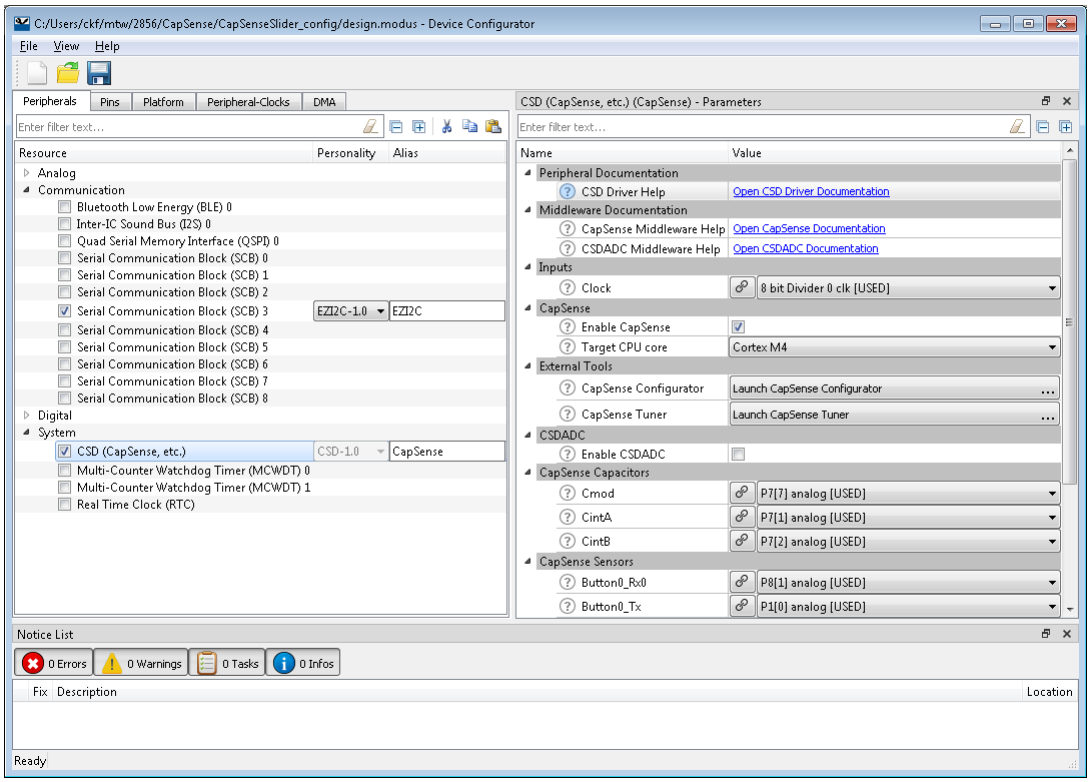
ModusToolbox™ Device Configurator Guide

Version 1.1

Overview

The Device Configurator is part of a collection of tools included in the ModusToolbox software. Use the Device Configurator to enable and configure platform peripherals, such as clocks and pins, as well as standard MCU peripherals that do not require their own tool. Some complex peripherals, such as BLE, CapSense®, etc., have specialized configuration tools, and the Device Configurator provides links to launch those separate tools (see Launch Other Configurators). After configuring and saving a particular device's settings, the Device Configurator generates firmware for use in your application (see Code Generation).



Definitions

The following are the terms used in this guide that you may not be familiar with:

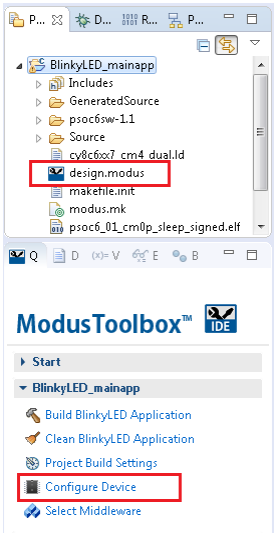
- **Resource –** Includes peripherals, pins, clocks, etc. used in an application.
- **Configurator –** A GUI-based tool used to configure a resource.
- **Application –** In ModusToolbox, an application consists of one or more projects, which are all related to each other.
- **Personality –** A file that defines a resource behavior.
- **Platform –** Collection of settings to define the hardware, such as power and debug settings. This could also refer to a development kit.

Launch the Device Configurator

The Device Configurator is a stand-alone tool that contains menus, icons, tabs, and several panes used to configure MCU peripherals. You launch it from, and use it with, a ModusToolbox IDE application. You can also run it independently of the ModusToolbox IDE. Then, you can either use the generated source with a ModusToolbox IDE application, or use it in any software environment you choose.

From a ModusToolbox IDE Application

Run the Device Configurator from an application within the ModusToolbox IDE using the *design.modus* file. You can also click the “Configure Device” link in the IDE **Quick Panel** to open this file.



The *design.modus* file contains all the required hardware configuration information about the device for the application. When you save updates to the *design.modus* file, the tool generates/updates source code in the “GeneratedSource” folder. ModusToolbox IDE applications use the *design.modus* file and generated source code in future application builds.

Independent of the ModusToolbox IDE

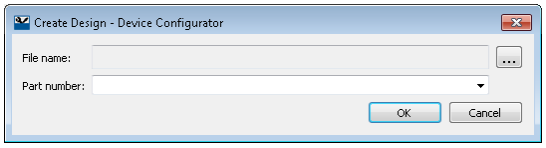
To run the Device Configurator independently, navigate to the install location and run the executable. On Windows, the default install location for the Device Configurator is:

[user_home]\ModusToolbox_<version>\tools\device-configurator-<version>

For other operating systems, the installation directory will vary, based on how the software was installed.

When run independently, the Device Configurator opens without any content. You can either open a specific *<app-name>.modus* file or create a new one. See Menus for more information.

- If you create a new *<app-name>.modus* file, specify the file name and location to store the new *<app-name>.modus* file, and select a part number for the application.



- If you open an existing *<app-name>.modus* file from a **non**-ModusToolbox IDE application, it will be your preferred working environment flow.

- If you open a *design.modus* file for a ModusToolbox IDE application, it will be the same flow as if you opened it from within a ModusToolbox IDE application.

