M1 BUILD

USER MANUAL

MoTeC

Table of Contents

Overview

M1 Build is a powerful program used to generate firmware for M1 series ECUs. It includes a sophisticated software editor with predefined and simplified possibilities to provide a user-friendly, time-saving and elaborated programming experience.

The integrated compiler ensures automatic firmware integration into M1.

☛ *In this manual, only the handling of the M1 Build menus and options is addressed. See the M1 Development Manual for more information about the generation and structure of an M1 Build Project.*

Important Note - Saving Projects

Intermediate changes that have been made to a Project before generating a Package cannot be recovered. The **Save Project** function always overwrites the last saved file of the current revision.

Only by generating a new revision (that is by building a Package), or by creating a new version, can that previous revision be recovered at a later time.

To save the current software status for a later recovery without building a Package, create a new Project version. To do this, select **File > Open Project...** to display the Open Main Project window and then select the **New Version...** option.

See Project Revision Number

Project Revision Number

Project

A Project is the comprehensive definition of a unique M1 ECU application.

See Important Note - Saving Projects

Major version

The major version is the first part of a Project's revision number (see Revision number). It matches the version of M1 Build used to create the Project.

Project version

Apart from its unique name, each Project version has its specific, ascending version number which is the middle part of the revision number (see below).

A Project has at least one Project version. Additional Project versions can be generated. Each Project version has to be named differently. The name can be defined freely, but once assigned, the name cannot be changed.

Revision number

The revision number has three parts xx.yy.zzzz

xx is the major version.

yy is the Project version number.

zzzz is incremented every time the Project is built (Package created) and is a unique revision of a given version.

A revision is the working layer of a current application. Each Project version has at least one revision, which is automatically generated when creating a new Project version (initially 0 is assigned as the last number).

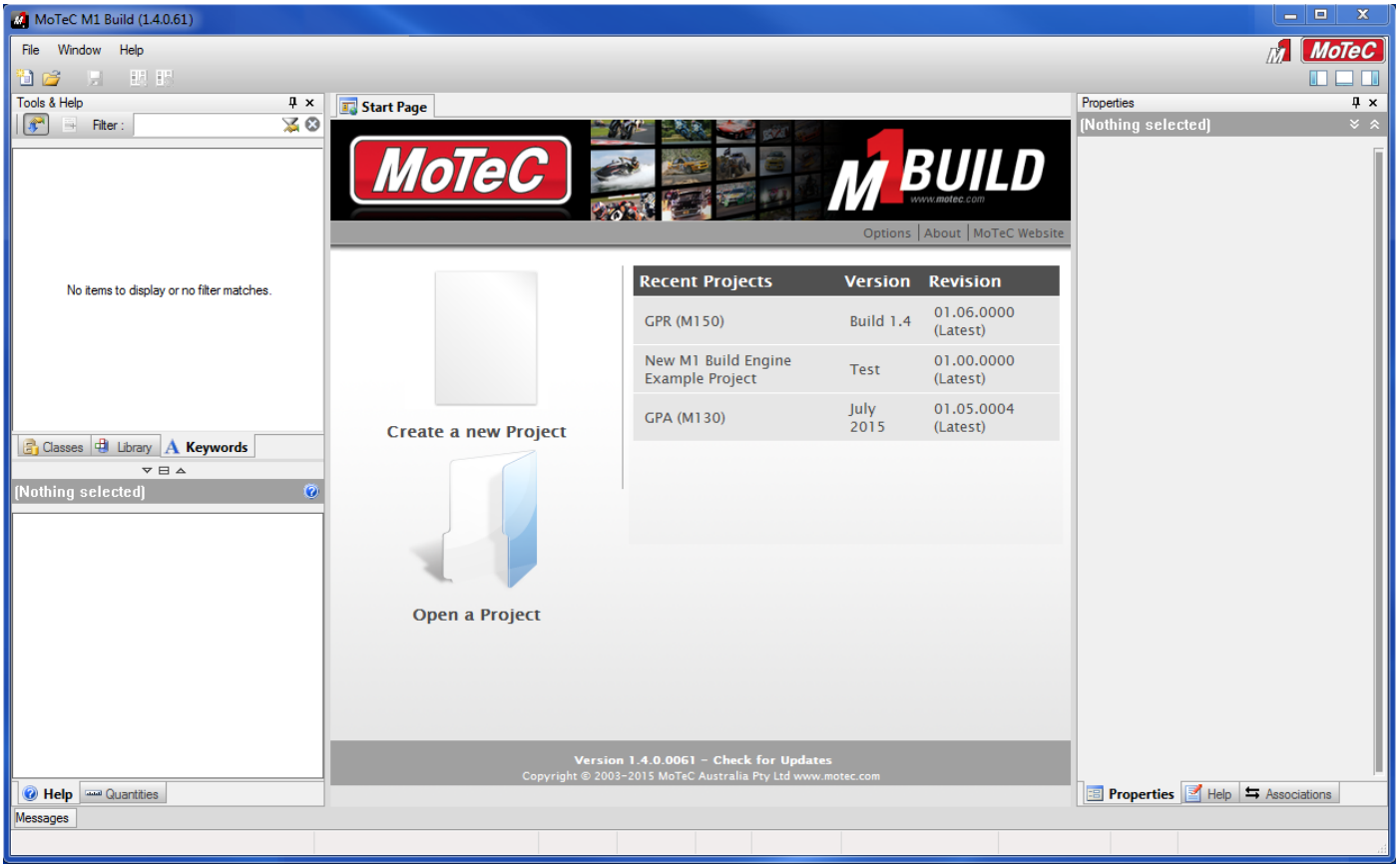
Each time a Package is compiled, the current number is fixed and the Package revision using this number is set as read only. The last number is then increased for all further software changes.

☛ *The revision number is unique for each Package. For this reason it is always possible to match the M1 Build software to any M1 Package. When using M1 Tune, this same information is included in the M1 Tune Project name, that is - the Project version name and the revision number of the Package in the M1 ECU.*

Screen Layout

After starting M1 Build, a screen similar to the following displays.

Default Screen Layout



The rotating icon  at the top right corner of the screen notifies about available software, module and license updates and allows to download them.

☛ *Updates cannot be performed when a Project is open.*

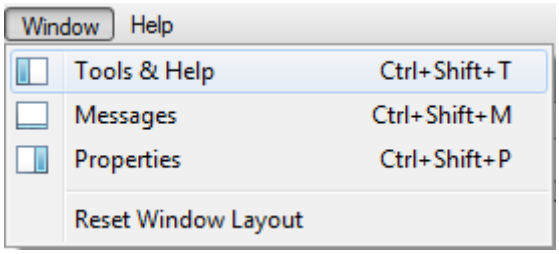
The screen layout consists of four windows:

- Tools & Help window on the left
- Main working window in the middle (this cannot be hidden)
- Properties window on the right
- Messages window along the bottom

Controlling Windows

Display and Hide

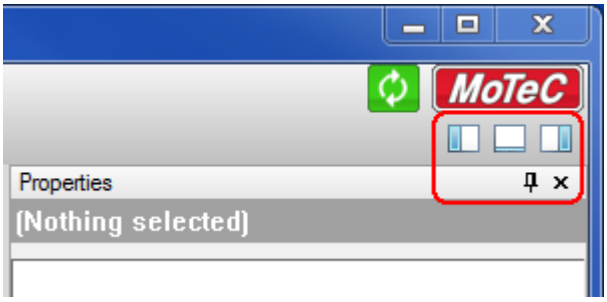
The windows can be displayed or hidden by using the options available in the **Window** menu.



The **Reset Window Layout** resets the layout to the default window layout.

Click on the appropriate screen icon at the upper right corner of the screen (as highlighted below) to toggle between *display* and *close*. Selecting the **X** icon will also close the window; the representative window icon will be greyed out.

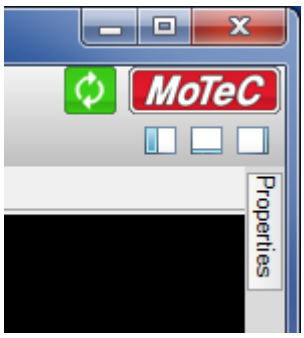
In the example image below, Tools & Help window is closed, Messages is hidden and Properties is pinned.



☛ *How the window display options function depends on whether the window is pinned in place or not. The pin icon is found at the top right corner of each window. Each click on this icon will toggle between pinned and unpinned.*

Indicates the window is **pinned**. Using any of the above options while pinned fully displays and/or hides the window, any other cursor/mouse action has no effect. In the example above, the Messages window is unpinned and the Properties window is pinned.

 Indicates the window is **unpinned**. When unpinned and hidden, the window contracts to its respective side and only displays a window label. The following image is an example of an unpinned Properties window and pinned Tools & Help and Messages windows.



Using any of the above options while unpinned will display the window. However, a mouse click occurring anywhere in Build (except in the displayed window) causes the window to again be hidden. Also, rolling the cursor over the window label causes the window to display, and the label is hidden again once the cursor rolls out of the window.

Adjust Width and Height

To adjust the width and height, drag the relevant window edge.

Split Windows

Where a window is in two segments, you can adjust the relative height of each by dragging the dividing bar that sits between the two segments.

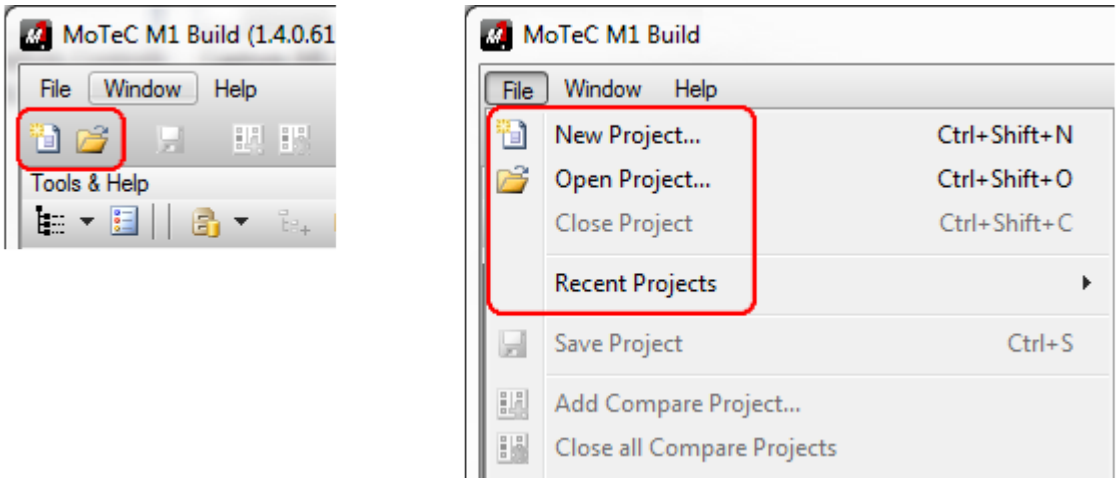
Also, you can use the window segment controls  located between the segments (just under the dividing bar). The **down** arrow expands the top segment to use the whole window. The **up** arrow expands the bottom segment to use the whole window. The bar between the two arrows resets both segments to their respective proportions.

Start a Project

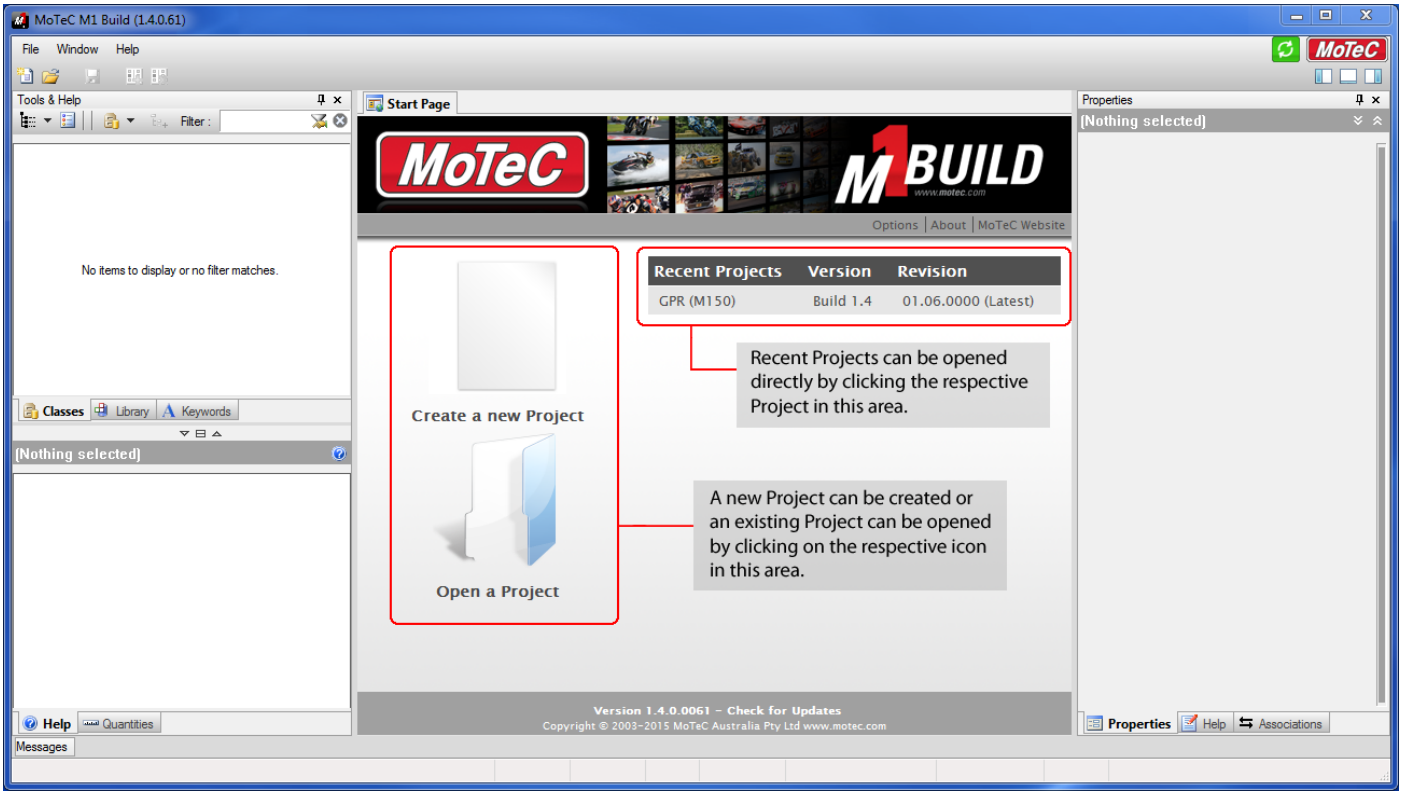
A Project can be created, or an existing Project can be opened, by using:

- the toolbar icons in the upper left section of the screen
- the menu options in the **File** menu
- the options in the main window

Toolbar Icons and Menu Options



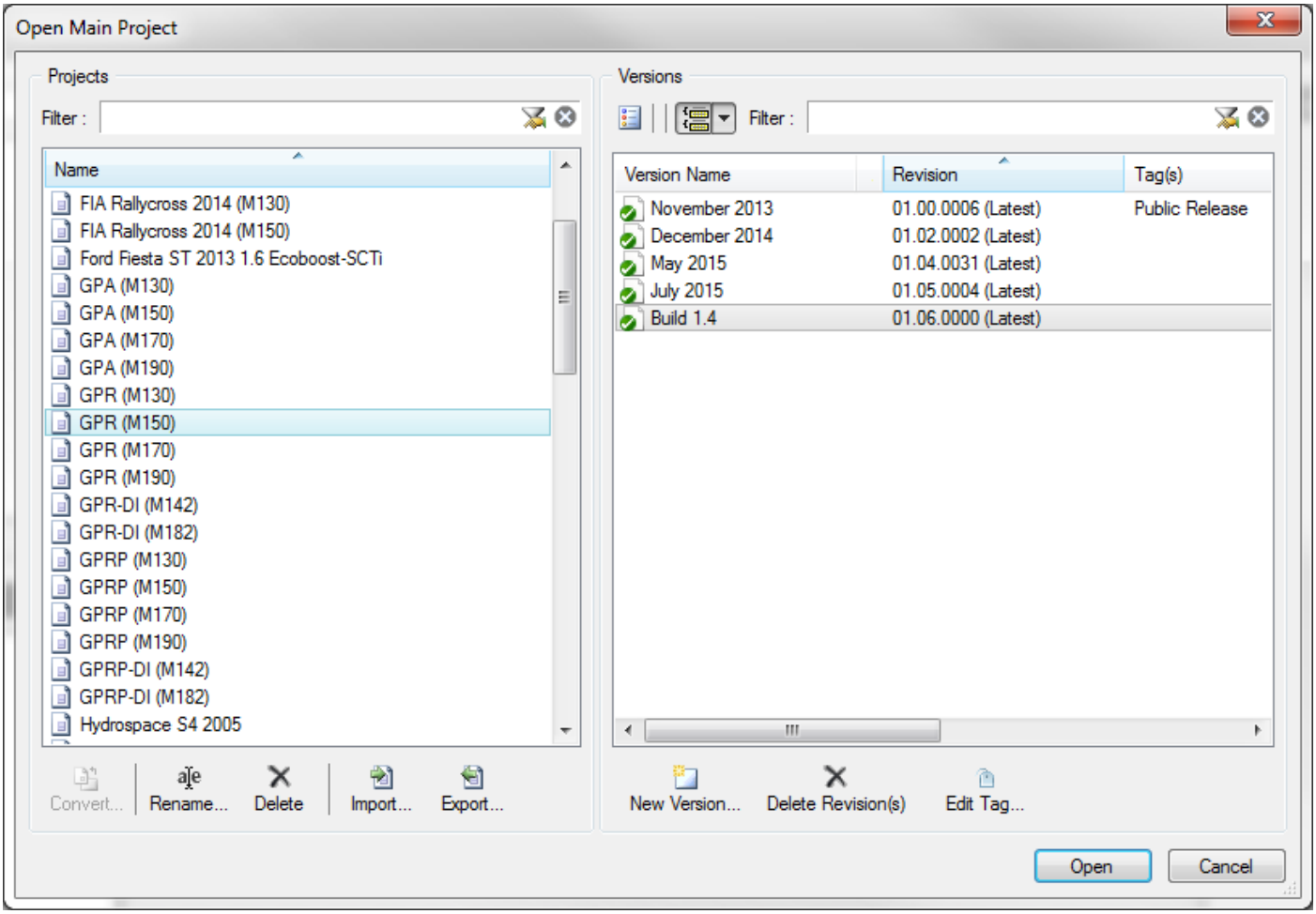
Main Window Options



Open an Existing Project

Choosing to open a Project lists the available Projects in the Project folder, together with their versions and revisions.

Open Project Example



The Projects can be filtered by name. The Project versions and revisions can be filtered by latest revision from all versions, or by latest overall revision.

Additionally, this window contains functions to manage Projects, see Managing Projects and Revisions.

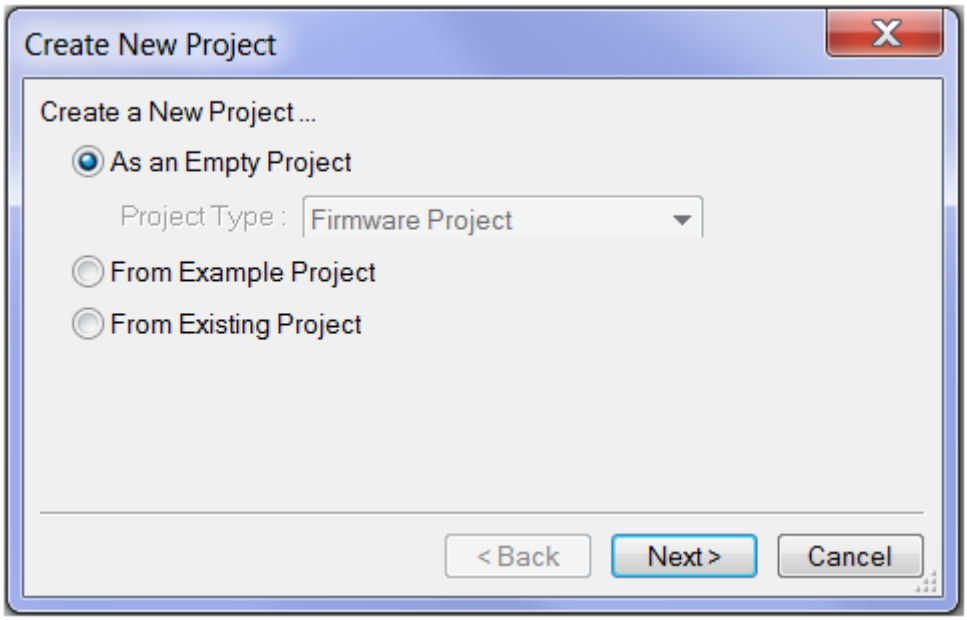
Create a New Project

Three methods exist for creating a new Project:

- As an empty (blank) Project
- Using an example Project as a reference
- Using an existing Project as a reference

1. Select **File > New** to display the Create New Project window.

Create New Project Window Example



   Currently the only available Project Type is **Firmware Project**.

