediate effect on the ECU, this change is not saved into flash memory at this point, but is stored in RAM. The ECU will still have the original value stored in its flash memory. If the connection between M1 Tune and the ECU is lost, the ECU will revert back to its stored values.

For any changes in M1 Tune to become permanent, it is necessary to save the Package. When a save is performed, the changes are saved to the Package file on the PC, and also saved into the ECU flash memory.

To save, select menu option **File > Save**.

Example saving scenario




1. A user is tuning an engine, and at 100% throttle and 5000 RPM there is a fuel number in the ECU of 49.5. The ECU is using this number whenever the engine is at 5000 RPM and 100% throttle.
2. The user selects this site and changes the value from 49.5 to 55.5. Tune is still connected to the ECU, so when the engine goes to 5000rpm and 100% throttle, the ECU will use 55.5 for the fuelling.
3. If the user then disconnects M1 Tune from the ECU without saving, and the engine goes back to 5000RPM and 100% throttle, the ECU will revert to using 49.5 as the fuel number.
4. If the user plugs M1 Tune back in, the user will be offered to reapply the previous set of changes, in this case the 55.5. This value is still not saved in the ECU at this point.
5. Finally, the user saves the Package, and the 55.5 is saved into the ECU flash memory and saved into the Package on disk.
6. When the user now disconnects M1 Tune, the ECU will use 55.5 as the fuel number for 5000 rpm and 100% throttle.

11.6 LIVE DATA CONTROL

M1 Tune is able to display live data as it happens.

The values are displayed in a combination of charts, graphs, and gauges. Displaying live data allows monitoring of the running engine.

At times, it may be necessary to go back in time to look at an event that occurred during the live data display. To do this, it is necessary to use the Time Graph component.

To view a past event it is necessary to pause the live display using the **Pause** button on the menu toolbar  or by pressing **T** (recording of live data continues to occur, but the screen is not updated). When M1 Tune live data is paused, the "Connected" icon flashes between  and  and channel values pause in all components.

After pausing, it possible to move the cursor in the Time Graph back to the point in time that is to be examined (all components display values as they were for the time selected). From this position, you can zoom in and out to look at data in more detail, same as in i2.

Using the Pause function is a fast way to work during an engine tune. The engine can be ramped up through its range, and once that is done, the M1 Tune live data can be paused. This allows the tuner to now go back and examine in detail the ramp run, and all values from that point in time.

When the M1 Tune application is to taken out of pause (by using the **Pause** button or pressing **T**), the component value displays and the Time Graph will return to the live display state.

11.7 Q CALIBRATE FUNCTIONS

The **Q** key performs special functions on parameters and tables that were not available in older ECUs. The function is different depending on the selected item.

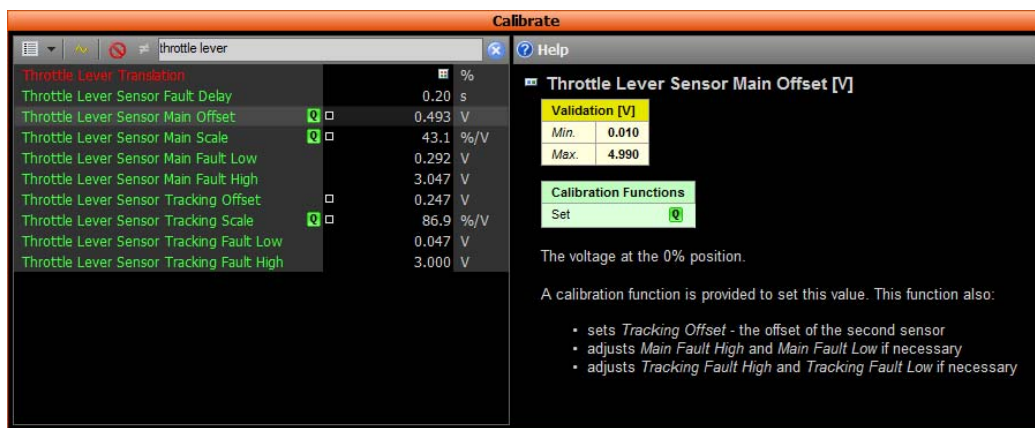
Note: The **Q** function can now perform a calibrate against any parameter or table displaying the **Q** icon.

For example

When the item is selected, and the **Q** key pressed, M1 Tune performs a special function that will generally calibrate that value.

An example of this is setting throttle position high and low values. The process for this would be as follows:

1. Select the **Throttle Pedal Main Closed** parameter.



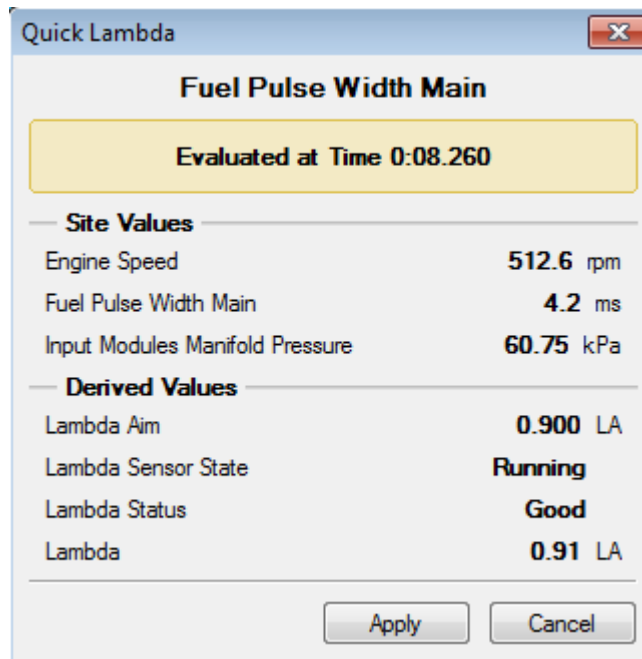
2. Close the throttle and press the **Q** key.

