Libero SoC **for Classic Constraint Flow v11.7**

User's Guide

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Microsemi

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Welcome to Microsemi's Libero® SoC v11.7

Libero SoC is the most comprehensive and powerful FPGA design and development software available, providing start-to-finish design flow guidance and support for novice and experienced users alike. Libero SoC combines Microsemi's tools with such EDA powerhouses as Synplify Pro® and ModelSim®.

What's New in Libero SoC v11.7

Enhanced Constraint Flow

Libero SoC v11.7 introduces an enhanced constraint flow designed to simplify the management of all constraints for your design. I/O, timing, floor planning and netlist optimization constraints can be created, imported, edited, checked and organized in a single view. Timing constraints need only be entered once, and can be automatically applied to Synplify synthesis, Timing-Driven Layout and Timing Verification. Timing constraints for known hardware blocks and IPs (CCC, Oscillator, MSS/HPMS, FDDR, SERDES), can also be derived automatically. Constraints for these blocks are derived based on the selected block configuration, and can easily be applied to Synthesis, Layout, or Timing Verification.

To learn more, start with the new Constraint Manager.

Chip Planner

Libero SoC v11.7 introduces a full overhaul of the Chip Planner floorplanning tool. Chip Planner v11.7 provides a snappy interface, with a contemporary look and feel. Significant runtime enhancements compared to earlier versions of the same tool provide a smoother user experience on large, high-utilization designs. Navigate through your design with ease using the revamped design hierarchy browser, with advanced search and filtering support. Chip Planner also introduces further usability enhancements, with easy access to instance properties, and a highly customizable display interface for enhanced productivity. Cross-probing from SmartTime to Chip Planner is also supported in Libero SoC v11.7.

For more information, refer to the Chip Planner User's Guide.

SmartDebug

SmartDebug in Libero SoC v11.7 introduces a redesigned Debug FPGA Array probe management User Interface. A new netlist hierarchy browser helps you navigate through your design to manage Live Probes, Active Probes, and Probe Insertion. Active Probes can be also organized using the new Probe Grouping feature. New for v11.7 are the Device Status Report, eNVM Page Status enhancements for SmartFusion2 and IGLOO2 devices, and Debug SERDES enhancements for SmartFusion2, IGLOO2, and RTG4 devices. Also included in this release are run time improvements.

Starting in v11.7, SmartDebug can be run in as a standalone tool for SmartFusion2, IGLOO2, and RTG4 devices. SmartDebug in standalone mode is launched outside of the Libero Design Flow; it is intended to be used in debug environments – lab setups, for example – where the full Libero SoC tools suite is not installed. The SmartDebug standalone can be installed using the new Program and Debug Tools installer, which also contains FlashPRO, FlashPRO Express, and Job Manager.

For more information, refer to the SmartDebug User's Guide.

Microsemi's Secure Production Programming Solution (SPPS)

SPPS enables the customer to prevent overbuilding of their systems, using Thales e-Security FIPS140-2 level 3 certified hardware security modules (HSMs), custom firmware, and the state-of-the-art security protocols built into every Microsemi SmartFusion2 SoC FPGA and IGLOO2 FPGA. To learn more, see the Microsemi website.

More Information

- Release Notes - See the Libero SoC v11.7 Release Notes for a complete list of devices/packages along with timing and power data versions supported in this release.
- Libero - Learn more about Libero SoC
- Programming – Learn more about Programming Solutions

- Power Calculators – Find XLS-based estimators for device families
- Development Kits – Learn more about development kits to accelerate your design
- Licensing- Learn more about Libero licensing

Design Flow - Libero SoC

See the Libero SoC SmartFusion2 Design Flow topic for more information on designing for that device.

The Libero SoC Build button enables you to proceed from synthesis to programming in one click.

Once you create your design (configure your MSS; create SmartDesign; Create HDL) and click the **Build** button the software automatically executes the following operations with default settings (if it encounters no errors):

- Synthesis
- Compile
- Place and Route
- Verify Timing
- Generate Programming Data

You can also import constraint files, organize and associate them for use during synthesis and compile.

In the event of an error the operation is halted and an explanatory error message appears in the Log window.

To change the default settings for any of the operations, right-click and choose **Open Interactively** to open the tool associated with the operation.

For example, to change the Compile settings, expand **Implement Design**, right-click **Compile** and choose **Open Interactively**. This displays the Compile options for your design.

Libero SoC Design Flow (Classic Constraint Flow)

The Libero SoC Build button enables you to proceed from synthesis to Place and Route in one click (using default settings).

The basic design flow is shown in the figure below.

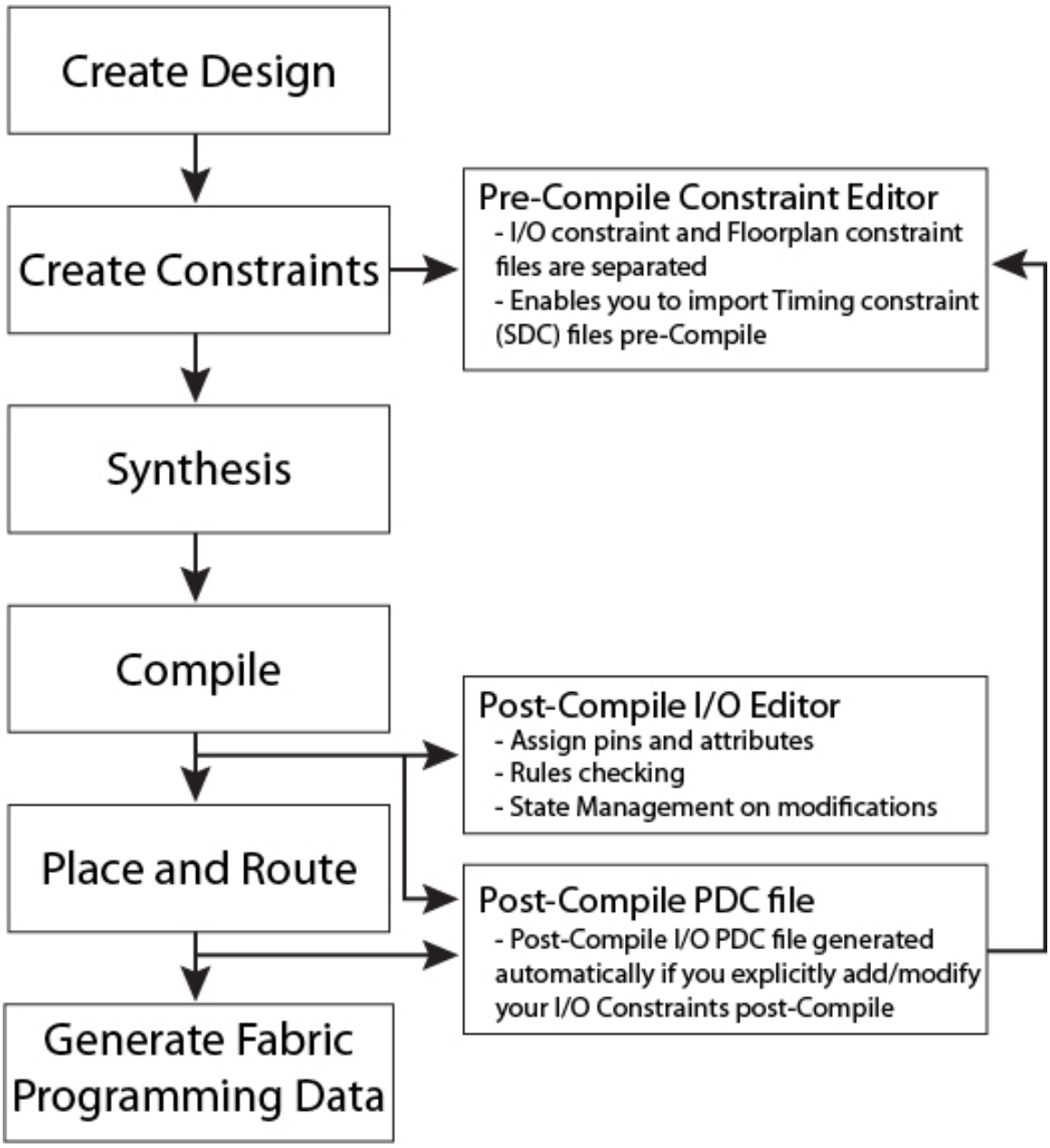

Figure 1 · Libero SoC Classic Constraint Design Flow

Create Design

Once you create your design (using System Builder; using the MSS builder - the flow for which is similar to the MSS flow for SmartFusion; create SmartDesign; Create HDL; SmartDesign Testbench) and click the **Build** button the software automatically executes the operations below with default settings (if it encounters no errors).

Create Constraints - Pre-Compile

I/O constraint PDC files are separate from Floorplan constraint PDC files; if you have a PDC file that contains both I/O and Floorplan constraints then Libero SoC errors out with an invalid constraint error.

- I/O Constraints - To add an I/O constraint, in the Design Flow window expand Create Constraints, right-click **I/O Constraints** and choose **Import Files**.
- Timing Constraints - Enables you to import SDC files pre-Compile.

- Floorplan Constraints - Created with the Floorplanner or a text editor; to add a Floorplan constraint, in the **Design Flow** window expand **Create Constraints**, right-click **Floorplan Constraints** and choose **Import Files**.

Synthesis

Double-click **Synthesize** to run synthesis on your design automatically; automatic synthesis uses the default settings in your synthesis tool.

Compile

To compile your design with custom settings, right-click **Compile** in the Design Flow window and choose **Configure Options**.

Place and Route

Place and Route runs automatically with default settings as part of the push-button design flow in Libero SoC.

Edit Constraints - Post-Compile

- I/O Constraints - The Post-Compile I/O Editor displays all assigned and unassigned I/O macros and their attributes in a spreadsheet format; use this editor to view, sort, select, edit, lock and unlock assigned attributes.

  The post compile editor ensures that the Compile/Place and Route state is maintained (you do not have to rerun Compile or Place and Route), if you make changes to the attributes that do not require it.

  However, if you modify the I/O PDC file directly, it is equivalent to modifying the source file of the design, which means the tools starting from Compile will become out of date because one of the source files was modified.
- Timing Constraints - Run SmartTime to perform Min/Max analysis and manage timing constraints.
- Floorplan Constraints - Use to create and edit regions on your chip and assign logic to these regions.

Generate Fabric Programming Data

Generates programming data for your design.

IGLOO, ProASIC3, and Fusion Programming

SmartFusion, IGLOO, ProASIC3, and Fusion devices use the FlashPoint program file generator to create a programming file. For SmartFusion, IGLOO, and ProASIC3, the FlashPoint interface also enables the advanced security features.

To open FlashPoint, expand Implement Design, right-click Generate Programming Data, and choose **Open Interactively**. FlashPoint allows you to generate the following programming files:

- IEEE 1532 files (*.bsd, *.isc)
- DirectC files (*.dat)
- Programming Data File (*.pdb)
- STAPL file (*.stp)
- Serial Vector Files (*.svf)

You must have completed your design to generate your programming (*.stp or STAPL) file.

SmartFusion2, IGLOO2, and RTG4 Programming

You do not have to open FlashPro or FlashPoint to program your SmartFusion2 device. All programming functionality is available from within the Design Flow window, including:

Programming Connectivity and Interface - Organizes your programmer(s) and devices.

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Programmer Settings - Opens your programmer settings; use if you wish to program using settings other than default.

Device I/O States During Programming - Sets your device I/O states during programming; use if your design requires that you change the default I/O states.

Security Policy Manager - Enables you to set your Secured Programming Use Model, User Key Entry and Security Policies for your design.

The figure below shows a SmartFusion Design Flow window on the left and a SmartFusion2 Design Flow window on the right.

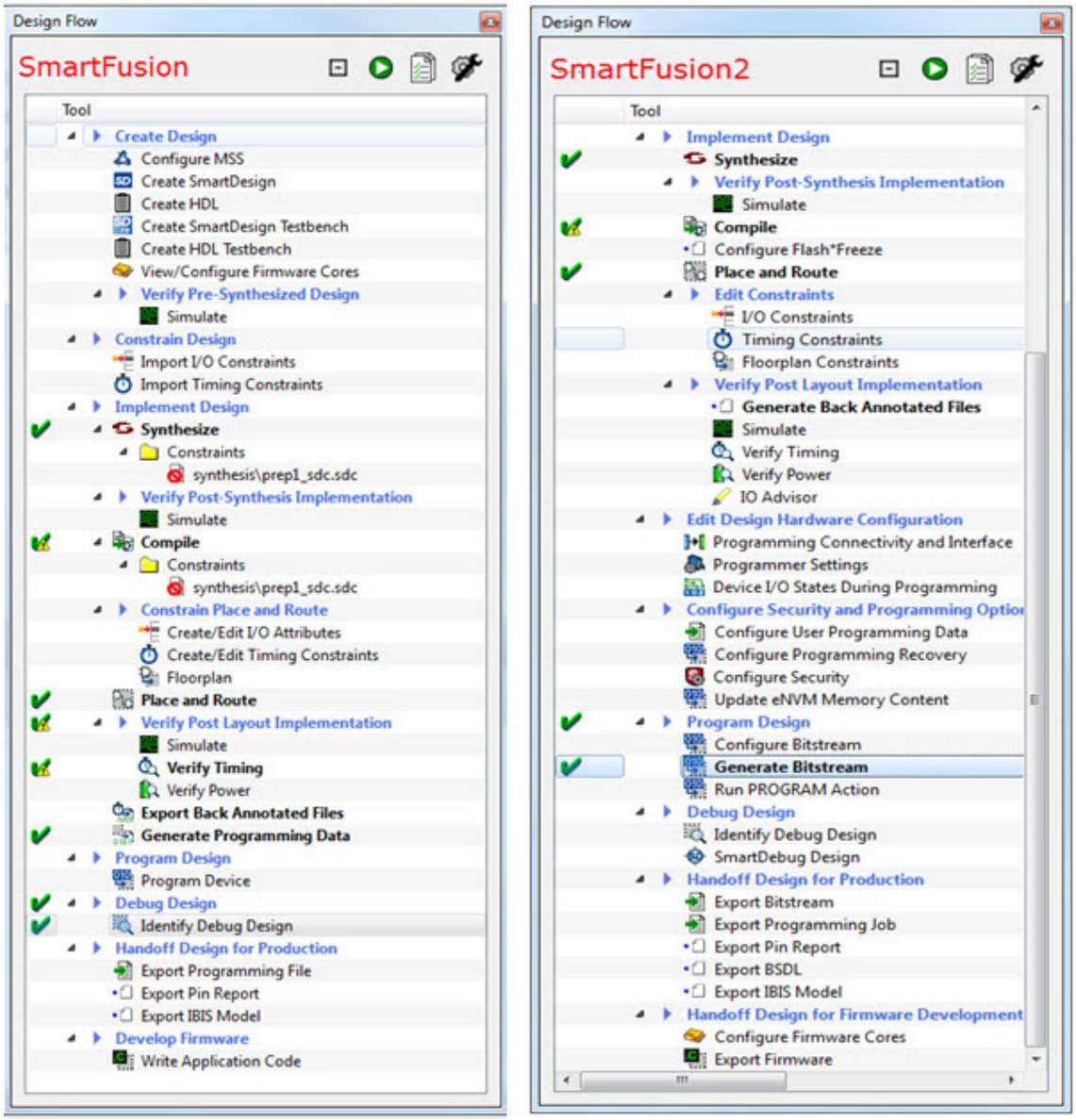

Figure 2 · SmartFusion (left) and SmartFusion2 (right) Design Flow Windows

File Types in Libero SoC

When you create a new project in the Libero SoC it automatically creates new directories and project files. Your project directory contains all of your local project files. When you import files from outside your current project, the files are copied into your local project folder.

The Project Manager enables you to manage your files as you import them. If you want to store and maintain your design source files and design constraint files in a central location outside the Project location, Libero gives you the option to link them to your Libero project folders when you first create your project. These linked files are not copied but rather linked to your project folder.

Depending on your project preferences and the version of Libero SoC you installed, the software creates directories for your project.

The top level directory (<project_name>) contains your PRJ file; only one PRJ file is enabled for each Libero SoC project.

component directory - Stores your SmartDesign components (SDB and CXF files) for your Libero SoC project.

constraint directory **-** All your constraint files (SDC, PDC)

designer directory **-** ADB files (Microsemi Designer project files), -_ba.SDF, _ba.v(hd), STP, PRB (for Silicon Explorer), TCL (used to run designer), impl.prj_des (local project file relative to revision), designer.log (logfile)

Note: The Microsemi ADB file memory requirement is equivalent to 2x the size of the ADB file. If your computer does not have 2x the size of your ADB file's memory available, please make memory available on your hard drive.

hdl directory **-** all hdl sources. *.vhd if VHDL, *.v and *.h if Verilog

simulation directory - meminit.dat, modelsim.ini files, BFM files

smartgen directory - GEN files and LOG files from generated cores

stimulus directory - BTIM, Verilog, and VHDL stimulus files

synthesis directory - *.edn, *_syn.prj (Synplify log file), *.psp (Precision project file), *.srr (Synplify logfile), precision.log (Precision logfile), *.tcl (used to run synthesis) and many other files generated by the tools (not managed by Libero SoC)

viewdraw directory - viewdraw.ini files

Software Tools - Libero SoC

The Libero SoC integrates design tools, streamlines your design flow, manages design and log files, and passes design data between tools.

For more information on Libero SoC tools, please visit:

http://www.microsemi.com/products/fpga-soc/design-resources/design-software/libero-soc#overview

Function	Tool	Company
Project Manager, HDL Editor, Core Generation	Libero SoC	Microsemi SoC
Synthesis	Synplify® Pro ME	Synopsys
Simulation	ModelSim® ME	Mentor Graphics
Timing/Constraints, Power Analysis, NetlistViewer, Floorplanning, Package Editing, Place-and-Route, Debugging	Libero SoC	Microsemi SoC
Programming Software	FlashPro	Microsemi

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Function	Tool	Company
		SoC
Programming Software	FlashPro Express	Microsemi SoC

Project Manager, HDL Editor targets the creation of HDL code. HDL Editor supports VHDL and Verilog with color, highlighting keywords for both HDL languages.

Synplify Pro ME from Synopsys is integrated as part of the design package, enabling designers to target HDL code to specific devices.

Microsemi SoC software package includes:

- **ChipPlanner** displays I/O and logic macros in your design for floorplanning
- **NetlistViewer** design schematic viewer
- **SmartPower** power analysis tool
- **SmartTime** static timing analysis and constraints editor

ModelSim ME from Mentor Graphics enables source level verification so designers can verify HDL code line by line. Designers can perform simulation at all levels: behavioral (or pre-synthesis), structural (or post-synthesis), and back-annotated (post-layout), dynamic simulation. (ModelSim is supported in Libero Gold and Platinum only.)

Frequently Asked Questions - Libero SoC

The collection of Frequently Asked Questions are useful for anyone that is new to Libero SoC. All the information listed below is explained in detail in other sections of the help, but the information is summarized here for easy reference. Click any question to go to the corresponding explanation.

Libero SoC Frequently Asked Questions

1. How do I set my Multi-Pass place and route options?
2. How do I set FlashPro security options?
3. How do I instantiate my HDL in SmartDesign?
4. How do I add a bus interface to my HDL code and then add it to SmartDesign?
5. I don't see any DirectCore IP's in the Catalog but I have both Libero IDE 9.1 and Libero SoC 10.0 installed. Where are the DirectCore IP's?
6. How do I assign I/O/s in Libero SoC?
7. How do I make sure that my design is using the latest driver(s)?
8. How do I improve the timing of my design?
9. How do I manage clocks?
10. How do I write a testbench?

Firmware Cores Frequently Asked Questions

1. Where are the firmware files generated?
2. Why are some firmware in italics?
3. Why am I getting the following error on generation? "Error: 'Missing Core Definition': Core 'Actel:Firmware:MSS_SPI_Driver:2.0.101 ' is missing from the vault."?
4. Why is my firmware view empty?
5. Why are there multiple firmware instances of the same type?

Libero SoC Frequently Asked Questions

How do I set my Multi-Pass place and route options?

The steps to run Multi-Pass place and route vary depending on the device family.

For SmartFusion, IGLOO, ProAsic and Fusion: In the Design Flow window, expand **Implement Design**, right-click **Place and Route** and choose **Open Interactively**. Designer opens. Click **Layout** to open the Layout Options dialog box and choose **Use Multiple Pass**. Click the Configure button to open the Multi-Pass Configurator. Set your Multi-Pass Options. Once Layout is complete, save your ADB to retain your custom place and route options.

For SmartFusion2, IGLOO2 and RTG4: In the Design Flow window, expand **Implement Design**, right-click **Place and Route** and choose **Configure Options**. When the Layout Options dialog box appears, check the **Use Multiple Passes** option and click **Configure**. When the Multi-Pass configuration dialog box appears, set your Multi-Pass options.

How do I set FlashPro security options?

In the Libero SoC Design Flow window, expand **Program Design**, right-click **Program Device** and choose **Open Interactively**. FlashPro opens and enables you to set/change your security options. See the FlashPro help for more information.

How do I instantiate my HDL in SmartDesign?

Import your HDL file into the Libero SoC (File > Import Files). After you do this, your HDL module appears in the Project Manager Hierarchy. Then, drag-and-drop it from the Hierarchy onto your SmartDesign Canvas.

How do I add a bus interface to my HDL code and then add it to SmartDesign?

If you want to add a bus interface to your HDL code and then add it to SmartDesign, see the Adding or Modifying Bus Interfaces in SmartDesign topic.

I don't see any DirectCore IP's in the Catalog but I have both Libero IDE 9.1 and Libero SoC 10.0 installed. Where are the DirectCore IP's?

Make sure the vault location is correct. Click the Catalog Options button to open the Catalog Options dialog box. Then check and, if necessary, update your vault location.

How do I assign I/O's in Libero SoC?

In the Design Flow window, expand **Implement Design**, then expand **Constrain Place and Route**. Right-click **Edit I/O Attributes** and choose **Open Interactively** to open the I/O Attribute Editor.

How do I make sure that my design is using the latest driver(s)?

In the Design Flow tab, expand **Create Design** and double-click **View/Configure Firmware Cores** to view the DESIGN_FIRMWARE tab. The Firmware table lists the compatible firmware and drivers based on the hardware peripherals that you have used in your design. Use the Version drop down menus to check for the latest firmware and firmware drivers.

How do I improve the timing of my design?

The SmartTime tool enables you to set clock constraints, analyze timing, identify critical paths, and find the minimum cycle time that does not result in a timing violation.

To improve the timing of your design:

1. Run timing analysis to identify timing violations.
2. View the paths with timing violations.
3. Modify timing constraints on the critical path(s) in order to meet your timing requirements.
4. Run Timing-Driven Place and Route.

For more information on improving timing, see the Analysis and Optimization application notes. The Designing for Performance on Flash-Based FPGAs application note is a good starting point.

How do I manage clocks?

Specify clock constraints in your design. See the sections on explicit clocks, potential clocks and clock networks for more information on clocks in Libero SoC.

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How do I write a testbench?

You can write or edit a testbench manually using the HDL editor, or you can create a new HDL testbench and automatically populate it with all your design information with Create New HDL Testbench in Libero SoC. Create New HDL Testbench is in the Design Flow window under **Create Design**.

Testbench file are generated automatically when you generate a SmartDesign. You can find them in your Files window in Libero SoC (**View > Window > Files**).

Firmware Cores Frequently Asked Questions

Where are the firmware files generated?

The firmware files are generated to the firmware working directory <project>\firmware. Your software IDE workspace is generated to <project>\<software IDE tool chain>.