2. Select how to create the Project.

If as an Empty Project:

1. Select **Next**, M1 Build prompts for Project name and version name.
2. Enter a Project name and the name of the first Project version.

   ☛ *Once defined, the Project name can be changed but not the version name.*

3. Select **Finish** to create the empty Project.

After selecting **Finish**, the Settings window displays. See Settings Tab for details.

The settings can be defined or adjusted at any time. However, it is recommended to do so at the start of each Project. This is because:

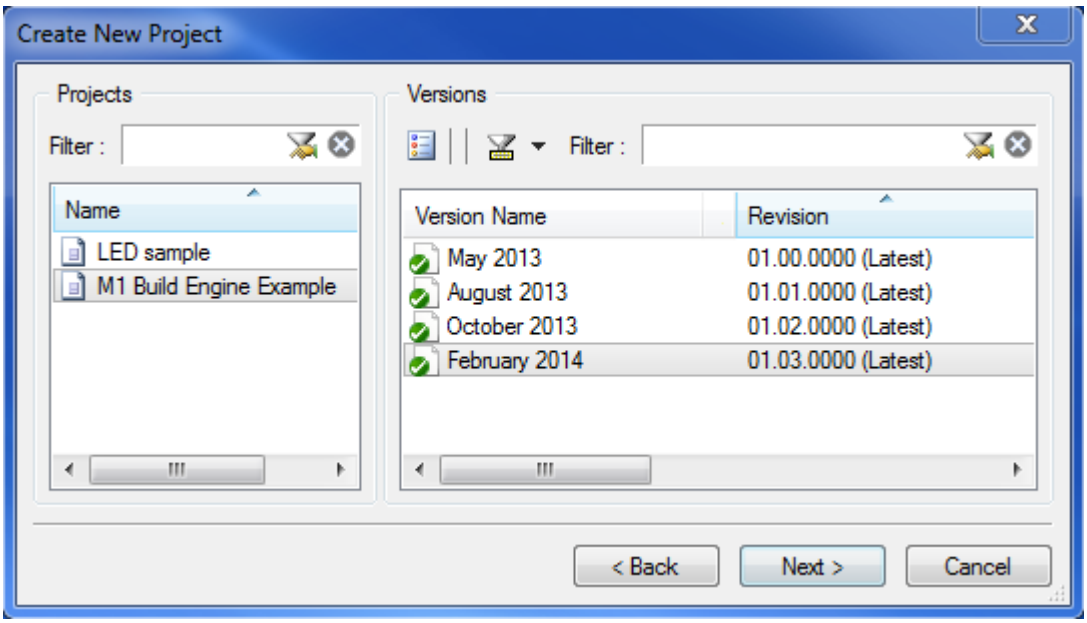
- The chosen System Version influences the hardware classes that are available.
- The Target Hardware defines the input and output pins that are made available in the Project.

If from an Example Project

☛ *Each example Project comes with an associated presentation which is accessible via the **Help** menu.*

1. Select **Next**. M1 Build displays the example Projects (provided as part of the M1 Build installation).

Example Projects Example



2. Select a ***Project*** and a ***Project*** version.
3. Select **Next**, M1 Build prompts for ***Project*** name and version name.
4. Enter a ***Project*** name and the name of the first ***Project*** version.

   ☛ *Once defined, the **Project** name can be changed but not the version name.*

5. Select **Finish**. A copy of the selected ***Project*** is made and the Objects tab will open, leaving the source version untouched.
   The ***Project*** settings are taken from the copied ***Project***. It is recommended to check these before any further work is done. See Settings Tab for details.

If from an Existing Project:

1. Select **Next**, M1 Build displays the available Projects.
2. Select a ***Project*** and a ***Project*** version.
3. Select **Next**, M1 Build prompts for ***Project*** name and version name.
4. Enter a ***Project*** name and the name of the first ***Project*** version.

   ☛ *Once defined, the **Project** name can be changed but not the version name.*

5. Select **Finish**. A copy of the selected ***Project*** is made and the Objects tab will open, leaving the source version untouched.
   The ***Project*** settings are taken from the copied ***Project***. It is recommended to check these before any further work is done. See Settings Tab for details.

Managing Projects and Revisions

Managing Projects and revisions is done from the Open Main Project window, selected from **File > Open Project...**.

Rename Project Name

Select the Project and select the **Rename** button.

Import and Export

Import... and **Export...** uses a MoTeC M1 Project archive that transfers a Project (with all its available Project versions and revisions) to or from a different location. Importing a Project does not necessarily require the archive to be put into the Project folder. However, the imported Project will be integrated into the Project folder.

☛ *Archives are single files that contain all the information required to correctly install various MoTeC components.*

Delete Revision(s)

If more than one revision is listed for a Project, older revisions can be deleted using the **Delete Revision(s)** option.

Tagging a Revision

The **Edit Tag...** option allows the inclusion of a tag (annotation) to a revision. The tag is displayed in M1 Tune when the user is browsing for a Package.

Create a New Version

To generate a new Project version, select the relevant Project then the **New Version...** option. This is helpful to preserve a former Project version for a future use, without generating a new revision by compiling a Package.

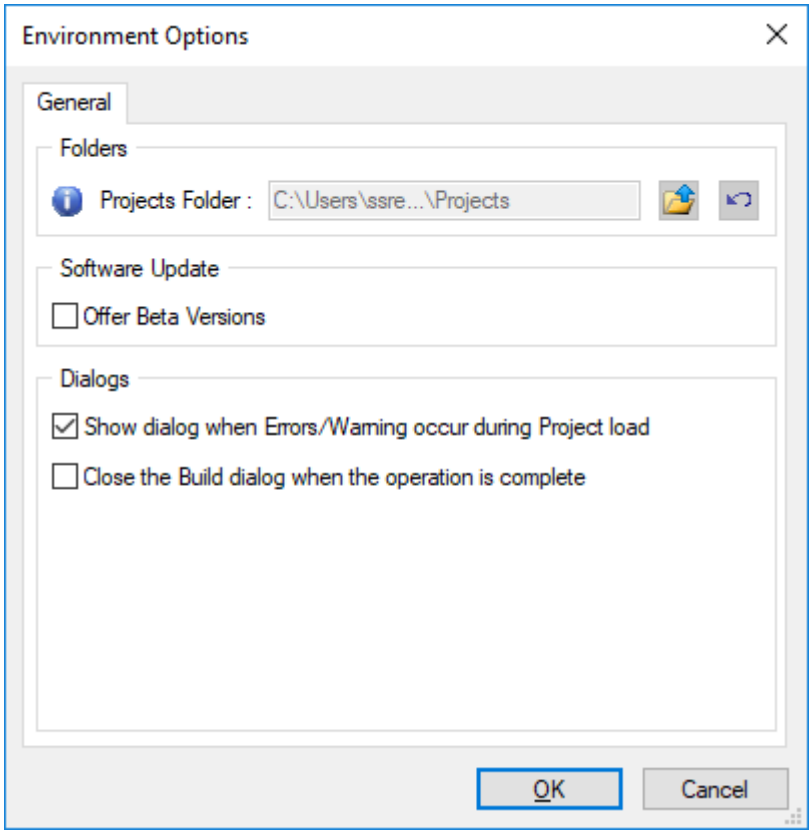
A new Project version created in this manner can then be directly opened as the current working Project.

☛ *Save changes regularly.*

See Important Note - Saving Projects

Project Environment Settings

Set up the Environment Options from the **File > Environment Options** menu.



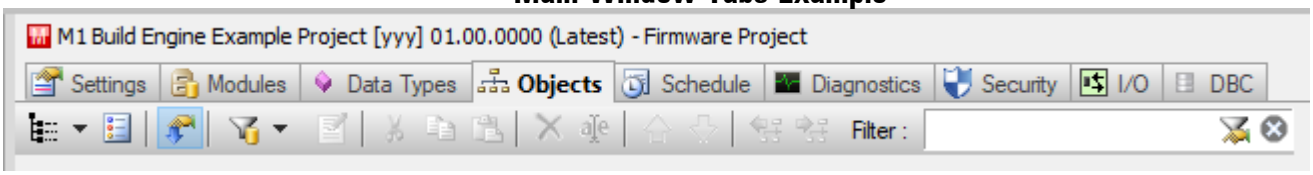
Set the options as required.

☛ *It is strongly recommended that the Projects Folder is not changed.*

Using the Main Window

At the top of the main window, the name of the current Project, the Project version and revision is displayed. Below that name, a number of tabs divide the main window.

Main Window Tabs Example



Each tab is described in the following topics.

Settings Tab

This tab includes basic information about the Project.

The settings can be defined or adjusted at any time. However, it is recommended to do so at the start of each Project. This is because:

- The chosen System Version influences the hardware classes that are available.
- The Target Hardware defines the input and output pins that are made available in the Project.

System

Defines the System Version used by M1 Build and the M1 ECU. See the M1 Development Manual for further explanation of the Package structures.

The System Version influences the hardware classes available. Therefore, changing the System Version in an existing Project may cause undesired changes in the Project and should be avoided.

Target Hardware

Contains information about the specific type of M1 ECU on which the firmware is intended to run, such as the input and output pins that are made available in the Project.

Compilation

Requires the user to select an M1 Development Licence from the drop-down menu.

☛ *M1 Build can be downloaded for evaluation, in which case the user may not have a **Development Licence**. Once a Development Licence has been purchased, the user will be able to download their Development Licence archive from MoTeC Online. After the archive has been installed, the Licence is available to select in M1 Build.*

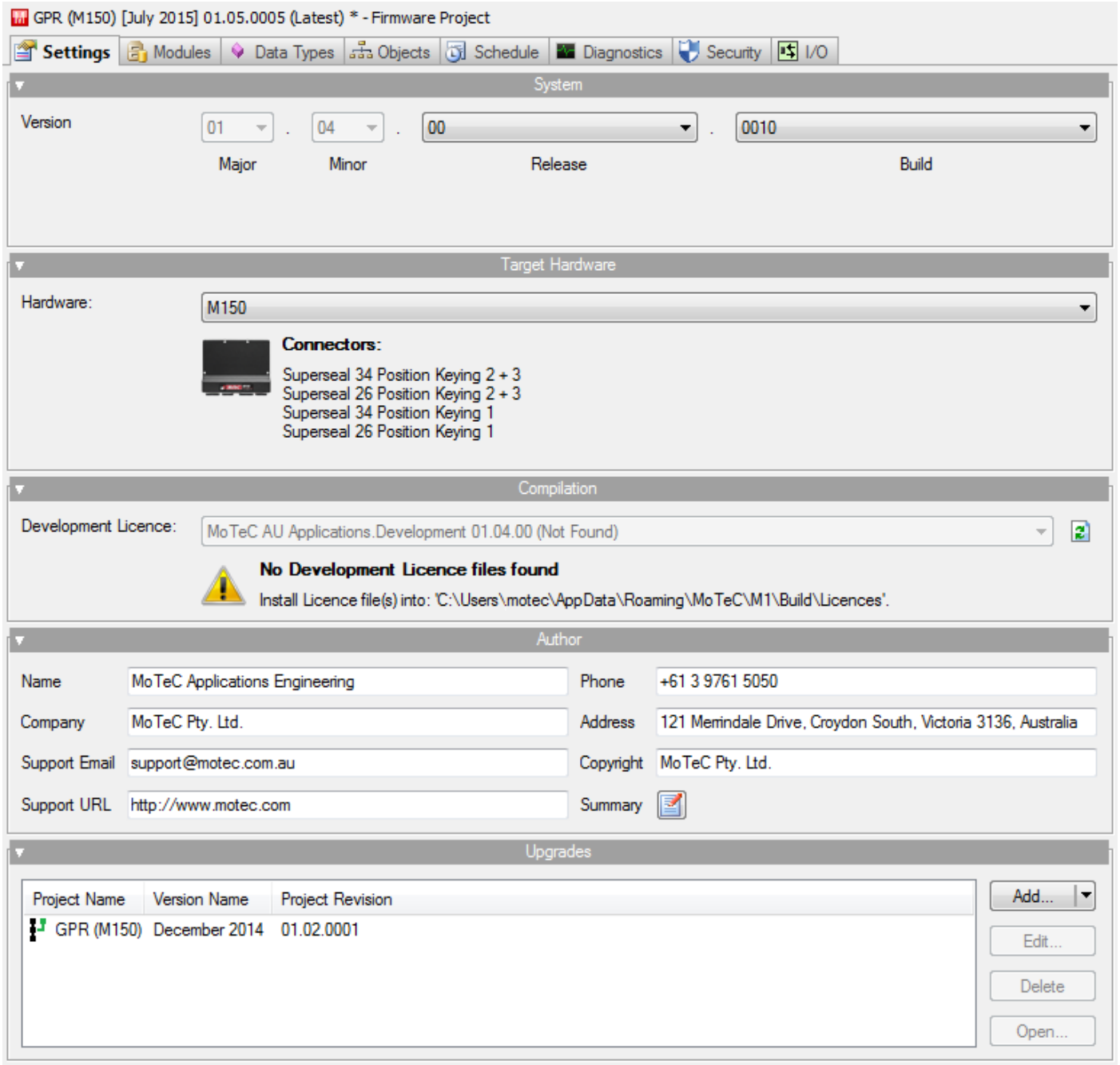
Author

Used to store contact details. The **Summary** button provides a free text formatted text field in which to add pertinent information about the Project. This information is stored with the generated Package and can be accessed in M1 Tune.

Upgrades

This specifies other Projects that this Project 'upgrades' or supersedes. This is automatically populated when a new Project is created from an existing Project.

Settings Tab Example



Modules Tab

☛ *Even if not explicitly mentioned, most commands will also be available in the **Edit** or **View** menus, and the right-click menu.*

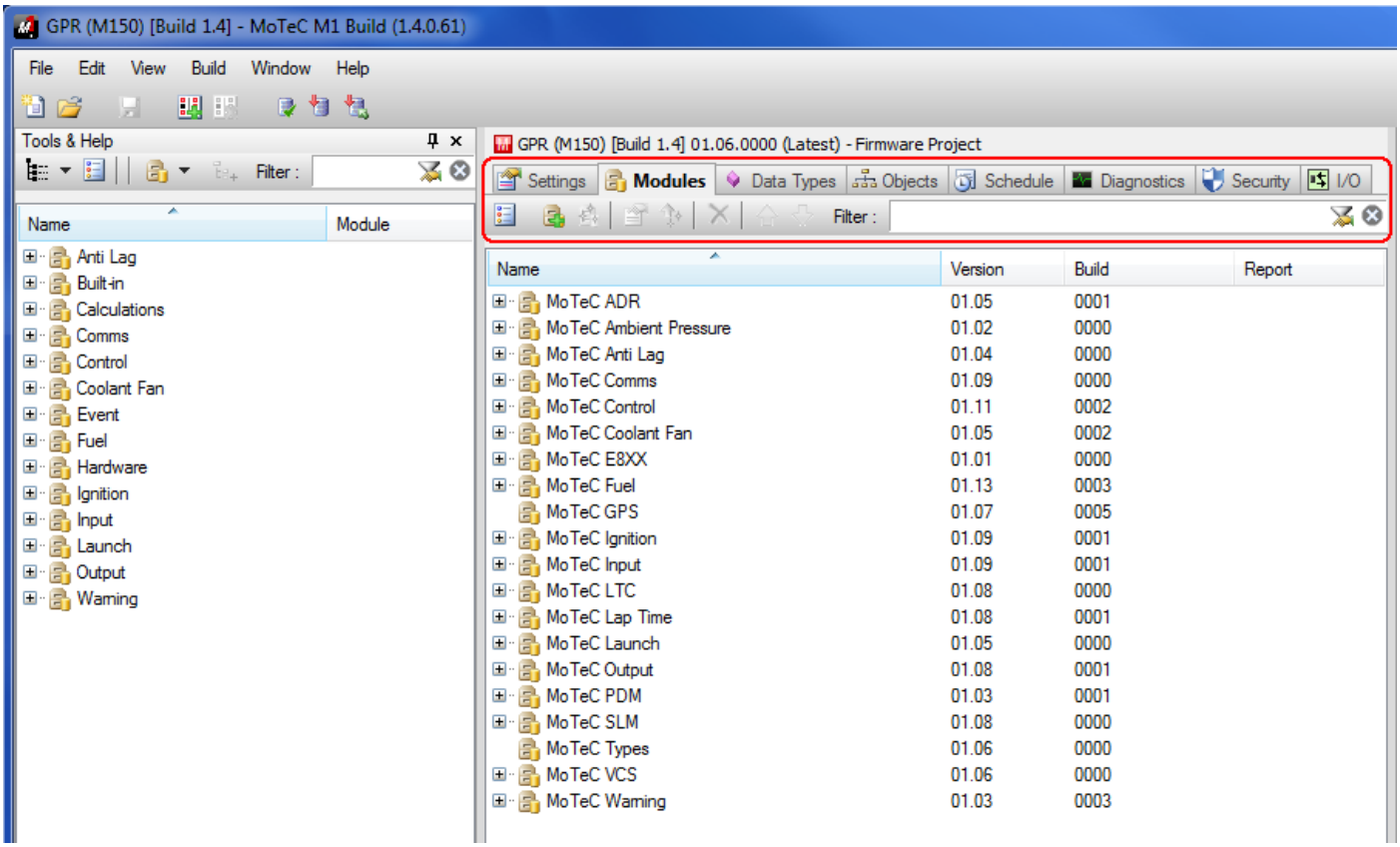
Modules are a collection of fixed, predefined classes and/or data types that can be embedded in the Project.

A common use of classes is to accommodate tasks that are needed often, or to facilitate inclusion of complex tasks where the user is able to set the boundary conditions by adjusting the properties. M1 Build comes with various classes to simplify the building of a Project.

EXAMPLE:
If all input and output pins have to be controlled on a hardware level, it is not necessary to set up the activation of a pin on the hardware level in every Project, as there are predefined classes that fulfil that task. By using these classes, the user only needs to specify the properties, such as the channel or data corresponding to the respective pin and the boundary conditions.
Other classes may comprise basic functions that are needed to run an engine.

Display and Filtering Modules

Modules Tab Example



To sort items in the list display alphabetically, click on the column header. Repeated clicks toggles between ascending and descending order.

To modify the content of list display, click **Columns...** and add, remove or reorder columns as required.

Filtering

To manage the items shown in the list display, enter filter criteria in the **Filtering** box.

For advanced filtering, click  **Build Filter string** to combine several filter criteria and optionally apply the filter to Properties.

Filtering is not case sensitive and wildcard (*) entries can be used.

Filter criteria are applied to all listed items, names and terms and displays results if the criteria matches the full or the initial part of the item, name or term.

Managing Modules

The Modules tab allows administration of the available modules and displays all modules that are currently used.

There is a set of buttons that perform the following functions.

 **Add...** Displays available modules and allows any to be added to the Project.

 **Auto Add** If available for use, it indicates that there are modules available that need to be imported, because other, already imported modules, use classes from these. By selecting the button they are automatically imported. Note that this does not mean that *all available* modules will be imported, only modules which contain classes for existing modules will be imported.

 **Version...** Displays version and build information of the currently selected module. If there are different versions or builds available for a module, the user can choose which one to use.

 **Auto Upgrade** If available for use it indicates that, for at least one module, a newer version is available. If the button is selected, a list of the modules that have newer versions available is displayed, and the user can then select to upgrade these modules to the newer version.

 **Remove** Remove selected module from the Project.

Data Types Tab

☛ *Even if not explicitly mentioned, most commands will also be available in the **Edit** or **View** menus, and the right-click menu.*

This tab provides for the administration of data types, enumerated data types and their enumerators.

Data types define characteristics of values allocated to an object. See the M1 Development Manual for a detailed description of data types.

M1 Build comes with a set of predefined data types.