► The current pin voltage is determined and **Throttle Pedal Main Closed** parameter is set to that value.

11.7.1 Quick Lambda Function

When **Q** is used on the Fuel Main table, the function performed is a Quick Lambda.

A Quick Lambda function, when used live (that is, live data is not paused), takes the single site closest to the current running engine location, and place that site's details in the **Quick Lambda** window, for example:



M1 Tune will then retrieve the **Fuel Aim** value for this site, and the current Lambda value.

To perform the Quick Lambda on this site, review the information and click **OK**.

This same Quick Lambda function also works with recorded data. See [Dyno Tuning with M1 Tune](#).

11.7.2 Dyno Tuning with M1 Tune

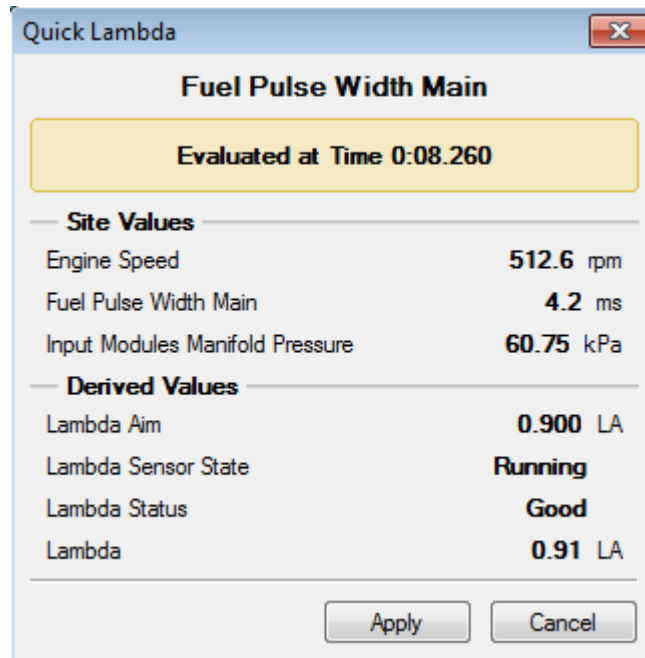
To make engine tuning faster, it is possible to Quick Lambda fuel table values at a point in the past using pause live data, see [LIVE DATA CONTROL](#).

The process is as follows:

1. Connect the laptop to the M1 ECU and watch the live data in M1 Tune.
2. Ramp engine through the Ramp test.
3. Press the **T** key to pause the live data display.
4. Scroll back through the saved data on the Time Graph and review the ramp test.

5. When a site (data) is found that needs to be re-tuned with quick lambda, press the **Q** key.

► M1 Tune displays a summary window of the action about to be performed. For example:



6. Select **OK** to run the Quick Lambda function.

7. Press **T** to restart display of live data.

11.8 W AND L FUEL TUNING

When performing fuel tuning, the **Q** function adjusts the closest site to the current values. There is another option that performs a similar function, "**W**".

When "**W**" is used while connected live on an engine, M1 Tune:

1. Selects the site closest to the current engine running site.
2. Performs a quick lambda against this site using the current lambda reading and the lambda aim value for that site.
3. Tune then performs the same quick lambda function against the next site in the table in the direction of more engine speed and more efficiency (plus the diagonal site) using the current lambda reading, and aim values for those sites.

This same function works using recorded data.

11.9 LAMBDA WAS

If the fuel table needs to be tuned from data either offline or offsite, the " L " (Lambda Was) function can be used.

This function works exactly the same as " Q " does but with user entered lambda values. When " L " is pressed, a window prompts for the user to enter the recorded lambda value, rather than using a recorded value.

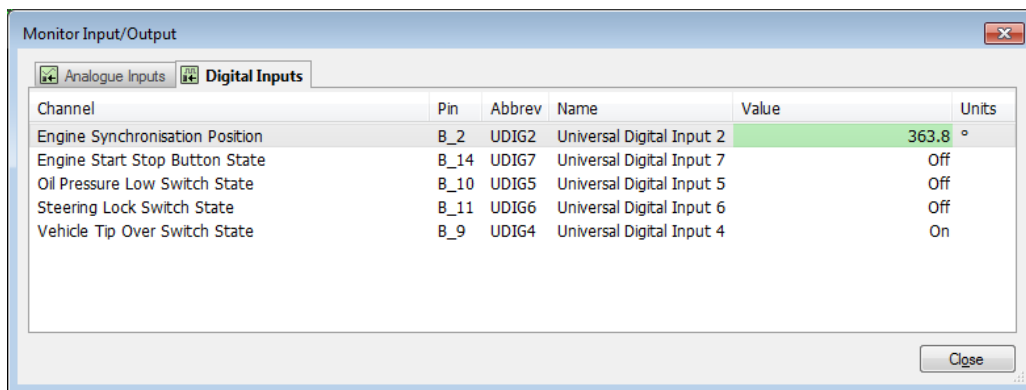
11.10 VIEWING LIVE PIN VOLTAGE VALUES

At times it is necessary to know the actual voltage that is on a particular pin, whether that is an input or an output.

Note: If connected to an ECU, all voltage values shown are instantaneously updated in real time.