From the Command Line

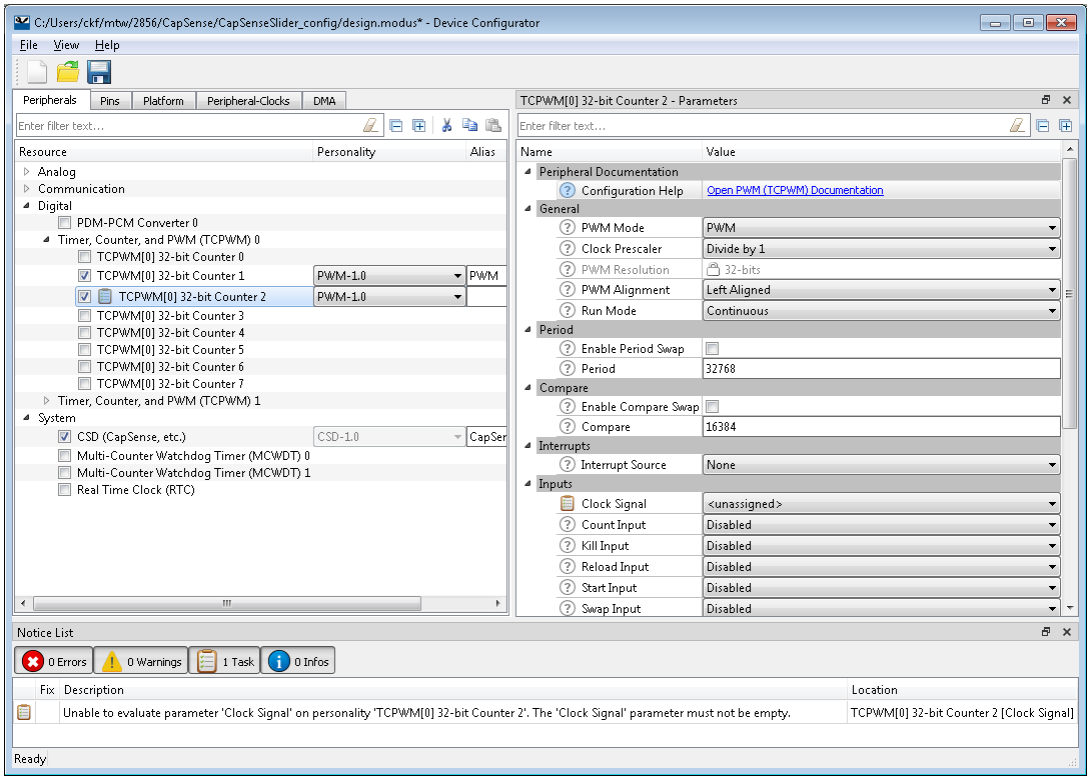
You can run the configurator from the command line. However, there are only a few reasons to do this in practice. The primary use case would be to re-generate source code based on the latest configuration settings. This would often be part of an overall build script for the entire application.

For information about command line options, run the configurator using the `-h` option.

Quick Start

This section provides a simple workflow for how to use the Device Configurator.

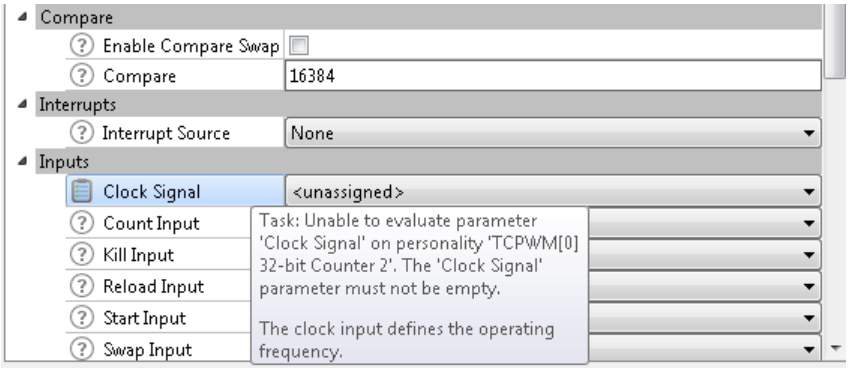
1. Launch the Device Configurator.
2. Enable a desired peripheral on the Peripherals Tab by clicking the enable check box. Notice the Parameters Pane becomes populated with fields.



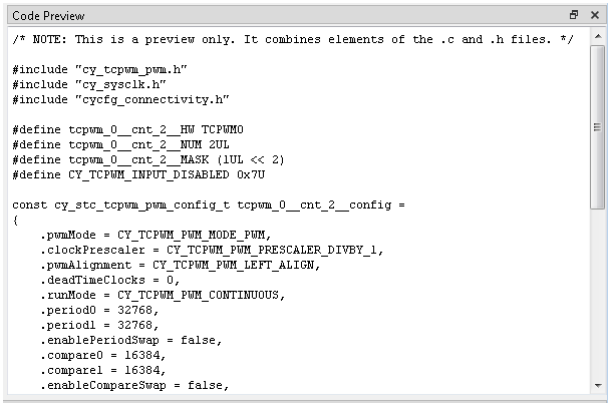
3. Notice also that a new task may appear in the Notice List Pane.

   See Icons for descriptions of the various icons displayed in the Device Configurator.

4. Double-click on the task to jump to the parameter that needs to be addressed.



5. Select an appropriate parameter value and the task should be removed from the Notice List.
6. Select the Code Preview Pane to see a preview of the code that will be generated upon saving.



7. Use the various tabs to enable and configure other resources as needed in the same manner as peripherals.
8. Save the **.modus* file to generate source code.

   The Device Configurator generates code into a “GeneratedSource” directory in your ModusToolbox IDE application, or in the same location you saved the *<app-name>.modus* file for non-ModusToolbox IDE applications. That directory contains the necessary source (.c) and header (.h) files that use the relevant driver APIs to configure the hardware. Application code then uses this code to configure the system.
9. Use the appropriate API in your application code.

Code Generation

The Device Configurator generates structures, defines, and initialization code for the blocks on the chip. All generated code is located in the *GeneratedSource* folder next to the **.modus* file. Refer to the Peripheral Driver Library (PDL) API Reference for more information about this code. Each enabled resource has a link to the specific driver documentation in the Parameters Pane.

Note The Device Configurator generates code based on the hardware resources that are enabled. If a resource is not enabled, no configuration will be generated for it. This means the resource will retain its default reset state. In most cases, this is powered off. However, some features are enabled by default, such as debug connectivity. To disconnect these features, you must call the appropriate API functions to turn the feature off.

The defines and structures are all named based on the resource that created it. In general, these have the form *<resource-name>_config*. These structures can be passed to the PDL functions that are responsible for configuring the hardware block.

The functions are specific to a resource category and have names of the form *init_cycfg_<resource-category>*. The init function for a particular resource type is located in *GeneratedSource/cycfg_<resource-category>.h*. There are also the *cycfg.h* and *cycfg.c* files. Include the *cycfg.h* file in your application to access the generated header files. The *cycfg.c* file implements init_cycfg_all(), which calls all other generated functions, for example init_cycfg_pins().

The resource types include:

- Clocks: peripheral clocks.
- Connectivity: configuration of the programmable analog and digital routing resources
- Peripherals: Fixed function analog and digital peripherals.
- Platform: Overall configuration function to setup all power and clock options.

It is up to you to make use of the generated code based on the application's needs. This can be done as part of the application's main() loop.

Menus

The menus include:

- **File** – Provides basic commands to open, close, and save files, as well as exit the tool.
  - **New** – Create a new **.modus* file. The current file, if any, will be closed.
  - **Open** – Open an existing **.modus* file. The current file, if any, will be closed.
  - **Close** – Close the current file. If there are pending changes, you will be prompted to save the file.
  - **Save** – Save the current file and generate code for the related ModusToolbox IDE application. If there are errors in the application, a dialog will indicate such. The file will still be saved.
  - **Save As** – Save the current file with a different name and/or location.
  - **Recent Files** – Shows up to five recent files that you can open directly.
  - **Update Referenced Libraries** – See Update Referenced Libraries.
  - **Exit** – Close the tool. You will be prompted to save any pending changes.
- **View** – Contains toggles to hide or show different panes. All panes are shown by default. There is also a command to show or hide the Toolbar (hidden by default).
- **Help** – Provides access to this document and an About box.