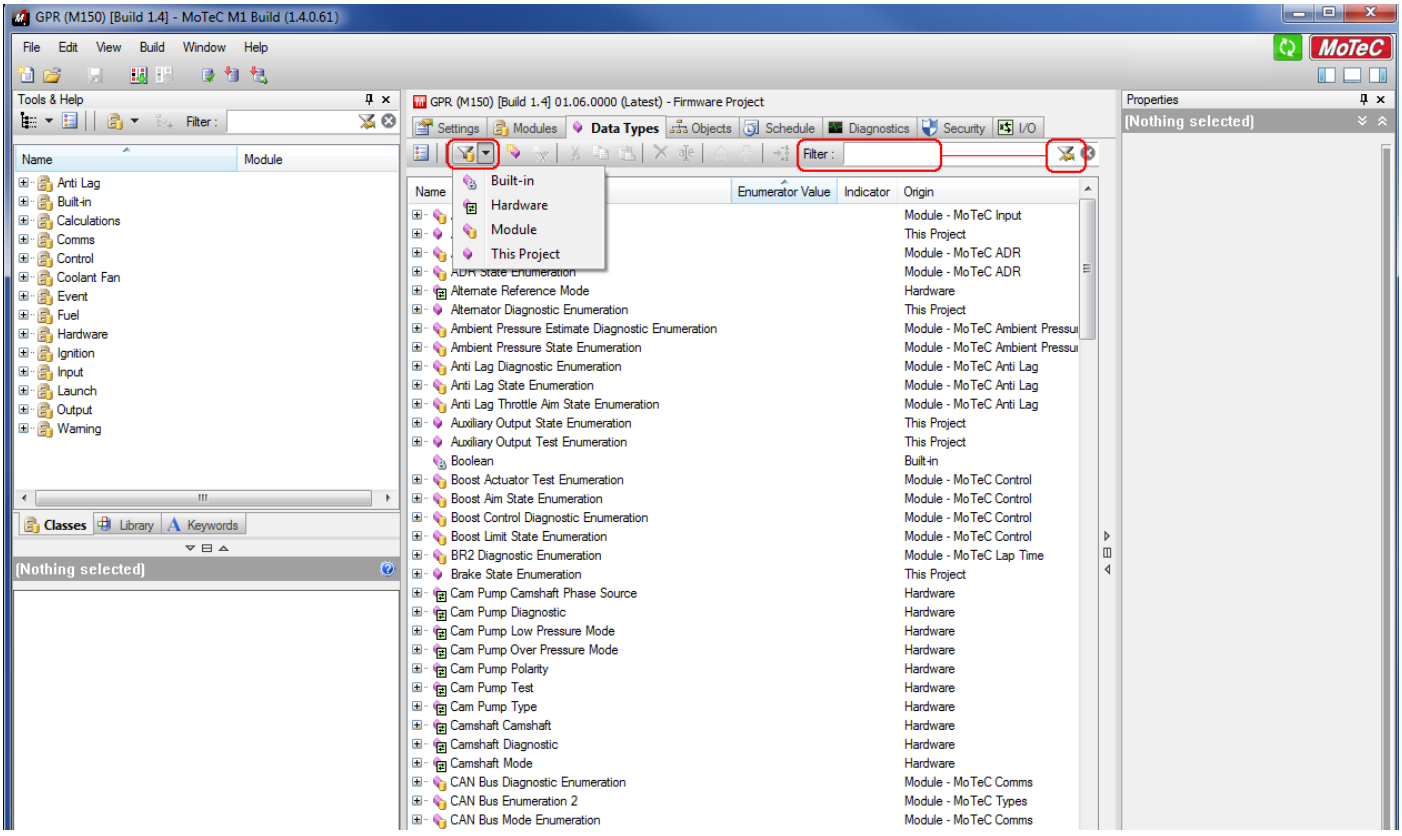
Origin of Data Types

- Built-in:These are default data types that come with M1 Build and are used for the implementation of channels and parameters.
- Hardware: These are data types that are used in the hardware related classes that come with M1 Build.
- Module: These are data types that are used in classes that come with M1 Build but do not refer directly to a hardware component.
- This Project: These are all the user defined data types that are used in the current Project. These are the only data types that can be modified.

See Default Data Types and User Defined Data Types.

Display and Filtering Data Types

Data Types Tab Example



To filter the list display to show only Data Types from one origin (for example Hardware), click **Filter by Origin**.

To sort items in the list display alphabetically, click on the column header. Repeated clicks toggles between ascending and descending order.

To modify the content of list display, click **Columns...** and add, remove or reorder columns as required.

Filtering

To manage the items shown in the list display, enter filter criteria in the **Filtering** box.

For advanced filtering, click **Build Filter string** to combine several filter criteria and optionally apply the filter to Properties.

Filtering is not case sensitive and wildcard (*) entries can be used.

Filter criteria are applied to all listed items, names and terms and displays results if the criteria matches the full or the initial part of the item, name or term.

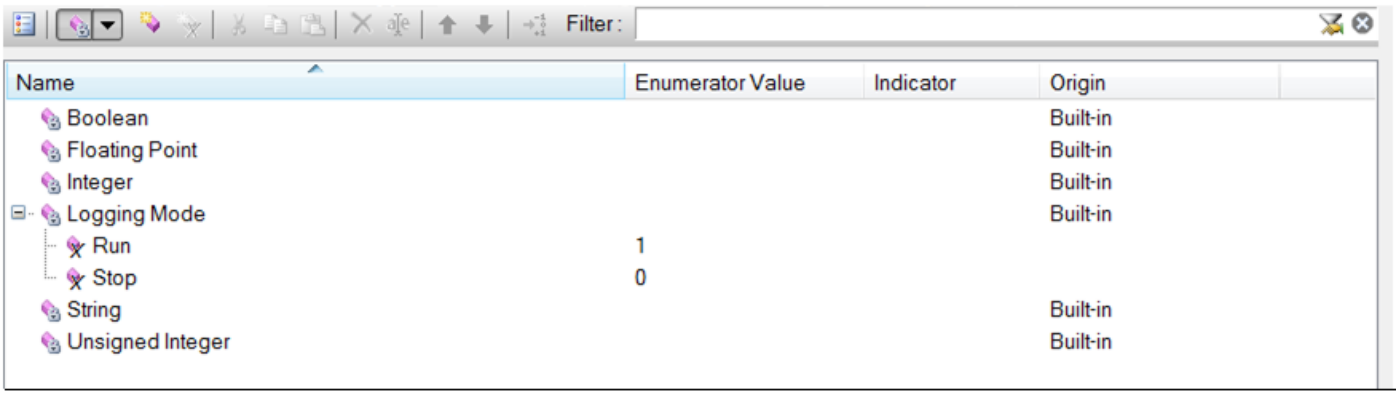
Default Data Types

M1 Build comes with a set of predefined data types (built-in, hardware and module data types). These data types cannot be modified.

Built-in Data Types

The following example shows the built-in data types (using the **Built-in** filter option).

Built-in Data Types Example



Most of these are the basic data types that define the resolution and implementation of channels and parameters.

One of the built-in data types is Logging Mode, which is the default data type for activation and deactivation of data logging in the M1. See Diagnostics Tab or the respective section in the M1 Development Manual.

Hardware and Module Data Types

These data types are used in the predefined M1 Build modules and are tailored for that use.

User Defined Data Types

The only data types that users can specify are enumerated data types.

Naming Convention

☛ *When the name of an enumeration or an enumerator is changed, occurrences of that name in code are not automatically updated.*

The name of an enumeration or an enumerator is restricted as follows:

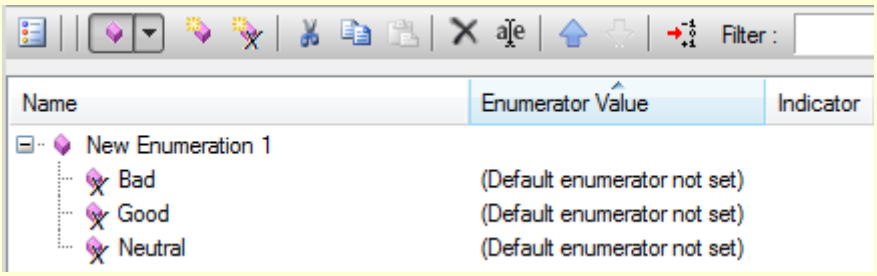
- Must begin with a character
- Must contain only characters, digits or spaces
- Two consecutive spaces are not allowed
- Characters used must not be a keyword of the programming language; such as 'if', 'and', 'false' etc.

Creating and Editing an Enumeration and Enumerators

☛ *Even if not explicitly mentioned, most commands will also be available in the **Edit** or **View** menus, and the right-click menu.*

1. To create a new enumeration, press **Ctrl+T** or use the  button.
2. To create a new enumerator for an existing enumeration, press **Ctrl+E** or use the  button.
   To cut, copy, past, delete or rename an enumeration or enumerator, the following standard Windows buttons can be used.

EXAMPLE:
In the following example, a new enumeration with three enumerators has been created. The enumerators have been named 'Bad', 'Good' and 'Neutral'.

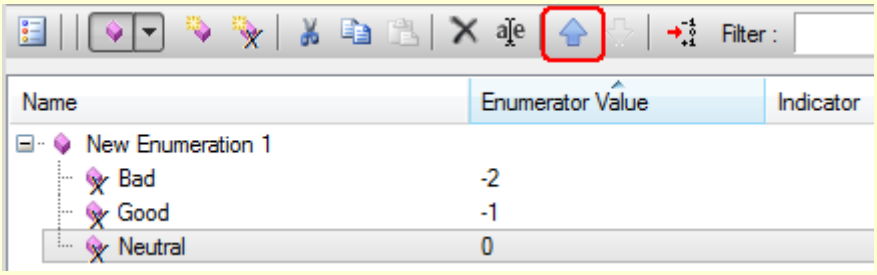


3. Define the enumerator values corresponding to each enumerator.
   As enumerators are internally handled by their enumerator value, **it is essential to assign them**. To do so, use the **Default Value** button .
   The currently marked enumerator will then be assigned a value of zero.

   ☛ *The default value for all data types in a Project is zero. So assigning a value of zero to a certain enumerator means that all objects using this enumeration will be initialised with the enumerator that corresponds to the enumerator value of zero when the M1 is activated.*

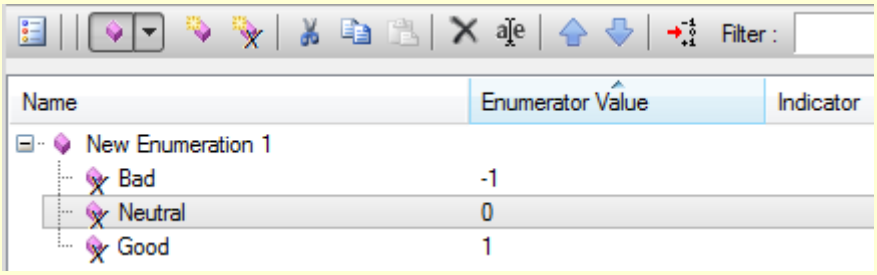
   Enumerators can have both negative and positive enumerator values. When assigning a default value, all enumerators above the selected enumerator will be assigned negative values, and all values below will be assigned positive values.
   Assigning a default value to an enumeration is also possible when the displayed order is defined by a filter or when another column is used as the sorting reference. However, the order assigned to the enumerations always refers to the order that was defined in the Enumerator Value column.

   EXAMPLE:
   In the previous example, it makes sense to assign the default value of Zero to the enumerator 'Neutral'. When done, the Enumerator Value column changes and displays the assigned values, as follows.



4. In the example above, the enumerator 'Good' should have a positive value. To achieve this:
   1. Ensure the Enumerator Value column is selected; otherwise, changing the order is not possible.
   2. Change the order of the enumerators using drag-and-drop, or by using the **Move Up** and **Move Down** buttons, as highlighted in the example above. Alternatively, the **Ctrl+U** and **Ctrl+D** keys can be used.

   EXAMPLE:
   In the above example, clicking the **Move Up** button once leads to the desired result, as shown below.



☛ *When changing the order of the enumerators, the enumerator which is assigned to the default value (zero) always maintains its enumerator value of zero, whereas all other enumerators are always assigned with the enumerator value that corresponds to the relative position of the enumerator to the default enumerator.*

Properties of an Enumerator

On the Properties tab, only the enumerator name can be changed and an indicator assigned. The properties window provides additional editing for an enumerator. This additional information will be displayed in the enumerator list that appears in the Help section of the screen, and also in M1 Tune.

If an indicator is chosen, any channel using the affected enumeration and whose value matches the enumerator, will also contribute to the respective list in M1 Tune. See the M1 Development manual for details.

All information in the Help tab (in the Properties window) of an enumeration or an enumerator will be displayed in M1 Tune. Only the enumerator Help will be shown in the Help window of M1 Build.

The Associations tab (in the Properties window) of an enumeration shows all objects of the Project that use the currently selected enumeration.

Objects Tab

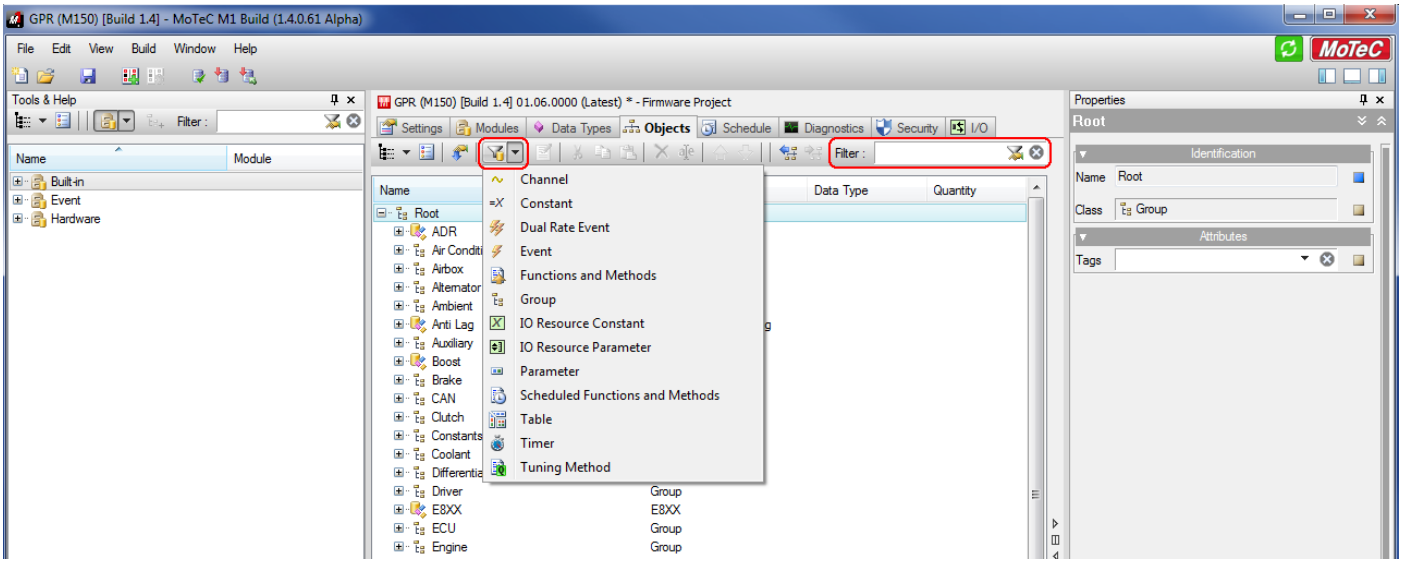
*Even if not explicitly mentioned, most commands will also be available in the **Edit** or **View** menus, and the right-click menu.*

This tab provides for the management of objects in the M1 Project.

Display and Filtering Objects

Also see Object Display Structure Order and Filtering and Other Display Options

Object Tab Example



To sort items in the list display alphabetically, click on the column header. Repeated clicks toggles between ascending and descending order.

To modify the content of list display, click **Columns...** and add, remove or reorder columns as required.

Filtering

To manage the items shown in the list display, enter filter criteria in the **Filtering** box.

For advanced filtering, click **Build Filter string** to combine several filter criteria and optionally apply the filter to Properties.

Filtering is not case sensitive and wildcard (*) entries can be used.

Filter criteria are applied to all listed items, names and terms and displays results if the criteria matches the full or the initial part of the item, name or term.

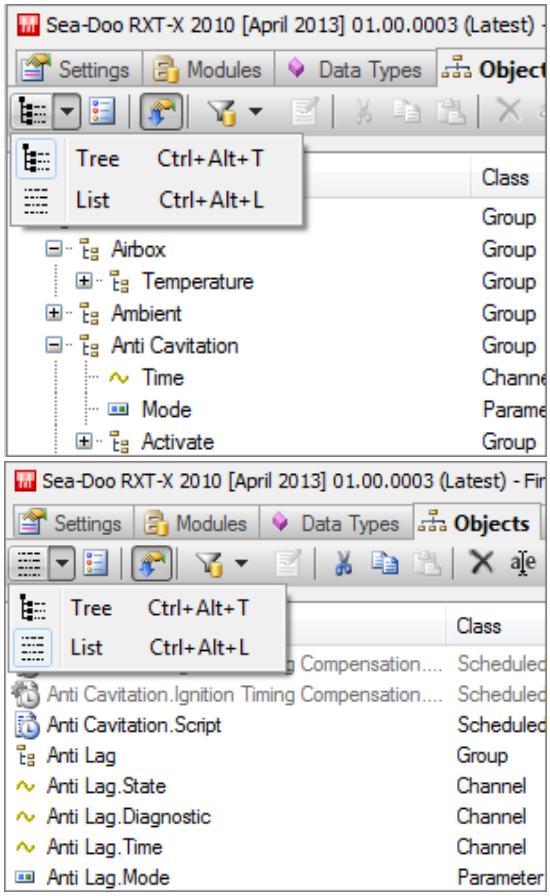
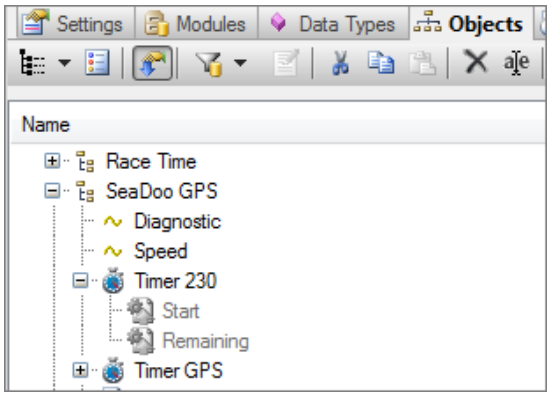
To filter the list display to show only Objects from one class (for example Channel), click **Filter by object class**.

Object Display Structure Order and Filtering

The structure, ordering and filtering of displayed objects behave differently, relative to current display settings.

Also see Display and Filtering Objects and Other Display Options

The toolbar buttons associated with the display functions, and their interrelationships are described below.

Toolbar Button	Behaviour	Examples
Tree or **List** button	This button toggles between **Tree** and **List**. If **List** is selected, the object's group is prefixed onto the name. This is because objects in different groups may have the same name. ☛ *If the **User-specified object order** button is not selected (off), the display is in alphabetical order. If it is selected (on), the order is the user specified order. See explanation of this button below.*	
User-specified object order button	This button toggles off and on. When toggled on, it will display objects in the user defined order, and it will also maintain the current display style, that is - tree or list. The **Move Up** and **Move Down** buttons become active when the **User-specified object order** button is selected. See Moving Objects. ☛ *When using M1 Tune, this is the order in which objects are displayed.*	

☛ *When the display is filtered, all other display settings are honoured. That is, the display style will remain as it was (tree or list) and, if it was on, the user defined order is maintained.*

Other Display Options

The following display options are also available from the relevant toolbar button.

Window Split button. This will cause the object window to be split, and subsequently contracted left or right as required. The object view will be displayed in both windows and each window controlled individually. This allows for two different views that can assist in keeping the program in perspective as objects are moved between different groups.

Also see, Selection History

Selection History

Go Back (**Ctrl+Alt+B**) and **Go Forward** (**Ctrl+Alt+F**) buttons. These buttons change the current selection in the Objects tab.

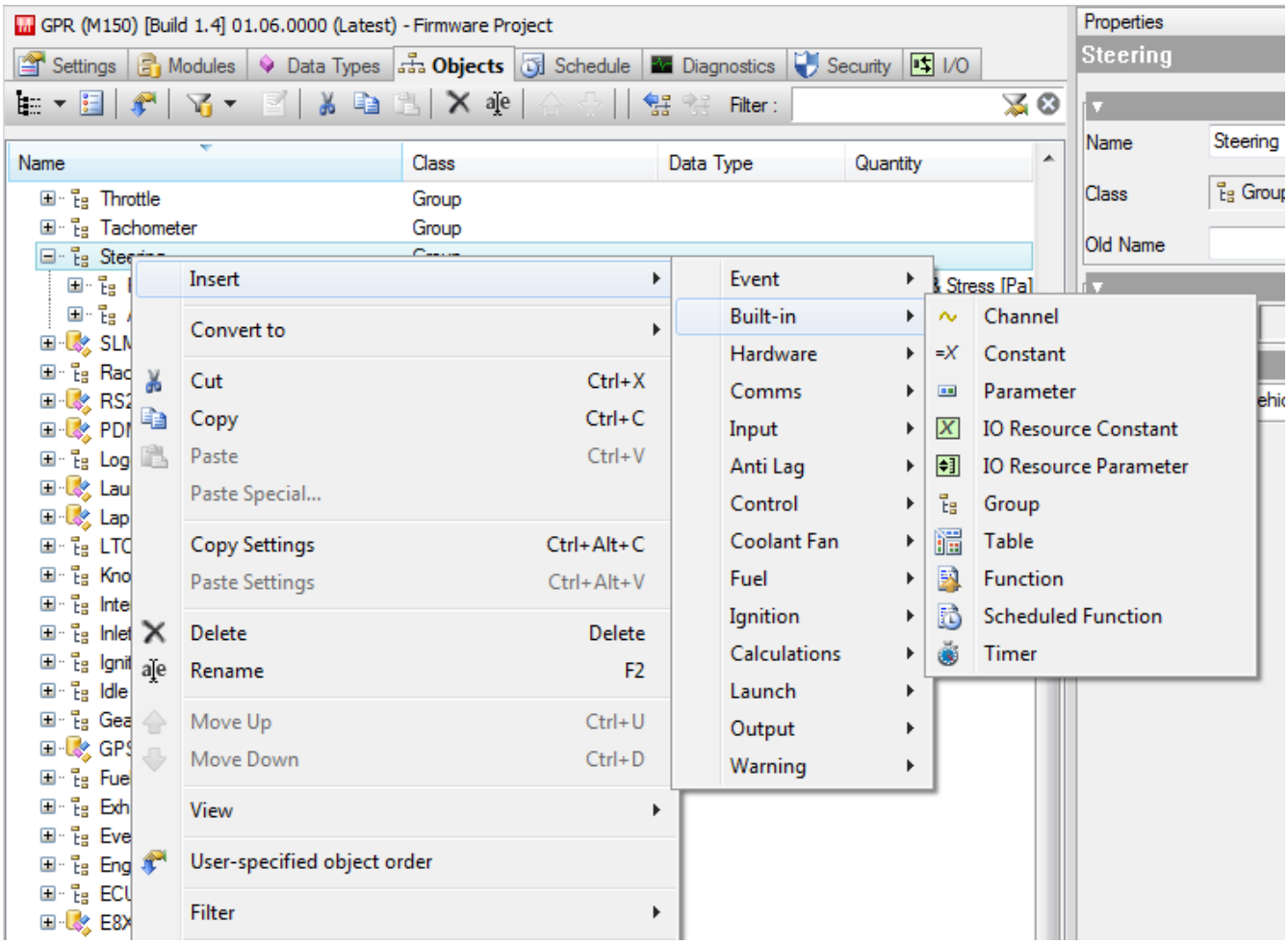
Selecting the **Go Back** button steps the selection through the previously selected objects. Selecting the **Go Forward** button (only applicable if **Go Back** has been used) steps the selection forward to the most recently selected object.