1. Select menu **Online »Monitor Inputs / Outputs**.

► *The **Monitor Input/Output** window displays showing the **Digital Input** tab, for example:*



2. Select the Analogue Inputs tab to display all analogue pin voltages, for example:

Monitor Input/Output						
<input checked="" type="checkbox"/> Analogue Inputs <input type="checkbox"/> Digital Inputs						
Channel	Pin	Abbrev	Name	Value	Units	
ECU Supply Voltage	A_26	BAT_POS	Battery Positive	13.922	V	
Coolant Temperature Sensor Voltage	B_4	AT2	Analogue Temperature Input 2	3.040	V	
ECU Sensor 5V0 A Voltage	A_2	SEN_5V0_A	Sensor 5.0V A	4.985	V	
ECU Sensor 5V0 B Voltage	A_9	SEN_5V0_B	Sensor 5.0V B	4.993	V	
ECU Sensor 6V3 Voltage	B_19	SEN_6V3	Sensor 6.3V	6.271	V	
ECU Internal 1V2 Voltage		INT_1V2	Internal 1.2V	1.208	V	
ECU Internal 1V5 Voltage		INT_1V5	Internal 1.5V	1.510	V	
ECU Internal 1V8 Voltage		INT_1V8	Internal 1.8V	1.797	V	
ECU Internal 2V5 Voltage		INT_2V5	Internal 2.5V	2.515	V	
ECU Internal 3V3 Voltage		INT_3V3	Internal 3.3V	3.318	V	
ECU Internal 7V0 Voltage		INT_7V0	Internal 7.0V	6.948	V	
ECU Internal Temperature Input		INT_TEMP	Internal Temperature	1.037	V	
ECU Acceleration X Input		INT_G_X	Internal G Sensor X	1.648	V	
ECU Acceleration Y Input		INT_G_Y	Internal G Sensor Y	1.647	V	
ECU Acceleration Z Input		INT_G_Z	Internal G Sensor Z	1.545	V	
Engine Speed Voltage	B_1	UDIG1	Universal Digital Input 1	2.091	V	
Engine Synchronisation Voltage	B_2	UDIG2	Universal Digital Input 2	-3.341	V	
Engine Start Stop Button Voltage	B_14	UDIG7	Universal Digital Input 7	0.342	V	
Fuel Cylinder 1 Voltage	A_19	INJ_PH1	Peak Hold Injector 1	12.261	V	
Fuel Cylinder 2 Voltage	A_20	INJ_PH2	Peak Hold Injector 2	12.300	V	
Fuel Cylinder 3 Voltage	A_21	INJ_PH3	Peak Hold Injector 3	12.222	V	
Fuel Pump Voltage	A_32	OUT_HB4	Half Bridge Output 4	13.921	V	
Ignition Knock Sensor Voltage	B_7	KNOCK1	Knock Input 1	2.492	V	
Ignition Knock Window Voltage	A_13	IGN_LS8	Low Side Ignition 8	6.509	V	
Ignition Cylinder 1 Voltage	A_3	IGN_LS1	Low Side Ignition 1	0.000	V	
Ignition Cylinder 2 Voltage	A_4	IGN_LS2	Low Side Ignition 2	0.000	V	
Ignition Cylinder 3 Voltage	A_5	IGN_LS3	Low Side Ignition 3	0.049	V	
Inlet Manifold Temperature Sensor Voltage	B_3	AT1	Analogue Temperature Input 1	2.392	V	
Inlet Manifold Pressure Sensor Voltage	A_15	AV2	Analogue Voltage Input 2	2.275	V	
Muffler Temperature Sensor Voltage	B_5	AT3	Analogue Temperature Input 3	4.951	V	
Oil Pressure Sensor Voltage	B_20	AV6	Analogue Voltage Input 6	1.618	V	
Oil Pressure Low Switch Voltage	B_10	UDIG5	Universal Digital Input 5	3.971	V	
Starter Motor Relay Voltage	A_24	INJ_LS2	Low Side Injector 2	0.010	V	
Steering Lock Switch Voltage	B_11	UDIG6	Universal Digital Input 6	3.970	V	
Throttle Lever Sensor Main Voltage	A_25	AV5	Analogue Voltage Input 5	1.701	V	
Throttle Lever Sensor Tracking Voltage	A_17	AV4	Analogue Voltage Input 4	0.009	V	
Throttle Servo Position Main Voltage	A_14	AV1	Analogue Voltage Input 1	0.002	V	
Throttle Servo Position Tracking Voltage	A_16	AV3	Analogue Voltage Input 3	0.009	V	
Vehicle Tip Over Switch Voltage	B_9	UDIG4	Universal Digital Input 4	3.772	V	

Close

11.11 VIEWING THE ECU PIN CONFIGURATION

ECU pin configuration in M1 is determined when the package is built and changes with each Package, no longer is it one solution fits all. Therefore, rather than provide a wiring diagram for each Package and for all M1's, M1 Tune generates a Wiring Summary,

The M1 **Wiring Summary** shows the pin number used for each input and output, along with its type, name and abbreviation.

Unused inputs are shown without any information in the Usage column.

To display and/or print the **Wiring Summary**:

1. Select menu **Help »Package Wiring...**

► The **Wiring Summary** window displays, for example:

PIN	Abbreviation	Name	Usage
B_3	AT1	Analogue Temperature Input 1	Analogue Input Inlet Manifold Temperature Sensor Voltage
B_4	AT2	Analogue Temperature Input 2	Analogue Input Coolant Temperature Sensor Voltage
B_5	AT3	Analogue Temperature Input 3	Analogue Input Muffler Temperature Sensor Voltage
B_6	AT4	Analogue Temperature Input 4	
A_14	AV1	Analogue Voltage Input 1	Analogue Input Throttle Servo Position Main Voltage
A_15	AV2	Analogue Voltage Input 2	Analogue Input Inlet Manifold Pressure Sensor Voltage
A_16	AV3	Analogue Voltage Input 3	Analogue Input Throttle Servo Position Tracking Voltage
A_17	AV4	Analogue Voltage Input 4	Analogue Input Throttle Lever Sensor Tracking Voltage
A_25	AV5	Analogue Voltage Input 5	Analogue Input Throttle Lever Sensor Main Voltage
B_20	AV6	Analogue Voltage Input 6	Analogue Input Oil Pressure Sensor Voltage
B_21	AV7	Analogue Voltage Input 7	
B_22	AV8	Analogue Voltage Input 8	
B_12	BAT_BAK	Battery Backup	
A_10	BAT_NEG	Battery Negative	
A_11	BAT_NEG	Battery Negative	
A_26	BAT_POS	Battery Positive	Analogue Input ECU Supply Voltage
B_17	CAN_HI	CAN Bus High	
B_18	CAN_LO	CAN Bus Low	
B_26	ETH_RX-	Ethernet Receive-	
B_25	ETH_RX+	Ethernet Receive+	
B_24	ETH_TX-	Ethernet Transmit-	

2. To print the **Wiring Summary**, use the **Print** button



at the top left of the window.