Why are some firmware in italics?

This indicates the firmware is in the IP repository but not in your local IP vault. You must download it to your local IP vault so that the Libero SoC will generate the firmware files.

Why am I getting the following error on generation? "Error: 'Missing Core Definition': Core 'Actel:Firmware:MSS_SPI_Driver:2.0.101 ' is missing from the vault."?

This happens when a firmware that is in your design but the VLNV definition could not be found in your IP vault. This can happen if you:

- Changed your vault settings to point to another vault
- Opened a project that was created on another machine

Why is my firmware view empty?

Check that you are pointing to the proper firmware repository:

www.actel-ip.com/repositories/Firmware

Check with your network administrator to make sure you can communicate with Microsemi's IP repository URL.

Why are there multiple firmware instances of the same type?

Some firmware cores have configurable options, and in certain cases you will have two peripherals of the same firmware VLNV. In this situation, you may want to configure each peripheral driver separately.

Software IDE Integration

Libero SoC simplifies the task of transitioning between designing your FPGA to developing your embedded firmware.

Libero SoC manages the firmware for your FPGA hardware design, including:

- Firmware hardware abstraction layers required for your processor
- Firmware drivers for the processor peripherals that you use in your FPGA design.
- Sample application projects are available for drivers that illustrate the proper usage of the APIs

You can see which firmware drivers Libero SoC has found to be compatible with your design by opening the Firmware View. From this view, you can change the configuration of your firmware, change to a different version, read driver documentation, and generate any sample projects for each driver.

Libero SoC manages the integration of your firmware with your preferred Software Development Environment, including SoftConsole, Keil, and IAR Embedded Workbench. The projects and workspaces for your selected development environment are automatically generated with the proper settings and flags so that you can immediately begin writing your application.

See Also

Exporting Firmware and the Software IDE Workspace

Libero SoC Frequently Asked Questions

Running Libero SoC from your Software Tool Chain

View/Configure Firmware Cores

System Builder

System Builder is a graphical design wizard that enables you to enter high-level design specifications for SmartFusion2 or IGLOO2.

System Builder takes you through the following steps:

- Asks basic questions about your system architecture and peripherals
- Builds a correct-by-design complete system

System Builder automatically configures the silicon features you select. To complete the design, add your custom logic or IP and connect them to your System Builder-generated design.

See the SmartFusion2 System Builder documentation or the IGLOO2 System Builder documentation for a complete family-specific explanation of the tool.

Instantiate a SmartFusion MSS in your Design

You can configure peripherals within the SmartFusion MSS, such as the ARM® Cortex™-M3, embedded nonvolatile memory (eNVM), Ethernet MAC, timer, UART, and SPI to suit your needs. The MSS operates standalone without any dependencies on other logic within the device; however, designs that require functionality beyond a standalone MSS are handled by using SmartDesign to add user logic in the SmartFusion FPGA fabric.

You can instantiate a Microcontroller Subsystem into your design from the New Project Creation Wizard when you start a new SmartFusion project, or from the Design Flow window after you have created a new project.

To instantiate a SmartFusion MSS from the New Project Creation Wizard you must enable **Use Design Tool** (under **Design Templates and Creators**) and click to select **SmartFusion Microcontroller Subsystem (MSS**) from the list.

If you opted not to use a Design Tool when you created your project, in the Design Flow window expand **Create Design** and double-click **Configure MSS**. This opens the **Add Microcontroller Subsystem** dialog box. Enter your **Design Name** and click **OK** to continue. A SmartDesign Canvas appears with the MSS added to your project; double-click the MSS to view and configure MSS components.

Configure the SmartFusion MSS

Documents for specific SmartFusion MSS peripherals are available on the Peripheral Documents web page.

The SmartFusion Microcontroller Subsystem (MSS) Configurator (as shown in the figure below) contains the elements listed below. Double-click any element in the MSS to configure it; click the checkbox (if available) to enable or disable it in your design.

MSS ARM® Cortex™-M3

Peripherals

- ACE Configuration
- ACE Simulation
- AHB Bus Matrix Configuration
- Clock Configuration
- Configurator Overview
- Embedded FlashROM (eFROM) Configuration
- Embedded Nonvolatile Memory (eNVM) Configuration

- Ethernet MAC Configuration
- External Memory Controller (EMC) Configuration
- Firmware
- GPIO Configuration
- I2C Configuration
- Interrupt Management
- I/O Configuration
- I/O Editor
- Peripheral DMA Configuration
- Real Time Counter (RTC) Configuration
- Reset Management Configuration
- SPI Configuration
- Timer Configuration
- UART Configuration
- Watchdog Configuration

Fabric

- Dedicated Fabric Clock Conditioning Circuit with PLL Integration

Interfaces

- How to Create a MSS and Fabric AMBA AHBLite Design (MSS Master Mode)
- How to Create a MSS and Fabric AMBA APB3 Design (MSS Master Mode)
- How to Create a MSS and Fabric AMBA AHBLite/APB3 Design (MSS Master Mode)

SmartFusion SmartDesign Documents

- SmartDesign MSS Canvas
- SmartDesign MSS Simulation
- SmartDesign MSS Running the MSS Configurator in your Software Tool Chain

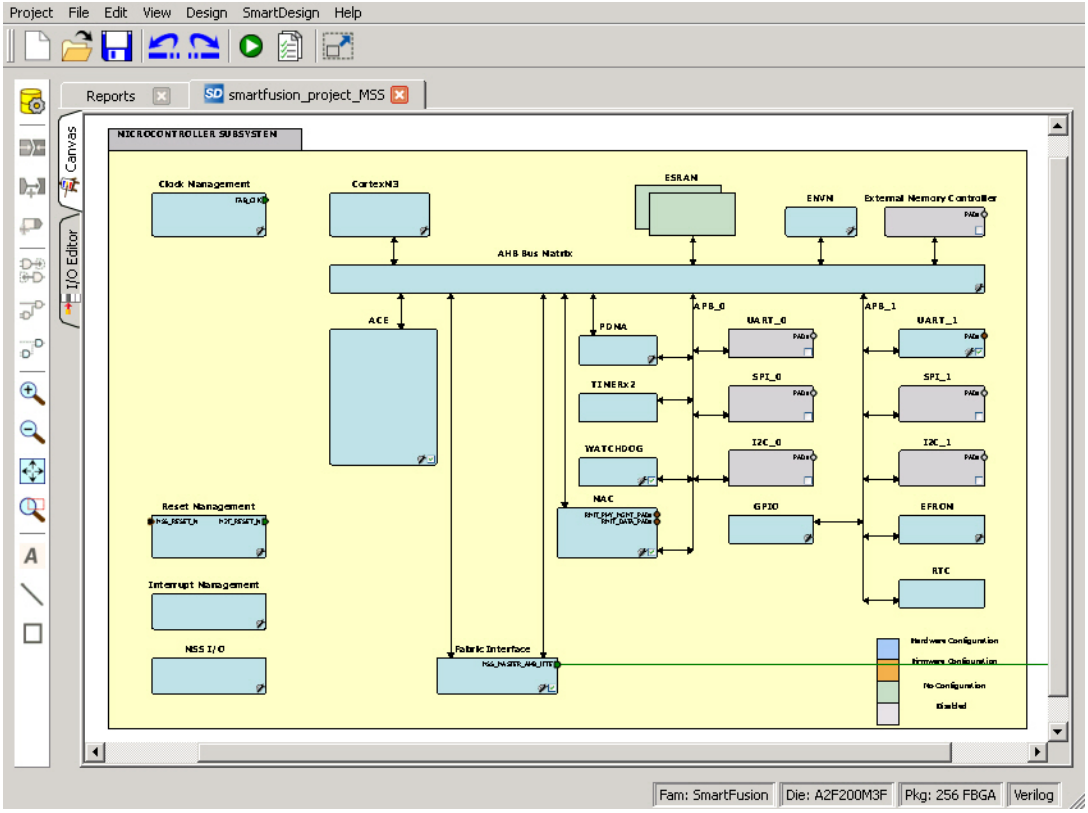

Figure 3 · SmartFusion MSS

Generate SmartFusion MSS Files

See the MSS Configurator help for more information on generating SmartFusion MSS files.

Click the **Generate Component** button to create your SmartFusion MSS files.

The MSS Configurator generates the following files:

- HDL files for the MSS design and its sub-components: MSS CCC, etc. HDL files are automatically managed by the Libero SoC and passed to the Synthesis and Simulation point tools.
- EFC File. MSS hardware configuration that is loaded into eNVM. FlashPro automatically detects this file and includes it in your final programming file.
- UFC file. Contains your Embedded FlashROM configuration and data. FlashPro automatically detects this file and includes it in your final programming file.
- Firmware drivers and memory maps are exported into the <project>\firmware\ directory - Libero SoC automatically generates a Software IDE project that includes your Firmware drivers. If you are not using a software project automatically created by Libero, you can import this directory into your Software IDE project.
- Testbench HDL and BFM script for the MSS design: These files are managed by Libero SoC and automatically passed to the Simulation point tool.
- PDC files for the MSS and the top-level design: These files are managed by Libero SoC and automatically integrated during Compile and Layout.

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Instantiate a SmartFusion2 MSS in your Design

You can configure peripherals within the SmartFusion2 MSS, such as the ARM® Cortex™-M3, embedded nonvolatile memory (eNVM), Ethernet MAC, timer, UART, and SPI to suit your needs. The MSS operates standalone without any dependencies on other logic within the device; however, designs that require functionality beyond a standalone MSS are handled by using SmartDesign to add user logic in the SmartFusion2 FPGA fabric.

You can instantiate a Microcontroller Subsystem into your design from the New Project Creation Wizard when you start a new SmartFusion2 project, or from the Design Flow window after you have created a new project.

To instantiate a SmartFusion2 MSS from the New Project Creation Wizard you must enable **Use Design Tool** (under **Design Templates and Creators**) and click to select **SmartFusion2 Microcontroller Subsystem (MSS**) from the list.

If you opted not to use a Design Tool when you created your project, in the Design Flow window expand **Create Design** and double-click **Configure MSS**. This opens the **Add Microcontroller Subsystem** dialog box. Enter your **Design Name** and click **OK** to continue. A SmartDesign Canvas appears with the MSS added to your project; double-click the MSS to view and configure MSS components.

Configure the SmartFusion2 MSS

Documents for specific SmartFusion2 MSS peripherals are available on the Peripheral Documents web page.

The SmartFusion2 Microcontroller Subsystem (MSS) Configurator (as shown in the figure below) contains the elements listed below. Double-click any element in the MSS to configure it; click the checkbox (if available) to enable or disable it in your design.

MSS ARM® Cortex™-M3 Peripherals

- MSS CAN
- MSS Peripheral DMA (PDMA)
- MSS GPIO
- MSS I2C
- MSS Ethernet MAC
- MSS DDR Controller (MDDR)
- MSS MMUART
- MSS Real Time Counter (RTC)
- MSS Embedded Nonvolatile Memory (eNVM)
- MSS SPI
- MSS USB
- MSS Watchdog Timer

Fabric Interfaces

- MSS Fabric Interface Controllers (FICs)

Additional Information

- MSS Cache Controller
- MSS DDR Bridge Controller
- MSS AHB Bus Matrix
- MSS Clocks Configurator (MSS CCC)
- MSS Interrupts Controller
- MSS Reset Controller
- MSS SECDED Configurator
- MSS Security Configurator

The MSS generates a component that is instantiated into your top-level design.

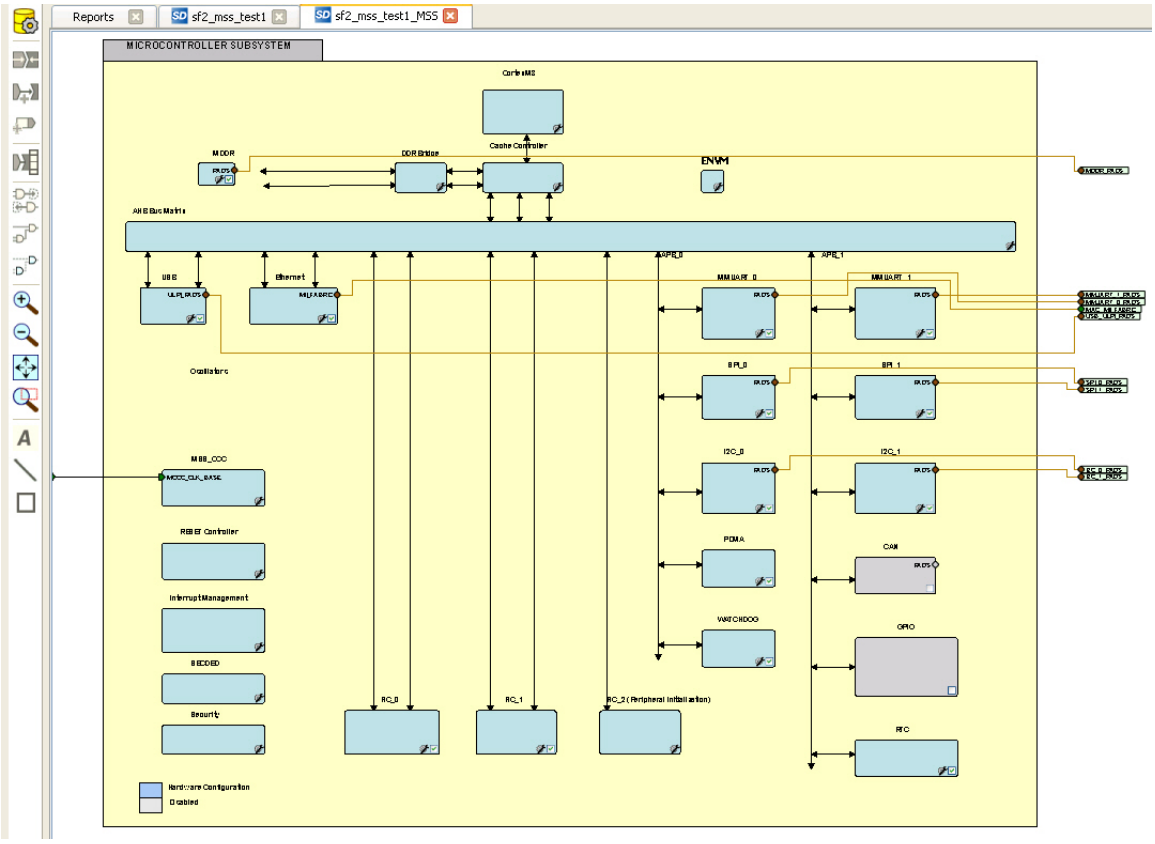

Figure 4 · Microcontroller Subsystem Configurator

Generate SmartFusion2 MSS Files

See the MSS Configurator help for more information on generating SmartFusion2 MSS files.

Click the **Generate Component** button to create your SmartFusion2 MSS files.

The MSS Configurator generates the following files:

- HDL files for the MSS components, including timing shells for synthesis - HDL files are automatically managed by the Libero SoC and passed to the Synthesis and Simulation tools.
- EFC File: Contains your eNVM client data - The EFC content is included in your final programming file.
- Firmware drivers and memory maps are exported into the <project>\firmware\ directory - Libero SoC automatically generates a Software IDE project that includes your Firmware drivers. If you are not using a software project automatically created by Libero, you can import this directory into your Software IDE project.
- Testbench HDL and BFM script for the MSS design: These files are managed by Libero SoC and automatically passed to the Simulation tool.
- PDC files for the MSS and the top-level design: These files are managed by Libero SoC and automatically integrated during Compile and Layout.

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Create ViewDraw Schematic

You must enable ViewDraw in your Project Settings to create a schematic source file in Libero SoC.

To create a schematic source file:

1. In the Design Flow window, double-click **Create ViewDraw Schematic**.
2. Type a name for your schematic file in the Name field. Click **OK**. ViewDraw AE starts.
3. **Using ViewDraw AE, create your schematic**.
4. When you are done, click **Save+Check** in ViewDraw. The Save+Check command creates your WIR file. When Save and Check is complete, the message Check complete, 0 errors and 0 warnings in project <name> appears in the status bar.

   You must select Save & Check. Selecting Save will not generate the needed WIR file for that block.

5. (Optional) **Right-click the schematic file** in the Files tab and choose **Check Schematic**. The connectivity checker checks the connectivity of the WIR file. Errors and warnings appear in the log window.
6. From the **File** menu, choose **Exit**. The schematic is saved to your project in Libero SoC and appears in both the File Manager and the Design Hierarchy tabs.

About SmartDesign

SmartDesign is a visual block-based design creation tool for instantiation, configuration and connection of Microsemi IP, user-generated IP, custom/glue-logic HDL modules. The final result is a design-rule-checked and automatically abstracted synthesis-ready HDL file. A generated SmartDesign can be the entire FPGA design or a component subsystem of a larger design.

Instantiate IP cores, macros and HDL modules by dragging them from the Catalog onto the Canvas, where they are viewed as blocks in a functional block diagram. From the Canvas you can:

- Configure your blocks
- Make connections between your blocks
- Generate your SmartDesign
    - This step generates the HDL and testbench files required to proceed with Synthesis and Simulation.
    - View a Memory Map / Datasheet - The datasheet reports the memory map of the different subsystems of your design, where a subsystem is any independent bus structure with a Master and Slave peripheral attached.

SmartDesign supports all Microsemi SoC product families.

SmartDesign Design Flow

SmartDesign enables you to stitch together design blocks of different types (HDL, IP, etc) and generate a top-level design. The Files tab lists your SmartDesign files in alphabetical order.

You can build your design using SmartDesign with the following steps:

Step One – Instantiating components: In this step you add one or more building blocks, HDL modules, components, and schematic modules from the project manager to your design. The components can be blocks, cores generated from the core Catalog, and IP cores.

Step Two – Connecting bus interfaces: In this step, you can add connectivity via standard bus interfaces to your design. This step is optional and can be skipped if you prefer manual connections. Components generated from the Catalog may include pre-defined interfaces that allow for automatic connectivity and design rule checking when used in a design.

Step Three – Connecting instances: The Canvas enables you to create manual connections between ports of the instances in your design. Unused ports can be tied off to GND or VCC (disabled); input buses can be tied to a constant, and you can leave an output open by marking it as unused.

Step Four – Generating the SmartDesign component: In this step, you generate a top-level (Top) component and its corresponding HDL file. This component can be used by downstream processes, such as synthesis and simulation, or you can add your SmartDesign HDL into another SmartDesign.

When you generate your SmartDesign the Design Rules Check verifies the connectivity of your design; this feature adds information to your report; design errors and warnings are organized by type and message and displayed in your Datasheet / Report.

You can save your SmartDesign at any time.

Using Existing Projects with SmartDesign

You can use existing Libero SoC projects with available building blocks in the project to assemble a new SmartDesign design component. You do not have to migrate existing top-level designs to SmartDesign and there is no automatic conversion of the existing design blocks to the SmartDesign format.

SmartDesign Frequently Asked Questions

The collection of SmartDesign Frequently Asked Questions are useful for anyone that is new to SmartDesign. All the information listed below is explained in detail in other sections of the help, but the information is summarized here for easy reference. Click any question to go to the corresponding explanation.

General Questions

What is SmartDesign?

SmartDesign is a design entry tool. It's the first tool in the industry that can be used for designing System on a Chip designs, custom FPGA designs or a mixture of both types in the same design. A SmartDesign can be the entire FPGA design, part of a larger SmartDesign, or a user created IP that can be stored and reused multiple times. It's a simple, intuitive tool with powerful features that enables you to work at the abstraction level at which you are most comfortable.

It can connect blocks together from a variety of sources, verify your design for errors, manage your memory map, and generate all the necessary files to allow you to simulate, synthesize, and compile your design.

How do I create my first SmartDesign?

In the Libero SoC Project Manager Design Flow window, under Create Design, double-click **Create SmartDesign**.

Instantiating Into Your SmartDesign

Where is the list of Cores that I can instantiate into my SmartDesign?

The list of available cores is displayed in the Project Manager Catalog. This catalog contains all DirectCore IP, Design Block cores, and macros.

How do I instantiate cores into my SmartDesign?

Drag and drop the core from the Catalog onto your SmartDesign Canvas. An instance of your Core appears on the Canvas; double-click to configure it.

I have a block that I wrote in VHDL (or Verilog), can I use that in my SmartDesign?

Yes! Import your HDL file into the Project Manager (File > Import Files). After you do this, your HDL module will appear in the Project Manager Hierarchy. Then, drag-and-drop it from the Hierarchy onto your SmartDesign Canvas.

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My HDL module has Verilog parameters or VHDL generics declared, how can I configure those in SmartDesign?

If your HDL module contains configurable parameters, you must create a 'core' from your HDL before using it in SmartDesign. Once your HDL module is in the Project Manager Design Hierarchy, right-click it and choose **Create Core from HDL**. You will then be allowed to add bus interfaces to your module if necessary. Once this is complete, you can drag your new HDL+ into the SmartDesign Canvas and configure your parameters by double-clicking it.

Working in SmartDesign

How do I make connections?

Let SmartDesign do it for you. Right-click the Canvas and choose **Auto Connect**.

Auto Connect didn't connect everything for me, how do I make manual connections?

Enter **Connection Mode** and click and drag from one pin to another. Click the Connection Mode button in the Canvas to enter Connection Mode.

Alternatively:

1. Select the pins you want connected by using the mouse and the CTRL key.
2. Right-click one of the selected pins and choose **Connect**.

How do I connect a pin to the top level?

Right-click the pin and choose **Promote to Top Level**. You can even do this for multiple pins at a time, just select all the pins you want to promote, right-click one of the pins and choose **Promote to Top Level**. All your selected pins will be promoted to the top level.

Oops, I just made a connection mistake. How do I disconnect two pins?

Use CTRL+Z to undo your last action. If you want to undo your 'undo', hit redo (CTRL+Y).

To disconnect pins you can:

- Right-click the pin you want to disconnect and choose **Disconnect**
- Select the net and hit the delete key

I need to apply some simple 'glue' logic between my cores. How do I do that?

For basic inversion of pins, you can right-click a pin and choose **Invert**. An inverter will be placed at this pin when the design is generated. You can also right-click a pin and choose Tie Low or Tie High if you want to connect the pin to either GND or VCC.

To tie an input bus to a constant, right-click the bus and choose **Tie to Constant**. To mark an output pin as unused, right-click the pin and choose **Mark as Unused**.

To clear these, just right-click on the pin again and choose **Clear Attribute**.

My logic is a bit more complex than inversion and tie offs - what else can I do?

You have full access to the library macros, including AND, OR, and XOR logic functions. These are located in the Project Manager Catalog, listed under Macro Library. Drag the logic function you want onto your SmartDesign Canvas.

How do I create a new top level port for my design?

Click the **Add Port** button in the Canvas toolbar

How do I rename one of my instances?

Double-click the instance name on the Canvas and it will become editable. The instance name is located directly above the instance on the Canvas.

How do I rename my top level port?

Right-click the port you want to rename and choose **Modify Port**.

How do I rename my group pins?

Right-click the group pin you want to rename and choose **Rename Group**.

I need to reconfigure one of my Cores, can I just double-click the instance?

Yes.

I want more Canvas space to work with!

Maximize your workspace (CTRL-W), and your Canvas will maximize within the Project Manager. Hit CTRL-W again if you need to see your Hierarchy or Catalog.

Working with Processor-Based Designs in SmartDesign

How do I connect my peripherals to the bus?

Click **Auto Connect** and it will help you build your bus structure based on the processor and peripherals that you have instantiated.

But I need my peripheral at a specific address or slot.

Right-click the Canvas and choose **Modify Memory Map** to invoke the Modify Memory Map dialog that enables you to set a peripheral to a specific address on the bus.