Inserting Objects into a Project

New objects can be inserted in three ways.

1. **Drag-and-drop** an object from the Classes tab in the Tools & Help window to the desired position in the Objects tab.
   A valid drop position is highlighted in green. When dropped on a green highlight, the class is appended at the end of the current object tree.
   Another valid drop position is indicated by an insertion bar that appears across the window. When dropped on an insertion bar, the class is inserted at that location in the object tree.
   Locations where it is not possible to insert the chosen object will not display an insertion bar or be highlighted (for example, a parameter cannot be inserted into a channel, but only into a group).
2. **New Object**  button in the Tools & Help toolbar or **Ctrl+I**.
   Select the target location in the Objects window, and the desired object to insert from the Tools & Help window, then insert the object.

3. **Using the right-click menu**. Select the target location in the Objects window, bring up the right-click menu and select the required object from the sub menu of the Insert option.
   Only objects that can be inserted at the chosen target location are listed in the right-click menu. For example:



Moving Objects

Move Up and Move Down Buttons

☛ *This is the recommended method for arranging the order of objects within a group.*

The **Move Up** and **Move Down** buttons become active when the **User-specified object order** button is selected.

These buttons only allow the movement of objects within a group. To move a group, or to move elements from one group to another, the drag-and-drop method must be used.

☛ *When using M1 Tune, the **User-specified object order** is the order in which objects are displayed.*

Drag-and-Drop

This method allows movement of objects in a group or between groups and adjusting the order of groups. With this method, all cross references within the Project are maintained when the object is moved into another group. This means that all references to the object in functions or links are adjusted automatically.

Cut, Copy and Paste

These standard functions can also be used to change the position of an object. However, the cross-referencing of moved objects within the Project will not be maintained.

Naming Conventions

The naming of an object is restricted as follows:

- Must begin with a character
- Must contain only characters, digits or spaces
- Two consecutive spaces are not allowed
- Characters used must not be a keyword of the programming language; such as 'if', 'and', 'false' etc.

☛ *When the name of an object is changed, all references in the Project to that object are automatically updated.*

Editing Objects

To cut, copy, paste, delete or rename an object, the following standard Windows buttons can be used.

Editing occurs in the Objects tab and Properties window.

The **Properties tab** of the Properties window defines features of the object that can be edited. These are different for each type of object.

The **Help tab** of the Properties window contains text that can be edited and displayed in M1 Tune when the object is selected.

The **Associations tab** of the Properties window displays all places where the chosen object is used in the current Project. This is automatically populated and cannot be edited.

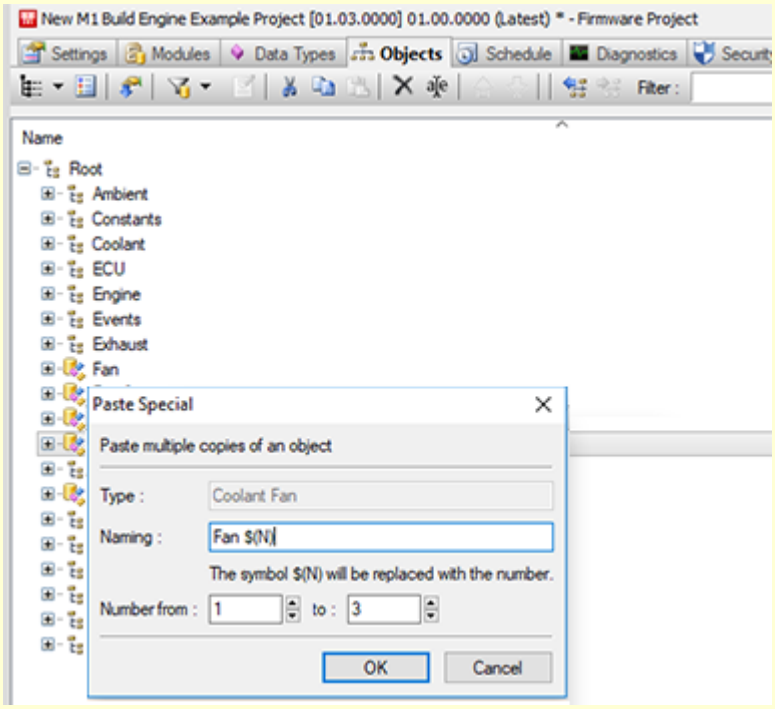
Specific unique editing functions are available via the right-click menu. These are described in the following sections.

Paste Special...

In the **Edit** menu and in the **right-click** menu, a **Paste Special...** option is available that allows pasting multiple versions of a copied object.

EXAMPLE:

In this example, parameter 'Fan' was copied and is currently in the clipboard. Using **Paste Special...**, the parameter can be pasted multiple times, in this example the parameter will be pasted 3 times, assigning the names Fan 1, Fan 2 and Fan 3.



Copy and Paste Settings

In the **Edit** menu and in the **right-click** menu, **Copy Settings** and **Paste Settings** options are available.

Copy Settings copies all property definitions of the selected object.

Paste Settings pastes all compatible property definitions to the selected object.

These functions allow for easy transfer of property settings to other objects, without the need to type in all settings every time a similar object is included in a Project.

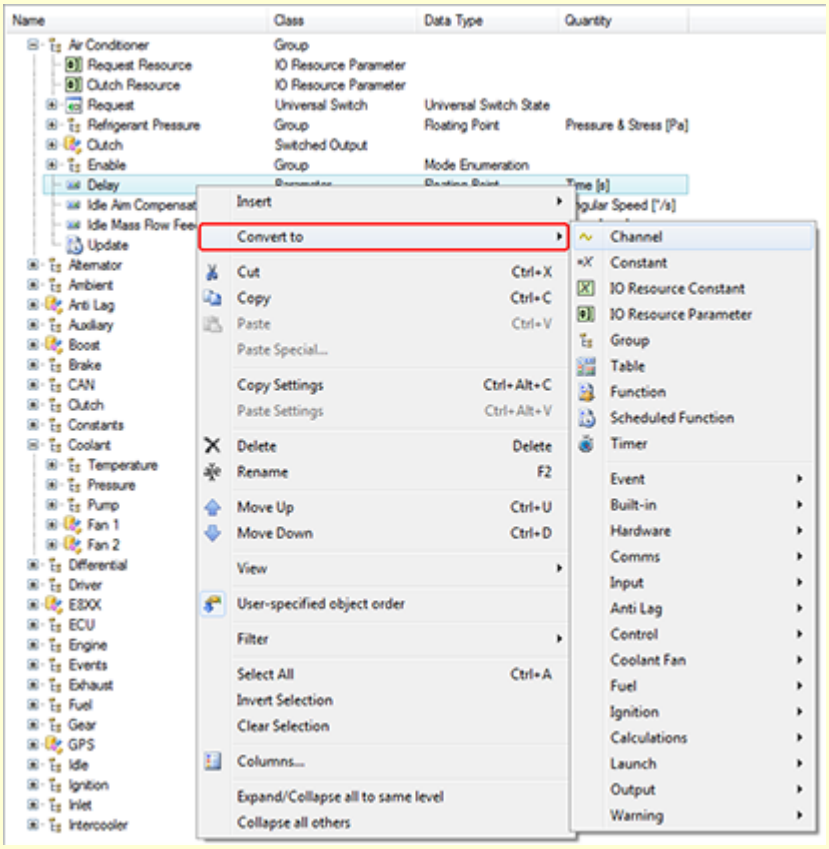
☛ *The target object does not have to be of the same type. If the target object type is different, all conforming or compatible property settings are copied, all other property settings remain unchanged.*

Convert to

This function is only available in the **right-click** menu.

The function enables the user to change the object type (class). Conforming property settings are maintained.

EXAMPLE:
In this example, the selected object of a type 'Parameter' is about to be converted to a 'Channel'.

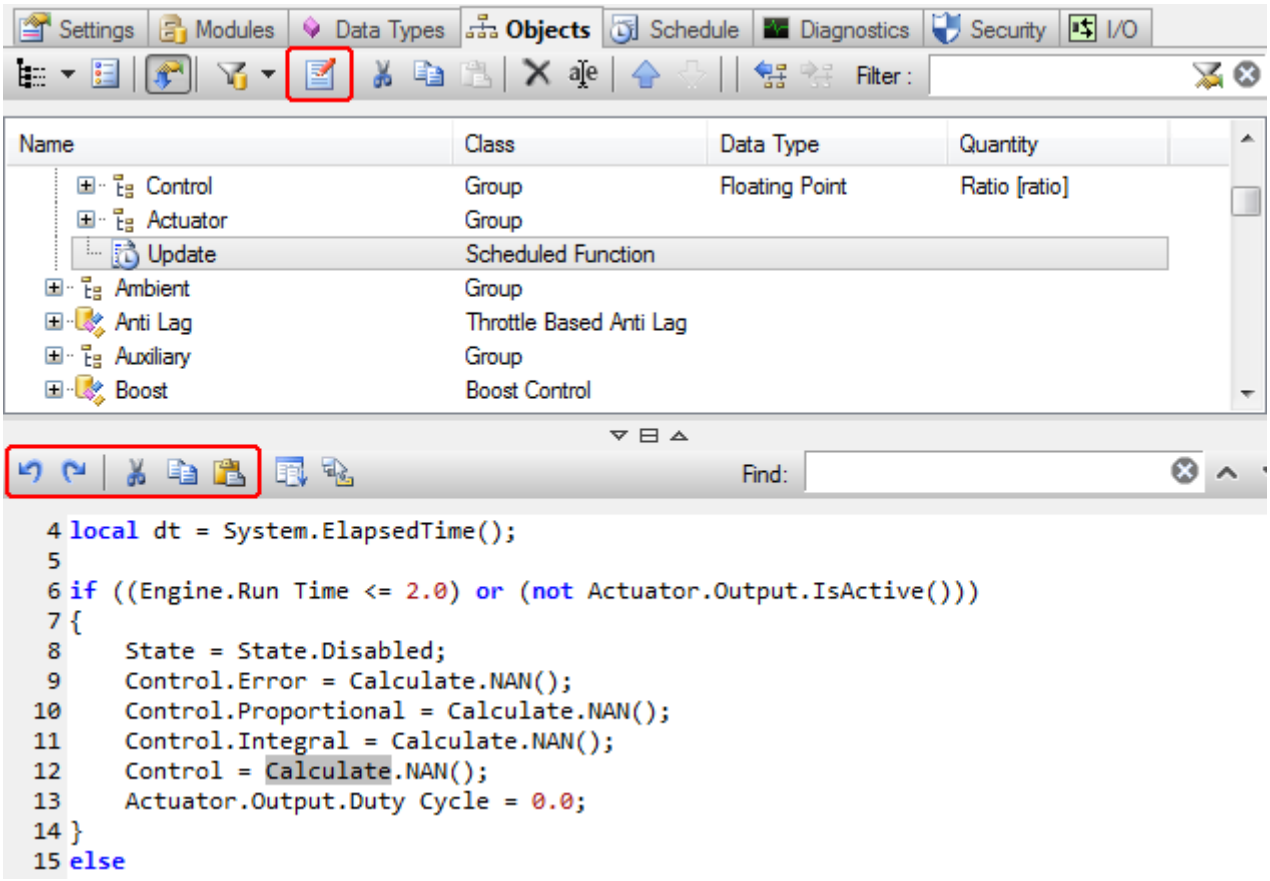


Editing Code

Only calibration methods, functions and scheduled functions can contain code.

To access the code editor, double-click on the object or select the **Edit** button.

Editing Code Example



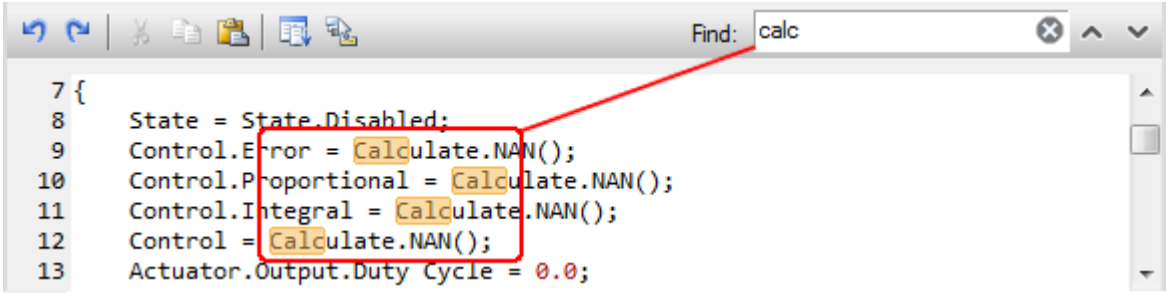
Use the standard **Undo**, **Redo** and editing buttons as shown above.

See the M1 Development Manual for information on structuring code.

Find

Typing into the Find field highlights matching text in the code editor.

Find Code Example



Using **Ctrl-F** while the cursor is positioned at a letter or number will carry over the whole word or number into the Find field and highlights the occurrences in the code accordingly.

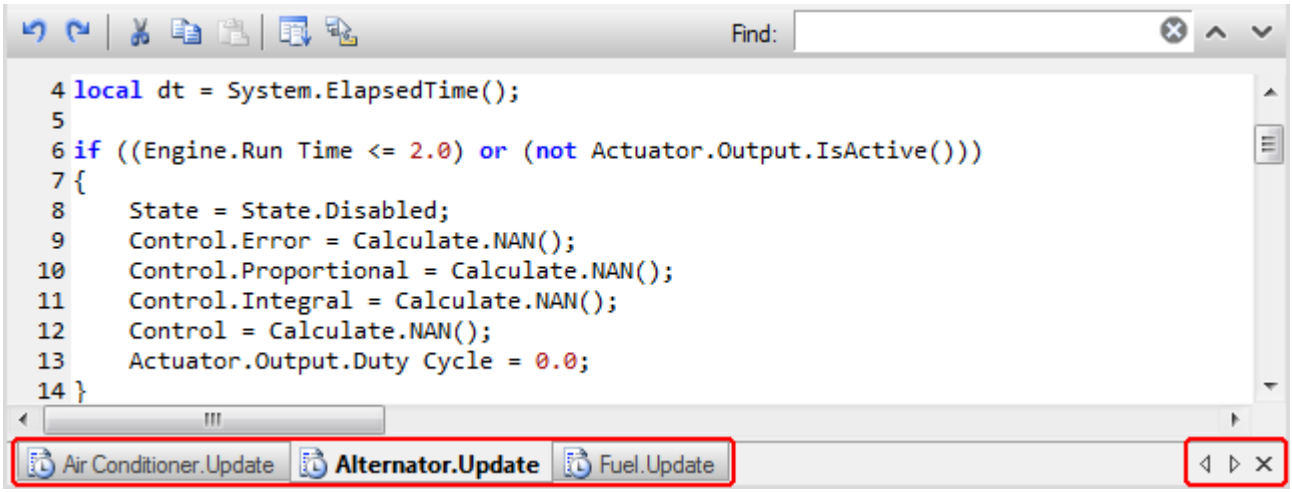
The selection can be cleared by using the button. The buttons can be used to scroll through the occurrences of the current selection in the code.

Multiple Code Editor Tabs

More than one code editor can be opened at a time. Each code editor pane has its own tab placed horizontally along the bottom of the code editor pane.

The buttons below the code editor pane, on the right-hand side, can be used to scroll through the tabs, the **X** button can be used to close the currently displayed code editor.

Multiple Code Editor Example



Formatting Code

To assist with a helpful code structure, using the **Tab** key will create an indent to the right from the cursor position, using the **Shift+Tab** key will remove a right indent. This is helpful in making code more readable. See M1 Development Manual for details.

A complete line or multiple lines can be indented at one time by selecting the lines before using the **Tab** key.

Renaming Local Variables

A local variable can be renamed by placing the cursor anywhere in the variable and selecting the **Rename** from the right-click menu.

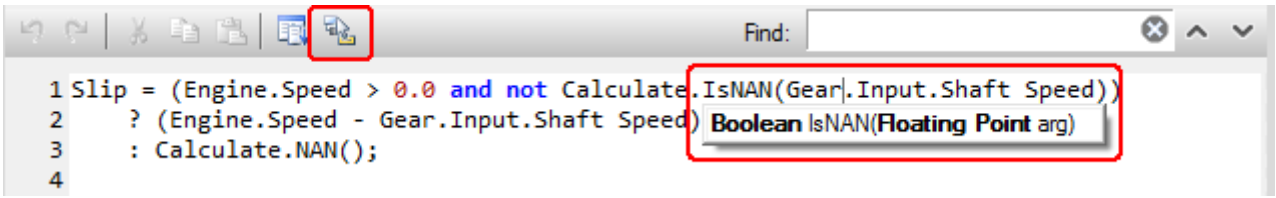
Renaming a local variable in this fashion will rename all occurrences of that local variable in the code.

☛ *Editing the name of a local variable by directly typing in the code **will not** rename other occurrences of that local variable.*

Function and Parameter Information

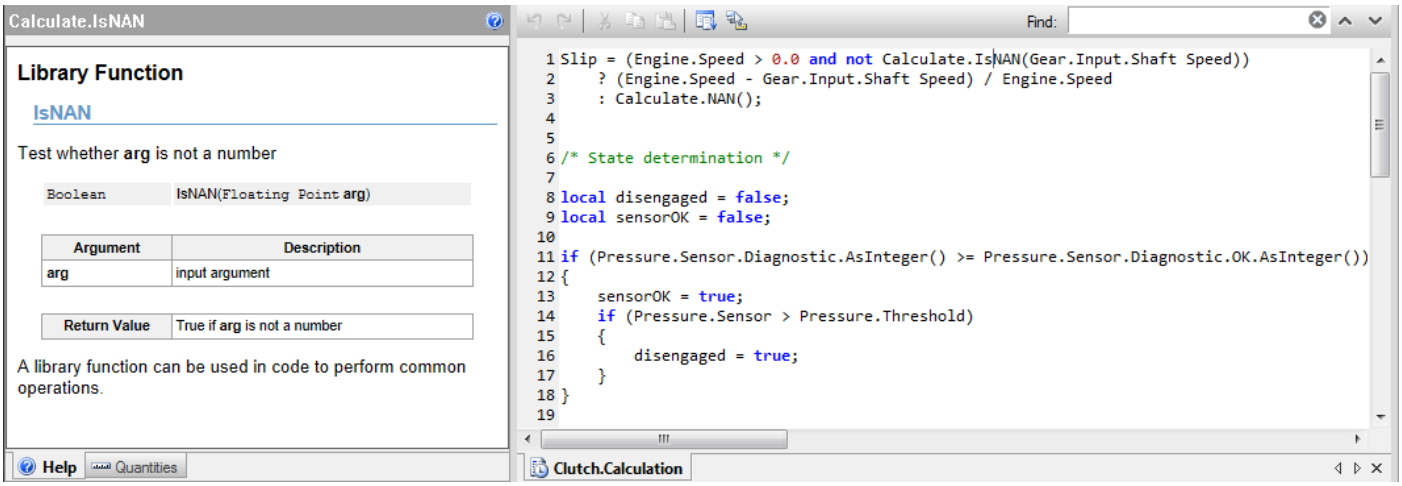
To display function parameters, place the cursor inside the parenthesis of a function and either select the **Show Parameter Info** button (**Ctrl+Shift+Space**) or select **Show Parameter Info** from the right-click menu.