11.12 ERROR MANAGEMENT AND STATUS LIST

Note: Sensors not in use should be set to disabled where possible so that the Error Status list, which is displayed in the Status window, is only used for genuine errors.

M1 Tune senses that a channel has gone into error when its value goes outside the configurable channel parameter limits.

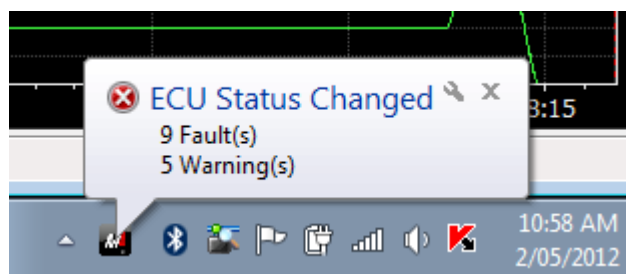
The channel parameter limits are configured within the sensor settings, using the fault low and high limits.

Note: It is also important to set a reasonable default value for the sensor parameter. If the channel goes into fault, the sensor will report its value to be this default value. Consider how this value will affect the running engine in the event of a channel fault.

How these errors are displayed is shown below.

Channels	
Throttle Lever	0.0 %
Throttle Lever Translation	0.0 %
Throttle Lever Sensor	-7.1 %
Throttle Lever Sensor Diagnostic	Single Sensor
Throttle Lever Sensor Main	-7.1 %
Throttle Lever Sensor Main Diagnostic	Closed Warning
Throttle Lever Sensor Main Voltage	0.330 V
Throttle Lever Sensor Main Voltage Abs...	0.329 V
Throttle Lever Sensor Tracking	0.0 %
Throttle Lever Sensor Tracking Diagnostic	Low Fault
Throttle Lever Sensor Tracking Voltage	0.008 V
Throttle Lever Sensor Tracking Voltage ...	0.008 V
Throttle Servo Request	Disabled
Throttle Servo Status	Fault
Throttle Servo Diagnostic	Aim Tracking Fault
Throttle Servo Error	0.0 %
Throttle Servo Tracking Limit	31.8 %

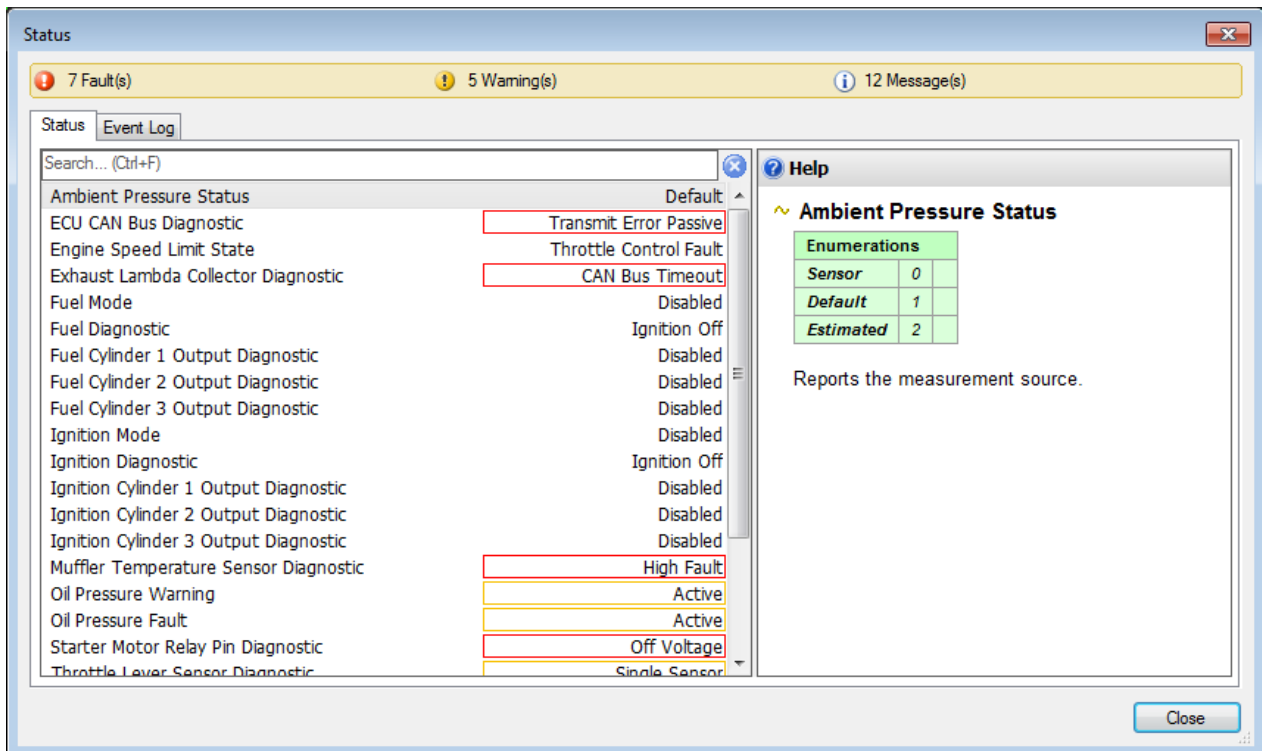
When an error occurs, the channel parameter and its value are added to an Error Status list and the following popup displays to notify the user of the change to the list of errors.



The popup lists the current number of errors, but only appears if there has been a change to the number of errors.