The bus core will show the slot numbers on the bus interface pins. These slot numbers correspond to a memory address on the bus.

Verify that your peripheral is mapped to the right bus address by viewing your design's Memory Map.

How do I view the Memory Map of my design?

Generate your project and open datasheet in the **Report View**.

The memory map section will also show the memory details of each peripheral, including any memory mapped registers.

How do I simulate my processor design?

SmartDesign automatically generates the necessary Bus Functional Model (BFM) scripts required to simulate your processor based design. A top level testbench for your SmartDesign is generated automatically as well.

Create your processor design, generate it, and you will be able to simulate it in ModelSim.

I have my own HDL block that I want to connect as a peripheral on the AMBA bus. How can I do that?

SmartDesign supports automatic creation of data driven configurators based on HDL generics/parameters.

If your block has all the necessary signals to interface with the AMBA bus protocol (ex: address, data, control signals):

1. Right-click your custom HDL block and choose **Create Core from HDL**. The Libero SoC creates your core and asks if you want to add bus interfaces.
2. Click **Yes** to open the Edit Core Definition dialog box and add bus interfaces. Add the bus interfaces as necessary.
3. Click **OK** to continue.

Now your instance has a proper AMBA bus interface on it. You can manually connect it to the bus or let Auto Connect find a compatible connection. See the DirectCore Advanced Microcontroller Bus Architecture - Bus Functional Model User's Guide for more information on CoreAMBA BFM commands.

How do I generate the firmware drivers for my design?

SmartDesign automatically finds all the compatible firmware drivers based on your peripherals and processor. You can view the list of firmware drivers that the design found by going to the design flow and choosing **View/Configure Firmware Cores**.

How do I start writing my application code for my design?

Libero SoC simplifies the embedded development process by automatically creating the workspace and project files for the Software IDE that you specify in the Tools profile.

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Once you have generated your design, the firmware and workspace files will automatically be created. Click **Write Application Code** in the Design Flow tab and the Software IDE tool will open your design's workspace files.

VHDL Construct Support in SmartDesign

What VHDL constructs do you support?

VHDL types Record, Array, Array of Arrays, Integer and Unsigned are supported on entity ports of imported VHDL files - these are treated as special types in Libero.

How can I import files with VHDL Special Types into SmartDesign?

To work with a VHDL file with Special Types you must:

1. Drag and drop the entity into SmartDesign and connect it just as you would with any other SmartDesign instance.
2. Generate the Mapping File (meta.out):
   Navigate to the Design Hierarchy view, under the current SmartDesign.
   Right-click every VHDL file or every top hierarchical file and choose **Create Mapping File (VHDL)**.
3. Generate the SmartDesign
4. Continue with the Libero SoC Design Flow steps (Synthesis, Simulation, etc.)

If you do not generate the Mapping File, and try to Generate your SmartDesign, you will see the following error in the log window:

```
Error: Select the HDL file in the Design Hierarchy and right-click the HDL file and
choose Create Mapping File(VHDL) because at least one entity port is of type Array or
Record.
```

The above is reported only if the entity port is of type Record, Array, Array of Array, or Unsigned.

What is the purpose of the mapping file?

The mapping file contains the mapping information between the SmartDesign ports and original user-specified data types of ports in design files, and is used for type casting of signals during design generation.

Where will the mapping file meta.out be generated?

The file is generated in your $project_dir/hdl folder. This file will be used to during SmartDesign generation.

What are the VHDL special types that are not generated automatically?

The following types are not automatically generated from the right-click menu option **Create Mapping File(VHDL)**:

- Array of array is not supported
- Array of record is not supported
- Enum in range of array is not supported.
- Constants are not supported.
- Buffer output ports are not supported

What do I do if I am using VHDL types that are not generated automatically?

You must manually write the mapping information in the meta.out file for unsupported types (types which are not generated automatically) in the prescribed format. Click the link to see an example.

- Integer
- Unsigned
- Array and Array of Arrays
- Record

What is the meta.out file format?

See the meta.out file format topic for more information.

Making Your Design Look Nice

Can the tool automatically place my instances on the Canvas to make it look nice?

Yes. Right-click the Canvas white space and choose **Auto Arrange Instances**.

My design has a lot of connections, and the nets are making my design hard to read. What do I do?

You can disable the display of the nets in the menu bar (RMC > Hide Nets). This automatically hides all the nets in your design.

You can still see how pins are connected by selecting a connected pin, the net will automatically be visible again.

You can also selectively show certain nets, so that they are always displayed, just right click on a connected pin and choose **Show Net**.

My instance has too many pins on it; how can I minimize that?

Try grouping functional or unused pins together. For example, on the CoreInterrupt there are 8 FIQSource* and 32 IRQSource* pins, group these together since they are similar in functionality.

To group pins: Select all the pins you want to group, then right-click one of the pins and choose **Add pins to group**.

If a pin is in a group, you are still able to use it and form connections with it. Expand the group to gain access to the pin.

Oops, I missed one pin that needs to be part of that group? How do I add a pin after I already have the group?

Select the pin you want to add and the group pin, right-click and choose **Add pins to <name> group**.

I have a pin that I don't want inside the group, how do I remove it?

Right-click the pin and choose **Ungroup selected pins**.

How can I better see my design on the Canvas?

There are zoom icons in the Canvas toolbar. Use them to Zoom in, Zoom out, Zoom to fit, and Zoom selection. You can also maximize your workspace with CTRL-W.

Generating your Design

Ok, I'm done connecting my design, how do I 'finish' it so that I can proceed to synthesis?

In the Canvas toolbar, click the Generate Project icon .

I get a message saying it's unable to generate my SmartDesign due to errors, what do I do? What is the Design Rules Check?

The Design Rules Check is included in your Report View. It lists all the errors and warnings in your design, including unconnected input pins, required pin connections, configuration incompatibilities between cores, etc.

Errors are shown with a small red stop sign and must be corrected before you can generate; warnings may be ignored.

What does this error mean? How do I fix it?

Review the Design Rules Check topic for an explanation of errors in the Design Rules Check and steps to resolve them.

How do I generate my firmware?

In the Design Flow window, expand **Handoff Design for Firmware Development** and double-click **Configure Firmware Cores**and **Export Firmware**.

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Getting Started with SmartDesign

Creating a New SmartDesign Component

1. From the **File** menu, choose **New > SmartDesign** or in the Design Flow window double-click **Create SmartDesign**. The **Create New SmartDesign** dialog box opens (see figure below).

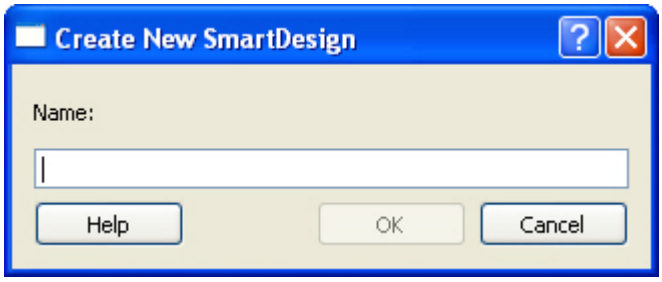


Figure 5 · Create New SmartDesign Dialog Box

2. Enter a component name and click **OK**. The component appears in the Hierarchy tab of the Design Explorer. Also, the main window displays the design Canvas.

Note: The component name must be unique in your project.

Opening an Existing SmartDesign Component

To open an existing component do one of the following:

Click the **Design Hierarchy** tab and double-click the component you want to open.

The main window displays the SmartDesign Canvas for the SmartDesign component.

Saving/Closing a SmartDesign Component

To save the current SmartDesign design component, from the **File** menu, choose **Save** <component_name>. Saving a SmartDesign component only saves the current state of the design; to generate the HDL for the design refer to Generating a SmartDesign component.

To close the current SmartDesign component without saving, from the **File** menu, choose **Close**. Select **NO** when prompted to save.

To save the active SmartDesign component with a different name use Save As. From the **File** menu choose **Save SD_<filename> As**. Enter a new name for your component and click **OK**.

Generating a SmartDesign Component

Before your SmartDesign component can be used by downstream processes, such as synthesis and simulation, you must generate it.

Click the Generate button to generate a SmartDesign component.

This will generate a HDL file in the directory <libero_project>/components/<library>/<yourdesign>.

Note: The generated HDL file will be deleted when your SmartDesign design is modified and saved to ensure synchronization between your SmartDesign component and its generated HDL file.

Generating a SmartDesign component may fail if there are any DRC errors. DRC errors must be corrected before you generate your SmartDesign design.

Generating a Datasheet (SmartFusion, IGLOOe, ProASIC3L, ProASIC3E, Fusion)

If your SmartDesign is the root design in your project, then a Memory Map / Datasheet that contains your design information is produced.

Generating Firmware and Software IDE Workspace (SmartFusion, IGLOOe, ProASIC3L, ProASIC3E, Fusion)

If your SmartDesign is the root design in your project, then any compatible firmware drivers for your peripherals are generated to <project>/firmware.

The datasheet provides all the specifics of the generated firmware drivers.

Importing a SmartDesign Component

From the **File** menu, choose **Impor**t and select the CXF file type.

Importing an existing SmartDesign component into a SmartDesign project will not automatically import the sub-components of that imported SmartDesign component.

You must import each sub-component separately.

After importing the sub-components, you must open the SmartDesign component and replace each sub-component so that it references the correct component in your project. .

Deleting a SmartDesign Component from the Libero SoC Project

To delete a SmartDesign component from the project:

1. In the **Design Hierarchy** tab, select the SmartDesign component that you want to delete.
2. Right-click the component name and select **Delete from Project** or **Delete from Disk and Project**, or click the **Delete** key to delete from project.

Memory Maps / Data Sheet

If your design contains standard Bus Instances such as the DirectCore AMBA bus cores, CoreAPB or CoreAHB, then you can view the Memory Map Configuration of your design in the Report View. To do so, generate your top level design and click the Reports button in the toolbar.

The design's memory map is determined by the connections made to the bus component. A bus component is divided into multiple slots for slave peripherals or instances to plug into. Each slot represents a different address location and range to the Master of the bus component.

The datasheet reports the memory map of the different subsystems of your design, where a subsystem is any independent bus structure with a Master and Slave peripheral attached.

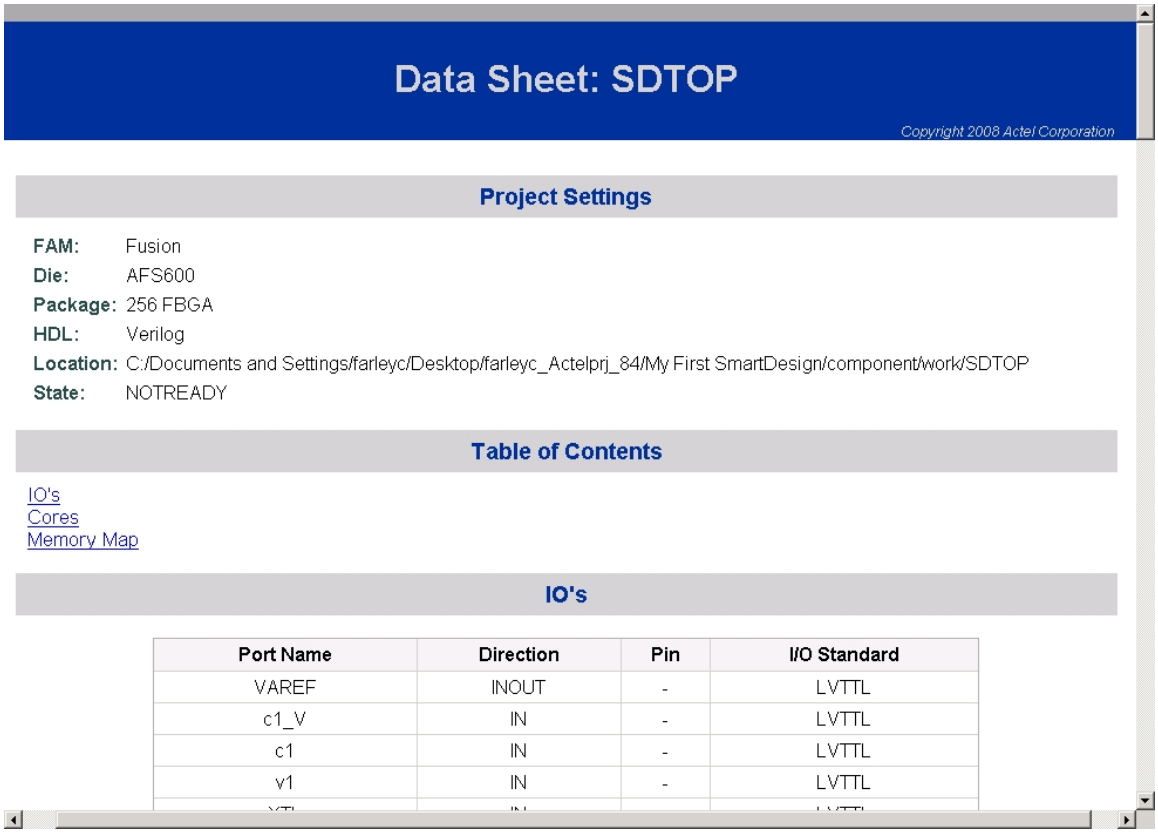
Connecting peripherals to busses can be accomplished using the normal SmartDesign connectivity options:

- **Auto-Connect -** the system creates a bus structure based on the peripherals that you have instantiated and finds compatible bus interfaces and connects them together
- The Modify Memory Map dialog box
- Canvas - Make connections between your blocks.

Your application and design requirements dictate which address location (or slots) is most suitable for your bus peripherals. For example, the memory controller should be connected to Slot0 of the CoreAHB bus because on Reset, the processor will begin code execution from the bottom of the memory map.

An example of the datasheet is shown in the figure below.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**



Data Sheet: SDTOP

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Project Settings

FAM: Fusion
Die: AFS600
Package: 256 FBGA
HDL: Verilog
Location: C:/Documents and Settings/farleyc/Desktop/farleyc_Actelprj_84/My First SmartDesign/component/work/SDTOP
State: NOTREADY

Table of Contents

IO's
Cores
Memory Map

IO's

Port Name	Direction	Pin	I/O Standard
VAREF	INOUT	-	LVTTL
c1_V	IN	-	LVTTL
c1	IN	-	LVTTL
v1	IN	-	LVTTL

Figure 6 · Example Memory Map

Modify Memory Map Dialog Box

The Modify Memory Map dialog box (shown in the figure below) enables you to connect peripherals to buses via a drop-down menu. To open the dialog box, right-click the bus instance and choose **Modify Memory Map**.

This dialog simplifies connecting peripherals to specific base addresses on the bus. The dialog shows all the busses in the design; select a bus in the left pane to assign or view the peripherals on a bus. Busses that are bridged to other busses are shown beneath the bus in the hierarchy.

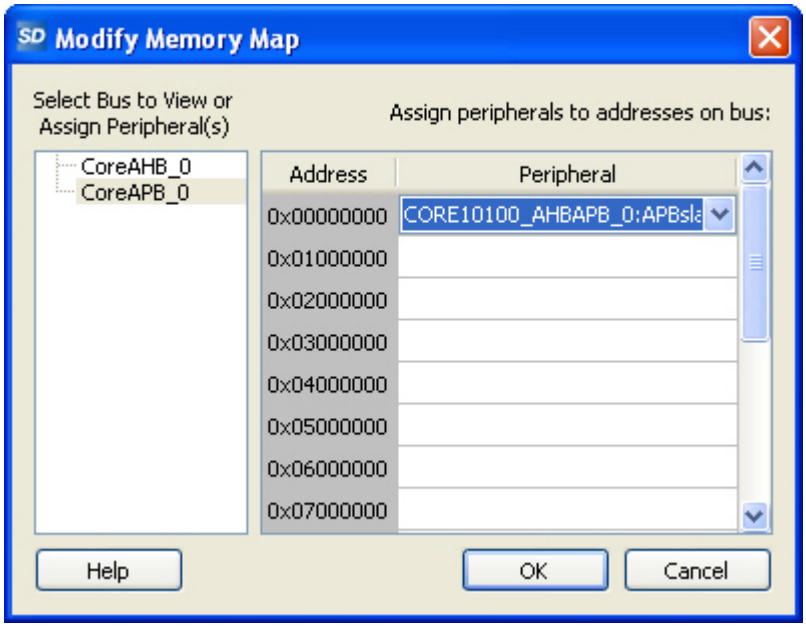

Figure 7 · Modify Memory Map Dialog Box

Click the Peripheral drop-down menu to select the peripheral you wish to assign to each address. To remove (unassign) a peripheral from an address, click the drop-down and select the empty element.

Click OK to create the connections between the busses and peripherals in the design.

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Canvas View

Canvas Overview

The SmartDesign Canvas is like a whiteboard where functional blocks from various sources can be assembled and connected; interconnections between the blocks represent nets and busses in your design.

You can use the Canvas to manage connections, set attributes, add or remove components, etc. The Canvas displays all the pins for each instance (as shown in the figure below).

The Canvas enables you to drag a component from the Design Hierarchy or a core from the Catalog and add an instance of that component or core in the design. Some blocks (such as Basic Blocks) must be configured and generated before they are added to your Canvas. When you add/generate a new component it is automatically added to your Design Hierarchy.

To connect two pins on the Canvas, click the **Connection Mode button** to enable it and click and drag between the two pins you want to connect. The Connection Mode button is disabled if you attempt to illegally connect two pins.

Click the **Maximize Work Area button** to hide the other windows and show more of the Canvas. Click the button again to return the work area to the original size.

The Canvas displays bus pins with a + sign (click to expand the list) or - (click to hide list). If you add a slice on a bus the Canvas adds a + to the bus pin.

Components can be reconfigured any time by double-clicking the instance on the Canvas. You can also add bus interfaces to instances using this view. In the Canvas view, you can add graphic objects and text to your design.

Inputs and bi-directional pins are shown on the left of components, and output pins are shown on the right.

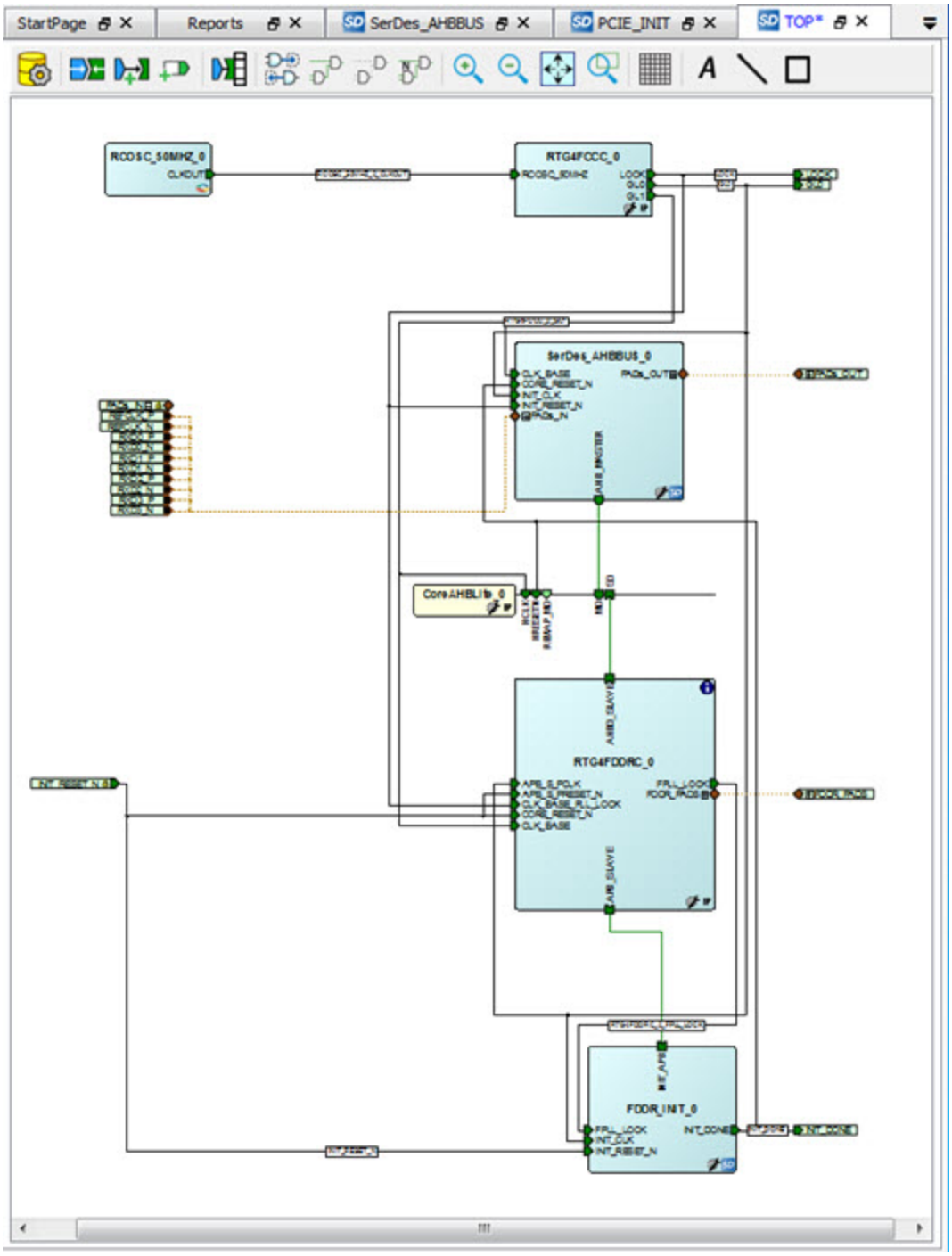


Figure 8 · SmartDesign Canvas

See Also

Canvas Icons

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Displaying Connections on the Canvas

The Canvas shows the instances and pins in your design (as shown in the figure below). Right-click the Canvas and choose Show Net Names to display nets.

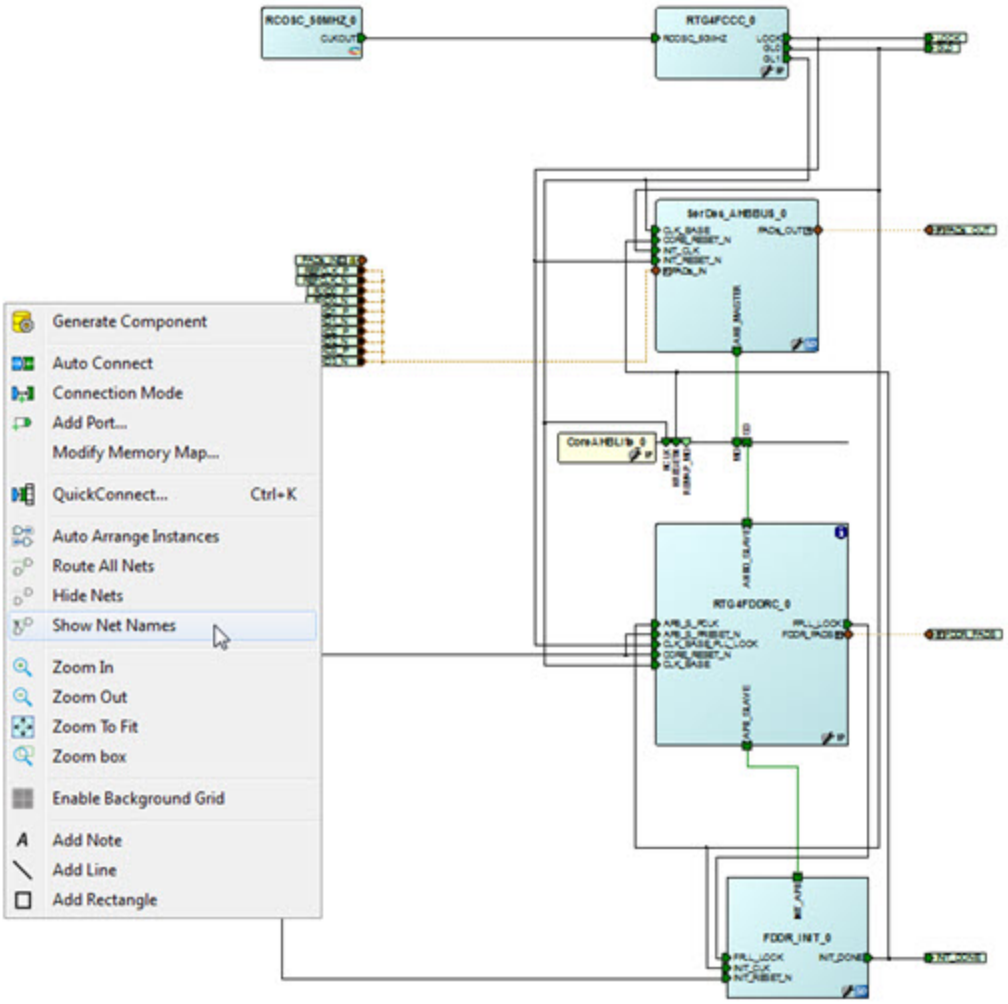


Figure 9 · Components in SmartDesign

Pin and Attribute Icons

Unconnected pins that do not require a connection are gray.