Icons

When configuring various options with this tool, you will see the following icons:

	Indicates there is a tooltip. Hover over the icon to display a brief message about the setting.
	Enables or disables a specific resource.
	There may be occasions where an error, warning, task, or info icon displays for an enabled resource. See Notice List Pane for more details.
	Indicates that it is a read-only field.
	After assigning a signal, clicking this icon jumps to the linked resource(s).

Resource Tabs

The Device Configurator contains the following tabs, each of which provides access to specific resources. Separate sections in this document provide more descriptions of these tabs.

Note If you open the Device Configurator for a WICED Bluetooth device, there is only one resource tab that also shows the pins.

When you enable a resource, or select an enabled resource, the Parameters pane displays various configuration options. As described under Icons, some enabled resources may contain errors, warnings, tasks, or infos that indicate some action might be required to resolve the issue. See Notice List Pane for more details.

Note Some of the tabs may not be included for some devices.

- Peripherals – Options to enable any of the analog, digital, system, and communication hardware capabilities of the chip that are not related to the platform.
- Pins – Options for all the pin related resources.
- Platform – Options for chip-wide configuration settings such as system clocks, power management, and debug interfaces.
- Peripheral-Clocks – Options for all the peripheral clocks.
- DMA – Provides configuration of the DMA channel and transaction descriptors.

Each of the tabs has the following features:

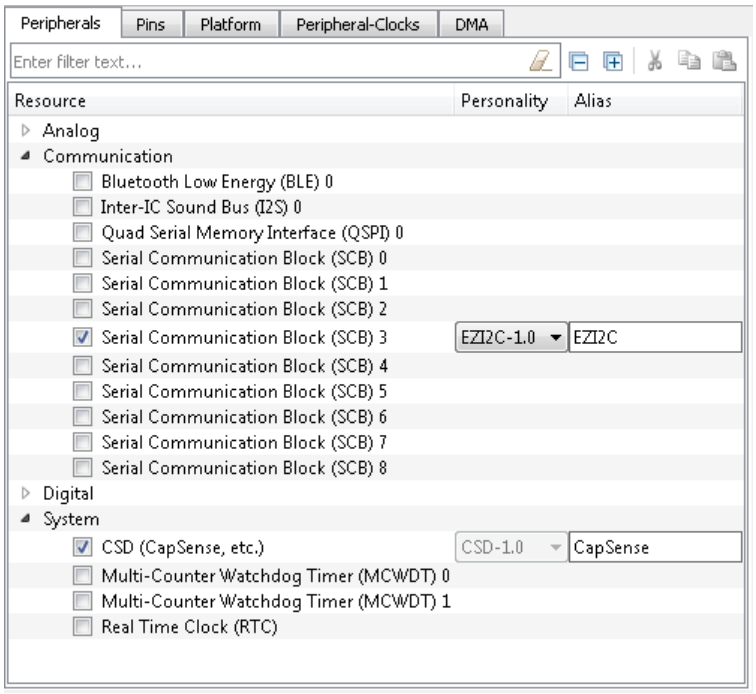
- **Filter** – The **Resource** column shows all available resources in an expandable tree. The filter box above the list of peripherals allows you to limit the peripherals shown in the tree. There are also **Expand** and **Collapse** commands.
- **Cut, Copy Paste** – Use these commands to move and copy settings from one resource of the same type to another.
    - When you use **Cut**, the settings will be copied to the clipboard, and the selected resource will be disabled.
    - When you use **Copy**, the settings will just be copied to the clipboard.
    - When you use **Paste**, the selected resource will be enabled if needed. The selected resource must have the same Personality name and version as the cut/copied resource.
- **Personality** – Each resource has a “Personality” file that contains the information for the given resource. For some peripherals, such as Serial Communication Block (SCB) and Timer, Counter, Pulse Width Modulator (TCPWM), there is a pull-down menu to select a specific personality, such as UART, SPI, or I^2C. For other peripherals, this is a read-only field that only shows the name of this resource’s personality file.
- **Alias** – This is an editable field where you can specify an optional, application-specific name for this resource. This is also used in generated code.

  Note Enter any string in this field. During code generation, the tool converts the alias into a legal C identifier, and replaces non-legal characters with underscores.

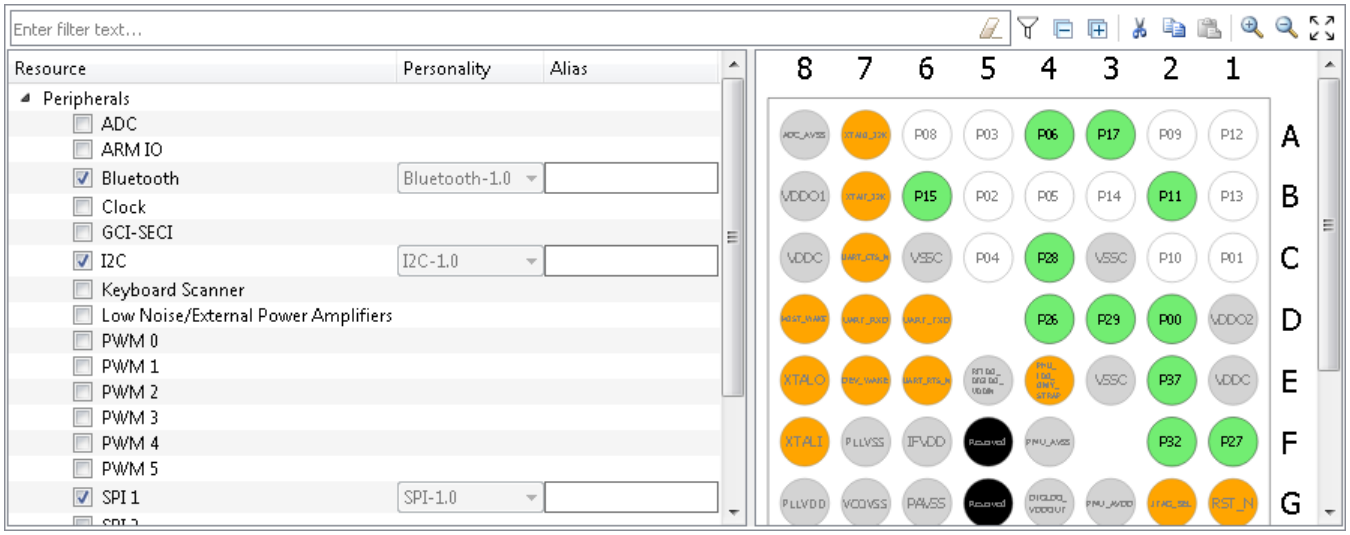
Peripherals Tab

The **Peripherals** tab is where you enable various analog, digital, system, and communication peripherals for the device to include in your application. The filter box above the list of peripherals allows you to limit the resources shown in the tree. This tab shows the selected Personality and allows you to enter an Alias.