Press **F3** to display the **Status** window.

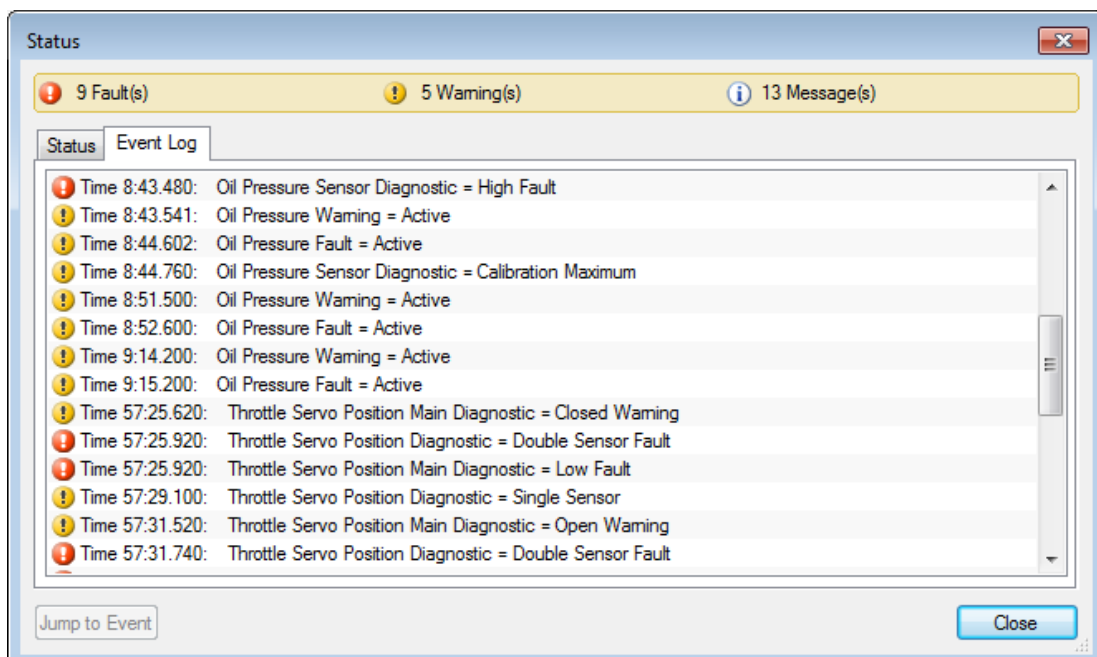
Example Status window



The **Status** window displays all current Errors and Status values. To see only errors, de-select the **Show Messages** checkbox box from the bottom of the window.

Sometimes, the error will only be active for a short period of time, and it may not appear in the Status list when it is opened at a later time. In this instance, select the **Event Log** tab to see a history of errors, when they occurred and for how many times.

Example Event Log



11.13 INPUT VALIDATION AND INVALID ITEMS

When a Package is created, parameters and tables are normally set up with input validation.

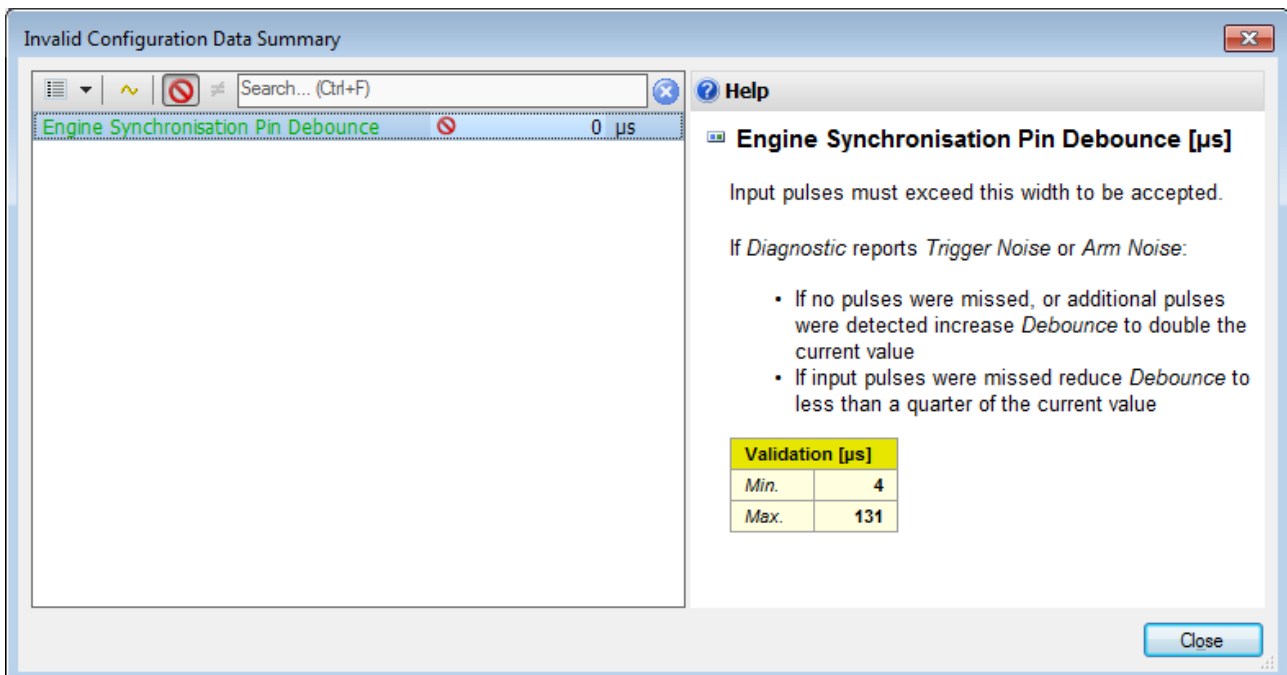
Input validation sets high and low limits for the parameter. When a Package is first built, most values are set to 0. In many instances this will not be valid value, and the table or parameter will display as containing invalid items.