Unconnected pins that require a connection are red.

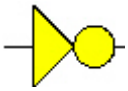
Unconnected pins that have a default tie-off are pale green.

Connected pins are green.

Right-click a pin to assign an attribute.

Pins assigned attributes are shown with an icon, as shown in the table below.

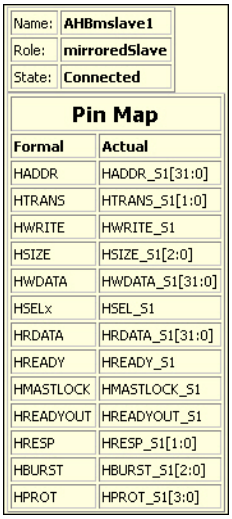
Table 1 · Pin Attribute Icons

Attribute	Icon
Tie Low	
Tie High	
Invert	
Mark as Unused	
Tie to Constant	

See the Canvas Icons reference page for definitions for each element on the Canvas.

Each connection made using a bus interface is shown in a separate connection known as a bus-interface net.

Move the mouse over a bus interface to display its details (as shown below).



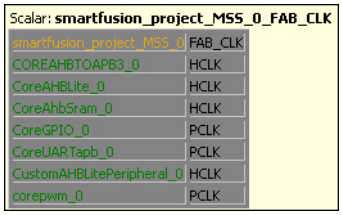
Name:	AHBmslave1
Role:	mirroredSlave
State:	Connected

Pin Map

Formal	Actual
HADDR	HADDR_S1[31:0]
HTRANS	HTRANS_S1[1:0]
HWRITE	HWRITE_S1
HSIZE	HSIZE_S1[2:0]
HWDATA	HWDATA_S1[31:0]
HSELx	HSEL_S1
HRDATA	HRDATA_S1[31:0]
HREADY	HREADY_S1
HMASTLOCK	HMASTLOCK_S1
HREADYOUT	HREADYOUT_S1
HRESP	HRESP_S1[1:0]
HBURST	HBURST_S1[2:0]
HPROT	HPROT_S1[3:0]

Hover over a bus interface net to see details (as shown below).

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**



Making Connections Using the Canvas

Use the Canvas or Connectivity dialog box to make connections between instances.

You can use Connection Mode on the Canvas to quickly connect pins. Click the **Connection Mode** button to start, then click and drag between any two pins to connect them. Illegal connections are disabled. Click the Connection Mode button again to exit Connection Mode.

To connect two pins on the Canvas, select any two (Ctrl + click to select a pin), right-click one of the pins you selected and choose **Connect**. Illegal connections are disabled; the Connect menu option is unavailable.

Promoting Ports to Top Level

To automatically promote a port to top level, select the port, right-click, and choose **Promote To Top Level**. This automatically creates top-level ports of that name and connects the selected ports to them. If a port name already exists, a choice is given to either connect to the existing ports or to create a new port with a name <port name>_<i> where i = 1…n.

Double-click a top-level port to rename it.

Bus slices cannot be automatically promoted to top level. You must create a top level port of the bus slice width and then manually connect the bus slice to the newly created top level port.

Tying Off Input Pins

To tie off ports, select the port, right-click and choose **Tie High** or **Tie Low**.

Tying to Constant

To tie off bus ports to a constant value, select the port, right-click and choose **Tie to a Constant**. A dialog appears (as shown in the figure below) and enables you to specify a hex value for the bus.

To remove the constant, right-click the pin and choose **Clear Attribute** or **Disconnect**.

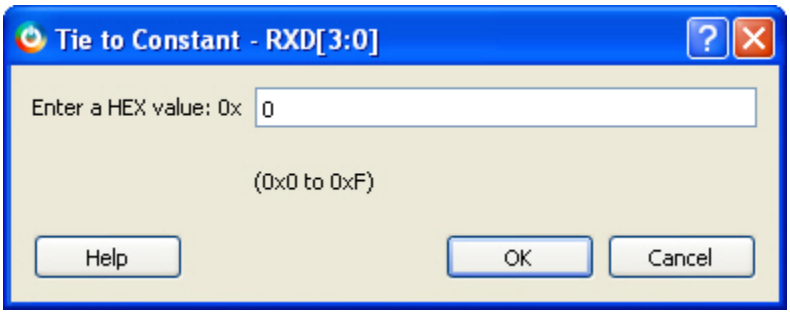


Figure 10 · Tie to Constant Dialog Box

Making Driver and Bus Interface Pins Unused

Driver or bus interface pins can be marked unused (floating/dangling) if you do not intend to use them as a driver in the design. If you mark a pin as unused the Design Rules Check does not return Floating Driver or Unconnected Bus Interface messages on the pin.

Once a pin is explicitly marked as unused it cannot be used to drive any inputs. The unused attribute must be explicitly removed from the pin in order to connect it later. To mark a driver or bus interface pin as unused, right-click the driver or bus interface pin and choose **Mark as Unused**.

See Also

Show/Hide Bus Interface Pins

Simplifying the Display of Pins on an Instance using Pin Groups

The Canvas enables you to group and ungroup pins on a single instance to simplify the display. This feature is useful when you have many pins in an instance, or if you want to group pins at the top level. Pin groups are cosmetic and affect only the Canvas view; other SmartDesign views and the underlying design are not affected by the pin groups.

Grouping pins enables you to:

- Hide pins that you have already connected
- Hide pins that you intend to work on later
- Group pins with similar functionality
- Group unused pins
- Promote several pins to Top Level at once

To group pins:

1. Ctrl + click to select the pins you wish to group. If you try to click-and-drag inside the instance you will move the instance on the Canvas instead of selecting pins.
2. Right-click and choose **Add pins to group** to create a group. Click + to expand a group. The icon associated with the group indicates if the pins are connected, partially connected, or unconnected (as shown in the figure below).

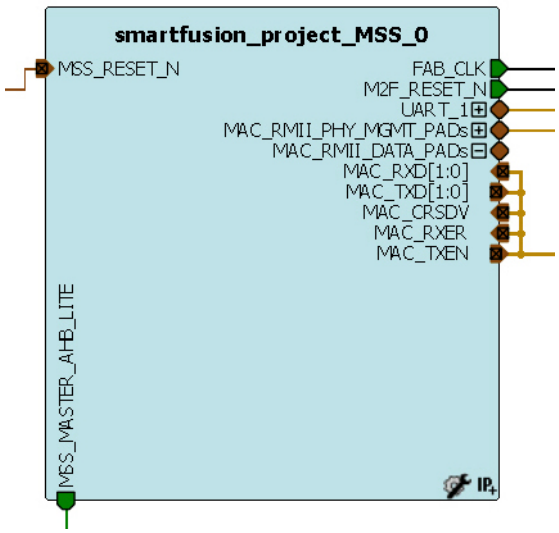


Figure 11 · Groups in an Instance on the Canvas

To add a pin to a group, Ctrl + click to select both the pin and the group, right-click and choose **Add pin to group**.

To name a group:

To name a group, right-click the port name and choose **Rename Group**.

To ungroup pins:

1. Click + to expand the group.
2. Right-click the pin you wish to remove from the group and choose **Ungroup selected pins**. Ctrl + click to select and remove more than one pin in a group.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

A group remains in your instance after you remove all the pins. It has no effect on the instance; you can leave it if you wish to add pins to the group later, or you can right-click the group and choose **Delete Group** to remove it from your instance.

If you delete a group from your instance any pins still in the group are unaffected.

To promote a group to Top level:

1. Create a group of pins.
2. Right-click the group and choose **Promote to Top Level**.

Bus Instances

Bus Components in the Core Catalog, such as CoreAHB or CoreAPB, implement an on-chip bus fabric. When these components are instantiated into your canvas they are displayed as horizontal or vertical lines. Double-click the bus interfaces of your component to edit the connections.

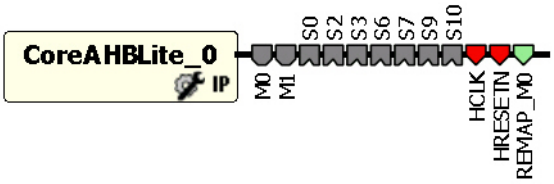


Figure 12 · Bus Instance in SmartDesign

Adding Graphic Objects

You can document your design by adding comments and notations directly on the Canvas.

The Canvas toolbar enables you to add and modify decorative graphic objects, such as shapes, labels and lines on the Canvas.

Adding and Deleting Lines and Shapes

To add a line or a shape:

1. Select the line or shape button.
2. Click, drag and release on the Canvas. The table below provides a description of each button.

Button	Description
	Line
	Rectangle

Note: Hold the Shift key to constrain line and arrow to 45 degree increments or constrain the proportions of the rectangle (square).

To change the line and fill properties:

1. Select the element(s), right-click it, and choose **Properties**.
- Select **Line** to modify the color, style and width of the line.
- Select **Fill** to modify the crosshatch and the foreground and background colors.
2. Click **OK**.

To delete a line or shape, select the object and press Delete.

Adding Text

To add text, select the text tool and click the Canvas to create a text box. To modify the text, double-click the text box and then type.

To modify the text box properties:

1. Select the text box, right-click it, and choose **Properties**.

- Select **Text** to modify the text alignment.
- Select **Line** to modify the color, style and width of the line.
- Select **Fill** to modify the crosshatch and the foreground and background colors.
- Select **Font** to modify the font properties.

2. Click **OK**.

Editing Properties for Graphic Objects on the Canvas

Right-click any graphic object to update properties, such as Fill, and Line properties for shapes and lines, or Font options for text properties.

Auto-Arranging Instances

Right-click the Canvas and choose **Auto Arrange Instances** from the right-click menu to auto-arrange the instances on the Canvas.

Locking Instance and Top Level Port Positions

You can lock the placement of instances on the Canvas. Right-click the instance or Top-level port and choose **Lock** to lock the placement. When you lock placement you can click and drag to move the instance manually but the Auto Arrange Instances menu option has no effect on the instance.

To unlock an instance, right-click the instance and choose **Unlock**.

Right-click a top level port and choose **Unlock Position** to return it to its default position.

See Also

Bus Instances

Simplifying the Display of Pins on an Instance using Pin Groups

Replace Component for Instance

You can use the Replace Component for Instance dialog box (shown in the figure below) to restore or update version instances on your Canvas without creating a new instance and losing your connections.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

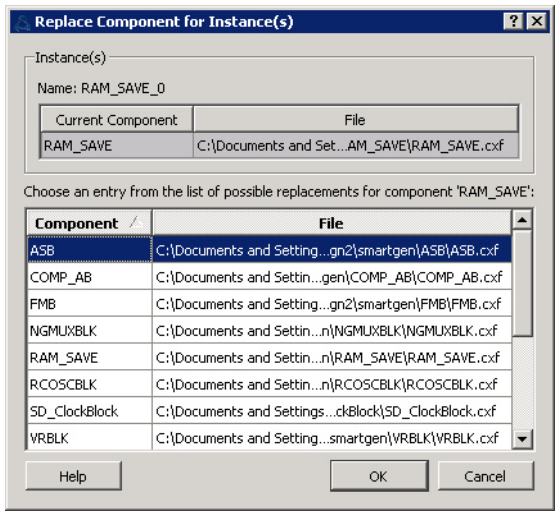


Figure 13 · Replace Component for Instance Dialog Box

To change the version of an instance:

1. From the right-click menu choose **Replace Component for Instance**. The Replace Component for Instance dialog box appears.
2. Select a component and choose a new version from the list. Click **OK**.

Replace Instance Version

The Replace Instance Version dialog box enables you to replace an IP instance with another version. You can restore or replace your IP instance without creating a new instance or losing your connections.

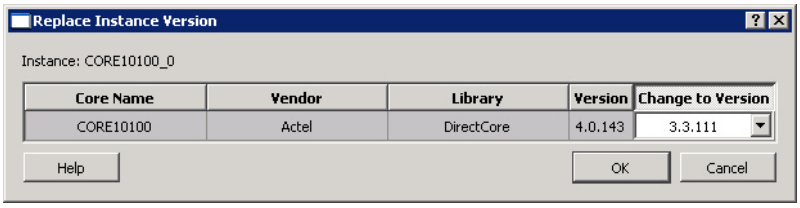


Figure 14 · Replace Instance Version Dialog Box

To replace an instance version:

1. Right click any IP instance and choose **Replace Instance Version**. The dialog box appears.
2. Choose the version you wish to use from the **Change to Version** dropdown menu (as shown in the figure above) and click OK to continue.

Slicing

Bus ports can be sliced or split using Slicing. Once a slice is created, other bus ports or slices of compatible size can be connected to it.

The Edit Slices dialog box enables you to automatically create bus slices of a specified width.

To create a slice:

1. Select a bus port, right-click, and choose **Edit Slice.** This brings up the **Edit Slices** dialog box (see figure below).

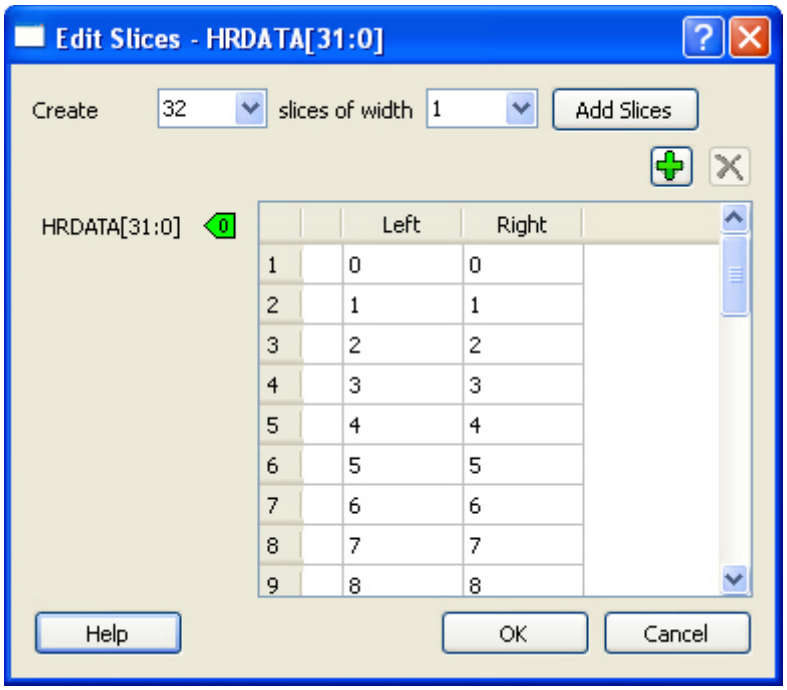


Figure 15 · Edit Slices Dialog Box

2. Enter the parameters for the slice and click **Add Slices**. You can also create individual slices and specify their bus dimensions manually.
3. Click **OK** to continue.

Note: Overlapping slices cannot be created for IN and INOUT ports on instances or top-level OUT ports.

To remove a slice, select the slice, right-click, and choose **Delete Slice.**

Rename Net

To rename a net:

1. Right-click the net on the Canvas and choose **Rename Net**. This opens the Rename Net dialog box.
2. Type in a new name for the net.

Note: The system automatically assigns net names to nets if they are not explicitly specified. Once you have specified a name for a net, that name will not be over-written by the system.

Automatic Names of Nets

Nets are automatically assigned names by the tool according to the following rules:

In order of priority

1. If user named then name = user name
2. If net is connected to top-level port then name = port name; if connected to multiple ports then pick first port
3. If the net has no driver, then name = net_[i]
4. If the net has a driver, name = instanceName_driverpinName

Slices

For slices, name = instanceName_driverpinName_sliceRange; for example u0_out1_4to6.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

GND and VCC Nets

The default name for GND/VCC nets is net_GND and net_VCC.

Expanded Nets for Bus Interface Connections

Expanded nets for bus interface connections are named busInterfaceNetName_<i>_driverPinName.

Organizing Your Design on the Canvas

You may find it easier to create and navigate your SmartDesign if you organize and label the instances and busses on the Canvas.

You can show and hide nets, lock instances, rotate busses, group and ungroup pins, rename instances / groups / pins, and auto-arrange instances.

To organize your design:

1. Right-click the Canvas and choose **Auto Arrange Instances** from to automatically arrange instances. SmartDesign's auto-arrange feature optimizes instance location according to connections and instance size.
2. Right-click any instance and choose Lock Location to fix the placement. Auto-Arrange will not move any instances that are locked.
3. Click Auto-Arrange again to further organize any unlocked instances. Continue arranging and locking your instances until you are satisfied with the layout on the Canvas.

If your design becomes cluttered, group your pins. It may help to group pins that are functionally similar, or to group pins that are already connected or will be unused in your design.

To further customize your design's appearance:

Double-click the names of instances to add custom names. For example, it may be useful to rename an instance based on a value you have set in the instance: the purpose of an instance named 'array_adder_bus_width_5' is easier to remember than 'array_adder_0'.

Creating a SmartDesign

Adding Components and Modules (Instantiating)

SmartDesign components, Design Block cores, IP cores, and HDL modules are displayed in the Design Hierarchy and Files tabs.

To add a component, do either of the following:

- Select the component in the Design Hierarchy tab or Catalog and drag it to the Canvas.
- Right-click a component in the Design Hierarchy tab or Catalog and choose **Instantiate in <SmartDesign name>.**

The component is instantiated in the design.

SmartDesign creates a default instance name. To rename the instance, double-click the instance name in the Canvas.

Adding a SmartDesign Component

SmartDesign components can be instantiated into another SmartDesign component.

Once a SmartDesign is generated, the exported netlist can be instantiated into HDL like any other HDL module.

Note: HDL modules with syntax errors cannot be instantiated in SmartDesign. However, since SmartDesign requires only the port definitions, the logic causing syntax errors can be temporarily commented out to allow instantiation of the component.

Adding or Modifying Top Level Ports

You can add ports to, and/or rename ports in your SmartDesign.

Add Prefixes to Bus Interface / Group Names on Top-level Ports:

Bus Interfaces and Groups are composed of other ports. On the top level, you can add prefixes to the group or bus interface port name to the sub-port names. To do so, right-click the group or bus interface port and choose **Prefix <name> to Port Names**.

Adding/Renaming Ports

To add ports:

1. From the **SmartDesign** menu, choose **Add port**. The Add Port dialog box appears (as shown below).

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

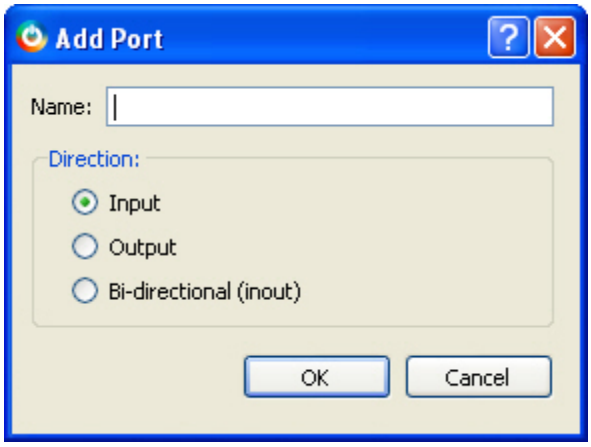


Figure 16 · Add New Port Dialog Box

2. Specify the name of the port you wish to add. You can specify a bus port by indicating the bus width directly into the name using brackets [ ], such as mybus[3:0].
3. Select the direction of the port.

To remove a port from the top level, right-click the port and choose **Delete Top Level Port**.

Modify Port

To rename a top-level port, right-click the top-level port and choose **Modify Top Level Port**. You can rename the port, change the bus width (if the port is a bus), and change the port direction.

Right-click a top-level port and choose **Modify Port** to change the name and/or direction (if available).

See Also

Top Level Connections

Connecting Instances

Automatic Connections

Using automatic connections (as shown in the figure below) enables the software to connect your design efficiently, reducing time required for manual connections and the possibility of introducing errors.

Auto Connect also constructs your bus structure if you have a processor with peripherals instantiated. Based on the type of processor and peripherals, the proper busses and bridges are added to your design.

To auto connect the bus interfaces in your design, right-click the design Canvas and select **Auto Connect**, or from the **SmartDesign** menu, choose **Auto Connect**.

SmartDesign searches your design and connects all compatible bus interfacescompatible bus interfaces.

SmartDesign will also form known connections for any SoC systems such as the processor CLK and RESET signals.