Show Parameter Example



When the cursor is placed in the function name, all accessible information about the function will be displayed in the 'Tools & Help' window.

Function Help Example



Autocomplete Function

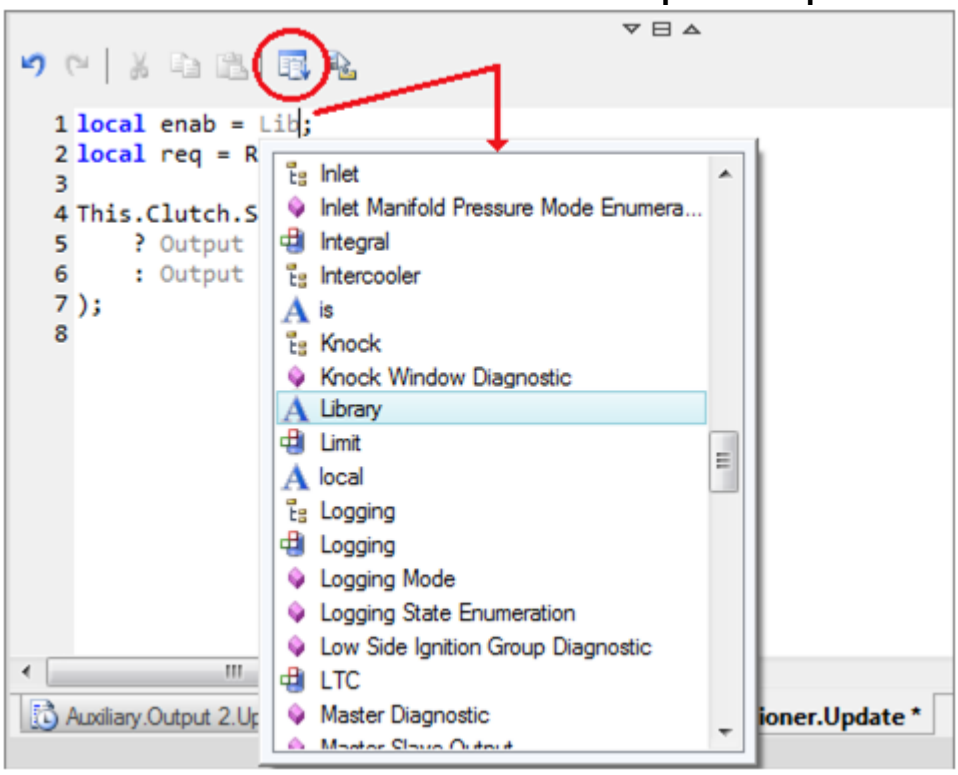
To simplify code generation, M1 Build provides an autocomplete function for user-defined objects as well as libraries and data types. When active, M1 Build will automatically show a list of selectable object options matching the currently typed characters (not case sensitive), the closest match being highlighted.

To activate autocomplete and display the list, either select the **Show Autocomplete** button (**Ctrl+Space**) or select **Show Autocomplete** from the right-click menu.

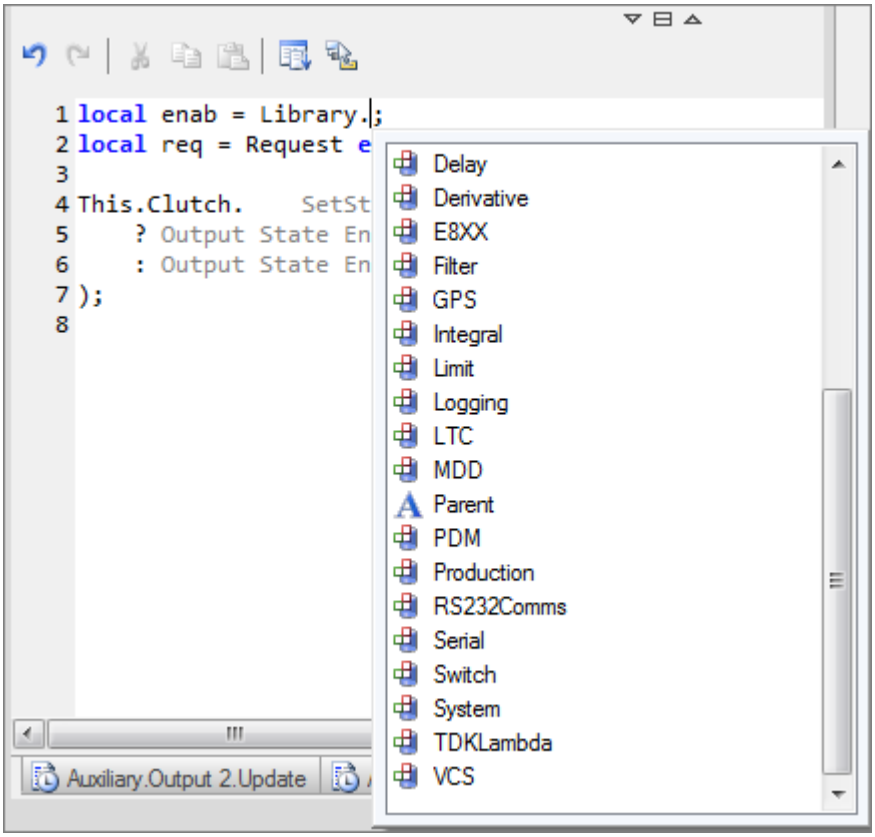
The list can be scrolled with the mouse or arrow keys and a selection inserted with a double-click, the **Enter** key or a dot (.).

The dot is useful if there is a child or sub part that follows as it both completes the term and displays a further selection list (if relevant). For example, an enumeration is selected which must be followed by one of its enumerators, both of them divided by a dot. In the example below, a dot is entered after 'Lib' is typed.

Autocomplete Example



...



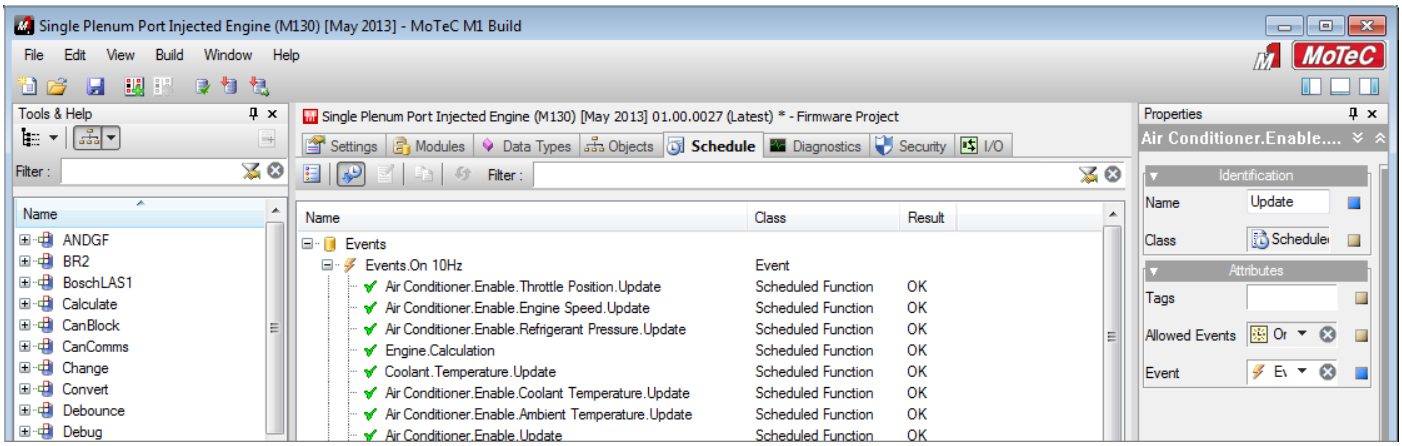
Schedule Tab

☛ *Even if not explicitly mentioned, most commands will also be available in the **Edit** or **View** menus, and the right-click menu.*

As M1 Build automatically determines the sequence of all tasks that need to be scheduled, the Schedule window is mainly for reference.

Display and Filtering Schedules

Schedule Tab Example



To sort items in the list display alphabetically, click on the column header. Repeated clicks toggles between ascending and descending order.

To modify the content of list display, click  **Columns...** and add, remove or reorder columns as required.

Filtering

To manage the items shown in the list display, enter filter criteria in the **Filtering** box.

For advanced filtering, click  **Build Filter string** to combine several filter criteria and optionally apply the filter to Properties.

Filtering is not case sensitive and wildcard (*) entries can be used.

Filter criteria are applied to all listed items, names and terms and displays results if the criteria matches the full or the initial part of the item, name or term.

Code Editing

Double-clicking on a Scheduled Function or selecting the  **Edit** button will switch the display to the Objects tab, display the code editor and open the selected function.

Circular Dependencies

M1 Build detects circular dependencies between different functions and identifies how well these dependencies are resolved.

The icon next to each object's name indicates the status of its scheduling order. Two arrows indicate that M1 Build detected a circular dependency to at least one other object. Also, how M1 handles the dependencies is shown in the Results column.

 Indicates that there was no problem in determining the event order for this object.

 Indicates that a reasonable process flow was found to resolve the circular dependency.

 Indicates that objects are dependent on each other and an unambiguous process flow could not be determined. M1 Build sorts the related objects into an event order with the least interference between the objects.

 Indicates that the circular dependencies could not be managed by M1 Build. The event order reverts to the literal list order shown in the Objects tab.

Select the  **View Circular Dependencies Group** button to display further information about the dependencies.

See the M1 Development Manual for details about scheduling and how to avoid circular dependencies.

Diagnostics Tab

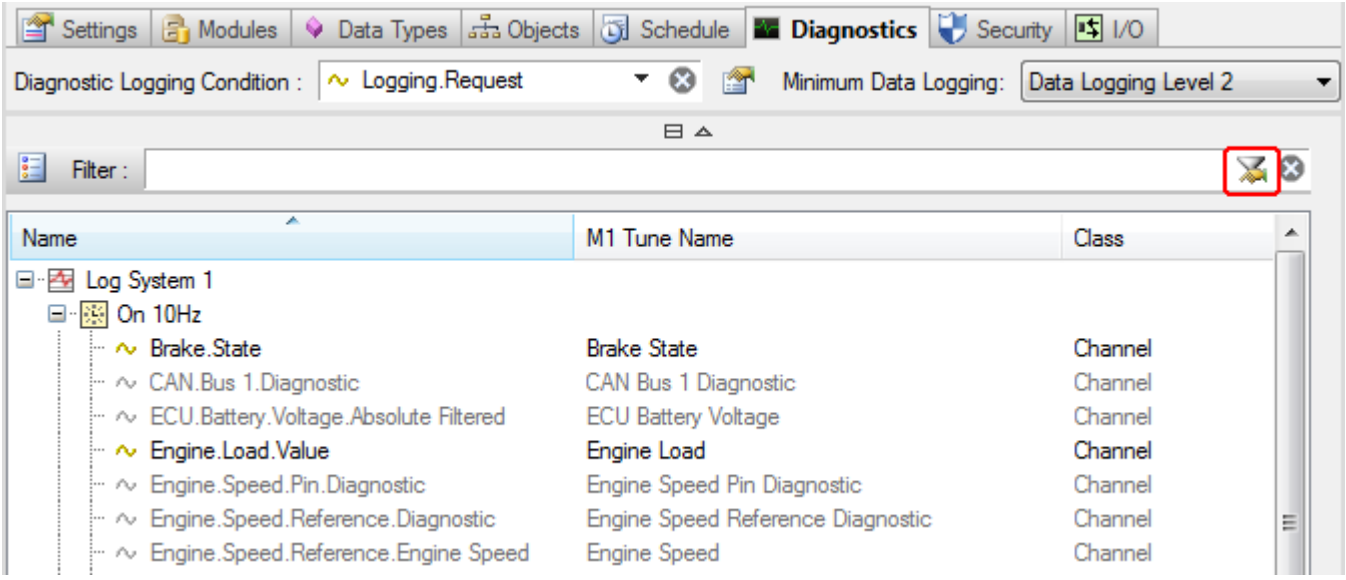
☛ *Even if not explicitly mentioned, most commands will also be available in the **Edit** or **View** menus, and the right-click menu.*

This tab is used to manage diagnostic setup.

Channels that are selected for diagnostic logging are mandatorily logged in M1 Tune when logging is active.

Display and Filtering Diagnostics

Diagnostics Tab Example



To sort items in the list display alphabetically, click on the column header. Repeated clicks toggles between ascending and descending order.

To modify the content of list display, click **Columns...** and add, remove or reorder columns as required.

Filtering

To manage the items shown in the list display, enter filter criteria in the **Filtering** box.

For advanced filtering, click **Build Filter string** to combine several filter criteria and optionally apply the filter to Properties.

Filtering is not case sensitive and wildcard (*) entries can be used.

Filter criteria are applied to all listed items, names and terms and displays results if the criteria matches the full or the initial part of the item, name or term.

Defining Channels for Diagnostic Logging

Each channel of the Project can be selected for diagnostic logging by ticking the Diagnostic Logging checkbox in the Attributes section of the Properties window (this is done from the Objects tab).

To remove a channel from the diagnostic list, deselect the Diagnostic Logging checkbox of the relevant channel on the Diagnostic tab or from the Objects tab. Channels that are part of a fixed predefined class that are defined for diagnostic logging (indicated by a grey tick in the checkbox) can be removed by deselecting the Diagnostic Logging checkbox exposed by their parent class.

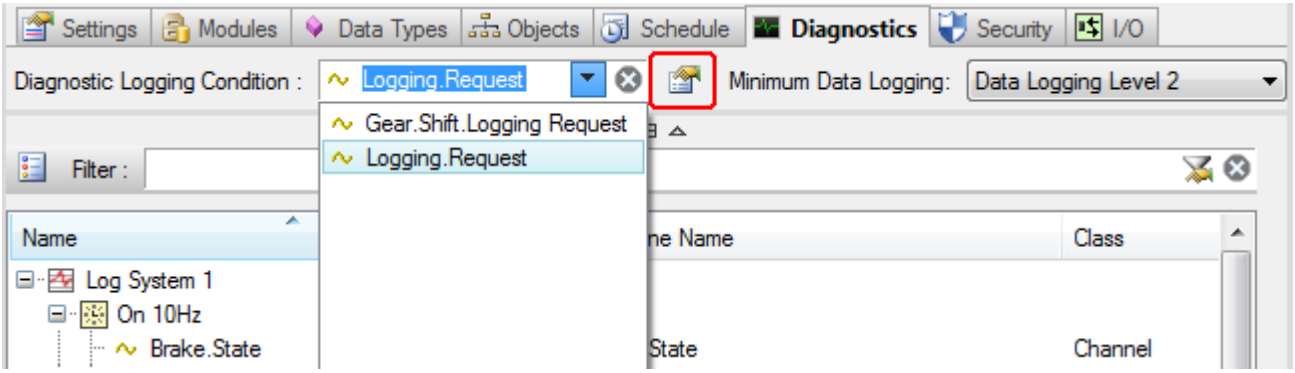
Defining the Diagnostic Logging Condition

If at least one channel of the current Project is selected for diagnostic logging, it is necessary to define a logging condition. This determines when logging for the selected diagnostic channels is active in the ECU. The conditions set in M1 Build cannot be changed in M1 Tune.

Only channels with the data type **Logging Mode** can function as a valid logging activation condition. A channel with that data type must be defined in the Project by the user. **Logging Mode** is a built-in data type of M1 Build.

All channels that have the data type **Logging Mode** defined in the Project will be listed in the Diagnostic Logging Condition drop-down list, see example below.

Example of Channels with Data Type Logging Mode



Alternatively, selecting the button highlighted above will open the Select Diagnostic Logging Condition window, which provides greater scope for viewing and filtering available Logging Mode channels.

Security Tab

☛ *Even if not explicitly mentioned, most commands will also be available in the **Edit** or **View** menus, and the right-click menu.*

The security settings can be configured to enforce restricted access (by user) to certain Project objects and configurations in M1 Tune.

There are four security levels available:

- **Off**
  No restrictions apply to any user in M1 Tune; additionally, no further restrictions can be defined in the Package by M1 Tune.
  In the M1 Build Project, no further configuration is necessary for this security setting.
- **Basic**
  As a default, no restrictions apply to any user in M1 Tune, but it is possible in M1 Tune to set up security permissions for different users (however it is not possible in M1 Tune to group channels into different permission groups).
  In M1 Tune, defined security permissions will be saved with the Package. A change in the security permissions requires only a change in the Package and not in the M1 Build Project.
  In the M1 Build Project, no further configurations are necessary for this security setting.
- **Advanced**
  In the M1 Build Project, security permissions are predefined.
- **Automatic**
  In the M1 Build Project, security permissions are automatically applied based on the tags assigned to an object.

  ☛ *All the existing security groups and users will be deleted and new security groups will be automatically created from tags.*

  Any change in these security permissions, therefore, requires a change in the M1 Build Project and the generation of a new firmware version.

☛ *In this manual, only the handling of the M1 Build menus and options is addressed. See the M1 Development Manual for further information about the handling of security permissions.*

Display and Filtering Security Settings

To sort items in the list display alphabetically, click on the column header. Repeated clicks toggles between ascending and descending order.

To modify the content of list display, click  **Columns...** and add, remove or reorder columns as required.

See Security Groups on how to show objects that do not belong to a group at the top of the list.

Filtering

To manage the items shown in the list display, enter filter criteria in the **Filtering** box.

For advanced filtering, click  **Build Filter string** to combine several filter criteria and optionally apply the filter to Properties.

Filtering is not case sensitive and wildcard (*) entries can be used.

Filter criteria are applied to all listed items, names and terms and displays results if the criteria matches the full or the initial part of the item, name or term.

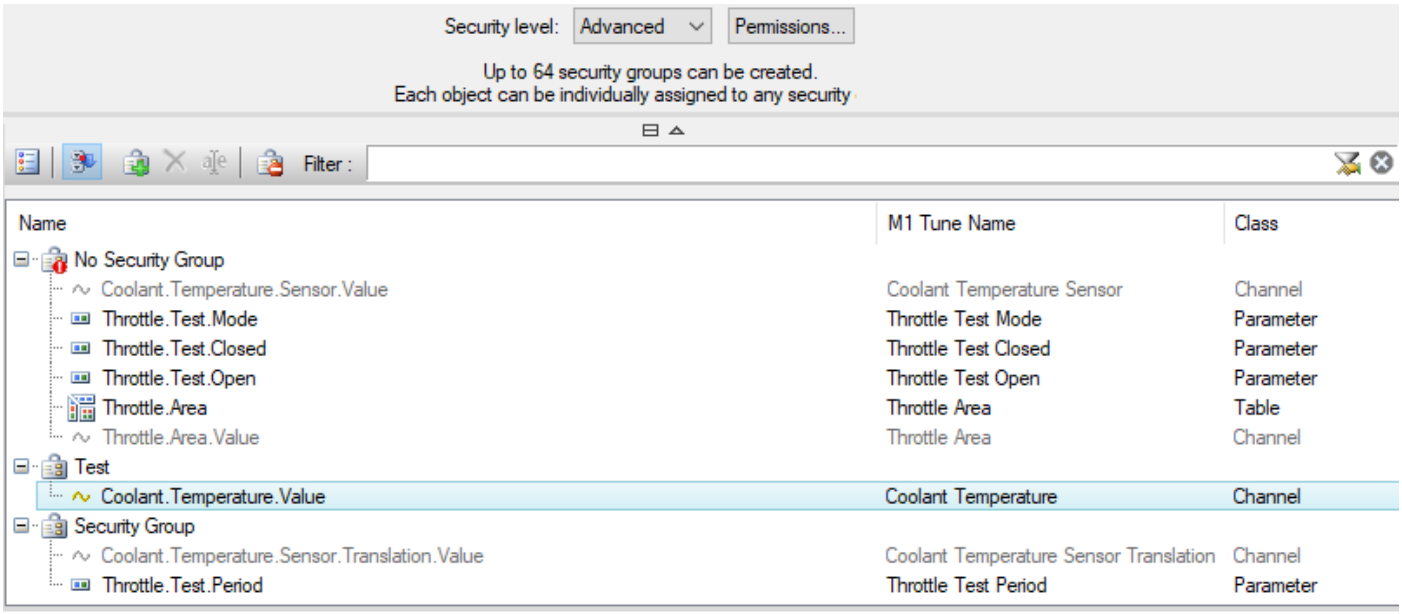
Setup Advanced Security

For this security level, all channels, tables and parameters must be assigned to a security group.

Security Groups

The **Show errors at top of the list** button displays the No Security Group at the top of the list, as in the example below. Objects that are not assigned to a defined group are automatically listed in the No Security Group (which is not a valid security group).

No Security Group Example



Managing Groups

The following toolbar buttons are provided.

Add new Group button will create a new security group, which can then be populated with objects. Objects can be assigned to a security group using drag-and-drop.

Delete button deletes the group. Objects from the deleted group remain in a pseudo group of the same name until moved. This pseudo group is only a placeholder and cannot be used for any security management.