Invalid items are displayed with a yellow triangle (as shown below). In this example, the valid peak timer values are 0.3ms to 8.4ms, and the current parameter value is 0.0ms.



It is possible to search for all invalid parameters using the *Invalid Configuration Data Summary* window, which is displayed by pressing **F7**. Within this window, it is possible to update the parameters and channels to valid values.

Example of a the Invalid Configuration Data Summary



11.14 MIGRATING DATA

Data migration refers to the copying of tune data from one Package to another.

Migration can be required for a number of reasons. The most common is to populate new firmware. New firmware will initially have empty fuel maps, ignition maps, sensor calibrations Etc. Rather than requiring the user to manually search through the Package and fill in all of the tables and parameters, existing M1 Tune data can be migrated to the new Package using the migration tools.

There are two main method by which migration can occur.

- Auto migration

M1 Tune automatically takes values from the source and migrates them into the destination. This will occur when you install new firmware into an ECU and the previous firmware matches the new firmware.

- Manual migration

The user uses compare mode features to explicitly copy values from the source to the destination Package. Manual migration is completed by opening two M1 Tune files at the same time, and using the compare or migrate tools to copy the data.

11.14.1 Auto Migration

Auto Migration copies:

- Tables
- Parameters
- User Package Details
- Log setups
- Package Workspaces

Items will not migrate if:

- The source does not exist
- The destination does not exist
- Item quantities have changed (for example, item changes from Pressure to Force)
- Item changes data type (for example, item changes from a floating point to an enumeration)
- An enumeration name does not exist
- The user performing the migration does not have appropriate security permissions

11.14.1.1 Manual Migration

As M1 projects can become quite complex, it may be required to compare two packages to see what has changed.

To do this:

1. Open an offline Package, or connect online to an ECU.
2. Select menu **File > Add Compare Package**.

When in the compare mode, the user can view the Packages through the usual components, such as Calibrate, and see the differences in the data.

There are also some dedicated windows to assist in looking at the changes. Two of these are accessed from **Tools > Compare Data** or **Tools > Compare Firmware**. The windows displayed from these options display the differences with a red highlight. The data in these windows can be both viewed and modified.

12 LOGGING

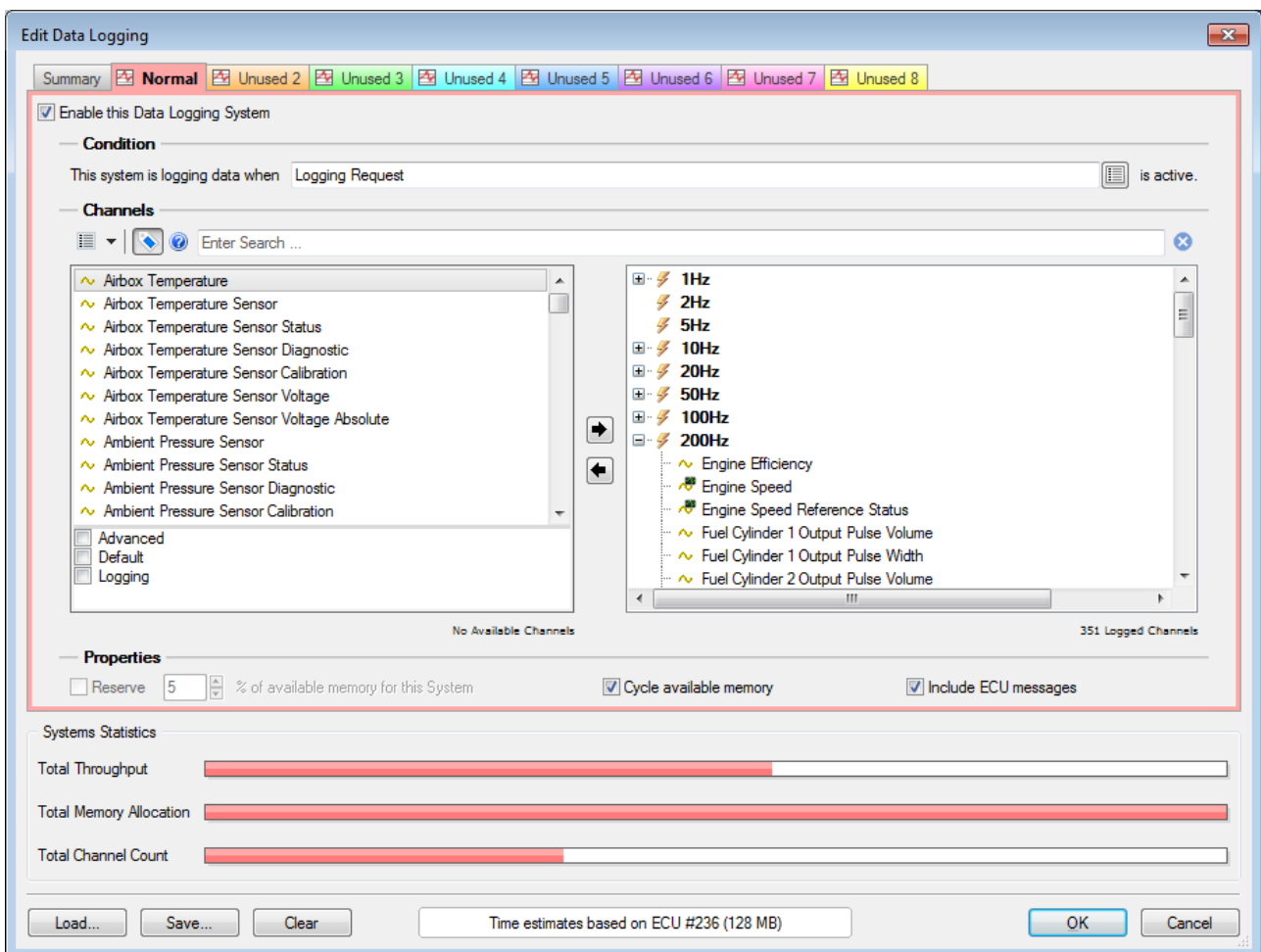
Logging in the M1 system includes a number of advanced features that make it highly configurable. It is possible to set it up logging from a simple one user environment to the requirements of a highly regulated category. There are 8 independent logging systems to cater for a variety of requirements.