If there are multiple potential interfaces for a particular bus interface, Auto Connect will not attempt to make a connection; you must connect manually. You can use the Canvas to make the manual connections.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

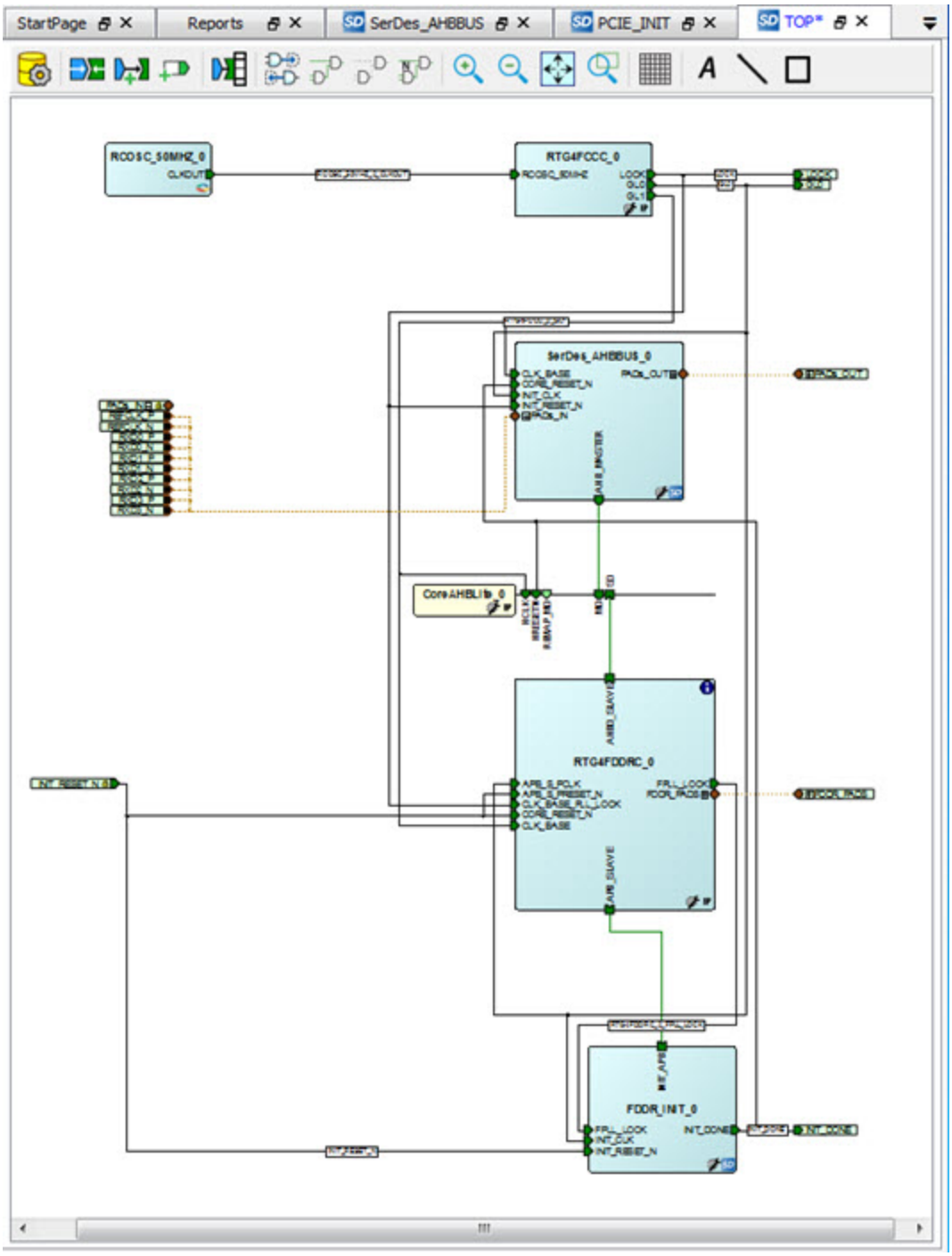


Figure 17 · Auto-Connected Cores

QuickConnect

The QuickConnect dialog box enables you to make connections in your design without using the Canvas. It is useful if you have a large design and know the names of the pins you wish to connect. Connections are reflected in the Canvas as you make them in the dialog box; error messages appear in the Log window immediately. It may be useful to resize the QuickConnect dialog box so that you can view the Log window or Canvas while you make connections.

To connect pins using QuickConnect:

1. Find the **Instance Pin** you want to connect and click to select it.
2. In **Pins to Connect**, find the pin you wish to connect, right-click and choose **Connect**. If necessary, use the **Search** field to narrow down the list of pins displayed in Pins to Connect.

   Note: If the connection is invalid, Connect is grayed out.

If you wish to invert or tie a pin high, low or Mark Unused:

1. Find the **Instance Pin** you want to invert or tie high/low
2. Right-click **Connection** and choose **Invert**, **Tie High**, **Tie Low** or **Mark Unused**.

If you wish to promote a pin to the top level of your design:

1. Find the Instance Pin you want to promote.
2. Right-click the pin and choose **Promote to Top**.

You can perform all connectivity actions that are available in the Canvas, including: slicing bus pins, tying bus pins to a constant value, exposing pins from a bus interface pins and disconnecting pins. All actions are accessible from the right-click context menu on the pin.

Instance Pins lists all the available instance pins in your design and their connection (if any). Use the drop-down list to view only unconnected pins, or to view the pins and connections for specific elements in your design.

Pins to Connect lists the instances and pins in your design. Use the Search field to find a specific instance or pin. The default wildcard search is '*.*'. Wildcard searches for CLK pins (*.*C*L*K) and RESET pins (*.*R*S*T) are also included.

Here are some of the sample searches that you may find useful:

- *UART*.*: show all pins of any instances that contain UART in the name
- MyUART_0.*: only show the pins of the “MyUART_0” instance
- *.p: show all pins in the design that contain the letter ‘p’

Double-click an instance in Pins to Connect to expand or collapse it.

The pin letters and icons in the QuickConnect dialog box are the same as the Canvas icons and communicate information about the pin. Inputs, Outputs and I/Os are indicted by I, O, and I/O, respectively.

Additional information is communicated by the color:

- Red - Mandatory connection, unconnected
- Green - Connected
- Grey - Optional, unconnected pin
- Brown - Pad
- Light Green - Connected to a default connection on generation
- Blue - Driver pin

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

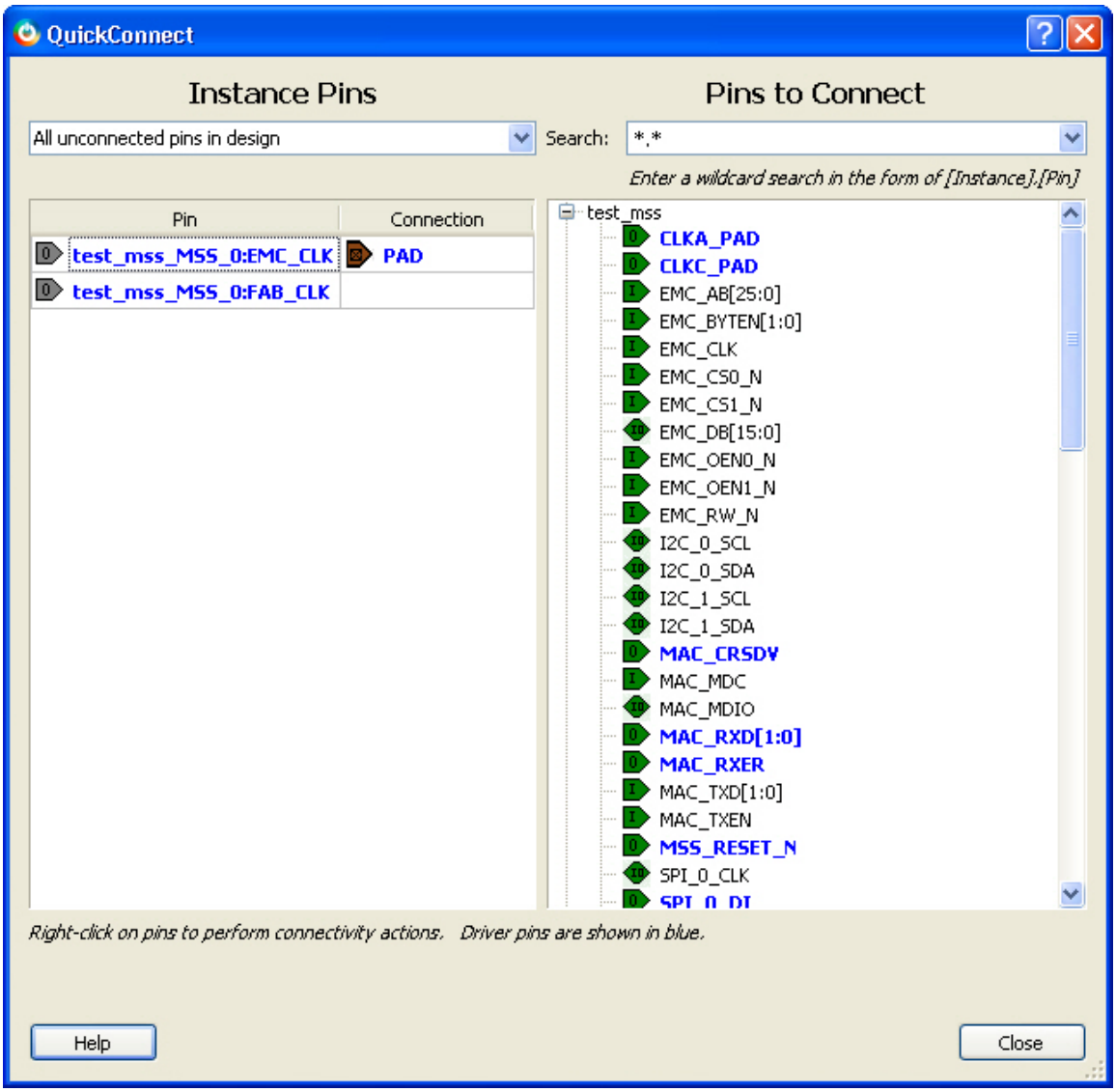


Figure 18 · QuickConnect Dialog Box

Manual Connections

You can use Connection Mode to click and drag and connect pins. Click the Connection Mode button to toggle it, and click and drag between any two pins to connect them. Illegal connections will not be allowed.

To make manual connections between to pins on the Canvas, select both pins (use CTRL + click), right-click either pin and choose **Connect**. If the pins cannot be legally connected the connection will fail.

Deleting Connections

To delete a net connection on the Canvas, click to select the net and press the Delete key, or right-click and choose **Delete**.

To remove all connections from one or more instances on the Canvas, select the instances on the Canvas, right-click and choose **Clear all Connections**. This disconnects all connections that can be disconnected legally.

Certain connections to ports with PAD properties cannot be disconnected. PAD ports must be connected to a design's top level port. PAD ports will eventually be assigned to a package pin. In SmartDesign, these ports are automatically promoted to the top level and cannot be modified or disconnected.

Top-Level Connections

Connections between instances of your design normally require an OUTPUT (Driver Pin) on one instance to one or more INPUT(s) on other instances. This is the basic connection rule that is applied when connecting.

However, directions of ports at the top level are specified from an external viewpoint of that module. For example, an INPUT on the top level is actually sending ('driving') signals to instances of components in your design. An OUTPUT on the top level is receiving ('sinking') data from a Driver Pin on an internal component instance in your SmartDesign design.

The implied direction is essentially reversed at the top-level. Making connections from an OUTPUT of a component instance to an OUTPUT of top-level is legal.

This same concept applies for bus interfaces; with normal instance to instance connections, a MASTER drives a SLAVE interface. However, they go through a similar reversal on the top-level.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Bus Interfaces

About Bus Interfaces

A bus interface is a standard mechanism for specifying the interconnect rules between components or instances in a design. A bus definition consists of the roles, signals, and rules that define that bus type. A bus interface is the instantiation of that bus definition onto a component or instance.

The available roles of a bus definition are master, slave, and system.

A master is the bus interface that initiates a transaction (such as read or write) on a bus.

A slave is the bus interface that terminates/consumes a transaction initiated by a master interface.

A system is the bus interface that does not have a simple input/output relationship on both master/slave. This could include signals that only drive the master interface, or only drive the slave interface, or drive both the master and slave interfaces. A bus definition can have zero or more system roles. Each system role is further defined by a group name. For example, you may have a system role for your arbitration logic, and another for your clock and reset signals.

Mirror roles are for bus interfaces that are on a bus core, such as CoreAHB or CoreAPB. They are equivalent in signal definition to their respective non-mirror version except that the signal directions are reversed.

The diagram below is a conceptual view of a bus definition.

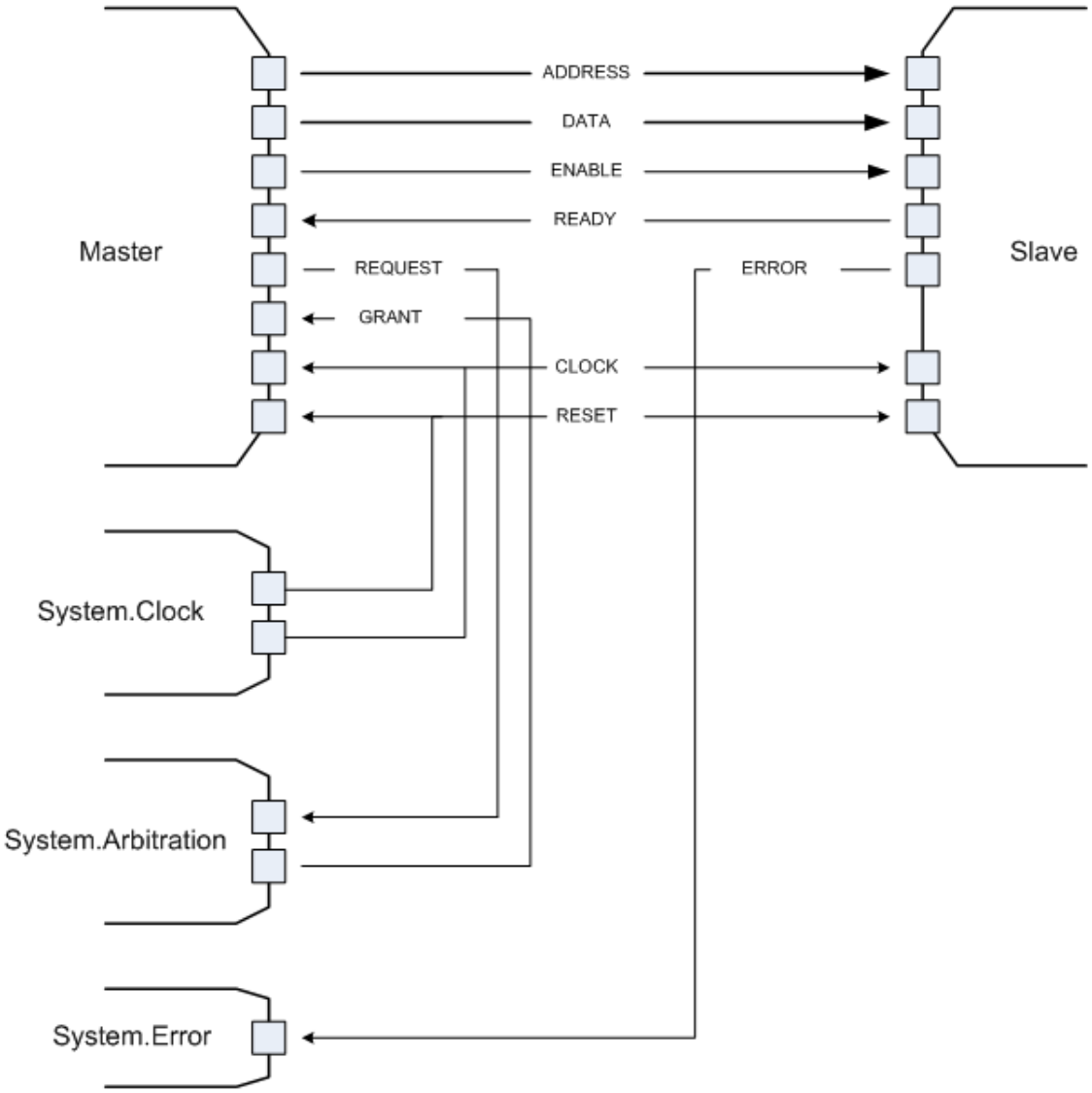


Figure 19 · Bus Definition

See Also:

Using bus interfaces in SmartDesign

Using Bus Interfaces in SmartDesign

Adding bus interfaces to your design enables SmartDesign to do the following:

- Auto connect compatible interfaces
- Enforce DRC rules between instances in your design
- Search for compatible components in the project

The Catalog in the Project Manager contains a list of Microsemi SoC-specific and industry standard bus definitions, such as AMBA.

You can add bus interfaces to your design by dragging the bus definitions from the Bus Interfaces tab in the Catalog onto your instances inside SmartDesign.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

SmartDesign supports automatic creation of data driven configurators based on HDL generics/parameters.

If your block has all the necessary signals to interface with the AMBA bus protocol (ex: address, data, control signals):

1. Right-click your custom HDL block and choose **Create Core from HDL**. The Libero SoC creates your core and asks if you want to add bus interfaces.
2. Click **Yes** to open the Edit Core Definition dialog box and add bus interfaces. Add the bus interfaces as necessary.
3. Click **OK** to continue.

Now your instance has a proper AMBA bus interface on it. You can manually connect it to the bus or let Auto Connect find a compatible connection.

Some cores have bus interfaces that are instantiated during generation.

Certain bus definitions cannot be instantiated by a user. Typically these are the bus definitions that define a hardwired connection and are specifically tied to a core/macro. They are still available in the catalog for you to view their properties, but you will not be able to add them onto your own instances or components. These bus definitions are grayed out in the Catalog.

A hardwired connection is a required silicon interconnect that must be present and specifically tied to a core/macro. For example, when using the Real Time Counter in a Fusion design you must also connect it to a Crystal Oscillator core.

Maximum masters allowed - Indicates how many masters are allowed on the bus.

Maximum slaves allowed - Indicates how many slaves are allowed on the bus.

Default value - indicates the value that the input signal will be tied to if unused. See Default tie-offs with bus interfaces.

Required connection - Indicates if this bus interface must be connected for a legal design.

Adding or Modifying Bus Interfaces in SmartDesign

SmartDesign supports automatic creation of data driven configurators based on HDL generics/parameters. You can add a bus interface from your HDL module or you can add it from the Catalog.

To add a bus interface using your custom HDL block:

If your block has all the necessary signals to interface with the AMBA bus protocol (such as address, data, and control signals):

1. Right-click your custom HDL block and choose **Create Core from HDL**. The Libero SoC creates your core and asks if you want to add bus interfaces.
2. Click **Yes** to open the Edit Core Definition dialog box and add bus interfaces. Add the bus interfaces as necessary.
3. Click **OK** to continue.

Now your instance has a proper AMBA bus interface on it. You can manually connect it to the bus or let Auto Connect find a compatible connection.

To add (or modify) a bus interface to your Component:

1. Right-click your Component and choose **Edit Core Definition**. The Edit Core Definition dialog box opens, as shown in the figure below.

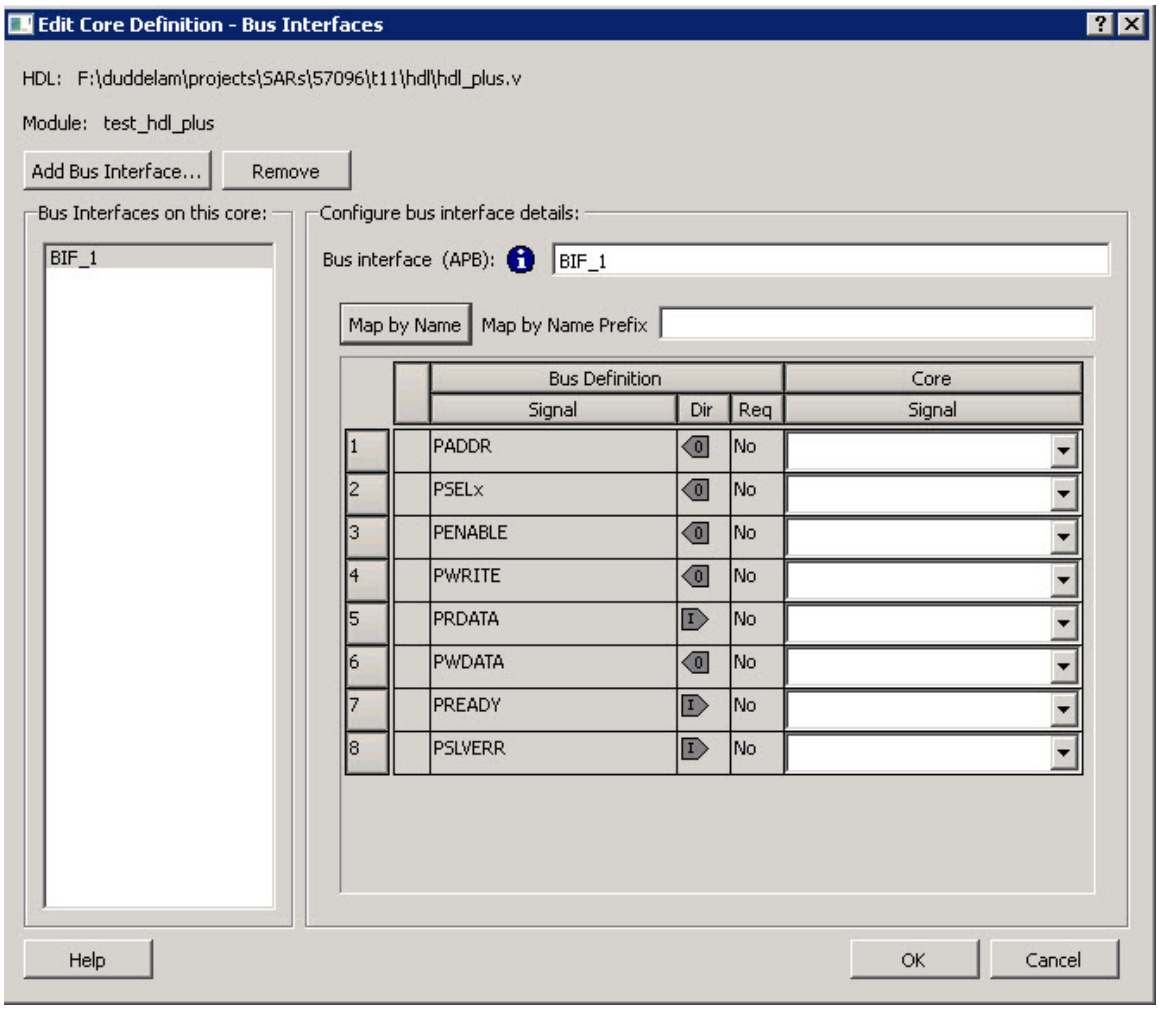


Figure 20 · Edit Core Definition Dialog Box

2. Click **Add Bus Interface**. Select the bus interface you wish to add and click **OK**.
3. If necessary, edit the bus interface details.
4. Click **Map by Name** to map the signals automatically. Map By Name attempts to map any similar signal names between the bus definition and pin names on the instance. During mapping, bus definition signal names are prefixed with text entered in the **Map by Name Prefix** field.
5. Click **OK** to continue.

Bus Interface Details

Bus Interface Details

Bus Interface: Name of bus interface. Edit as necessary.

Bus Definition: Specifies the name of the bus interface.

Role: Identifies the bus role (master or slave).

Vendor: Identifies the vendor for the bus interface.

Version: Identifies the version for the bus interface.

Configuration Parameters

Configuration Parameters

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Certain bus definitions contain user configurable parameters.

Parameter: Specifies the parameter name.

Value: Specifies the value you define for the parameter.

Consistent: Specifies whether a compatible bus interface must have the same value for this bus parameter. If the bus interface has a different value for any parameters that are marked with consistent set to **yes**, this bus interface will not be connectable.

Signal Map Definition

Signal Map Definition

The signal map of the bus interface specifies the pins on the instance that correspond to the bus definition signals. The bus definition signals are shown on the left, under the **Bus Interface Definition**. This information includes the name, direction and required properties of the signal.

The pins for your instance are shown in the columns under the Component Instance. The signal element is a drop-down list of the pins that can be mapped for that definition signal. .

If the Req field of the signal definition is Yes, you must map it to a pin on your instance for this bus interface to be considered legal. If it is No, you can leave it unmapped.

Bus Interfaces

When you add a bus interface the Edit Core Definition dialog box provides the following Microsemi SoC-specific bus interfaces:

ExtSeqCtrl

This bus interface defines the set of signals required to interface to the Analog System External Sequence Control. If the Analog System is configured with more than a single procedure, it will export this bus interface. Your own logic would need to connect to this bus interface to properly communicate and control the sequencer.

RTCXTL

This bus interface represents the hardwired connection needed between the Real Time Counter and the Crystal Oscillator.

RTCVR

This bus interface represents the hardwired connection needed between the Real Time Counter and the Voltage Regulator Power Supply Monitor.

InitCfg

This is the initialization and configuration interface that is generated as part of the Flash Memory Builder. Any clients can be initialized from the Flash Memory as long as it can connect to this bus interface. This is for pure initialization clients that do not require save-back to the Flash Memory.

InitCfgSave

This is the initialization and configuration interface that is generated as part of the Flash Memory Builder. Any client can be initialized or saved-back to the Flash Memory as long as it can connect to this bus interface. This is for clients that require initialization and save-back capabilities to the Flash Memory.