PSoC 6 Applications

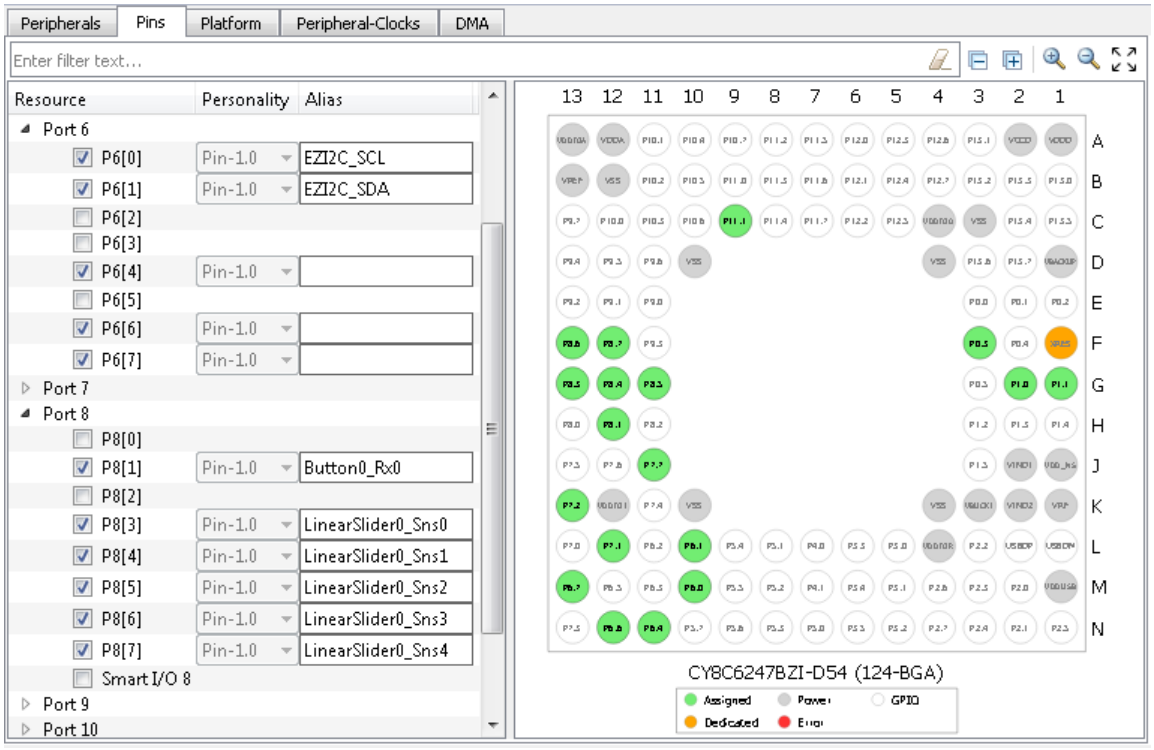


Bluetooth Applications



Pins Tab

The **Pins** tab is where you enable all the pin related resources. All available pins are shown in an expandable tree, arranged by port number. The filter box above the list of pins allows you to limit the pins shown in the tree. This tab shows the selected Personality and allows you to enter an Alias.



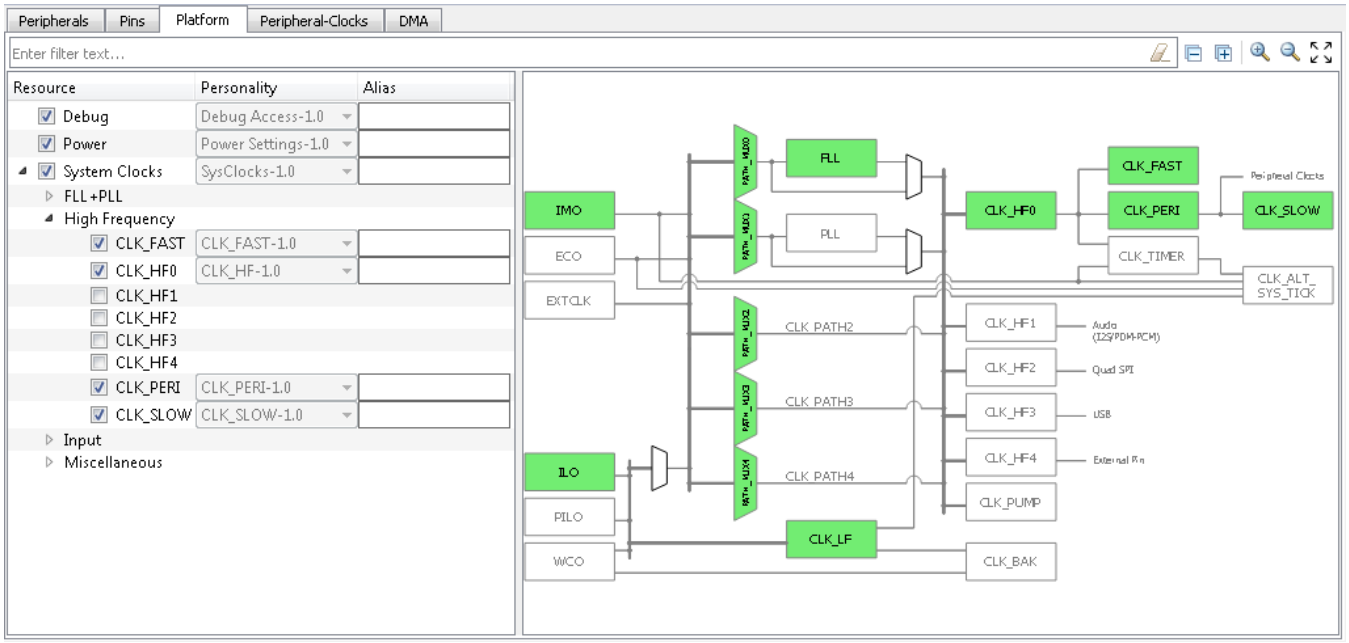
The interactive pin package diagram shows the different states of the pins; there is a legend on the diagram. You can enable/disable a pin by double-clicking it in the diagram. There are also zoom commands to resize the diagram as needed. If you zoom the image larger than the frame area, scroll bars appear to move to different area of the diagram. You can also press the [**Alt**] key to use the pan tool.

Pin states are shown in different colors:

- White – Disabled
- Green – Enabled
- Grey – Power/ground pins
- Orange – Fixed function pins
- Red – Error state

Platform Tab

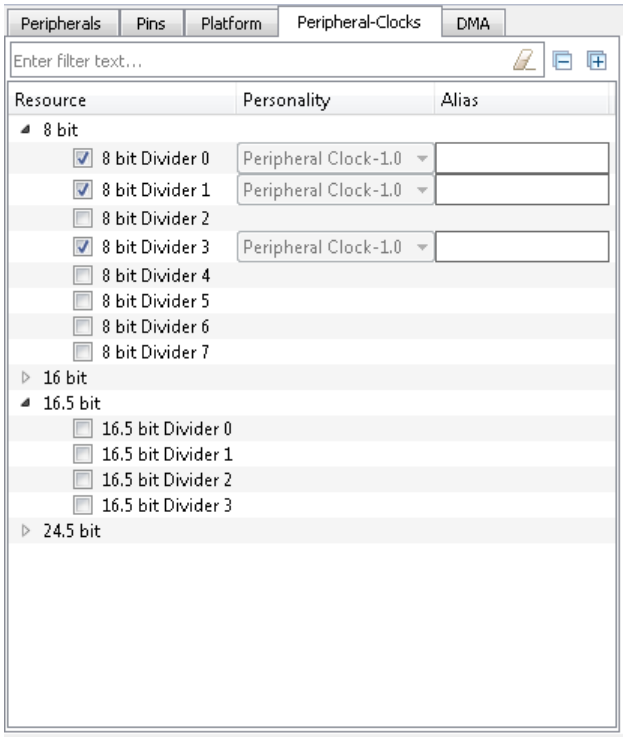
The **Platform** tab provides access to platform-level items, such as system clocks, power management, and debug interfaces. All available resources are shown in an expandable tree. The filter box above the list of resources allows you to limit the items shown in the tree. This tab shows the selected Personality and allows you to enter an Alias.