M1 logging can be configured so that it is user/role specific, so the tuner may be able to see one set of data, scrutineers a different set and the chassis engineers another. The data that each user can see may be overlapping or separated.

Setup can be individually secured so that each user can easily configure and see what they have access to, and no more. Using these features, a strictly separated category logging system can be setup.

For a simpler option, logging can be configured to have a single log setup, which uses all available memory, and has no security. This is a similar configuration to the M800 logging setup where logging is open.

Example Edit Logging window



12.1 LOGGING FEATURES

The M1 logging system has the following features:

- Eight independent log systems
- Tightly integrated with user security to ensure that users can only download and convert logging that they have access to view
- Ability to download logging, but not to convert logged data
- Control on user access to view restricted log setups
- Reserved memory allocation per log set
- Cyclic logging
- Configurable start / stop logging parameters
- Selectable logging rates

12.2 LOGGING CONFIGURATION

To configure M1 logging, select which log data set is intended to be used for logging.

From the Channels list, drag and drop channels or groups of channels into the logging update rate branch to suit the required log rates.

13 SECURITY

The MoTeC M1 system provides an advanced security system based on public-private key cryptography. This security method means that once an ECU has been correctly configured with appropriate security settings, it is practically impossible to access the ECU without the correct key or password.

Starting with this advanced method of security, an extremely flexible and comprehensive security system has been added to the M1 software. There are currently three security levels in the M1.

13.1 SECURITY LEVELS

The M1 Build software has the controls to configure the appropriate security settings for an M1 project. Security levels define the type of security used. Each level is defined below.

Off

When security is turned off, there is no security available throughout the M1 system. There is no option to configure users or security in either M1 Build or M1 Tune. Anyone who connects to the M1 ECU will be able to logon, download, modify or view any objects in the Package.

Basic

Basic security allows for a security setup that is easy to implement and maintain, but doesn't have the flexibility of the advanced security.

There are no configuration settings in build for the basic security method, it also has no security groups and no build users.

With basic security, all configurations are done in the M1 Tune application. When M1 Tune is first started with Basic security, the security system is effectively turned off. M1 Tune configures only a Guest user at this time, which has no password, and has full access to the system. The Guest account is a permanent account that is always available with Basic security. However, by adding a new user, you can set the Guest account to have no privileges. Doing this will effectively cause the Guest account to have no access, and administrator rights will pass to your new user. Your new user can have either password or key authentication for additional security. There must always be one user who has administrator access, and the administrator has access to everything. There can be more than one administrator. Other users can have varying levels of access, options for security include:

- Allow send firmware
- Allow change password
- Allow change workbooks
- Allow change ECU name
- Allow firmware send, or upgrade only
- View, adjust or no access to the default security group
- Configurable access to Adjust, View, Retrieval, Convert and Erase of the 8 log systems.

Each normal user can have a combination of the above settings configured for them by the ECU administrator.

13.1.1 Advanced

The M1 Advanced security configuration is a comprehensive and flexible method of setting up engine management access control. The security configuration allows the application developer to break up access to a project so that individual people or groups have access to the items that they need, whilst others can have a different subset.

14 HELP

In addition to this help, the following is provided:

- **Tune help**

This is only available from windows and dialogue boxes that display a **Help** button. Click the **Help** button to access.

- **Context Package Help**

Provides information on what particular items within the Package do, how they interact, and what are the appropriate values. To access this information, select the item that help is required for and press **F1**. The Help panel will fly out from the right hand side of the M1 Tune window and display the relevant information for the selected item. With the Help panel open, select other items to change the help focus.

- **Overall Package Help**

To see the Context Package Help in one overall structured view, select menu **Help > Package Help**. This will list the Package help for each function in a top to bottom tree structure. Select the **Show Contents** icon to ensure to see the tree view.

15 GLOSSARY

Term	Definition
Calculations	Blocks of functionality used to control different systems in the vehicle, for example, idle control, boost, gear shift Etc.
Channels	A value that is updated by the firmware only, and readable by the end user within the M1 Tune application.
Component	An element that is placed in a Worksheet and provides a customised view of tables, parameters and channels, for example, a gauge displaying oil pressure.
Configuration	A named collection of table and parameter values.
Firmware	The firmware can be considered to be the program that runs on the M1 ECU and is created by M1 Build. A firmware consists of: <ul style="list-style-type: none"> • Parameters • Tables • Channels • Calculations.
Migrate	The process of importing data from one Package into another
Package	A MoTeC M1 package is made up of a number of components. These components include: <ul style="list-style-type: none"> • Package details • System Image (Kernel) • Firmware • Log Setups • Security.
Package Details	The package details contain information used to describe a package.
Parameters	Represents a single value that can be adjusted by the end user within the M1 Tune application.
Resources	Allow the dynamic selection of I/O pins settings.
System Image (Kernel)	The MoTeC provided firmware that provides low level services to the running firmware.
Tables	Represent a sequence of values that can be adjusted by the end user within the M1 Tune application. A table can be represented as a function of 1, 2, or 3 axes.

Term	Definition
Workbook	Within a Workspace in M1 Tune, there can be a number of Workbooks. The Workbook is a method of grouping similar worksheets together.
Worksheet	The individual page or window that is used to contain components and gauges for the end user.
Workspace	Name given to the entire collection of M1 Tune layout and setting information.

16 KEYBOARD SHORTCUTS

Keyboard shortcuts are available as described below.