InitCfgCtrl

This interface is used to initiate the save-back procedure of the Flash Memory.

InitCfgAnalog

This interface is required between the Flash Memory System and the Analog System core.

FlashDirect

This bus interface defines the set of signals that are required to interface directly to the Flash Memory. From the Flash Memory, if you add a data storage client, this interface will be exported. Interfacing to this interface enables direct access to the Flash Memory.

XTLOscClk

This interface represents the Crystal Oscillator clock.

RCOscClk

This interface represents the RC Oscillator clock.

DirectCore Bus Interfaces

When you add a bus interface the Edit Core Definition dialog box provides the following DirectCore bus interfaces.

AHB

The AMBA AHB defines the set of signals for a component to connect to an AMBA AHB or AHBLite bus. The bus interface that is defined in the system is a superset of the signals in the AHB and AHBLite protocol. You can use the AHB bus interface in the bus definition catalog to connect your module to an AHB or AHBLite bus.

APB

The AMBA APB defines the set of signals for a component to connect to an AMBA APB or APB3 bus. The bus interface that is defined in the system is a superset of the signals in the APB and APB3 protocol. You can use the APB bus interface in the bus definition catalog to connect your module to an APB or APB3 bus.

SysInterface

The SysInterface is the interface used between the CoreMP7 and CoreMP7Bridge cores.

DBGInterface

This is the set of debug ports on the CoreMP7 core.

CPInterface

This is the co-processor interface on the CoreMP7 core.

Show/Hide Bus Interface Pins

Pins that are contained as part of a bus interface will automatically be filtered out of the display. These ports are considered to be connected and used as part of a bus interface.

However, there are situations where you may wish to use the ports that are part of the bus interface as an individual port, in this situation you can choose to expose the pin from the bus interface.

To Show/Hide pins in a Bus Interface:

1. Select a bus interface port, right-click, and choose **Show/Hide BIF Pins**. The Show/Hide Pins to Expose dialog box appears (as shown below).

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

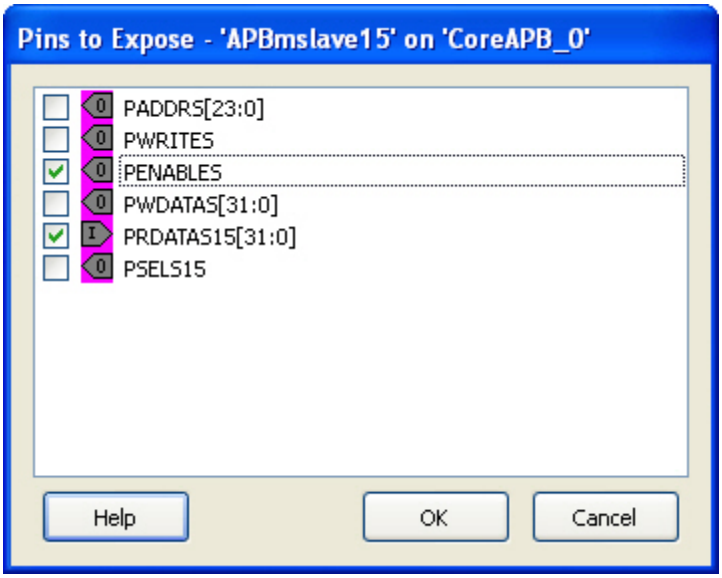


Figure 21 · Expose Driver Pin Dialog Box

2. Click the checkbox associated with the driver pin you want to show. Once the port is shown it appears on the Canvas and is available for individual connection.

   Note: If you have already connected the bus interface pin, then you will not be able to expose the non-driver pins. They will be shown grayed out in the dialog. This is to prevent the pin from being driven by two different sources.

To un-expose a driver pin, right-click the exposed port and choose **Show/Hide BIF Pins** and de-select the pin.

Default Tie-offs with Bus Interfaces

Bus definitions can contain default values for each of the defined signals. These default values specify what the signal should be tied to if it is mapped to an unconnected input pin on the instance.

Bus definitions are specified as required connection vs optional connection that defines the behavior of tie-offs during SmartDesign generation.

Required bus interfaces - The signals that are not required to be mapped will be tied off if they are mapped to an unconnected input pin.

Optional bus interfaces - All signals will be tied off if they are mapped to an unconnected input pin.

Tying Off (Disabling) Unused Bus Interfaces

Tying off (disabling) a bus interface sets all the input signals of the bus interface to the default value.

To tie off a bus interface, right-click the bus interface and select Tie Off.

This is useful if your core includes a bus interface you plan to use at a later time. You can tie off the bus interface and it will be disabled in your design until you manually set one of the inputs.

Some bus interfaces are required; you cannot tie off a bus interface that is required. For example, the Crystal Oscillator to RTC (RTCXTL) bus interface is a silicon interface and must be connected.

To enable your pin, right-click the pin and choose **Clear Attribute**.

Required vs. Optional Bus Interfaces

A required bus interface means that it must be connected for the design to be considered legal. These are typically used to designate the silicon interconnects that must be present between certain cores. For example, when using the Real Time Counter in a Fusion design you must also connect it up to a Crystal Oscillator core.

An optional bus interface means that your design is still considered legal if it is left unconnected. However, it may not functionally behave correctly.

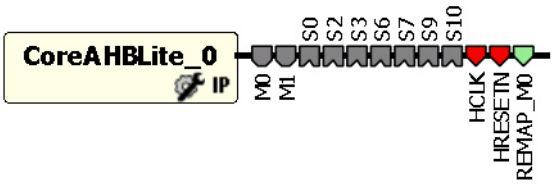


Figure 22 · Required Unconnected, Optional Unconnected, and Connected Bus Interfaces

See Also

Canvas icons

Promoting Bus Interfaces to Top-level

To automatically connect a bus interface to a top-level port, select the bus interface, right-click, and choose **Promote To Top Level**.

This automatically creates a top-level bus interface port of that name and connects the selected port to it. If a bus interface port name already exists, a choice is given to either connect to the existing bus interface port or to create a new bus interface port with a name <port name>_<i> where i = 1...n.

The signals that comprise the bus interface are also promoted.

Promoting a bus interface is a shortcut for creating a top-level port and connecting it to an instance pin.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Incremental Design

Reconfiguring a Component

To reconfigure a component used in a SmartDesign:

- In the Canvas, select the instance and double-click the instance to bring up the appropriate configurator, or the HDL editor; or select the instance, right-click it, and choose **Configure Component**.
- Select the component in the Design Hierarchy tab and from the right-click menu select **Open Component**.

When the configurator is launched from the canvas, you cannot change the name of the component.

See Also

Design state management

Replacing components

Fixing an Out-of-Date Instance

Any changes made to the component will be reflected in the instance with an exclamation mark when you update the definition for the instance. An instance may be out-of-date with respect to its component for the following reasons:

- If the component interface (ports) is different – after reconfiguration - from that of the instance
- If the component has been removed from the project
- If the component has been moved to a different VHDL library
- If the SmartDesign has just been imported

You can fix an out-of-date instance by:

- Replacing the component with a new component (as shown in the figure below)
- Updating with the latest component

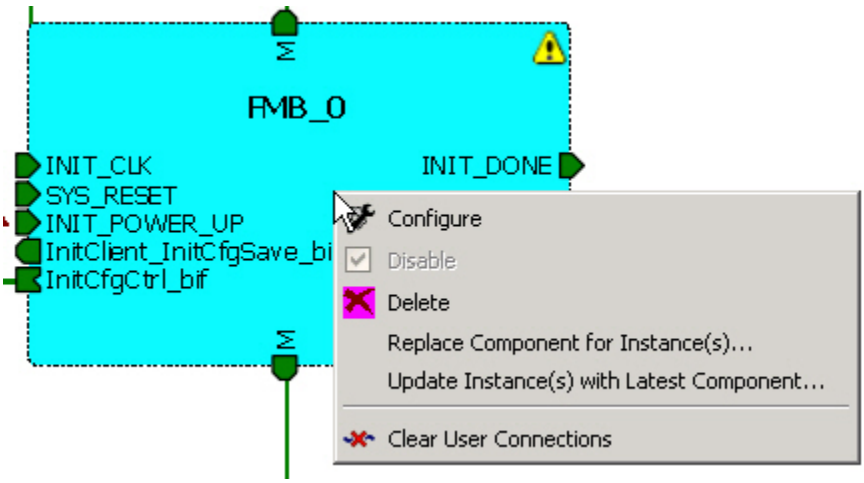


Figure 23 · Right-Click Menu - Replace Component for this Instance

See Also

Design state management

Reconfiguring components
Replacing components

Replacing Component Version

Components of an instance on the Canvas can be replaced with another component and maintain connections to all ports with the same name.

To replace a component in your design:

1. Select the component in the Design Hierarchy, right-click, and choose **Replace Component Version**. The Replace Component for Instance dialog box appears (see figure below).

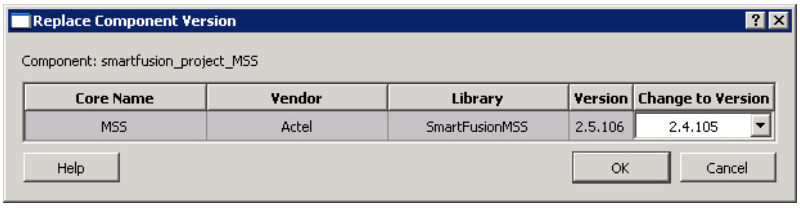


Figure 24 · Replace Component Version Dialog Box

2. Select the version you want to replace it with and click **OK**.

Design State Management

When any component with instances in a SmartDesign design is changed, all instances of that component detect the change.

If the change only affects the memory content, then your changes do not affect the component's behavior or port interface and your SmartDesign design does not need to be updated.

If the change affects the behavior of the instantiated component, but the change does not affect the component's port interface, then your design must be resynthesized, but the SmartDesign design does not need to be updated.

If the port interface of the instantiated component is changed, then you must reconcile the new definition for all instances of the component and resolve any mismatches. If a port is deleted, SmartDesign will remove that port and clear all the connections to that port when you reconcile all instances. If a new port is added to the component, instances of that component will contain the new port when you reconcile all instances.

The affected instances are identified in your SmartDesign design in the Grid and the Canvas with an exclamation point. Right-click the instance and choose **Update With Latest Component.**

Note: For HDL modules that are instantiated into a SmartDesign design, if the modification causes syntax errors, SmartDesign does not detect the port changes. The changes will be recognized when the syntax errors are resolved.

Changing memory content

For certain cores such as Analog System Builder, Flash Memory, or FlexRAM it is possible to change the configuration such that only the memory content used for programming is altered. In this case Project Manager (SoC) will only invalidate your programming file, but your synthesis, compile, and place-and-route results will remain valid.

When you modify the memory content of a core such as Analog System Builder or RAM with Initialization that is used by a Flash Memory core, the Flash Memory core indicates that one of its dependent components has changed and that it needs to be regenerated. This indication will be shown in the Hierarchy or Files Tab .

RAM with Initialization core - You can modify the memory content without invalidating synthesis.

Analog System Builder core - You can modify the following without invalidating synthesis:

- Existing flag settings: threshold levels, assertion/de-assertion counts, OVER/UNDER type

- Modifying sequence order or adding sequence operations
- Changing acquisition times
- Resistor Value for the Current Monitor
- RTC time settings
- Gate Driver source current

Flash Memory System Builder core - You can modify the following without invalidating synthesis:

- Modifying memory file or memory content for clients
- JTAG protection for Init Clients

Design Rules Check

The Design Rules Check runs automatically when you generate your SmartDesign; the results appear in the Reports tab. To view the results, from the **Design** menu, choose **Reports**.

- **Status** displays an icon to indicate if the message is an error or a warning (as shown in the figure below). Error messages are shown with a small red sign and warning messages with a yellow exclamation point.
- **Message** identifies the specific error/warning (see list below); click any message to see where it appears on the Canvas
- **Details** provides information related to the Message

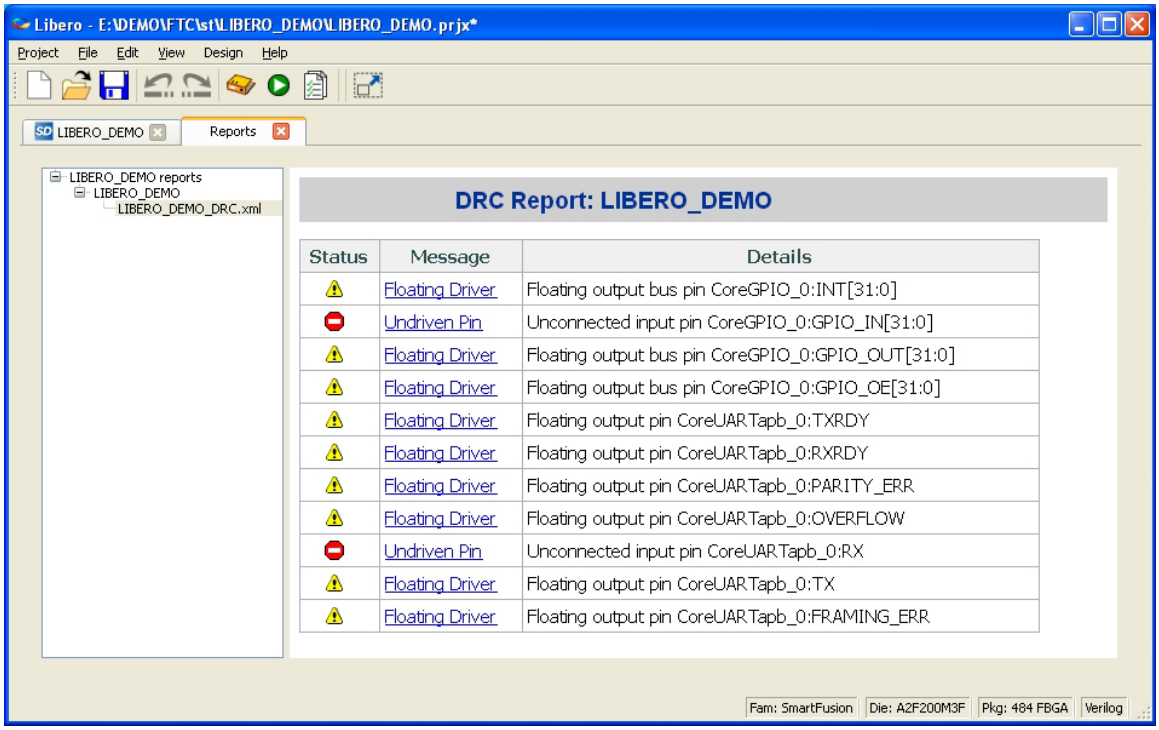


Figure 25 · Design Rules Check Results

Message Types:

Unused Instance - You must remove this instance or connect at least one output pin to the rest of the design.

Out-of-date Instance - You must update the instance to reflect a change in the component referenced by this instance; see Fixing an out-of-date instance.

Undriven Pin - To correct the error you must connect the pin to a driver or change the state, i.e. tie low (GND) or tie high (VCC).

Floating Driver - You can mark the pin unused if it is not going to be used in the current design. Pins marked unused are ignored by the Design Rules Check.

Unconnected Bus Interface - You must connect this bus interface to a compatible port because it is required connection.

Required Bus Interface Connection – You must connect this bus interface before you can generate the design. These are typically silicon connection rules.

Exceeded Allowable Instances for Core – Some IP cores can only be instantiated a certain number of times for legal design. For example, there can only be one CortexM1 or CoreMP7 in a design because of silicon rules. You must remove the extra instances.

Incompatible Family Configuration – The instance is not configured to work with this project's Family setting. Either it is not supported by this family or you need to re-instantiate the core.

Incompatible Die Configuration – The instance is not configured to work with this project's Die setting. Either it is not supported or you need to reconfigure the Die configuration.

Incompatible 'Debug' Configuration – You must ensure your CoreMP7 and CoreMP7Bridge have the same 'Debug' configuration. Reconfigure your instances so they are the same.

No RTL License, No Obfuscated License, No Evaluation License – You do not have the proper license to generate this core. Contact Microsemi SoC to obtain the necessary license.

No Top level Ports - There are no ports on the top level. To auto-connect top-level ports, right-click the Canvas and choose Auto-connect

Generating a SmartDesign Component

Before your SmartDesign component can be used by downstream processes, such as synthesis and simulation, you must generate it.

Click the Generate button to generate a SmartDesign component.

This will generate a HDL file in the directory <libero_project>/components/<library>/<yourdesign>.

Note: The generated HDL file will be deleted when your SmartDesign design is modified and saved to ensure synchronization between your SmartDesign component and its generated HDL file.

Generating a SmartDesign component may fail if there are any DRC errors. DRC errors must be corrected before you generate your SmartDesign design.

Generating a Datasheet (SmartFusion, IGLOOe, ProASIC3L, ProASIC3E, Fusion)

If your SmartDesign is the root design in your project, then a Memory Map / Datasheet that contains your design information is produced.

Generating Firmware and Software IDE Workspace (SmartFusion, IGLOOe, ProASIC3L, ProASIC3E, Fusion)

If your SmartDesign is the root design in your project, then any compatible firmware drivers for your peripherals are generated to <project>/firmware.

The datasheet provides all the specifics of the generated firmware drivers.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Reference

SmartDesign Menu

Command	Icon	Function
Generate Component		Generates the SmartDesign component
Auto Connect		Auto-connects instances
Connection Mode		Toggles connection mode on or off
Add Port		Opens the Add Port dialog box, adds a port to the top SmartDesign component
QuickConnect		Opens the QuickConnect dialog box, enables you to view, find and connect pins
Auto-Arrange Instances		Adds a port to the top of the SmartDesign component
Route All Nets		Re-routes your nets; useful if you are unsatisfied with the default display
Show/Hide Nets		Enables you to show or hide nets on the Canvas
Show/Hide Net Names		Enables you to show or hide net names on the Canvas
Zoom In		Zooms in on the Canvas
Zoom Out		Zooms out on the Canvas
Zoom to Fit		Zooms in or out to include all the elements on the Canvas in the view
Zoom Box		Zooms in on the selected area
Enable/Disable Back Background Grid		Toggle switch to enable or disable the background grid display in the Canvas
Add Note		Adds text to your Canvas

Command	Icon	Function
Add Line		Enables you to add a line to the Canvas
Add Rectangle		Enables you to add a rectangle to the Canvas

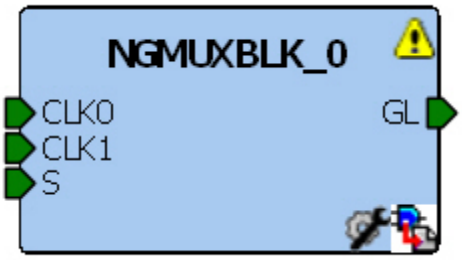
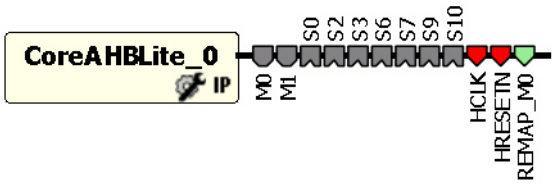
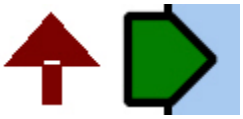
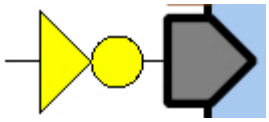
SmartDesign Glossary

Term	Description
BIF	Abbreviation for bus interface.
bus	An array of scalar ports or pins, where all scalars have a common base name and have unique indexes in the bus.
Bus Definition	Defines the signals that comprise a bus interface. Includes which signals are present on a master, slave, or system interface, signal direction, width, default value, etc. A bus definition is not specific to a logic or design component but is a type or protocol.
Bus Interface	Logical grouping of ports or pins that represent a single functional purpose. May contain both input and output, scalars or busses. A bus interface is a specific mapping of a bus definition onto a component instance.
Bus Interface Net	A connection between 2 or more compatible bus interfaces.
Canvas	Block diagram, connections represent data flow; enables you to connect instances of components in your design.
Component	Design element with a specific functionality that is used as a building block to create a SmartDesign core. A component can be an HDL module, non-IP core generated from the Catalog, SmartDesign core, Designer Block, or IP core. When you add a component to your design, SmartDesign creates a specific instance of that component.
Component Declaration	VHDL construct that refers to a specific component.
Component Port	An individual port on a component definition.
Driver	A driver is the origin of a signal on a net. The input and slave BIF ports of the top-level or the output and Master BIF ports from instances are drivers.
Instance	A specific reference to a component/module that you have added to your design.

Term	Description
	You may have multiple instances of a single component in your design. For each specific instance, you usually will have custom connections that differ from other instances of the same component.
Master Bus Interface	The bus interface that initiates a transaction (such as a read or write) on a bus.
Net	Connection between individual pins. Each net contains a single output pin and one or more input pins, or one or more bi-directional pins. Pins on the net must have the same width.
PAD	The property of a port that must be connected to a design's top level port. PAD ports will eventually be assigned to a package pin. In SmartDesign, these ports are automatically promoted to the top-level and cannot be modified.
Pin	An individual port on a specific instance of a component.
Port	An individual connection point on a component or instance that allows for an electrical signal to be received or sent. A port has a direction (input, output, bi-directional) and may be referred to as a 'scalar port' to indicate that only a single unit-level signal is involved. In contrast, a bus interface on an instance may be considered as a non-scalar, composite port. A component port is defined on a component and an instance port (also known as a 'pin') is part of a component instance.
Signal	A net or the electrical message carried on a net.
Slave Bus Interface	Bus interface that terminates a transaction initiated by a master interface.
System Bus Interface	Interface that is neither master nor slave; enables specialized connections to a bus.
Top Level Port	An external interface connection to a component/module. Scalar if a 1-bit port, bus if a multiple-bit port.

Canvas Icons

Hover your pointer over any icon in the SmartDesign Canvas view to display details.