The interactive clock diagram shows all the system clocks and how they connect to each other. You can enable/disable a clock by double-clicking it in the diagram. Enabled clocks are green, disabled clocks are white, and clocks in error state are red. There are also zoom commands to resize the diagram as needed.

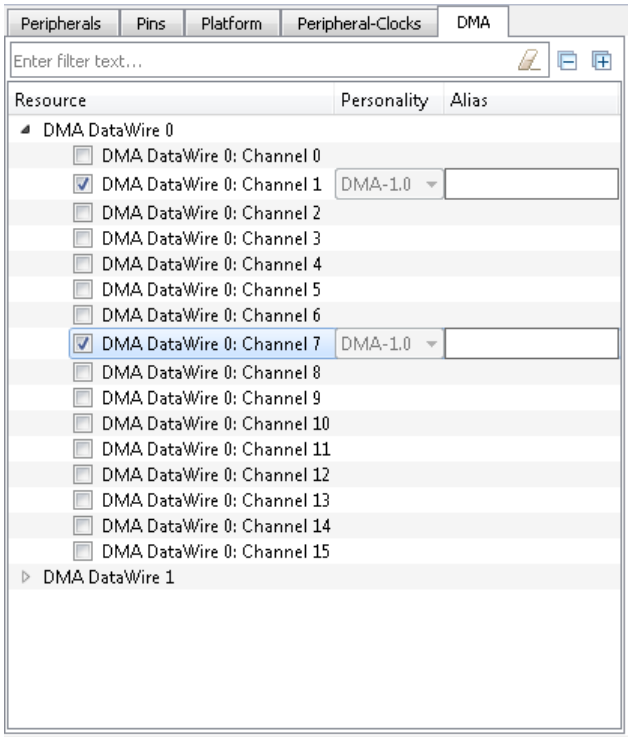
Peripheral-Clocks Tab

The **Peripheral-Clocks** tab lists all the clocks in a design used to drive the various peripherals. All available clocks are shown in an expandable tree. The filter box above the list of resources allows you to limit the items shown in the tree. This tab shows the selected Personality and allows you to enter an Alias.



DMA Tab

The **DMA** tab lists all the DMA resources in the design. All available DMA channels are shown in an expandable tree. The filter box above the list of resources allows you to limit the items shown in the tree. This tab shows the selected Personality and allows you to enter an Alias.



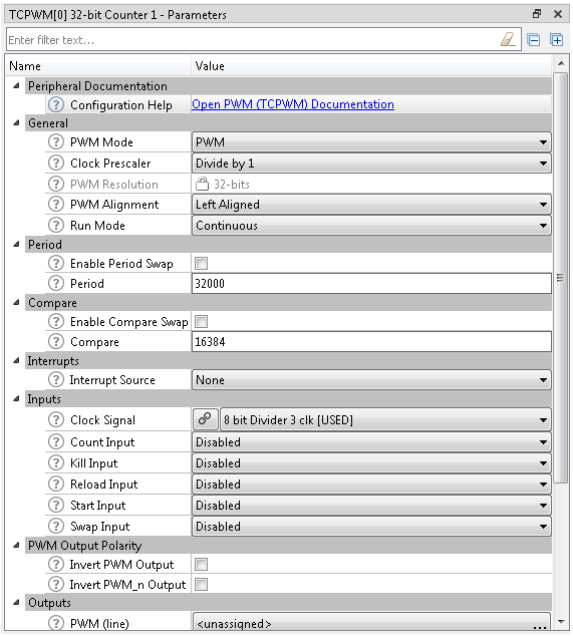
Panes

The Device Configurator tool contains the following primary panes that display information based on what is selected in a particular resource tab:

- Parameters – This pane shows the various parameters for any specific resource enabled in one of the tabs.
- Notice List – This pane shows any errors, warnings, tasks, and infos for the application.
- Code Preview – This pane shows a preview of the code that will be generated for the selected resource when you save the **.modus* file.
- Analog Diagram – This pane shows all the analog resources, whether enabled or not, and how they connect. It also allows you to edit routes.

Parameters Pane

The **Parameters** pane contains all the parameters for a selected, enabled resource. This pane will show different parameters for each resource, grouped by various categories. For example, the parameters for the TCPWM peripheral are completely different than those for a pin resource. The filter box above the list of parameters allows you to limit the items shown in the pane. Some resources also provide a link to launch a separate configurator.



Configuration Help

Nearly all resources provide a link to open the Peripheral Driver Library (PDL) documentation to the specific driver. This is the Doxygen-generated HTML file located in the installation directory.

Parameter Descriptions

As described under Icons, all parameters have a tooltip icon to indicate there is information about the parameter. Hover the mouse cursor over the icon to display a description of the parameter.

Parameter Values

Different parameter types have different ways to specify a value, as follows:

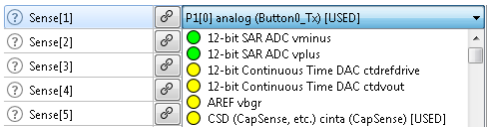
- **Pull-down Menu –** For parameters with a specific set of values, use the pull-down menu to select the appropriate value.
- **Selection Box –** For parameters with a variable set of values, click the ellipsis [**…**] button to open a selection box. There, use the check boxes to select one or more appropriate values for the parameter.

  Note After selecting these parameter types, use the **Go To** button to jump to the selected resource.
- **Check Box –** For parameters with a true or false value, use the check box to enable or disable the parameter.
- **Text Box –** For parameters with editable values, type the value in the text box.

  Note Values preceded by '0' are interpreted as octal; values preceded by '0x', '0X', and '#' are interpreted as hexadecimal.

Signal Select Indicators

For parameters where you select a signal, there is a pull-down menu for single-select signals and a button to open a dialog for multi-select signals.



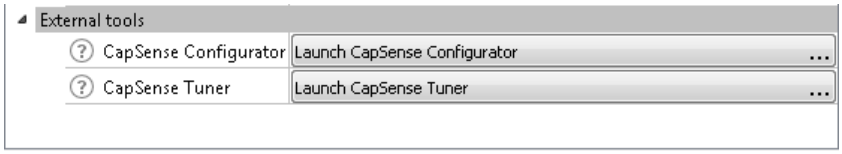
The signals have guidance icons next to them to indicate the status of the signal, as follows:

- Green – preferred
- Yellow – valid
- Red – Constrained

After selecting one or more signals, use the **Go To** button to jump to the selected signal or open a dialog to select from multiple signals.

Launch Other Configurators

For peripherals with their own configuration tools (BLE, CapSense, etc.), the Device Configurator provides links to launch those separate configurators. After enabling the peripheral on the Peripherals Tab, the Parameters pane will contain a **<Config Tool>** parameter, where <Config Tool> is the name of the other configurator.