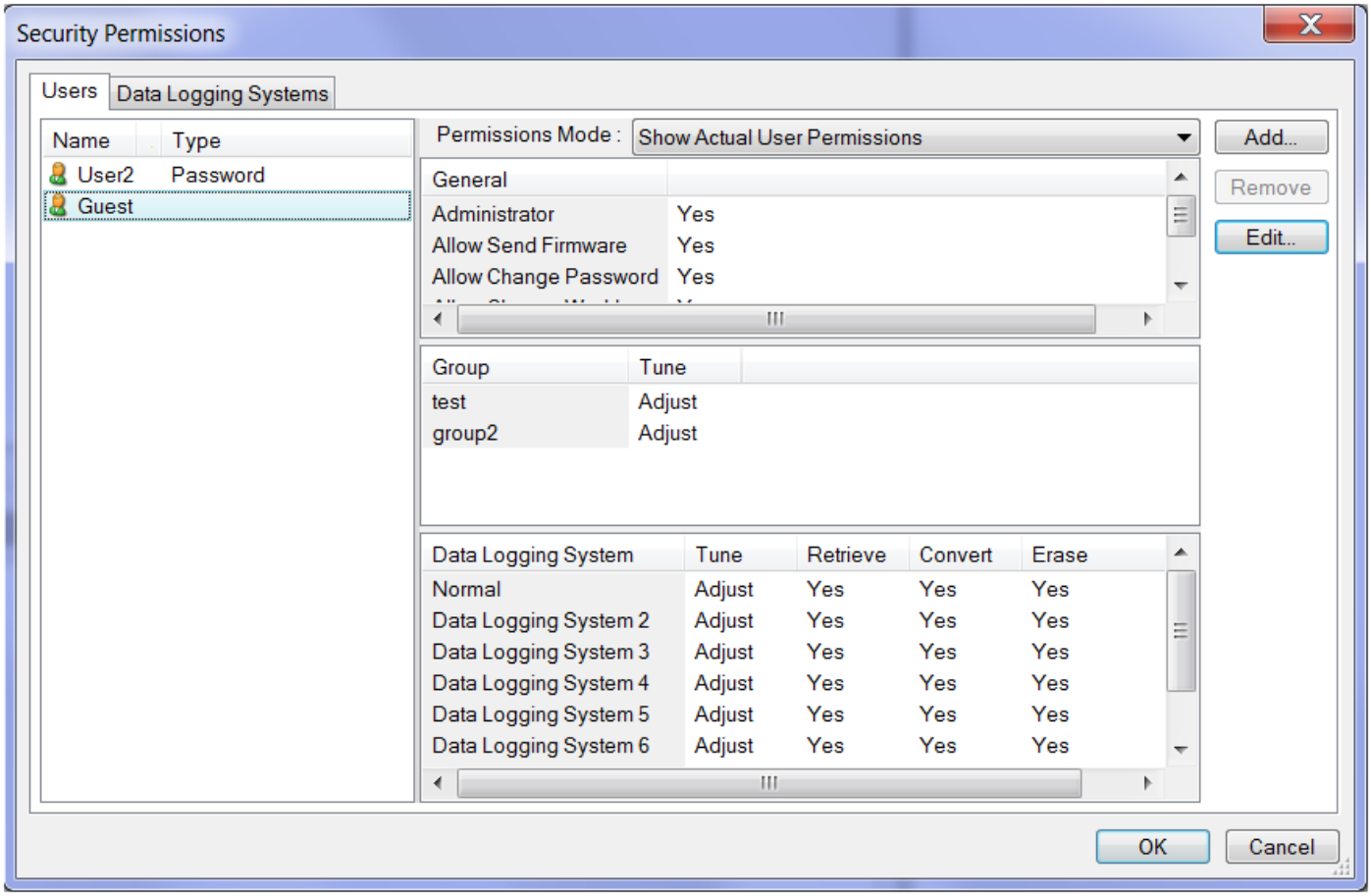
Rename button is used to rename the group.

Remove from Group button (**Ctrl+R**) removes an object's security group assignment. The object is automatically placed into the No Security Group.

Security Permissions

Selecting the **Permissions** button opens the Security Permissions window.

Security Permissions Example



The User tab pane on the left lists all defined users. The **Add...**, **Remove** and **Edit...** buttons provide the function their names imply.

The information in the middle pane of the window displays a read-only overview of permissions. Changes can be made using the **Edit...** button to change user-specific permissions, or via the Data Logging Systems tab.

The Permission Mode setting can be set to **Show Actual User Permissions**, which refers only to the currently selected user, or **Show Effective User Permissions...**, which shows a merge of the permissions of the currently selected user and the Guest user (as all users have Guest user permissions, regardless of other defined restrictions).

In the Data Logging Systems tab, a name can be specified for each of the eight data logging systems available in M1; these names are used in M1 Tune. The security groups permitted to be logged within each Data Logging System can be specified. The users' logging permissions can be set for each Data Logging System.

I/O Tab

☛ *Even if not explicitly mentioned, most commands will also be available in the **Edit** or **View** menus, and the right-click menu.*

This tab provides an overview on the use of all ECU hardware resources and their respective input/output assignments. The I/O window is mainly for reference.

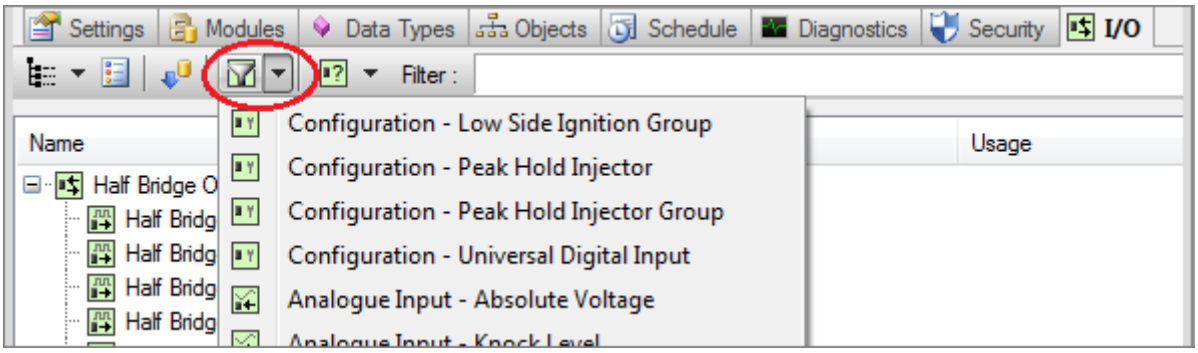
The resource assignment can be seen in the **Usage** property column.

Display and Filtering I/O Assignments

The following display options are available from the relevant toolbar option.

The **Tree** or **List** button toggles the display between a **Tree** and **List** view. The list option includes the group name, but not as a prefix - that is, the group name is not displayed relative to its members.

Hardware Database sort order button arranges resources in the same order as used in the hardware database.



To sort items in the list display alphabetically, click on the column header. Repeated clicks toggles between ascending and descending order.

To modify the content of list display, click **Columns...** and add, remove or reorder columns as required.

Filtering

To manage the items shown in the list display, enter filter criteria in the **Filtering** box.

For advanced filtering, click **Build Filter string** to combine several filter criteria and optionally apply the filter to Properties.

Filtering is not case sensitive and wildcard (*) entries can be used.

Filter criteria are applied to all listed items, names and terms and displays results if the criteria matches the full or the initial part of the item, name or term.

To filter the list display to show only I/O from one type (for example Digital input), click **Filter by I/O type**.

To toggle the list display between used I/O and unused I/O in the Project, click **Show all used/unused I/O**.

DBC Tab

☛ *Even if not explicitly mentioned, most commands will also be available in the **Edit** or **View** menus, and the right-click menu.*

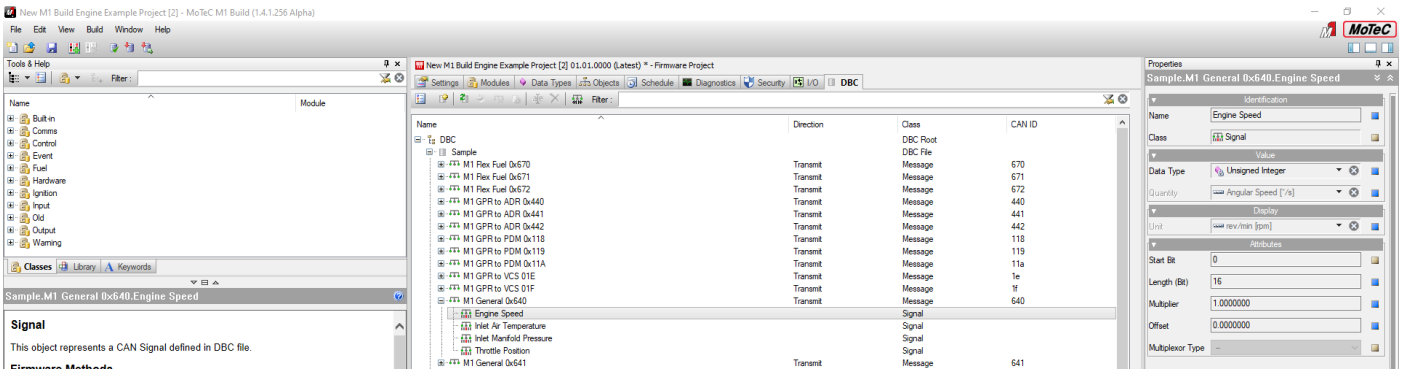
A DBC file (Vector CAN database file) can be imported in the Project. This defines the structure of the CAN messages and signals and simplifies the CAN scripts.

Properties for each message are imported from the file. Only the **Direction** - `Off, Transmit or Receive` needs to be set.

Properties for each signal are imported from the file. Only the **Data Type** needs to be entered.

Display and Filtering DBC

DBC Tab Example



To sort items in the list display alphabetically, click on the column header. Repeated clicks toggles between ascending and descending order.

To modify the content of list display, click  **Columns...** and add, remove or reorder columns as required.

Filtering

To manage the items shown in the list display, enter filter criteria in the **Filtering** box.

For advanced filtering, click  **Build Filter string** to combine several filter criteria and optionally apply the filter to Properties.

Filtering is not case sensitive and wildcard (*) entries can be used.

Filter criteria are applied to all listed items, names and terms and displays results if the criteria matches the full or the initial part of the item, name or term.

Managing DBC files

To import a DBC file into the project, select the root **DBC** and use  **Add DBC** to create a DBC object and name it.

To manage DBC files in the Project, ensure the DBC object is selected (not a message or signal) to enable the following commands:

To import data, use  **Import from file...**

When the DBC source file is changed, use  **Update DBC** to automatically import all changes.

To set the **Direction** of all messages to `Off`, use  **Turn off all messages**

All unused messages in the DBC can be removed by  **Remove unused messages**

To rename the DBC object, use  **Rename**.

To delete the DBC object, use  **Delete**.

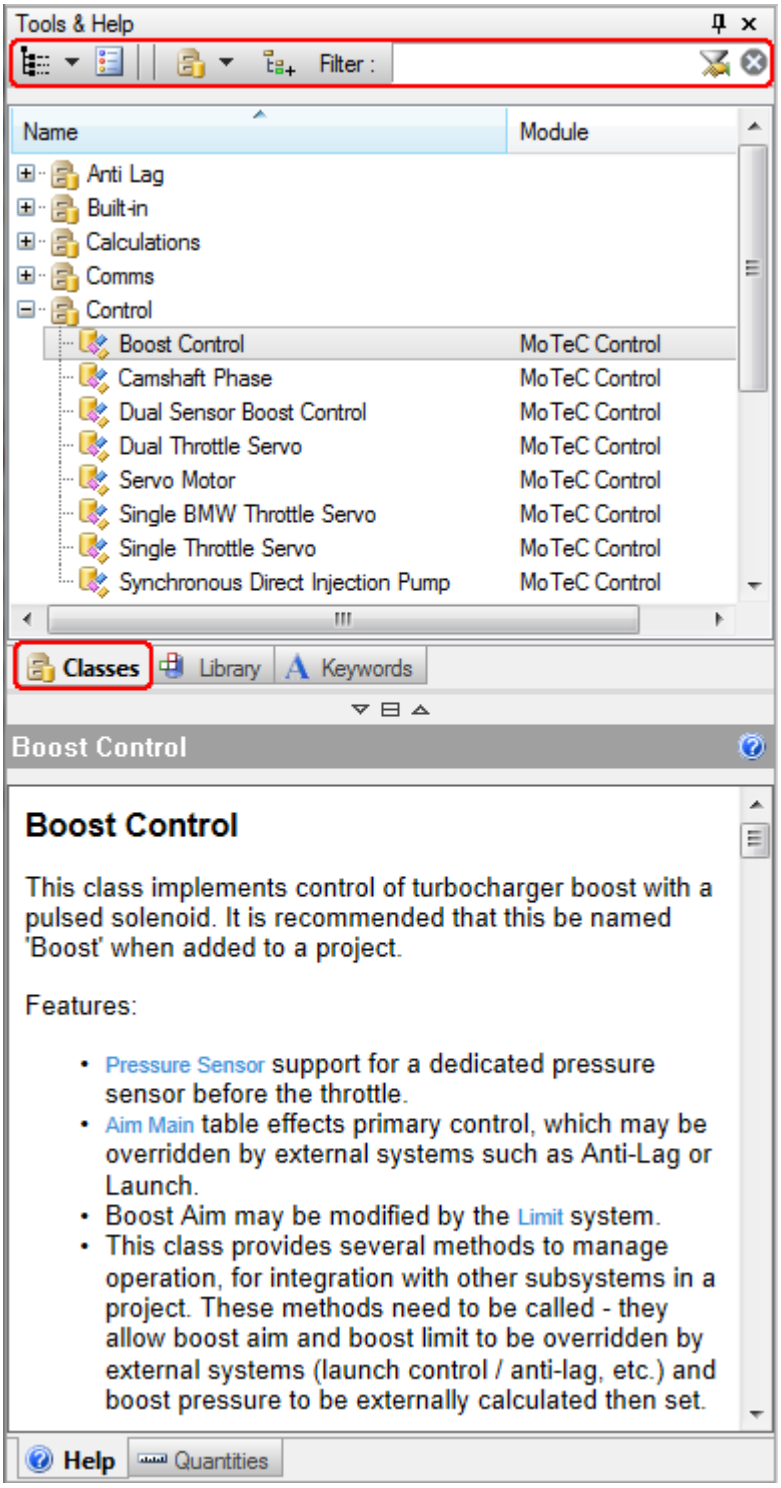
Using the Tools & Help Window

The Tools & Help window is at the left side of the screen. The top pane is the Tools section that is comprised of three tabs displayed along the bottom of the pane: Classes, Library and Keywords.

The bottom pane is the Help section that is comprised of two tabs displayed along the bottom of the pane: Help and Quantities.

The toolbar buttons that appear at the top of each pane vary depending on the tab selected.

Example Tools & Help window highlighting toolbar buttons on the Classes tab



Classes Tab

This tab displays all imported classes available in the project. See Managing Modules for information about importing classes.

Toolbar Buttons

The **Tree** or **List** button toggles the display between a **Tree** and **List** view.

Columns... button displays a dialogue box that lists available information and allows adding or removing columns displaying that information.

The display order can be modified by clicking on the column header. This will sort the items, relevant to the selected column, in an ascending or descending alphabetic order (each mouse click will toggle between ascending and descending order).

Filter by Module button provides a list of modules. The display is then filtered by the selected module.

New Object (**Ctrl+I**) button. If an object is selected in the Objects tab of the main window, a class can be inserted by using this button. The class is inserted at the location marked. If the type of class cannot be inserted at the marked location, it is inserted in the parent group. This occurs whether the Objects tab is currently displayed or not. If it is not currently displayed, the Objects tab will automatically display in the main window.

A **Filter** string can be entered in the Filter field so that only items that match the filter criteria are shown.

When entering a filter string, the filtering is not case sensitive and wildcard (*) entries are allowed.

Alternatively, you can use the **Build Filter string** button to not only define a filter string but to also apply the filter to Properties.

The defined filter criteria is applied to all listed items, names or terms available in the tab. A result will be displayed when the criteria matches an item, name or term. A result is also displayed if the string matches the initial part of an item, name or term.

Library Tab

This tab shows the available libraries and the included functions that come with M1 Build.

These library functions can be seen as an extension of the programming language, as they provide program structures or calculations that are often used but do not exist as a single command in the programming language.

Toolbar Buttons

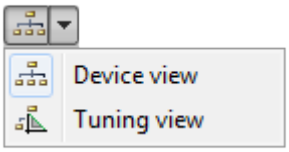
The **Tree** or **List** button toggles the display between a **Tree** and **List** view. If **List** is selected, the libraries group is prefixed onto the name. This is because libraries in different groups may have the same name.

A **Filter** string can be entered in the Filter field so that only items that match the filter criteria are shown.

When entering a filter string, the filtering is not case sensitive and wildcard (*) entries are allowed.

Alternatively, you can use the **Build Filter string** button to define a filter string.

The defined filter criteria is applied to all listed items, names or terms available in the tab. A result will be displayed when the criteria matches an item, name or term. A result is also displayed if the string matches the initial part of an item, name or term.



Device view button. The library function list can be filtered by Device view or Tuning view by using this button.

Device view will show the functions that can be used in a scheduled function or function.

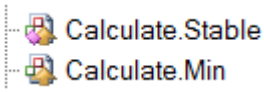
Tuning view will show the functions that can be used in a tuning method.

Alternatively, it is possible to arrange the order of the library functions in ascending or descending alphabetical order of the respective property by clicking on the corresponding column name bar.

In the Objects tab, if at least one code editor is open (at the lower side of the window) and a library function is selected (by choosing **Insert library function into code** either by **Ctrl+I** or the respective button ( )), this function will be inserted at the current or last position of the cursor in the code that is currently activated in the lower section of the Objects tab.

☛ *This will also happen when the main window view is not on the Objects area. The view of the main window will automatically change to this view.*

The two different kinds of library functions can be distinguished by their icons:



Functions with a purple diamond in the icon are called upon for every execution of a scheduled function. Therefore, they cannot be used inside conditional expressions. In the previous example, Calculate.Stable checks the stability of an input for a certain time, which can only be done by continuous calculation of the function.

In contrast, to calculate a minimum of two or more inputs, e.g. Calculate.Min, the function only needs to be called at the time this comparison result is needed.

User Library

MoTeC's M1 Integration Tool generates User Libraries from models developed in Simulink®. These libraries can be imported in an M1 Build project. More information can be found in the M1 Integration Tool User Manual.

Keywords Tab

This tab shows all available keywords and operators used by the M1 Programming Language.

By selecting an item, additional information concerning this item will be displayed in the 'Help' section in the upper part of the window.

A **Filter** string can be entered in the Filter field so that only items that match the filter criteria are shown.

Operators cannot be filtered.

When entering a filter string, the filtering is not case sensitive and wildcard (*) entries are allowed.

Alternatively, you can use the **Build Filter string** button to define a filter string.

The defined filter criteria is applied to all listed items, names or terms available in the tab. A result will be displayed when the criteria matches an item, name or term. A result is also displayed if the string matches the initial part of an item, name or term.

Group Keywords and Operators button.

If the **Group Keywords and Operators** button is activated, the display order will be arranged with uppercase characters first in ascending alphabetical order, then lowercase characters in ascending alphabetical order and then the operators in the order of their ASCII values.

In the Objects tab, if at least one code editor is open (at the lower side of the window) and a keyword or operator is selected (by choosing **Insert keyword into code** either by **Ctrl+I** or the respective button ( )), this keyword or operator will be inserted at the current or last position of the cursor in the code that is currently activated in the lower section of the Objects tab.

☛ *This will also happen when the main window view is not on the Objects area. The view of the main window will automatically change to this view.*

Help Tab

In this tab, available information about the currently selected item is displayed.

Quantities Tab

This tab provides an overview about the available quantities in M1 Build and their base unit. The quantities are predefined and cannot be changed or extended.

Note that all internal handling of values, like calculations and comparisons, is done using the base units (which is the SI-unit, with the exceptions: degree instead of radians for an angle, and degree Celsius instead of Kelvin for a temperature), regardless of which display unit has been chosen.

If, for example, a command shall be executed when a pressure is higher than 3 bar, in code this pressure has to be compared to a threshold of 300000, as the base unit for pressure is Pa (Pascal) and 3 bar = 300000 Pa.

Toolbar Buttons

The **Columns...** button displays a dialogue box that lists available information and allows adding or removing columns displaying that information.

The display order can be modified by clicking on the column header. This will sort the items, relevant to the selected column, in an ascending or descending alphabetic order (each mouse click will toggle between ascending and descending order).

A **Filter** string can be entered in the Filter field so that only items that match the filter criteria are shown.

When entering a filter string, the filtering is not case sensitive and wildcard (*) entries are allowed.