Icon	Description
	Representation of an instance in your design. An instance is a component that has been added to your SmartDesign component. The name of the instance appears at the top and the name of the generic component at the bottom. The instance type is indicated by an icon inside the instance. There are specific icons for instances from SmartDesign, HDL, and ViewDraw. The instance icon at left indicates a Microsemi SoC core.
	Bus instance; you can click and drag the end of a bus instance to resize it; also, the bus instance will resize based on the number of instances that you connect to it.
	Optional unconnected pin. Required pins are red.
	Connected pin
	Pin with default Tie Off
	Pin tied low
	Pin tied high
	Pin inverted
	Pin marked as unused

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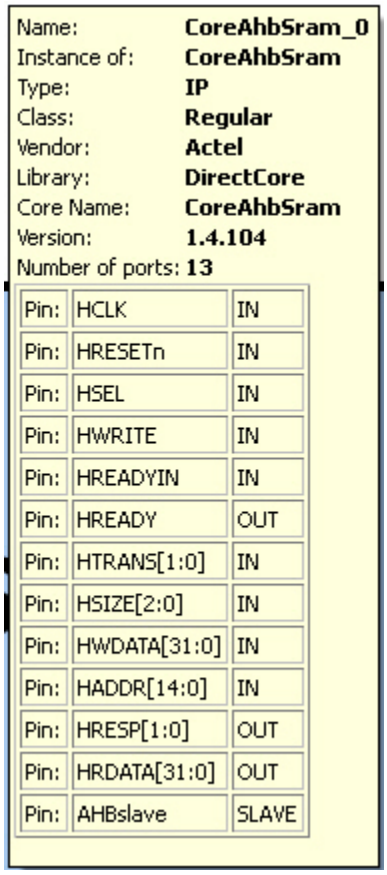
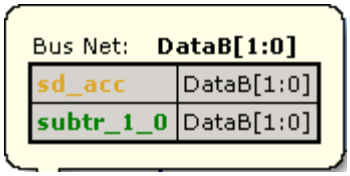
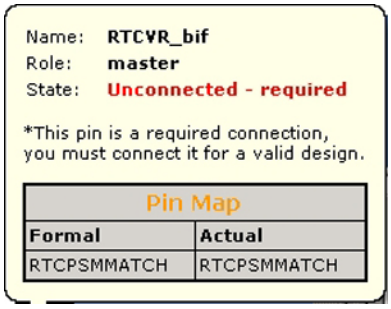
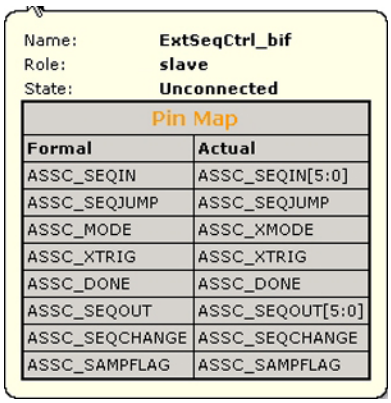
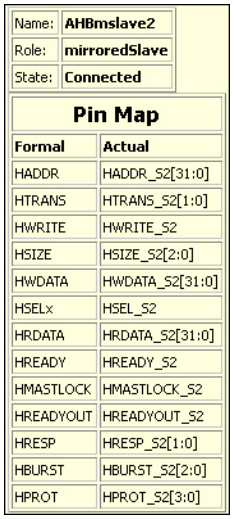
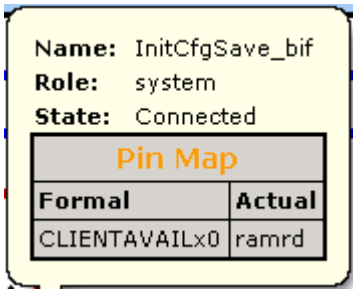
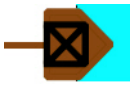
Icon	Description
	Pin tied to constant
	Instance details. If there are less than twenty ports, they are listed in the details.
	Bus Net details.
	Master bus interface icon. A master is a bus interface that initiates a transaction on a bus interface net. An unconnected master BIF with REQUIRED connection is red (shown at left). A master BIF with unconnected OPTIONAL connection is gray.

Icon	Description
	Master BIF details, showing name, role, and state. The Pin Map shows the Formal name of the pin assigned by the component (in this example, RCCLKOUT) and the Actual, or representative name assigned by the user (CLKOUT).
	Slave BIF (shown at left). Unconnected slave icons with REQUIRED connections are red. Unconnected slave icons with OPTIONAL connections are gray.
	Slave BIF details, showing name, role, and state. The Pin Map shows the Formal name of the pin assigned by the component (in this example, RCCLKOUT) and the Actual, or representative name assigned by the user (CLKA).
	Master-slave bus interface connection

Icon	Description
	Master-slave bus interface connection details.
	Groups of pins in an instance. Fully connected groups are solid green. Partially connected groups are gray with a green outline. Unconnected groups (no connections) are gray with a black outline.
	A system BIF is the bus interface that does not have a simple input/output relationship on both master/slave. This could include signals that only drive the master interface, or only drive the slave interface, or drive both the master and slave interfaces.
	System BIF details, showing name, role, and state. The Pin Map shows the Formal name of the pin assigned by the component (in this example, CLIENTAVAILx0), and the Actual name assigned by the user (in this example:

Icon	Description
	ramrd).
	Pad port icon; indicates a hardwired chip-level pin

VHDL Special Types - Examples and meta.out File Format

The VHDL Special Types are:

- Integer
- Unsigned
- Array and Array of Arrays
- Record

The meta.out file format follows the examples.

Integer

-- Package Declaration

```
library IEEE;
use IEEE.std_logic_1164.all;
use IEEE.std_logic_arith.all;
package universal_pkg is
  subtype integer1 is integer range 0 to 127;
  subtype integer2 is integer range 0 to 127;
end package universal_pkg;
```

--Entity Declaration

```
entity adder is
port (
  D1 , D2 : in integer1;
  D3 , D4 : in integer2;
  int_out1 : out integer range 0 to 255;
  int_out2 : out integer range 0 to 255
);
end entity adder;
```

Meta.out file:

```
package universal_pkg
integer integer1 [ 0 : 127 ]
integer integer2 [ 0 : 127 ]
end
entity adder
D1 integer1
D2 integer1
D3 integer2
D4 integer2
int_out1 integer [ 0 : 255 ]
```

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```
int_out2 integer [ 0 : 255 ]
end
```

Unsigned

Entity declaration:

```
entity unsigned_2multiply_acc is
port( A : in unsigned(16 downto 0);
  B : in unsigned(34 downto 0);
  C : in unsigned(13 downto 0);
  D : in unsigned(37 downto 0);
  E : in unsigned(51 downto 0);
  P : out unsigned(51 downto 0);
  clk : in std_logic
);
end unsigned_2multiply_acc;
```

Meta.out file:

```
entity unsigned_2multiply_acc
A unsigned [ 16 : 0 ]
B unsigned [ 34 : 0 ]
C unsigned [ 13 : 0 ]
D unsigned [ 37 : 0 ]
E unsigned [ 51 : 0 ]
P unsigned [ 51 : 0 ]
End
```

Array and Array of Arrays

--Package Declaration

```
library IEEE;
use IEEE.std_logic_1164.all;
package array_package is
  subtype ram_input is std_logic_vector(31 downto 0);
   type ram_in is array(1 downto 0) of ram_input;
   type ram_out is array(1 downto 0) of ram_input;
end package array_package;
```

-- Entity Declaration

```
entity ram_inference is
   port (
         ram_init : in ram_in;
         write_enable : in std_logic;
         read_enable : in std_logic;
         CLK : in std_logic;
         write_address : in integer range 63 downto 0;
         read_address : in integer range 63 downto 0;
         read_data : out ram_out
         );
  end entity ram_inference;
```

Meta.out file:

```
package array_package
array_of_array ram_in [ 1 : 0 ]
end
array_of_array ram_out [ 1 : 0 ]
end
end
entity ram_inference
ram_init[1] ram_in
ram_init[0] ram_in
write_address integer [ 63 : 0 ]
read_address integer [ 63 : 0 ]
read_data[1] ram_out
read_data[0] ram_out
end
```

Record

- Package Declaration

```
library IEEE;
use IEEE.std_logic_1164.all;
use IEEE.std_logic_arith.all;
package record_pkg is
  type array1 is array(3 downto 0) of std_logic;
  type array2 is array(3 downto 0) of std_logic_vector(3 downto 0);
  type test is record
        test_std_logic : std_logic;
        test_std_logic_vector : std_logic_vector(1 downto 0);
        test_integer : integer range 0 to 127;
        test_array : array1;
        test_array_of_array : array2;
        test_unsigned : unsigned(2 downto 0);
  end record;
end package record_pkg;
```

-- Entity Declaration

```
entity MUX is
generic ( N : integer := 1 );
port (
  mux_in1, mux_in2 : in test;
  sel_lines : in std_logic_vector(N-1 downto 0);
  mux_out : out test;
  mux_array : out array1
);
end entity MUX;
```

Meta.out file:

```
package record_pkg
array array1
end
array_of_array array2 [ 3 : 0 ]
```

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**


```
end
record test
test_integer integer [ 0 : 127 ]
test_array array1
test_array_of_array array2
test_unsigned unsigned [ 2 : 0 ]
end
end
entity MUX
mux_in1.test_std_logic test
mux_in1.test_std_logic_vector test
mux_in1.test_integer test
mux_in1.test_array test
mux_in1.test_array_of_array[0] test
mux_in1.test_array_of_array[1] test
mux_in1.test_array_of_array[2] test
mux_in1.test_array_of_array[3] test
mux_in1.test_unsigned test
mux_in2.test_std_logic test
mux_in2.test_std_logic_vector test
mux_in2.test_integer test
mux_in2.test_array test
mux_in2.test_array_of_array[0] test
mux_in2.test_array_of_array[1] test
mux_in2.test_array_of_array[2] test
mux_in2.test_array_of_array[3] test
mux_in2.test_unsigned test
mux_out.test_std_logic test
mux_out.test_std_logic_vector test
mux_out.test_integer test
mux_out.test_array test
mux_out.test_array_of_array[0] test
mux_out.test_array_of_array[1] test
mux_out.test_array_of_array[2] test
mux_out.test_array_of_array[3] test
mux_out.test_unsigned test
mux_array array1
end
```

meta.out File Format

MetaFile : MetaLibraryItem | MetaPackageList | MetaEntityList

MetaLibraryItem : **library** <lib_name>

MetaPackageList : MetaPackageItem MetaPackageList

MetaPackageItem : **package** <package_name> MetaItemDeclarationList **end**

MetaItemDeclarationList: MetaItem MetaItemDeclarationList

MetaItem : (MetaRecordItem | MetaArrayOfArrayItem | MetaIntegerType | MetaArrayItem)

MetaIntegerItem : (MetaIntegerType | MetaIntegerWithoutType)

MetaIntegerType : **integer** <integer_name> NumericRange

MetaIntegerWithoutType : **integer** NumericRange

MetaUnsignedItem : **unsigned** <name> NumericRange

MetaArrayOfArrayItem : **array_of_array** < MetaArrayOfArrayName> Range [MetaArrayItem] end

MetaRecordItem : **record** <record_name> RecordItemList **end**

RecordItemList : RecordItem RecordItemList

RecordItem : <Inst_name> (MetaArrayOfArrayName | MetaIntegerItem | MetaUnsignedItem | MetaSimpleArray)

MetaEnumuratedItem : **enum** <enum_name> (Item_name{,Item_name})

Range : [NumericRange | MetaEnumuratedItem]

NumericRange : lsd : msd

MetaArrayItem :**array** <array_name> [<record_name>] **end**

MetaEntityList : **entity** <entity_name> MetaEntityItemList **end**

MetaEntityItemList : MetaEntityItem MetaEntityItemList

MetaEntityItem : (RecordEntityItemList | IntegerEntityItemList | ArrayEntityItemList | ArrayOfArrayEntityItemList | UnsignedEntityItemList | BufferPortItemList)

RecordEntityItemList : RecordEntityItem RecordEntityItemList

RecordEntityItem : (RecordNormalItem | RecordArrayOfArrayItemList)

RecordNormalItem : <user_port_name>. RecordItem <record_name>

RecordArrayOfArrayItemList : <record_port_name>[index]. RecordItem <record_name>

BufferPortItemList : BufferPortItem BufferPortItemList

BufferPortItem : **buffer** <buffer_name>

IntegerEntityItemList : IntegerEntityItem IntegerEntityItemList

IntegerEntityItem : <user_port_name> (MetaIntegerType | MetaIntegerWithoutType)

ArrayEntityItemList : ArrayEntityItem ArrayEntityItemList

ArrayEntityItem : <user_port_name> MetaArrayItem

ArrayOfArrayEntityItemList : ArrayOfArrayEntityItem ArrayOfArrayEntityItemList

ArrayOfArrayEntityItem : <port_name> < MetaArrayOfArrayName>

UnsignedEntityItemList : UnsignedEntityItem UnsignedEntityItemList

UnsignedEntityItem : <user_port_name> MetaUnsignedItem

Create Core from HDL

You can instantiate any HDL module and connect it to other blocks inside SmartDesign. However, there are situations where you may want to extend your HDL module with more information before using it inside SmartDesign.

- If you have an HDL module that contains configurable parameters or generics.
- If your HDL module is intended to connect to a processor subsystem and has implemented the appropriate bus protocol, then you can add a bus interface to your HDL module so that it can easily connect to the bus inside of SmartDesign.

To create a core from your HDL:

1. Import or create a new HDL source file; the HDL file appears in the Design Hierarchy.
2. Select the HDL file in the Design Hierarchy and click the HDL+ icon or right-click the HDL file and choose **Create Core from HDL**.

   The Edit Core Definition – Ports and Parameters dialog appears. It shows you which ports and parameters were extracted from your HDL module.
3. Remove parameters that are not intended to be configurable by selecting them from the list and clicking the X icon. Remove parameters that are used for internal variables, such as state machine enumerations.

If you removed a parameter by accident, click **Re-extract ports and parameters from HDL file** to reset the list so it matches your HDL module.

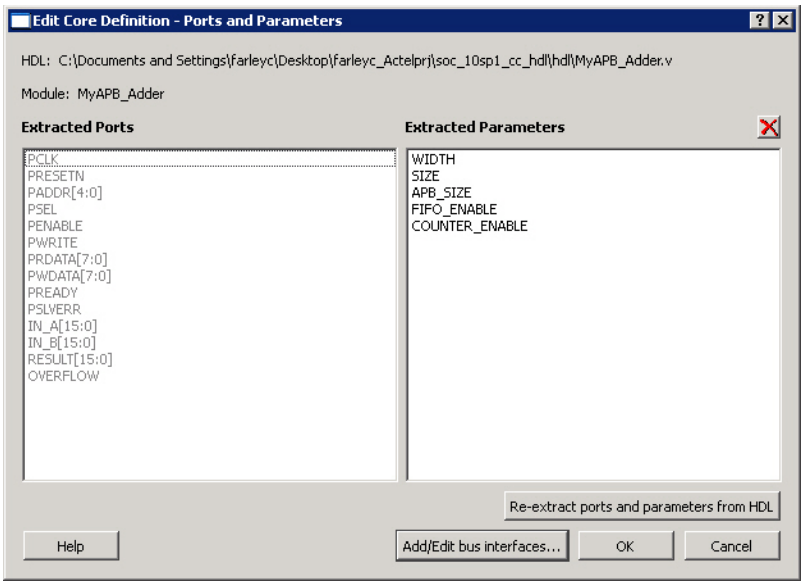

Figure 26 · Edit Core Definition - Ports and Parameters Dialog Box

4. (Optional) Click **Add/Edit Bus Interfaces** to add bus interfaces to your core.

After you have specified the information, your HDL turns into an HDL+ icon in the Design Hierarchy. Click and drag your HDL+ module from the Design Hierarchy to the **Canvas**.

If you added bus interfaces to your HDL+ core, then it will show up in your SmartDesign with a bus interface pin that can be used to easily connect to the appropriate bus IP core.

If your HDL+ has configurable parameters then double-clicking the object on the Canvas invokes a configuration dialog that enables you to set these values. On generation, the specific configuration values per instance are written out to the SmartDesign netlist.

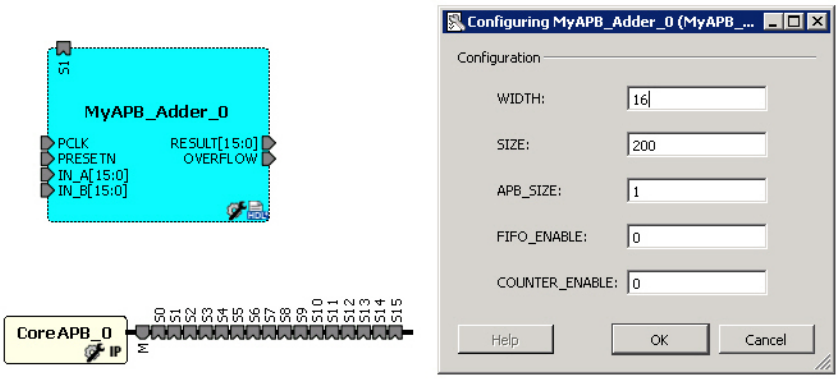

Figure 27 · HDL+ Instance and Configuration Dialog Box

You can right-click the instance and choose **Modify HDL** to open the HDL file inside the text editor.

Edit Core Definition

You can edit your core definition after you created it by selecting your HDL+ module in the design hierarchy and clicking the HDL+ icon.

Remove Core Definition

You may decide that you do not want or need the extended information on your HDL module. You can convert it back to a regular HDL module. To do so, right-click the HDL+ in the Design Hierarchy and choose **Remove Core Definition**. After removing your definition, your instances in your SmartDesign that were

referencing this core must be updated. Right-click the instance and choose **Replace Component for Instance**.

Create HDL

Create HDL opens the HDL editor with a new VHDL or Verilog file. Your new HDL file is saved to your /hdl directory; all modules created in the file appear in the Design Hierarchy.

You can use VHDL and Verilog to implement your design.

To create an HDL file:

1. In the Design Flow window, double-click **Create HDL**. The Create new HDL file dialog box opens.
2. Select your **HDL Type**. Choose whether or not to **Initialize file with standard template** to populate your file with default headers and footers. The HDL Editor workspace opens.
3. Enter a **Name**. Do not enter a file extension; Libero SoC adds one for you. The filename must follow Verilog or VHDL file naming conventions.
4. Click OK.

After creating your HDL file, click the **Save** button to save your file to the project .

Using the HDL Editor

The HDL Editor is a text editor designed for editing HDL source files. In addition to regular editing features, the editor provides keyword highlighting, line numbering and a syntax checker.

You can have multiple files open at one time in the HDL Editor workspace. Click the tabs to move between files.

Editing

Right-click inside the HDL Editor to open the Edit menu items. Available editing functions include cut, copy, paste, Go to line, Comment/Uncomment Selection and Check HDL File. These features are also available in the toolbar.

Saving

You must save your file to add it to your Libero SoC project. Select **Save** in the File menu, or click the **Save** icon in the toolbar.

Printing

Print is available from the File menu and the toolbar.

Note: To avoid conflicts between changes made in your HDL files, Microsemi recommends that you use one editor for all of your HDL edits.

HDL Syntax Checker

To run the syntax checker:

In the **Files** list, double-click the HDL file to open it. Right-click in the body of the HDL editor and choose **Check HDL File**.

The syntax checker parses the selected HDL file and looks for typographical mistakes and syntactical errors. Warning and error messages for the HDL file appear in the Libero SoC Log Window.

Commenting Text

You can comment text as you type in the HDL Editor, or you can comment out blocks of text by selecting a group of text and applying the Comment command.

To comment or uncomment out text:

1. Type your text.
2. Select the text.
3. Right-click inside the editor and choose **Comment Selection** or **Uncomment Selection**.

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Find

In the File menu, choose **Find** and the Find dialog box appears below the Log/Message window. You can search for a whole word or part of a word, with or without matching the case.

You can search for:

- Match Case
- Match whole word
- Regular Expression

The Find to Replace function is also supported.

Column Editing

Column Editing is supported. Press ALT+click to select a column of text to edit.

Importing HDL Source Files

To import an HDL source file:

1. In the Design Flow window, right-click **Create HDL** and choose **Import Files**. The Import Files window appears.
2. Navigate to the drive/folder that contains the HDL file.
3. Select the file to import and click **Open**.

Mixed-HDL Support in Libero SoC

You must have ModelSim PE or SE to use mixed HDL in the Libero SoC. Also, you must have Synplify Pro to synthesize a mixed-HDL design.

When you create a project, you must select a preferred language. The HDL files generated in the flow (such as the post-layout netlist for simulation) are created in the preferred language.

The language used for simulation is the same language as the last compiled testbench. (E.g. if tb_top is in verilog, <fam>.v is compiled.)

If your preferred language is Verilog, the post-synthesis and post-layout netlists are in Verilog 2001.

SmartDesign Testbench

SmartDesign Testbench is a GUI-based tool that enables you to design your testbench hierarchy. Use SmartDesign Testbench to instantiate and connect stimulus cores or modules to drive your Root design.

You can create a SmartDesign Testbench by right-clicking a SmartDesign in the Design Hierarchy and choosing **Create Testbench > SmartDesign**.

SmartDesign Testbench automatically instantiates the selected SmartDesign into the Canvas.

You can also double-click **Create SmartDesign Testbench** in the Design Flow window to add a new SmartDesign testbench to your project.

New testbench files appear in the Stimulus Hierarchy.

SmartDesign Testbench automatically instantiates your root design into the Canvas.

You can instantiate your own stimulus HDL or simulation models into the SmartDesign Testbench Canvas and connect them to your DUT (design under test). You can also instantiate Simulation Cores from the Catalog. Simulation cores are basic cores that are useful for stimulus generation, such as driving clocks, resets, and pulses.

Click the Simulation Mode checkbox in the Catalog to view available simulation cores.

HDL Testbench

You can create a HDL Testbench by right-clicking a SmartDesign in the Design Hierarchy and choosing **Create Testbench > HDL**.

HDL Testbench automatically instantiates the selected SmartDesign into the Canvas.

You can also double-click **Create HDL Testbench** to open the Create New HDL Testbench dialog box. The dialog box enables you to create a new testbench file and gives you the option to include standard testbench content and your design data.

Set your HDL Type, specify a name, select the data options and click OK to create a new testbench.

Initialize file with standard template populates the new HDL file with basic headers and Clock/Reset driver, as in the header of the example file below.

Instantiate Root Design includes your root design information in the new file. It includes architectural, constant, signal, component, clock, and port information.

Set as Active Stimulus sets the HDL Testbench as the stimulus file to use for simulations.

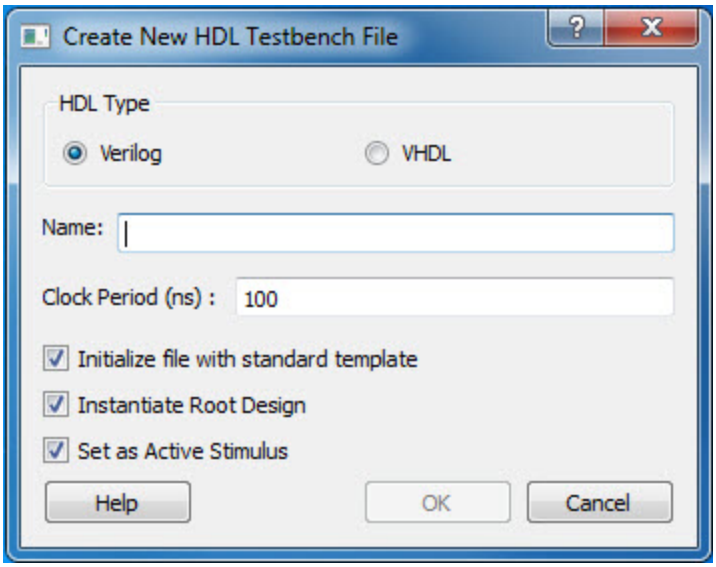

Figure 28 · Create HDL Testbench Dialog Box

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**