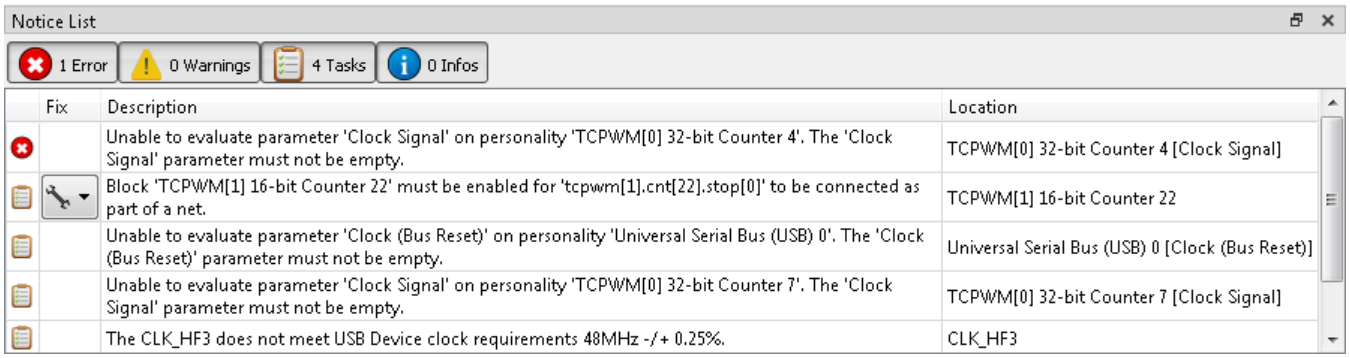


Click on **[Launch <Config Tool> . . .]** to launch the configurator.

Note When launching another configurator from the Device Configurator, it passes information, such as the location of the **.modus* file and any configuration data, to that other configurator. Those other configurators can be launched independently from the Device Configurator. When launched independently, you will need to either open or create the appropriate configuration file for that tool. If you want to use the configuration tools independently for the same application, make sure to save the source files in the correct "GeneratedSource" folder for the appropriate application.

Notice List Pane

The **Notice List** pane combines notices (errors, warnings, tasks, and infos) from many places in your design into a centralized list. If a notice shows a location, you can double-click the entry to show the error or warning.



Notices display in rows. Use the filters above the notices to show or hide different types of notices, as follows:

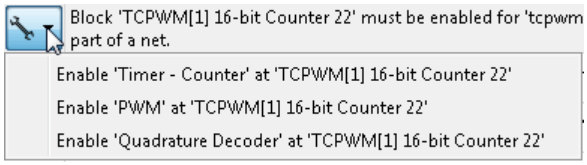
- **Errors** – These indicate there is at least one problem that must be addressed before you can build your application. Typical errors could include: compiler build errors, and connectivity errors.
- **Warnings** – These report unusual conditions that might indicate a problem, although you can usually build the application regardless.
- **Tasks** – These are actions you need to perform to resolve an issue, such as enabling a resource. If you save without resolving a task, it becomes an error.
- **Infos** – These are informational messages from the system to indicate something occurred.

The Notice List pane contains the following columns:

- **Icon** – Displays the icons for the error, warning, task, or info.
- **Fix** – This may display a wrench icon, which can be used to automatically address the required notice.
- **Description** – Displays a brief description of the notice.
- **Location** – Displays the specific line number or other location of the message, when applicable.

Fix a Task/Error

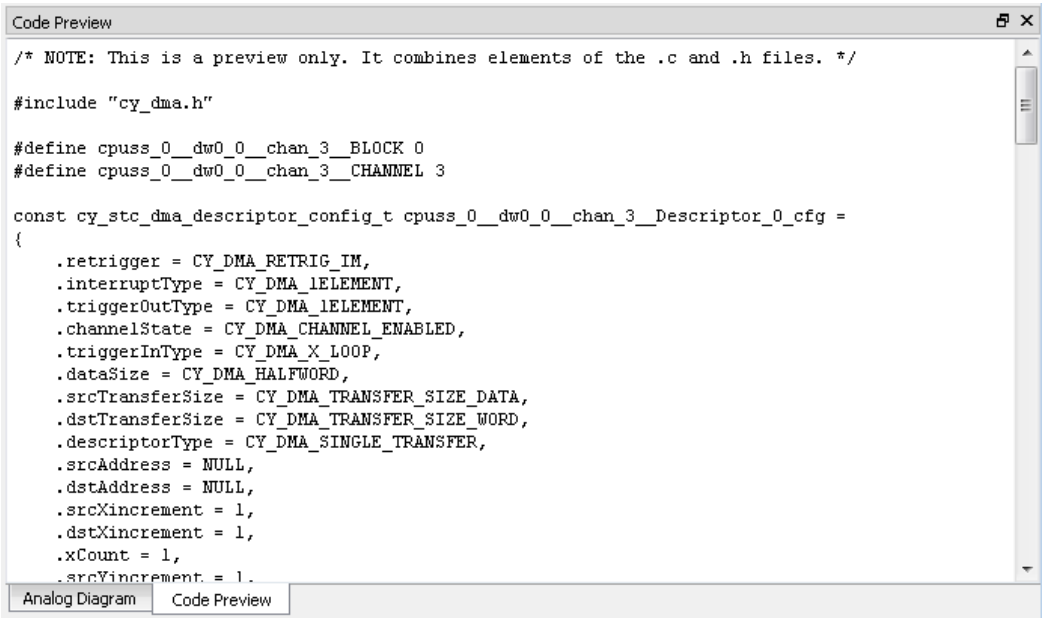
When a wrench icon displays in the **Fix** column, click on it and select the appropriate action from the pull-down menu. When all related issues have been addressed, the notice will be removed from the Notice List pane.



Note The fixes listed are not necessarily the only way to fix the issue. They are merely common options. Also, if you save the **.modus* file with outstanding tasks, they become errors saved in the *GeneratedSource/notices.h* file.