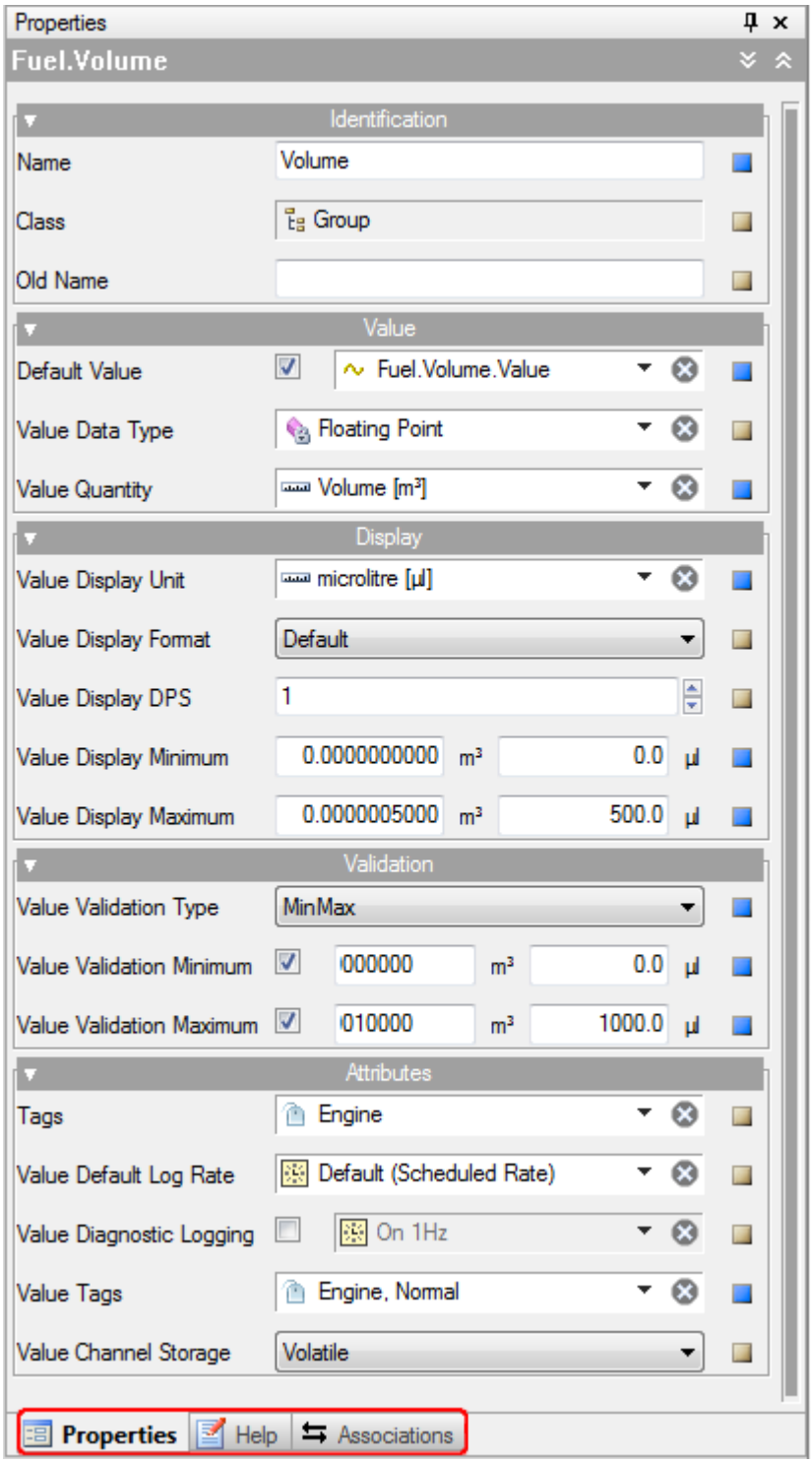
Alternatively, you can use the **Build Filter string** button to not only define a filter string but to also apply the filter to Properties.

The defined filter criteria is applied to all listed items, names or terms available in the tab. A result will be displayed when the criteria matches an item, name or term. A result is also displayed if the string matches the initial part of an item, name or term.

Using the Properties Window

The Properties window contains three tabs, as shown below:

Properties Window Example



Properties Tab

In this tab, additional implementation information about the currently chosen object is displayed and can be edited.

A displayed property section can be closed or opened by clicking onto the property section name bar.

Using the respective button on the upper right side of the Properties tab, will open  or close  all available properties sections.

The extent of available properties is different for each type of object.

See the M1 Development Manual for more details concerning the properties of objects, as only a short overview will be given here.

Possible property classifications are provided in the following topics.

Identification

Includes the name and the class type for the object.

Hardware

If the object is linked to a hardware input- or output resource, this can be defined here. Usually, an object can be linked to a constant, a parameter or an external resource.

Constant means that a resource has to be defined in the then opening selection, which will be fixed and cannot be changed in M1 Tune.

Parameter means that a resource can be chosen in M1 Tune by a calibration parameter.

External means that a hardware resource is not selected directly, but is defined by another object inside the Project which can be assigned here.

Input

Input is usually available for predefined classes which require configuration data.

Different sources can be defined here:

Channel means that this input object will be implemented as a channel, the value of which is assigned somewhere in a function of the Project.

Constant will open the input field to define a fixed value for the input object that cannot be changed in M1 Tune.

Parameter means that the value of the object can be chosen in M1 Tune by a calibration parameter.

Table means that the value of the object can be chosen in M1 Tune by a calibration table, which must be defined in the Table property.

External means that an existing object will be linked to the input object.

Value

The data type and the quantity can be defined here.

Usually, the data type Floating Point is the default data type. Any data type which has been defined in the Data Types tab can be used.

If the object represents a physical quantity, the quantity should be defined here accordingly. The unit cannot be chosen, as M1 Build always uses the base units of a quantity (which are the SI unit, with the exceptions: degree instead of radians for an angle, and degree Celsius instead of Kelvin for a temperature).

Display

For display in M1 Tune, the display unit can be selected. Note that this will not change the internal base unit of the object which will be used for calculations.

DPS (decimal places) defines the number of displayed decimal places in M1 Tune.

☛ *The displayed decimal places will have no effect on the internal value of an object.*

A minimum and a maximum displayed value can be chosen, either using the base unit or the display unit.

☛ *This will affect the displayed value in M1 Tune only and have no effect on the internal value of an object.*

The display settings can be overridden in M1 Tune.

Validation

Choose **MinMax** to set thresholds for the object, either using the base unit or the display unit, that will limit the value of the object. This affects the internal value of the object.

Attributes

Log Rate defines the recommended logging frequency of an object when logged in M1 Tune. If 'default' is selected, the default logging rate will be set to the rate at which the object is updated.

An object can be selected or deselected for diagnostic logging. See Diagnostics Tab for more details.

If desired, Tags can be assigned to an object.

Storage attribute defines if the value of a channel is lost when the ECU is switched off (volatile), or is only reset when a new firmware is flashed into the ECU (Flash backed).

In case of scheduled functions, the associated event has to be selected here.

Table

If the current object is a table or contains at least one table as an input object, the dimension of each table must be defined here.

X Axis, Y Axis, Z Axis

If a table is defined, the input object and the number of axis values for each specified axis is defined here. Additionally, it can be fixed if it is mandatory to define the axis in M1 Tune (if the box is not ticked, the axis can be disabled in M1 Tune).

Arguments

In case of *Functions*, optional input arguments and an optional return value can be defined.

Clicking on  adds an input argument to the *Function*. A return value can be added using the  button.

Double clicking on the argument or return value, or using the  button opens a window where the name and data type can be defined. Also a Help text that will be shown in the 'Help' window can be added on the Help tab of that window.

A selected item can be deleted using  .

The order of multiple input arguments can be arranged using the **Move Up** and **Move Down** arrow buttons. This also defines the order of the arguments when calling the function in a code.

If a property value has to be chosen from a predefined range of values, these are listed by using the drop-down menu.

Additionally, the displayed items can be filtered by typing a filter string.

Using the  button will reset the chosen value to the default value of M1 Build for that property.

 On the right side of each property, a small rectangle is placed which is either yellow or blue.

A yellow colour means that the default settings of M1 Build are active for that property.

A blue colour means that the property has experienced a change.

By clicking on this rectangle, additional information about this property will be displayed and advanced settings can be defined.

Attributes is for information only, showing internal enable conditions and dependencies of the property.

Choosing **Revert** will reset the property to the default settings of M1 Build for that property.

With **Link**, the property value can be linked to the corresponding property of another object, taking on that value.

Unlink deletes the link to the corresponding property of another object.

Select opens a menu where the value of the property can be chosen.

Help Tab

In the Help tab of the Properties window, text can be edited that will be shown in M1 Tune when that object is selected.

It is possible to type in text here without spending effort in formatting and style.

It is also possible to paste text here which was edited in other programs. Formats that were defined in MS Word, (for example, font size and style) will be maintained and shown in M1 Tune as defined.

If the  HTML Editor button at the upper right corner of the window is clicked, an editor opens which allows a certain amount of formatting and editing options.

Handling of this editor is comparative to common text processing programs like MS Word. In addition, the drop-down menu for the text styles allows the formatting of content in a style that is consistent with the style used from MoTeC in the class help:

1. **Enumerator** should be used to highlight enumerator names

2. **Object** should be used for channels, parameters, tables and groups that are visible in M1 Tune. It is recommended to state the full object reference.
3. **Information** style should be used to highlight important information, which will display the text in an information box.

EXAMPLE:
Help text:

Observe the Position Sensor and Position Sensor Diagnostic values while manually moving the throttle butterfly from fully closed to fully open. If readings from 0% to 100% are not evident, or Diagnostic errors such as Aim Tracking Fault occur, resolve these problems before proceeding further.

It is crucial that Position Sensor Diagnostic errors are eliminated before attempting any of the following steps.

4. **Warning** style should be used to highlight information that is critical for operation of the engine.

In addition, the text can be structured using the provided headings.

Pictures can be inserted into this editor by drag and drop. Paste from the clipboard is not supported. In accordance with Internet Explorer 8, the supported file formats comprise jpg, png, gif, tif, bmp and the size limit is 32kB.

If the  Text Tag Editor button at the upper right corner of the window is clicked, an editor opens which allows a certain amount of editing options.

Handling of this editor is comparative to common text processing programs like MS Word. It displays a plain text version of your code and allows text addition, replacement and deletion.

In addition, the text can be structured using the provided headings. Selecting the Show Preview checkbox, will display a preview of the text in the editor.

Pictures can be inserted into this editor using the Insert Image option. In accordance with Internet Explorer 8, the supported file formats comprise jpg, png, gif, tif, bmp and the size limit is 32kB.

Associations Tab

In the Associations tab of the Properties window, all places are shown where the chosen object is used in the current Project.

Toolbar Buttons

 **Columns...** Button displays a dialogue box that lists available information and allows adding or removing columns displaying that information.

The display order can be modified by clicking on the column header. This will sort the items, relevant to the selected column, in an ascending or descending alphabetic order (each mouse click will toggle between ascending and descending order).

A **Filter** string can be entered in the Filter field so that only items that match the filter criteria are shown.

When entering a filter string, the filtering is not case sensitive and wildcard (*) entries are allowed.

The defined filter criteria is applied to all listed items, names or terms available in the tab. A result will be displayed when the criteria matches an item, name or term. A result is also displayed if the string matches the initial part of an item, name or term.

Deactivating the **Hide child objects** button displays all associations of the current object and its child objects. If the button is activated, only associations of the currently selected object are shown.

This is particularly helpful when a group contains child objects and has a default value. If the button is activated, only associations for the group's default value are displayed. If the button is not activated, the associations for all objects within the group are displayed.

Double-clicking on an object, using the **Select in main view** button or **Ctrl+S** will mark this object in the Objects tab of the main window, which allows the user to easily find and edit references.

Using the Messages Window

The Messages window consists of two tabs: Project and Build.

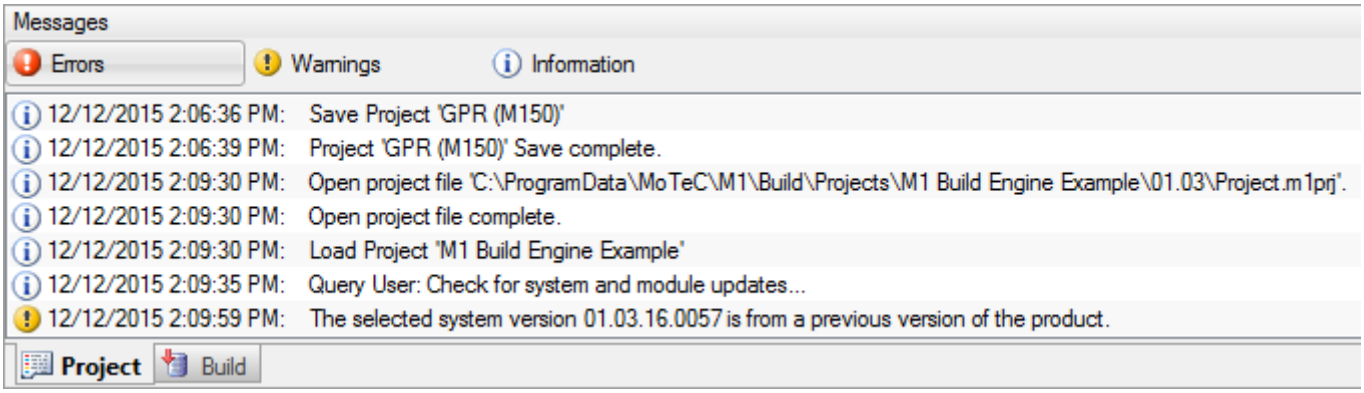
The Project tab comprises all system messages when a Project is loaded and edited.

The Build tab shows the messages that are generated when a Package is created from the current Project.

Project Tab

Using the buttons on the upper side of the window, the listed messages can be filtered regarding errors, warnings and messages. As a default, all buttons are activated and all errors, warnings and messages are listed. If one or more buttons is deactivated, only the items matching the activated buttons will be listed.

Messages Example



Right-clicking with the mouse into the window opens a menu that allows the user to copy the list into the clipboard (for example, it can then be pasted into a Notepad file to search for specific contents), or to clear the window.

Build Tab

This tab shows the result of a Package creation.

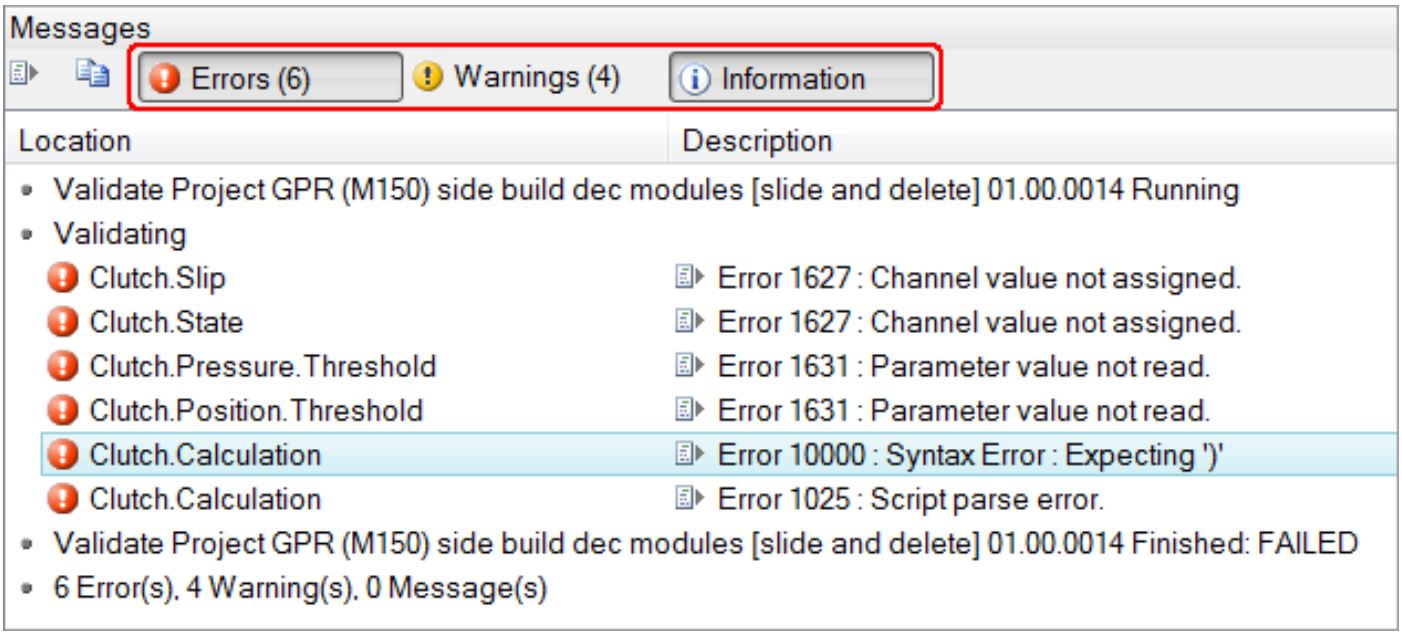
If no problems occurred, no errors or warnings are displayed.

If an error or a warning occurred, more information around the related problem can be obtained here.

Using the buttons on the upper side of the window, the listed messages can be filtered regarding errors, warnings and messages. As a default, all buttons are activated and all errors, warnings and messages are listed. If one or more buttons is deactivated, only the items matching the activated buttons will be listed.

The names of the buttons include the amount of current errors, warnings and messages that can be listed, as shown in the example below where the buttons are highlighted.

Messages Button Example



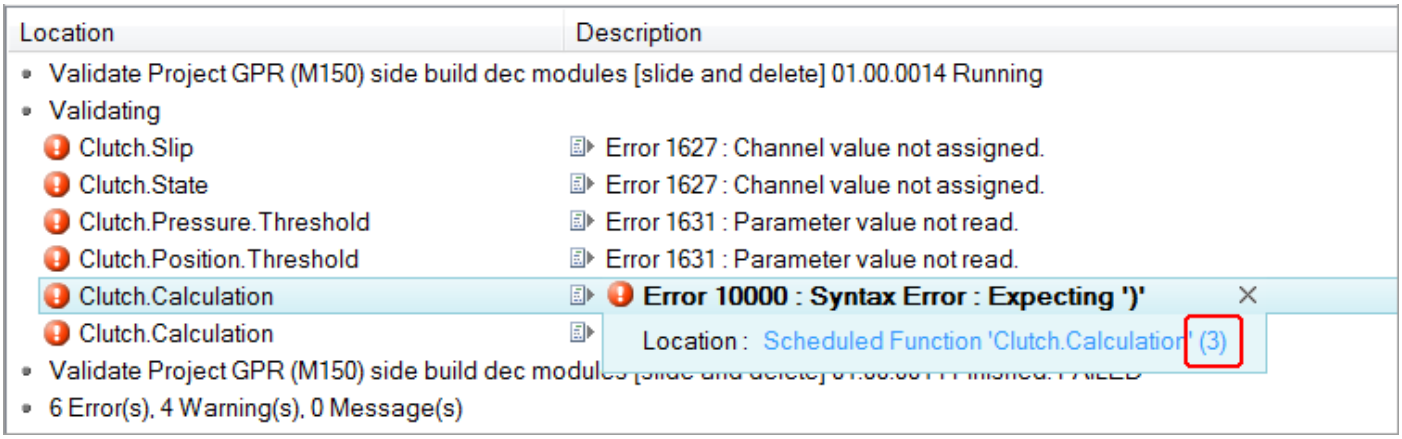
Use the **Copy Entry** button, **Right-click menu > Copy all Entries** option or **Ctrl+C** to copy all messages in the Messages window to the clipboard.

Use **Right-click menu > Clear** to clear all messages in the Messages window.

If an error entry is selected, more information about the error can be displayed by selecting the **Show error details** button, using **Ctrl+D** or selecting **Right-click menu > Show error details** option.

If the error occurred inside a function, the respective line in the code where the error was determined is mentioned, as highlighted in the example below.

Error in Code Example



By clicking onto the provided link (blue in the example above) or by double-clicking on the error, the respective object is marked in the Objects tab of the main window. If the error occurred inside a function, the code is opened automatically and the cursor is placed in the line where the error was determined.

Compare Projects Overview

M1 Build provides the ability to compare the current Project with another Project. This can be an older version of the current Project or a completely different Project.

Differences between the Projects can be examined and copied to the Project as desired.

The Project which is defined as the compare Project is always read only and cannot be modified.

If a modification in a compare Project is desired, the main Project and compare Project have to be swapped, see Using the Compare Projects Function.