M1 Tune Section	Description
M1 Tune general	These are shortcuts that perform high level general functions across M1 Tune.
Components common	These are shortcuts that perform common functions within any component.
Table component	These are shortcuts that perform specific functions in the table component.
Parameter List component	These are shortcuts that perform specific functions in the Parameter List component.
Time Graph component	These are shortcuts that perform specific functions in the Time Graph component.

16.1 M1 TUNE - GENERAL KEYBOARD SHORTCUTS

Function	Shortcut
Close Dock Window	[Esc]
Compare Mode	[F4]
Edit Comment...	[Ctrl+E]
Get Logged Data...	[Ctrl+F8]
Layout Editor...	[Ctrl+F7]
Next Workbook	[Ctrl+F12]
Next Worksheet	[Ctrl+Tab]
Next Worksheet	[F12]
Open ECU...	[F8]
Open Package...	[Ctrl+O]
Previous Workbook	[Ctrl+F11]
Previous Worksheet	[F11]
Print...	[Ctrl+P]
Recent Workbook	[Ctrl+F10]
Recent Worksheet	[F10]
Redo	[Ctrl+Y]
Save	[Ctrl+S]
Show Channels	[C]
Show Help	[F1]
Show Invalid Data Summary...	[F7]
Show Measurements	[M]
Show Status...	[F3]
Hold / Unhold Data Acquisition	[T]
Undo	[Ctrl+Z]

16.2 COMPONENTS - COMMON KEYBOARD SHORTCUTS

Function	Shortcut
Channel Properties...	[Ctrl+N]
Copy	[Ctrl+Shift+C]
Cut	[Ctrl+Shift+X]
Hide All Color Bands	[Alt+Page Down]
Hide Channel	[Ctrl+H]
Maximise	[F6]
Move Cursor Left	[Left]
Move Cursor Right	[Right]
Navigate Next	[Tab]
Navigate Previous	[Shift+Tab]
Paste	[Ctrl+Shift+V]
Properties...	[F5]
Channel Properties...	[Ctrl+N]
Remove Item	[Ctrl+Delete]
Show All Color Bands	[Alt+Page Up]
Show Values	[V]
Toggle Legend	[L]
Undo Delete	[Ctrl+Shift+Z]

16.3 TABLE COMPONENT - KEYBOARD SHORTCUTS

Function	Shortcut
Calibrate	[Q]
Calibrate (Copy Next Site)	[W]
Clear Ramp Run	[Ctrl+R]
Copy Data	[Ctrl+C]
Cycle View Layout	[G]
Decrement Value	[Page Down]
Decrement Value Fast	[Ctrl+Page Down]
Decrement Value Slow	[Shift+Page Down]
Increment Value	[Page Up]
Increment Value Fast	[Ctrl+Page Up]
Increment Value Slow	[Shift+Page Up]
Interpolate	[I]
Jump to Operating Site	[Space]
Next Table	[Alt+F12]
Paste Data	[Ctrl+V]
Previous Table	[Alt+F11]
Recent Table	[Alt+F10]
Reset Graph	[Home]
Rotate Graph Anticlockwise	[Ctrl+Right]
Rotate Graph Clockwise	[Ctrl+Left]
Scale/Offset	[=]
Select All	[Ctrl+A]
Select Down	[Shift+Down]
Select Left	[Shift+Left]
Select Right	[Shift+Right]

Function	Shortcut
Select Up	[Shift+Up]
Setup Axis...	[A]
Show Tables	[Esc]
Start/Stop Ramp Run	[R]
Swap Orientation	[Shift+G]
Tag Value	[Backspace]
Tilt Graph Back	[Ctrl+Up]
Tilt Graph Forward	[Ctrl+Down]
Untag Value	[Delete]
X Axis Descending	[X]
Y Axis Descending	[Y]
Zero Value	[Z]
Zoom Graph In	[+]
Zoom Graph Out	[-]

16.4 PARAMETER LIST COMPONENT - KEYBOARD SHORTCUTS

Function	Shortcut
Calibrate	[Q]
Calibrate All	Ctrl+Q]
Copy Data	[Ctrl+C]
Decrement Value	[Page Down]
Decrement Value Fast	[Ctrl+Page Down]
Decrement Value Slow	[Shift+Page Down]
Increment Value	[Page Up]
Increment Value Fast	[Ctrl+Page Up]
Increment Value Slow	[Shift+Page Up]
Paste Data	[Ctrl+V]
Scale/Offset	[=]
Show Grouped	[Shift+L]
Swap Orientation	[Shift+G]
Tag Value	[Backspace]
Untag Value	[Delete]
Zero Value	[Z]

16.5 TIME GRAPH COMPONENT - KEYBOARD SHORTCUTS

Function	Shortcut
AutoScale	[Ctrl+A]
Center On Cursor	[H]
Cursor Left	[Left]
Cursor Right	[Right]
Cycle Cursor Style	[Y]
Overlapped Groups	[G]
Fast Cursor Left	[Ctrl+Left]
Fast Cursor Right	[Ctrl+Right]
Horizontal Zoom Default	[W]
Horizontal Zoom Full Out	[F2]
Horizontal Zoom In	[Up]
Horizontal Zoom Out	[Down]
Jump Cursor End	[End]
Jump Cursor Start	[Home]
Next Channel	[Page Down]
Pan Down	[Shift+Down]
Pan Left	[Shift+Left]
Pan Left (i1)	[B]
Pan Right	[Shift+Right]
Pan Right (i1)	[F]
Pan Up	[Shift+Up]
Place Datum Cursor	[Space]
Previous Channel	[Page Up]
Show Datum Cursor	[D]
Show Status/Errors	[E]

Function	Shortcut
Swap Cursors	[X]
Toggle Trace Style	[S]
Vertical Zoom Full Out	[Alt+F2]
Vertical Zoom In	[Alt+Up]
Vertical Zoom Out	[Alt+Down]
Zoom to Cursors	[Z]