Code Preview Pane

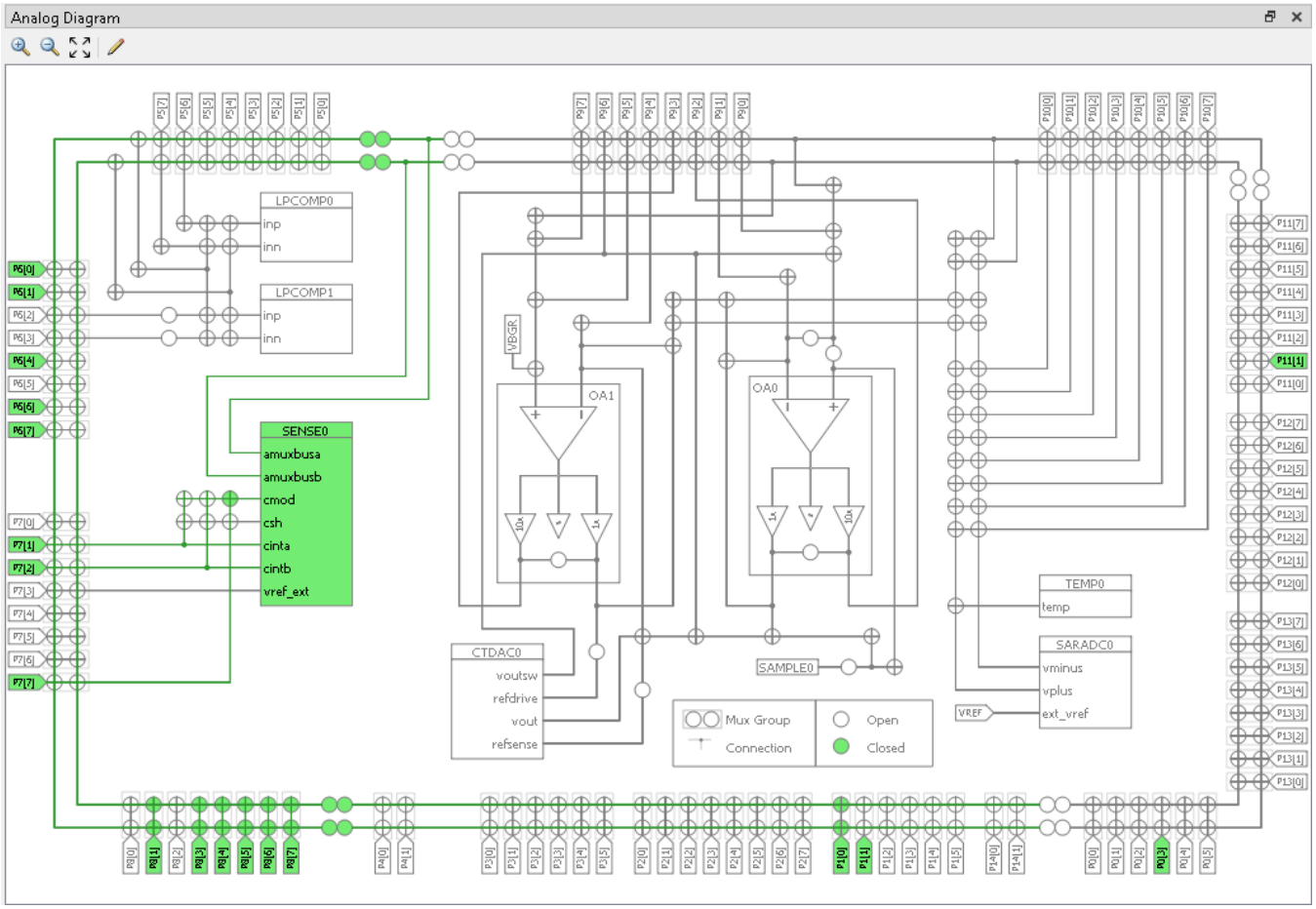
The **Code Preview** pane is a read-only preview of the code that will be generated for the currently selected resource when you save the **.modus* file. As you update configuration options, the Code Preview pane updates the code shown. This code will be written to the appropriate file(s) located in the *GeneratedSource* folder of your application.



Analog Diagram Pane

The **Analog Diagram** pane shows the various analog resources in your application. Enabled resources are green.

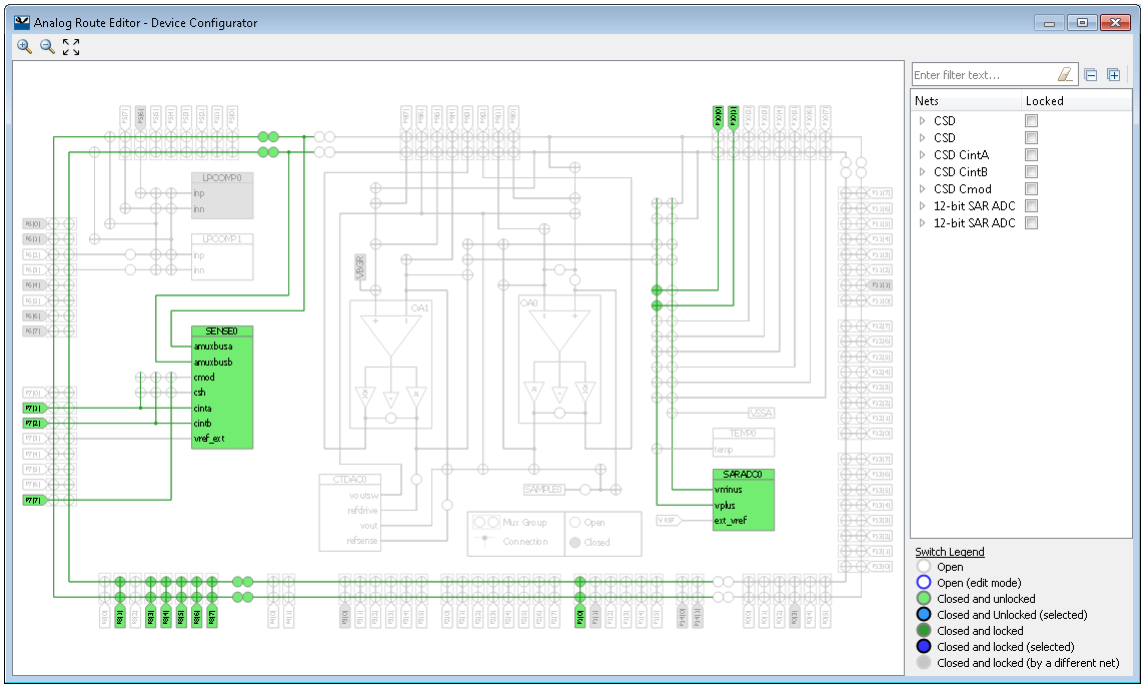
Note The Analog diagram is not applicable to WICED Bluetooth devices.



There are zoom commands to resize the diagram as needed. The **Edit** command opens the Analog Route Editor.

Analog Route Editor

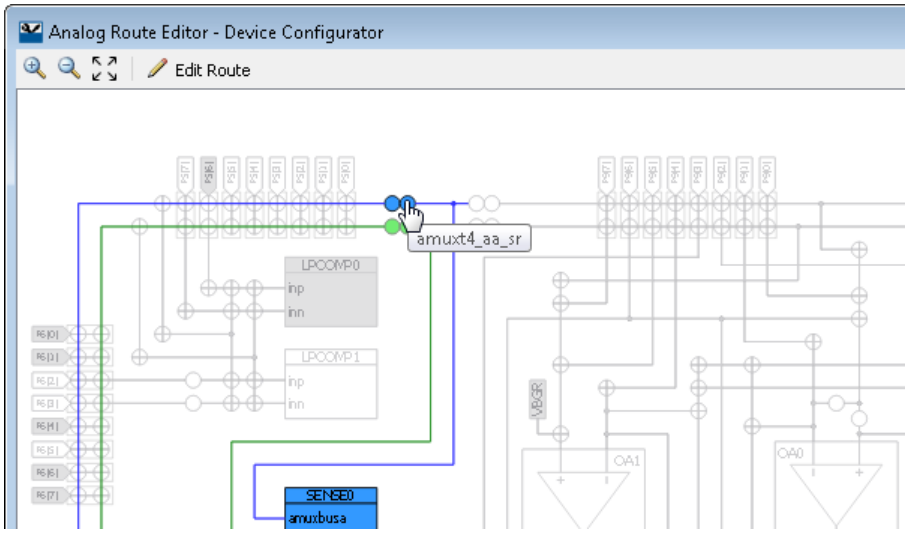
The Analog Route Editor allows you to manually edit the routing of analog resources in your application. It also provides the ability to lock-down all or some of the results.