☛ *Only Projects that are not read only can be modified.*

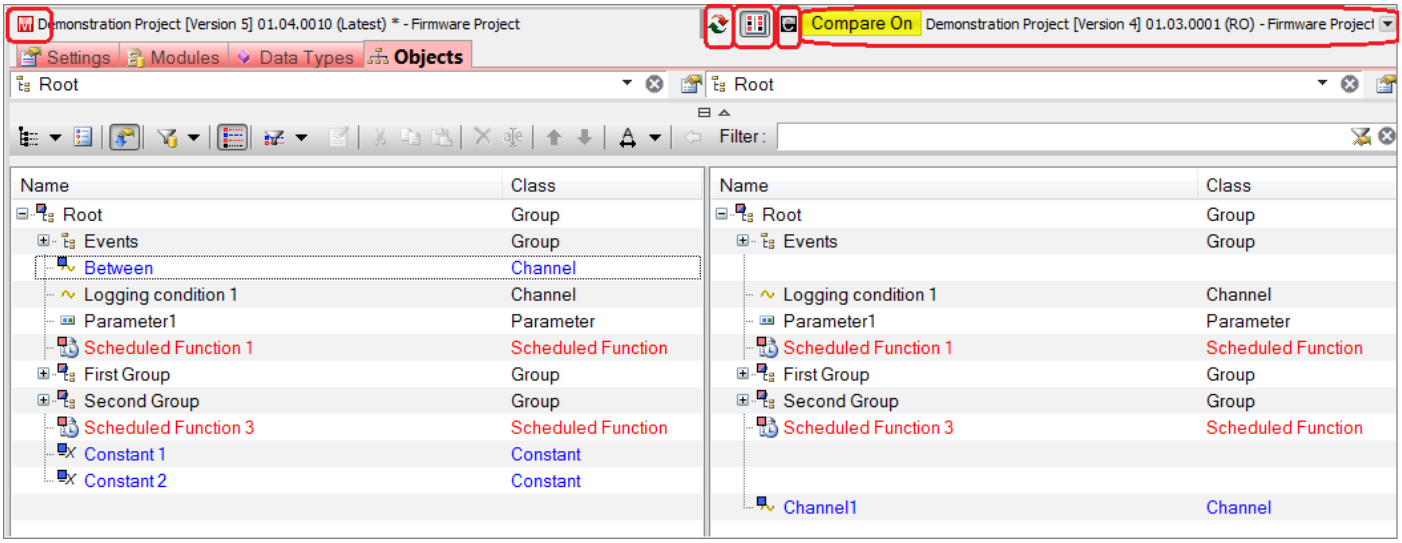
Select Projects to compare by selecting or the **File > Add Compare Project...** menu option. More than one Project can be added for compare, but only one Project can be compared with the Master Project at any time.

Close chosen compare Projects by selecting or the **File > Close all Compare Projects** menu option.

Managing the Compare Projects Function

After a Compare Project is chosen, the main window splits into two sections and looks similar to the example below. For the Main window changes as shown in the example diagram below, see Main Window Changes During Compare.

Compare Window Example



Compare mode is active when the **Compare On** button in the upper right section of the window is selected (active) and **Compare On** is highlighted.

Next to the **Compare On** indicator, the name of the Compare Project is displayed. Selecting the Down Arrow button displays a drop-down list from where another Project can be selected for compare (these are the Projects that were added using the **File > Add Compare Project...** menu option).

Compare Projects always use the display identifier next to the Project name.

The Main Project uses the display identifier next to its name.

Swapping Main and Compare Projects

Use the **Swap Main/Compare Projects** button to make the main Project the Compare and the Compare the Main. As only the Main Project can be updated, this provides the ability to update the Compare Project.

☛ *Projects that are read only cannot be modified, even if selected as the Main Project.*

Deactivating the Compare Function

Compare mode is deactivated when the **Compare On** button in the upper right section of the window is unselected (deactivated) and **Compare Off** is highlighted.

The main window will then return to its normal view, but the opened Compare Project names will remain visible at the upper right part of the main window until such time as the **File > Close all Compare Projects** menu option is selected.

Compare Deactivated Example

Main Window Changes During Compare

The following tabs are no longer available: Schedule, Diagnostics, Security and I/O.

Different scheduling will not be displayed, as any scheduling is automatically defined by M1 Build.

If a channel has different diagnostic settings, the channel will be highlighted as different, and the difference is shown in its Properties section.

Different diagnostic logging conditions will not be displayed.

Different Security settings will be listed in the Settings tab. If a channel's security group is different (when Security setting is set to Advanced), the channel will be highlighted as different and the difference shown in its Properties section.

In the tabs available, the toolbar buttons highlighted below (and the corresponding menu selections) have the same function as in the normal working mode. See the respective sections of the manual for more details.

Objects Tab Example

Data Types Tab Example

☛ *The Settings and Modules tabs are equivalent.*

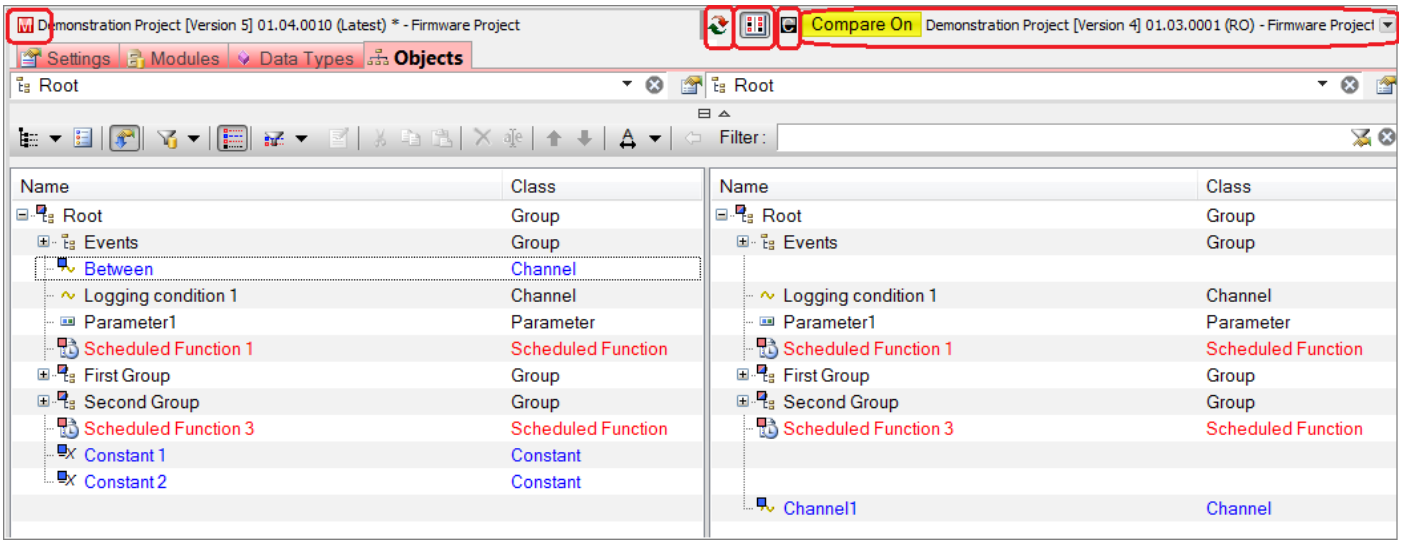
Using the Compare Projects Function

When the respective button is activated, differences between the Main and the Compare Project are shown in red or blue.

An object is marked **red** if it exists in both Projects but is different in the two Projects.

An object is marked **blue** if it exists only in one of the Projects. The respective line containing this object is left empty in the other Project.

Example Differences



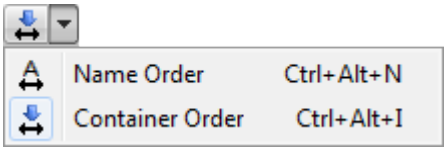
In the example above, **Scheduled Function 1** is marked red in both Projects as it exists in both Projects but contains differences.

The channel **Between** exists only in the Main Project but not in the Compare Project and is therefore marked blue.

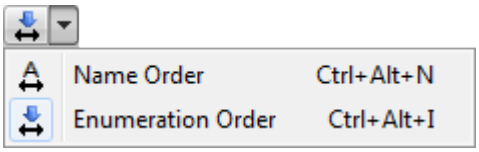
The channel **Channel1** exists only in the Compare Project but not in the Main Project and is therefore marked blue.

Also, objects that are different, or groups containing such objects, are marked with a small rectangle using the same colour or a combined colour. In the following example, the icon of **First Group** is marked with a mixed coloured rectangle as this group contains different objects (Channel 2) as well as added objects (New Named Channel):

 When using the filter option by respective button, Show Differences will show the differences in objects which exist in both Projects, even if they only differ in their Help content, Show Differences (No Help Only) will show differences in objects which exist in both Projects, but will not show these objects if they only differ in their Help content, and Show Added/Removed will show the added/removed objects on the screen.



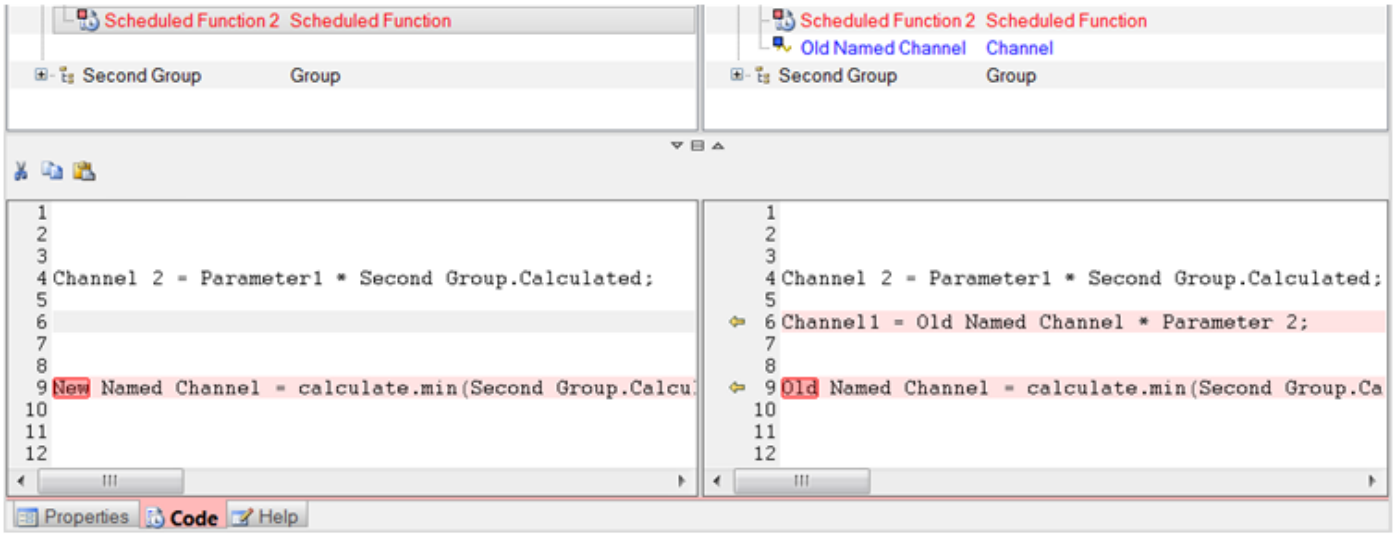
In the Objects tab, the displayed object order can also be influenced by the respective option where Name Order means that removed objects will be listed at the end of a group in the Compare Project, whereas Container Order means that they will be listed at the defined position of the Compare Project (which means that a blank line will be added in the Main Project at this position).



In the Data Types tab, if there are differences in the enumerators of an enumeration, the displayed enumerator order can be influenced by the respective option where Name Order means that differently named enumerators are highlighted in blue and shown in different lines, whereas Enumeration Order means that the enumerators will be sorted in the order of their enumerator value, and then different enumerator names will be highlighted in red.

If an object is selected in the Modules, Data Types or Object tab in the lower part of the main window, more details of this object are displayed, as shown in the example below. This can be the object's properties, the Help section and the code (in case of functions), with each of them having a specific tab in the opened window.

Tabs containing differences will be marked red, as can be seen in the example below.



 If properties are displayed, by using the **Columns...** selection the extent of displayed properties (columns) for the object can be defined.

Using the **'Filter'** option means only items matching the defined string will be displayed.

It is possible to use * as a wildcard. Upper- or lowercase writing is not distinguished.

The defined filter criteria is applied to all the items, names or terms available in the window. An item will be displayed when the criteria matches either the name or a part of the name that comes after a space between two name constituents of an object's name or displayed property.

 Clicking the button on the right side of the 'Filter' section will open a window with more sophisticated possibilities to define a filter criteria.

 By activating the respective button the properties will be arranged in the same order as they appear in the Properties window.

 As in the upper part of the main window, differences between the main and the compare Project's properties are shown in red or blue when the respective button is activated and the selected items can be restricted by using the respective filter option.

 In the Code and the Help tabs, the differences are always marked red.

 If a different object is marked, the content of the compare Project can be taken over into the main Project by using the **Resolve** option via this button.

☛ *No further warning or confirmation will be displayed, and that this action is not reversible.*

Both Projects need to have the same system version and the same set of modules to enable all resolve options. If this is not the case, it is possible to resolve code from conforming functions, but it is not possible to resolve objects. However, the common Copy & Paste option to transfer objects into the main Project is still available.

Building Packages

Three options are available from the **Build** menu:

Build > Validate Project...

Build > Build Firmware...

Build > Build Firmware and Open in M1 Tune...

Validate Project

This option allows the user to check if the code of the Project covers all requirements and can generate a working firmware. The result is shown in the 'Build Output' section of the 'Messages' window.

The Project version will be automatically saved when this option is executed.

☛ *No new version will be generated.*

This option is very useful for frequent checks of code validity during a development process.

Build Firmware

This option saves the current version and creates a new Firmware. This Firmware contains all necessary components to run on an M1 ECU. All calibration data is set to default values (zero).

The Firmware will be written into the defined directory on the computer.

If a new Firmware was generated successfully, the version will be defined as read only. Further changes in the current Project will have the version number incremented.

Build Firmware and Open in M1 Tune

The same actions are executed as for 'Build Firmware', but, in addition, M1 Tune will be started (if not yet running) and the newly created Firmware will be automatically opened in M1 Tune. If a previous version of the Project is currently active in M1 Tune, the calibration data of the previous version will be automatically migrated into the new Firmware.

This option is useful to integrate calibration data into the Firmware and can be used if M1 Tune is available.

In particular, this option helps to save a lot of time when an M1 ECU is connected to M1 Tune, as the Firmware, including potentially migrated calibration data, will then also be automatically sent to the ECU.

Main Menu Quick Reference

File menu

Menu Option	Description
New Project...	Generate a new Project. See Create a New Project.
Open Project...	Use to open an existing Project. See Start a Project.
Close Project	Close the current Project and open the start screen. See Start a Project.
Recent Projects	Open a recently used Project. See Start a Project.
Save Project	Save the current Project. This will overwrite the last saved version. See Start a Project.
Add Compare Project	Open an additional Project to compare with the current Main Project. See Compare Projects Overview.
Close all Compare Projects	Close all opened compare Projects. See Compare Projects Overview.
Swap Main/Compare Projects	Define the current Main Project as the Compare Project and the current Compare Project as the Main Project. See Compare Projects Overview.
Compare On	If a Compare Project is available, this switches on the compare mode. See Compare Projects Overview.
Environment Options	Define the storage location for Projects. See Start a Project.
Exit	Close the M1 Build application.

Edit menu

The availability and content of this menu varies according to the tab that is currently chosen in the main window. The menu is only available when one of the following tabs is selected:

- Modules - see also Modules Tab

Menu Option	Description
Add...	Allow the user to add an available module.
Auto Add	Allow the user to add modules that contain classes that are required by other classes, but are not yet part of the module selection, if available.
Version	Allow the version of a module to be displayed or chosen.
Auto Upgrade	Allow the user to select newer versions of the current modules, if available.
Remove	Remove a module from the selection.
Move Up	Change the order of the displayed modules by moving the selected module up.
Move Down	Change the order of the displayed modules by moving the selected module down.

- Data Types - see also Data Types Tab

Menu Option	Description
Cut	Copy the selected item into the clipboard and delete it.
Copy	Copy the selected item into the clipboard.
Paste	Copy the clipboard content into the selected position.
Delete	Remove the selected item.
Rename	Allow the user to change the name of the selected item.
Move Up	Change the order of user defined enumerators by moving the selected enumerator up.
Move Down	Change the order of user defined enumerators by moving the selected enumerator down.
Default Enumerator	Define the selected enumerator as default (value = 0).
New Enumeration	Create a new enumeration.
New Enumerator	Create a new enumerator for the selected enumeration.

- Objects - see also Objects Tab

Menu Option	Description
Edit	Open the selected code in the lower part of the main window. See Editing Code.
Cut	Copy the selected item to the clipboard and delete it. See Editing Objects.
Copy	Copy the selected item to the clipboard. See Editing Objects.
Paste	Copy the clipboard content into the selected position. See Editing Objects.
Paste Special	Allow the user to paste multiple versions of an object that is currently on the clipboard. See Editing Objects.
Copy Settings	Copy the properties of an object to the clipboard. See Editing Objects.
Paste Settings	Insert settings from the clipboard into the selected object. See Editing Objects.
Delete	Remove the selected item. See Editing Objects.
Rename	Allow the user to change the name of the selected item. See Editing Objects.
Move Up	Change the order of user defined objects by moving the selected object up. See chapter 'Arranging the object order'.
Move Down	Change the order of user defined objects by moving the selected object down. See chapter 'Arranging the object order'.

- Schedule - see also Schedule Tab

Menu Option	Description
Edit	Open the selected code in the Objects tab
Copy	Copy the selected item to the clipboard.
Copy Settings	Copy the properties of an object to the clipboard.

- DBC- see also DBC Tab

Menu Option	Description
Add DBC...	Add a DBC object into the project.
Rename	Rename the DBC object.
Update	Automatically import all changes when the DBC source file is changed.
Import from a file...	Import data from a DBC file into the object.
Turn off all messages	Set the direction of all messages to Off
Remove unused messages	Remove all messages from the DBC that are not used in the project.
Delete	Delete the DBC object.

View menu

The availability and content of this menu varies according to the tab that is currently chosen in the main window. The menu is only available when one of the following tabs is selected:

- Modules - see also Modules Tab

Menu Option	Description
Select All	Mark all items in the window.
Invert Selection	Mark all items that are currently not marked in the window.
Clear Selection	Unmark all items in the window.
Columns	Allows the user to select displayed properties (columns)

- Data Types - see also Data Types Tab

Menu Option	Description
Filter	Allows the user to filter the displayed data types by origin.
Select All	Mark all items in the window.
Invert Selection	Mark all items that are currently not marked in the window.
Clear Selection	Unmark all items in the window.
Columns	Allows the user to select displayed properties (columns)

- Objects - see also Other Display Options

Menu Option	Description
Go Back	Mark the object that has been marked before the currently selected object.
Go Forward	Mark the object that has been marked after the currently selected object.
View	Arrange the items in a list or tree display.
User-specified object order	Show the user specified object order
Filter	Show only objects that match the selected object type.
Select All	Mark all items in the window.
Invert Selection	Mark all items that are currently not marked in the window.
Clear Selection	Unmark all items in the window.
Columns	Allows the user to select displayed properties (columns).

- Schedule - see also Schedule Tab

Menu Option	Description
View Circular Dependency Group	Information about a found circular dependency will be shown.
Sort in Function call order	Arrange the order of the objects as they will be called in the Package.
Select All	Mark all items in the window.
Invert Selection	Mark all items that are currently not marked in the window.
Clear Selection	Unmark all items in the window.
Columns	Allows the user to select displayed properties (columns)

- Diagnostics - see also Defining Channels for Diagnostic Logging

Menu Option	Description
Select All	Mark all items in the window.
Invert Selection	Mark all items that are currently not marked in the window.
Clear Selection	Unmark all items in the window.
Columns	Allows the user to select displayed properties (columns)

- I/O - see also I/O Tab

Menu Option	Description
View	Arrange the items in a list or tree display.
Hardware Database sort order	Arrange the items as they are defined in the ECU hardware database.
Filter	Show only items that match the selected resource type.
Columns	Allows the user to select displayed properties (columns)

- DBC - see also DBC Tab

Menu Option	Description
Select All	Mark all items in the window.
Invert Selection	Mark all items that are currently not marked in the window.
Clear Selection	Unmark all items in the window.
Columns	Allows the user to select displayed properties (columns)

Build menu

Menu Option	Description
Validate Project	Checks if the current Project can generate valid code. See Validate Project.
Build Firmware	Compiles the current Project and creates a Package. See Build Firmware.
Build Firmware and Open in M1 Tune	Compiles the current Project, creates a Package and opens the Package in M1 Tune. See Build Firmware and Open in M1 Tune.

Window menu

See Screen Layout

Menu Option	Description
Tools & Help	Open or close the 'Tools & Help' window.
Messages	Open or close the 'Messages' window.
Properties	Open or close the 'Properties' window.
Reset Window Layout	Provides the possibility to return to the default window layout when starting M1 Build the next time.

Help menu

Menu Option	Description
Check For Updates...	The MoTeC webpage will be contacted to check if a newer version of M1 Build for the current Licence system is available for download.
Repair...	This repairs a script error issue if this occurs after upgrading the M1 Tune application. Follow any on-screen prompts to completion and restart the application. If problems persist, please contact your local MoTeC support person for further assistance.
Send Feedback...	Opens an email which can be used to contact MoTeC.
Send Error Report...	Opens an email which can be used to inform MoTeC about errors that occurred inside M1 Build.
Activate Features...	Check activated features and opens an email to contact the dealer to request additional features.
About MoTeC M1 Build...	Show the installed version of M1 Build.
Licence agreement...	Show the end user Licence agreement.
Release Notes...	Access information about the current release.
Manuals	Access documentation provided with M1 Build and example Projects.