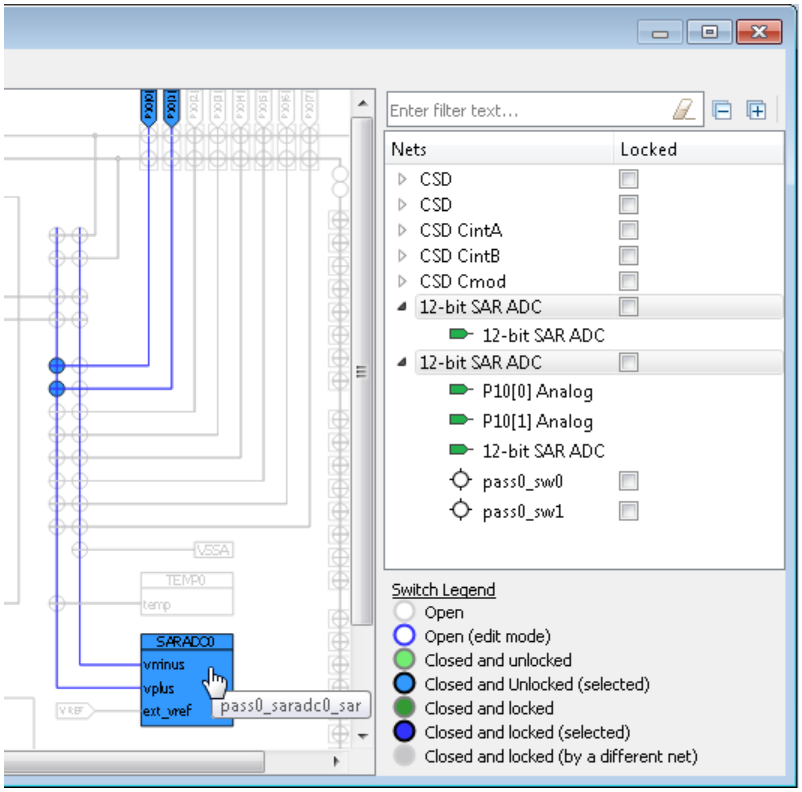
Note If there are configuration errors, complete routing results will not be available; only locked resources. If you open the Analog Editor in this error state, a warning message will display. You can still lock and unlock switches, but you won't get complete routing results as long as the configuration has errors.

Select a Resource

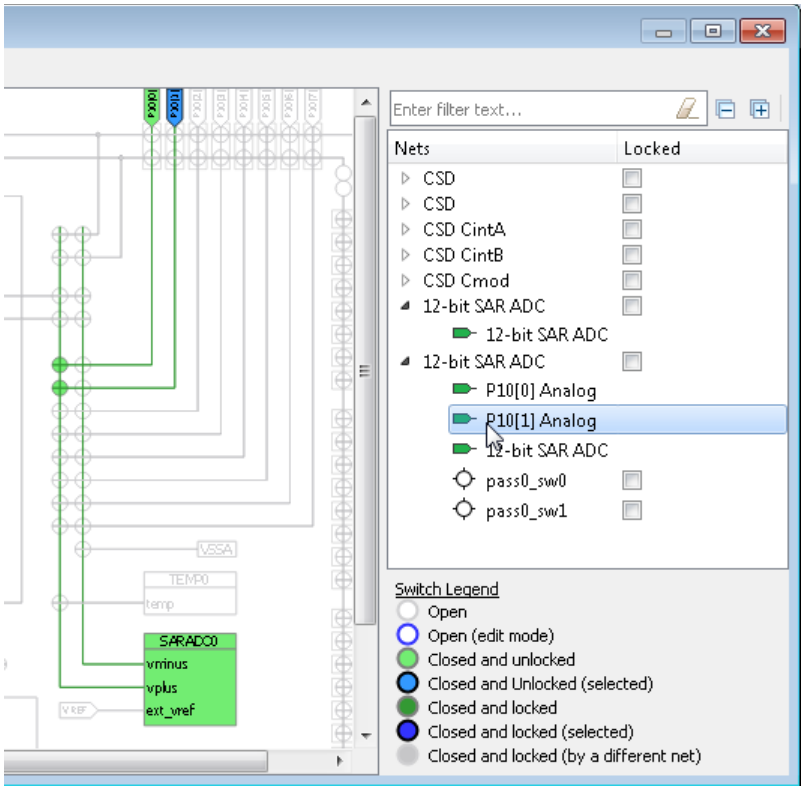
To select an analog resource, click on it. Any enabled (green) element in the tree can be selected. The resource and the associates route(s) becomes blue. Also, the **Edit Route** command appears on the toolbar. See Edit Route.



At the same time, the selected analog resource(s) is highlighted in the Nets tree.



You can also select items in the tree to highlight them in the diagram.



Edit Route

With an editable analog resource selected, click the **Edit Route** command to enable edit mode. If multiple routes are selected, a pull-down menu displays to select the route to edit. You cannot edit multiple routes at the same time.

In edit mode, the net tree shows only the applicable route entries, and you cannot select resources using the tree. However, the lock/unlock check boxes remain enabled for use. The inactive switches change color to indicate they can be selected to use for the route being edited.

Route changes are live with updates applied automatically as you make changes. Selecting a switch adds it to the current route in a locked state and the route tree is updated to reflect the modifications.

If a change results in an error, a message displays. The routes are automatically rolled back to the previous state, so you will lose at most the last invalid change.

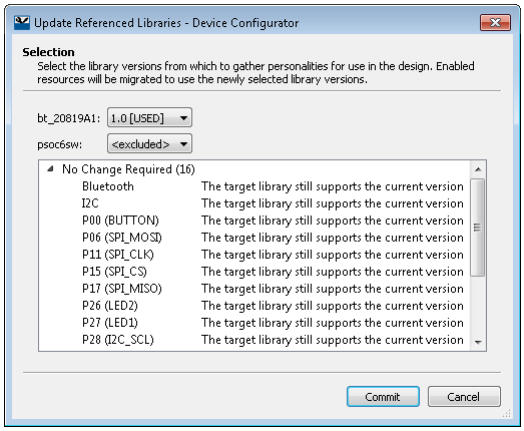
The toolbar shows the **Finish edit** command to return the editor to selection mode.

Note If a route is edited so that it uses switches associated with a location where no personalities are instantiated, you must manually power on the containing block at startup in order for the switches to function. Refer to the *PDL API Reference Guide* and the *Device Technical Reference Manual* for more details.

Update Referenced Libraries Dialog

The Update Referenced Library dialog allows you to select different library versions to use for various resource personalities in the design. See also Personality.

For example, if you updated an SDK or installed a new SDK, there may be updated resource personalities that could improve your application's performance. When the dialog is first opened, it shows the currently selected library versions. Each library version that is used in the current application is labeled as [USED].



The wizard consists of two pages:

Selection Page

This page lists all installed libraries that contain personalities. Use the pull-down menu to select which version to use for each library.

The tree below the menus displays a summary of the migration actions that would happen if the current selection were committed.

Results Page

This page displays a list of all the selected libraries after the migration is complete followed by the summary of migration action results.

References

Refer to the following documents for more information, as needed:

- ModusToolbox IDE User Guide
- API Reference Guides
- Device Datasheets
- Device Technical Reference Manuals

Version Changes

This section lists and describes the changes for each version of this tool.

Version	Change Descriptions
1.0	New tool.
1.1	Added support for WICED Bluetooth devices.