```
1  ------------------------------------------------------------------------------
2  -- Company: <Name>
3  --
4  -- File: hdl_testbench_1.vhd
5  -- File history:
6  --      <Revision number>: <Date>: <Comments>
7  --      <Revision number>: <Date>: <Comments>
8  --      <Revision number>: <Date>: <Comments>
9  --
10 -- Description:
11 --
12 -- <Description here>
13 --
14 -- Targeted device: <Family::SmartFusion> <Die::A2F200M3F> <Package::484 FBGA>
15 -- Author: <Name>
16 --
17 ------------------------------------------------------------------------------
18
19
20 library ieee;
21 use ieee.std_logic_1164.all;
22
23 entity hdl_testbench_1 is
24 end hdl_testbench_1;
25
26 architecture behavioral of hdl_testbench_1 is
27
28     constant SYSCLK_PERIOD : time := 100 ns;
29
30     signal SYSCLK : std_logic := '0';
31     signal NSYSRESET : std_logic := '0';
32
33     component test_mss
34         -- ports
35         port(
36             -- Inputs
37             UART_1_RXD : in std_logic;
38             UART_0_RXD : in std_logic;
39             SPI_1_DI : in std_logic;
40             SPI_0_DI : in std_logic;
41             MAC_CRSDV : in std_logic;
42             MAC_RXER : in std_logic;
43             MSS_RESET_N : in std_logic;
44             CLKA_PAD : in std_logic;
45             CLKC_PAD : in std_logic;
46             MAC_RXD : in std_logic_vector(1 downto 0);
47
```

Figure 29 · HDL Testbench Example - Standard Template and Root Design Enabled

View/Configure Firmware Cores

Use this dialog to select and configure firmware cores (drivers) for your Software IDE project. The Design Firmware tab lists the compatible firmware for the hardware that you have instantiated in your design. In the Design Flow tab, expand **Create Design** and double-click **View/Configure Firmware Cores** to view the DESIGN_FIRMWARE tab.

The Firmware table lists the compatible firmware and drivers based on the hardware peripherals that you have used in your design. Each row represents a firmware core that is compatible with a hardware peripheral in your design. The columns in the Firmware table are:

- **Generate** - Allows you to choose whether you want the files for this firmware core to be generated on disk and added to your Software IDE project. Click the checkbox to generate firmware for each peripheral in your design.
- **Instance Name** - This is the name of the firmware instance. This may be helpful in distinguishing firmware cores when you have multiple firmware cores with the same Vendor:Library:Name:Version (VLNV) in your design.
- **Core Type** - Firmware Core Type is the Name from the VLNV id of the core. This generally corresponds to the name of the hardware peripheral with which the firmware core is compatible.
- **Version** - Firmware Core Version; you can upgrade or choose a different version via a dropdown menu in this column.
- **Compatible Hardware Instance** - The hardware instance in your design that is compatible with this firmware core.

Downloading Firmware

Libero attempts to find compatible firmware located in the IP Vault located on your disk, as well as firmware in the IP Repository via the Internet.

If compatible firmware is found in the IP repository but not on your disk, the row will be italicized, indicating that it needs to be downloaded. To download all firmware cores necessary for your project peripherals, click the **Download All Firmware** icon in the vertical toolbar.

Configuring Firmware

Firmware cores that have configurable options will have a wrench icon in the row. Click the wrench icon to configure the firmware core.

It is important that you check the configuration of your firmware cores if they have configurable options. They may have options that target your software IDE (Keil, IAR or Softconsole), or your processor, that are vital configuration options to getting your system to work properly.

Generating Firmware

Click the Generate icon to export the firmware drivers and software IDE project for your project. The firmware drivers are generated into <project>\firmware and the software workspace is exported to <project>\<toolchain>. <toolchain> could be SoftConsole, IAR or Keil, depending on your software IDE.

The firmware drivers are also copied into the <toolchain> folder.

Changing Firmware Core Versions

You can manually change to the latest version by selecting the drop down in the Version column.

There will often be multiple versions of a firmware cores available for a particular peripheral. The MSS Configurator selects the latest compatible version for a new design.

However, once the firmware has been added to your design, Libero will not automatically change to the latest version if one becomes available.

Note: If a core version is shown in italics it is available in the Web Repository but not in your Vault; you must download the firmware core version to use it in your design.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Generating Sample Projects

Firmware cores are packaged with sample projects that demonstrate their usage. They are packaged for specific tool chains, such as Keil, IAR and SoftConsole

To generate a sample project, right-click the firmware core and choose **Generate Sample Project**, then select your IDE tool chain (such as Keil), and choose from the list of available samples.

You will be prompted to select the destination folder for the sample project.

Once this project is generated you can use it as a starting point in your Software IDE tool or use the example project as a reference on how to use the firmware driver.

Fabric Peripherals

Libero SoC also attempts to find compatible firmware for soft (fabric) peripherals that you have added in your top-level SmartDesign if that top-level is Set as Root.

To set your top-level design as a root, right-click your top-level design in the Design Hierarchy and choose **Set as Root**. The root component appears in bold.

The figure below shows CoreGPIO, CorePWM and CoreUARTapb soft cores that have been added into your top-level SmartDesign.

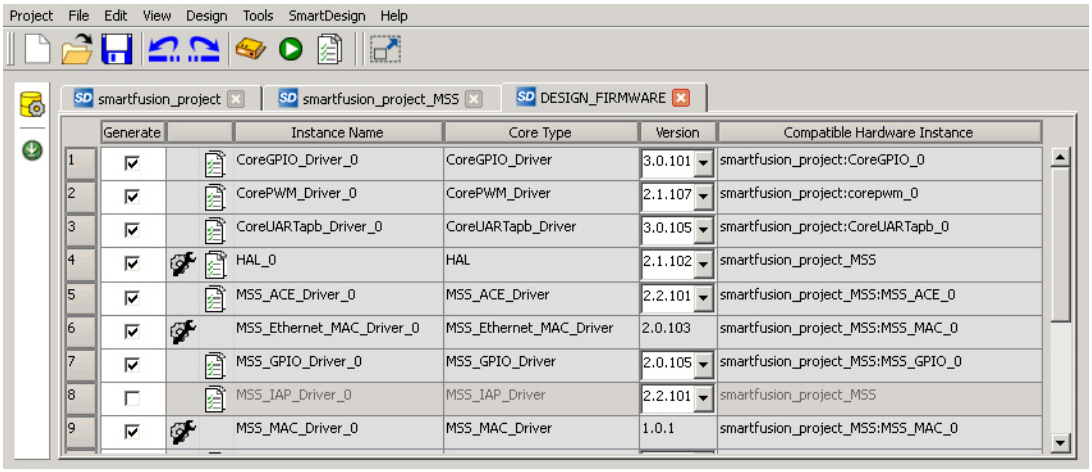

Figure 30 · Firmware Cores Tab (DESIGN_FIRMWARE)

See Also

Exporting Firmware and the Software IDE Workspace

Libero SoC Frequently Asked Questions

Running Libero SoC from your Software Tool Chain

Software IDE Integration

Designing with Designer Block Components

Designer Blocks (also generically called "components") enable you to partition a design and optimize critical sections. You can reuse them later in new applications, ensuring consistent performance. Designing with blocks enables multiple designers to work independently on parts of a single design.

Designer Block Advantages

- You can focus on the timing of critical blocks and ensure the timing across the blocks meets requirements before proceeding to the top-level flow.
- Changes in other blocks have no impact on your own block, you can re-use your block without re-calculating the timing.
- The block can be re-used in multiple designs
- Shorter verification time. You need to re-verify only the portion of the design that has changed.

Designer Block Features

- You can create a Designer Block with or without I/Os.
- A Designer Block can be synthesized, simulated, and placed-and-routed the same way as a regular design.
- You can lock the place-and-route of the Designer Block to ensure performance does not change.
- Performance and place-and-route can be fixed absolutely; however these rules can be relaxed gradually, if necessary, to ensure that you can integrate the Designer Block into your <top> project.
- You can use all the features in Designer Blocks in SmartDesign.

Use Designer Blocks When

- The design is congested (uses 90% of the resources on a given die).
- You have difficulty meeting timing by doing the design in its entirety. Blocks enable you to compartmentalize the design and optimize sections before you optimize the entire design.
- You want to re-use some elements of your design.
- You want to use the identical elements multiple times in a single design.

You cannot use Designer Blocks with all families, they are family and die specific; if your Designer Block has I/Os it is also package specific.

Supported Families

SmartFusion, IGLOO, ProASIC3, Fusion

Designer Blocks and Synthesis

You must run the synthesis tool in No I/O mode when you create your component. The Designer Block is not a full design; Libero SoC sets this option for Synplify if you Enable Designer Block creation.

When you Publish a Designer Block, the Project Manager creates a timing shell that enables the synthesis tool to better synthesize the <top> project. The timing shell is named <blockname>_syn.v(.vhd) if you are using Synplify or <blockname>_pre.v(.vhd) if you are using Precision.

When you are working in your <top> project, the synthesis tool does not know how many globals you have in your Designer Block, or if there will be clock sharing. The synthesis tool promotes as many globals as it can and if you have globals in the Designer Block you will exceed the total number of globals allowed in your device.

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In this case, you must limit the number of globals added by the synthesis tool so that the total number (Designer Block plus <top> project) does not exceed the number available on your device.

To add an internal global, you can use either the Synplify constraints editor (SCOPE) or an SDC file.

For example, to add a CLKINT after a CLK port, the command is:

```
define_attribute {n:CLK} syn_insert_buffer {CLKINT}
```

See Also

Creating a component in Designer

Creating a component in Libero SoC

Managing I/Os in a Designer Block Component

If you use I/Os in your Designer Block, use the following rules:

- If the I/O is placed in the block, placement and VCCI of the I/O cannot be changed in the <top> design.
- The register combining option cannot be changed in the <top> design.
- Attributes and Vref pins can be changed if the values are legal (the I/O will not be unplaced).

Globals and Designer Block Components

You must manage your globals when creating a Designer Block to ensure that you have some available after you import the Block into your <top> project.

There is no limit to the number of globals you can use in a Designer Block.

Global Sharing

You can share a global between the Designer Block and the <top> project. You must:

- Use an internal global in the Designer Block.
- Drive the global port in the <top> project with a global net.

Libero SoC removes the internal global and re-routes the entire net.

You can use other global macros in the Designer Block, but you cannot share them with the <top> project.

Global Sharing with SmartFusion, IGLOO, ProASIC3 and Fusion - Use CLKINT in the Designer Block to share the global in the component with the <top> project.

See the list of Physical Design Constraint (PDC) files for more information on how to assign constraints.

Local Clock

You can use local clocks in your component to save on globals, but you may need to do some floorplanning in your <top> project.

Limitations

When you create your block, you cannot assign a port-connected net to a local clock.

The routing for local clocks from the blocks cannot always be preserved.

For all other families, local clocks are rerouted only if they are used in more than one block. The local clock constraint is preserved and the only difference in the routing is from the driver to the entry point of the clock network (when it gets to the clock network you end up with the same routing since the macros are locked in the same location).

Designer Block Compile Report

If you instantiate Designer Blocks in your design, the Compile report includes a description of the blocks you used. The report appears in the Log window after Compile is complete.

The report lists the name of the module, the name of the instance, the number of macros and nets used in the blocks, and information on how conflicts between blocks were resolved by the Compile options or PDC commands (if any). For example:

```
Block Information Report :
==========================
Conflict resolution from Compile options :
==========================================
  Placement : Resolve conflict/Keep and Lock non conflicting placement
   Routing : Resolve conflict/Keep and Lock non conflicting routing
  ----------------------------------------------------
   Block Name : core1
  Instance Name : core1_inst
  | Locked | Total
   ---------------------------
   Instances | 4 | 4 (100.00%)
   Nets | 3 | 3 (100.00%)
  ----------------------------------------------------
  Block Name : core1
  Instance Name : core11_inst
  PDC Constraints :
   =================
   Move : move_block -inst_name {core11_inst} -left 10 -up 0 -non_logic UNPLACE
  | Locked | Total
   ---------------------------
   Instances | 4 | 4 (100.00%)
  Nets | 0 | 3 (0.00%)
```

Designer Block Component Limitations

If you instantiate the same Designer Block many times in the <top> design, only the first instance retains the place-and-route information (if it has any); the others do not. Only the netlist is preserved.

To preserve the relative placement and routing of other blocks you must move the blocks using a PDC command. This PDC file must be imported as a source file along with the netlist(s) and CDB files. If possible, routing is preserved when you move the blocks with a PDC command.

See the move_block PDC command for more information.

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Creating a Designer Block Component in Libero SoC

Creating a Designer Block Component in Libero SoC

You must create two Libero SoC projects in order to instantiate your Designer Block in Libero SoC: one to create and publish your Designer Block, and another in which to instantiate your Designer Block. This section describes how to create your Designer Block.

See Instantiating a Designer Block in Libero SoC for more information.

The general design flow for creating a Designer Block in Libero SoC is shown in the figure below.

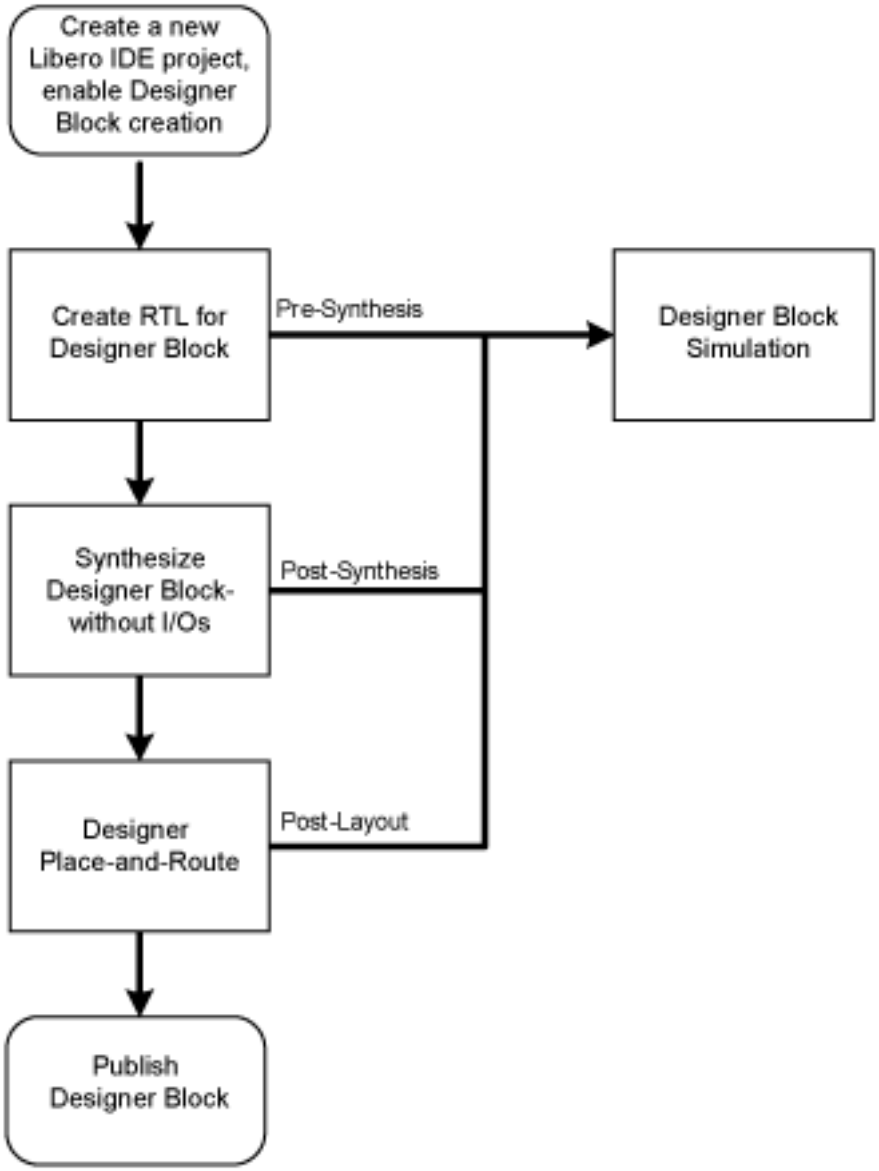

Figure 31 · Create a Designer Block Flow in Libero SoC

To create a Designer Block in Libero SoC with a new design:

1. Start a new project. You must select a family that supports Block designs (SmartFusion2, SmartFusion, IGLOO, ProASIC3, Fusion). After your project opens, from the **Project** menu, choose **Settings > Flow**, and click the **Enable Block Creation** checkbox.
2. Create a design in Libero SoC (standard design flow - create RTL, synthesize, run place-and-route and generate the block using Designer).

To create a Designer Block in the Libero SoC with an existing design, open your design and from the **Project** menu, choose **Setting > Flow**, and click the **Enable Block Creation** checkbox. Note that your design must use a device family that supports Designer Blocks (SmartFusion2, SmartFusion, IGLOO, ProASIC3, Fusion).

Instantiating a Designer Block in Libero SoC

You must have two projects in order to instantiate your Designer Block in Libero SoC: one to create and publish your Designer Blocks, and another in which to instantiate your Designer Block. This topic and the flow shown in the figure below describe how to instantiate your Designer Block in the Libero SoC.

See Creating a Designer Block in Libero SoC for information on how to create a Designer Block. You can also import your Designer Blocks into SmartDesign.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

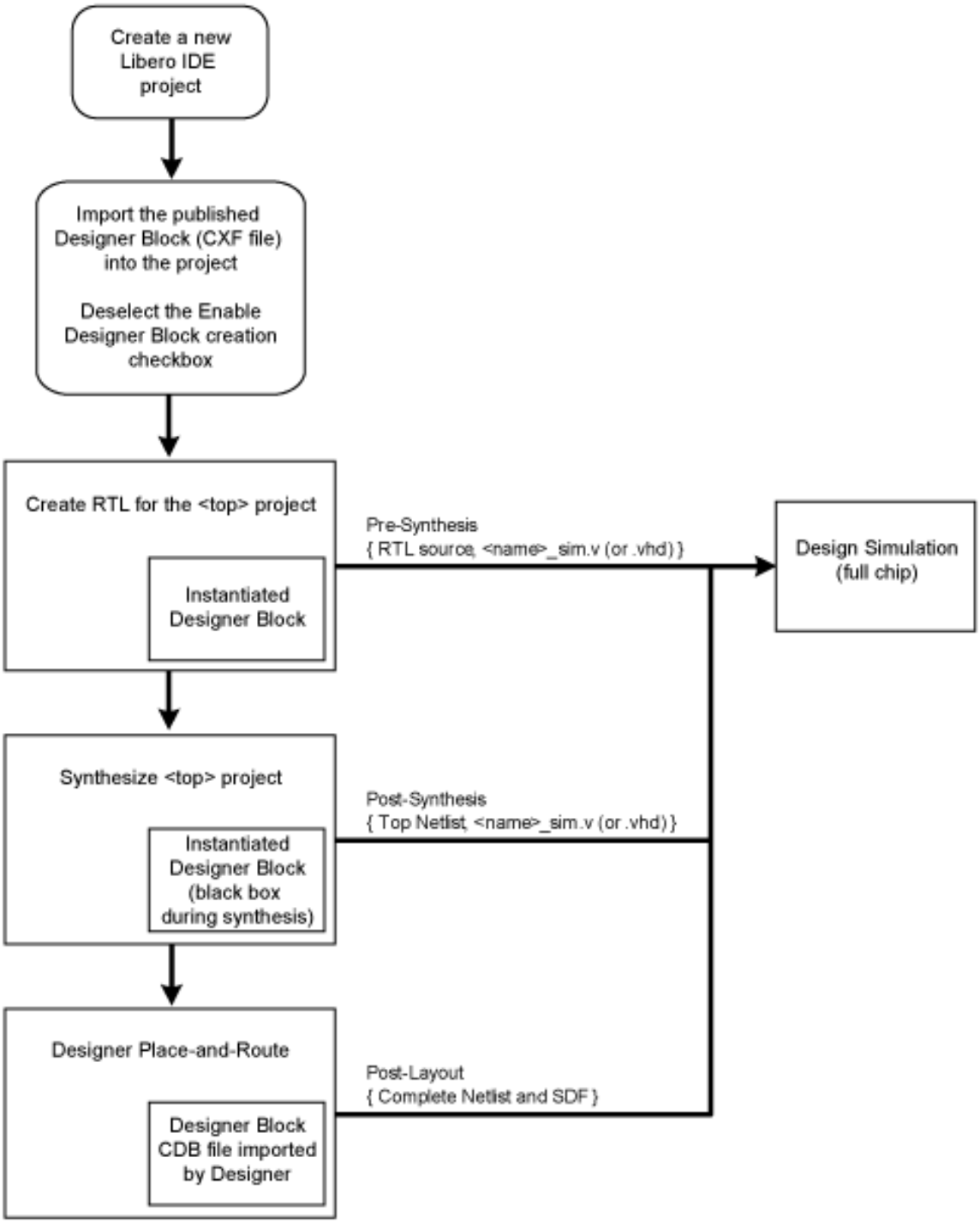

Figure 32 · Libero SoC Designer Block Instantiation Flow

To instantiate (import) a Designer Block in Libero SoC, import your design netlist and CXF file(s). The CXF file imports all the files you need for your Designer Block. After you import your files, the design flow is the same as regular Libero SoC designs. There is no limit to the number of CXF files you can import, but you cannot import the same Designer Block more than once, and the family and device for your imported block must match your project.

After you import the CXF file, the Project Manager displays the imported files in the Design Hierarchy tab.

The Designer Block(s) you instantiate must have the same family and die (and package, if it contains I/Os) as your current <top> project. If the family, die, and package do not match, Libero SoC asks if you want to change the current setting to match the one from the Designer Block.

The Project Manager passes all the Designer Block files to Designer automatically.

Note:

- Disable Designer Block creation when you import a component into your <top> project. If you are using a Designer Block component to create another Designer Block, leave it enabled.
- If you already have an HDL component with the same name as the one you imported, the new Designer Block component is not be used by default. You must and right-click the Designer Block component in the Project Manager and choose **Use this file** to make it use your Designer Block.

RTL Simulation

To perform pre-synthesis simulation, in the Stimulus Hierarchy right-click the testbench and choose **Simulate Pre-Synth Design > Run**.

If you wish to perform pre-layout simulation, in the Design Flow Window, under Verify Pre-Synthesized design, double-click Simulate.

The default tool for RTL simulation in Libero SoC is ModelSim ME.

ModelSimTM ME is a custom edition of ModelSim PE that is integrated into Libero SoC's design environment. ModelSim for Microsemi is an OEM edition of Model Technology Incorporated's (MTI) tools. ModelSim for Microsemi supports VHDL or Verilog. It only works with Microsemi libraries and is supported by Microsemi.

Other editions of ModelSim are supported by Libero SoC. To use other editions of ModelSim , simply do not install ModelSim ME from the Libero SoC CD.

Note: ModelSim for Microsemi comes with its own online help and documentation. After starting ModelSim, click the *Help* menu.

See the following topics for more information on simulation in Libero SoC:

- Simulation Options
- Selecting a Stimulus File for Simulation
- Selecting additional modules for simulation
- Performing Functional Simulation

Simulation Options

You can set a variety of simulation options for your project.

To set your simulation options:

1. From the **Project** menu, choose **Project Settings**.
2. Click the simulation option you wish to edit: **DO file**, **Waveforms**, or **Vsim commands**.
3. Click **Close** to save your settings.

DO File

- **Use automatic Do file -** Select to execute the wave.do or other specified Do file. Use the wave.do file to customize the ModelSim Waveform window display settings.
- **Simulation Run Time -** Specify how long the simulation should run in nanoseconds. If the value is 0, or if the field is empty, there will not be a run command included in the run.do file.
- **Testbench module name -** Specify the name of your testbench entity name. Default is "testbench," the value used by WaveFormer Pro.
- **Top Level instance name -** Default is <top_0>, the value used by WaveFormer Pro. The Libero SoC replaces <top> with the actual top level macro when you run ModelSim.

- **Generate VCD file** - Select this checkbox to have ModelSim automatically generate a VCD file based on the current simulation. VCD files can be used in SmartPower. For best results, we recommend that a postlayout simulation be used to generate the VCD.
- **VCD filename** - Specify the name of the VCD file that will be automatically generated by ModelSim
- **User defined DO file** - Available if you opt not to use the automatic DO file. Input the path or browse to your user-defined DO file.
- **DO Command parameters** - Text in this field is added to the DO command.

Waveforms

- **Include DO file** - Including a DO file enables you to customize the set of signal waveforms that will be displayed in ModelSim.
- **Display waveforms for** - You can display signal waveforms for either the top-level testbench or for the design under test. If you select top-level testbench then Libero SoC outputs the line 'add wave /testbench/*' in the DO file run.do. If you select DUT then Libero SoC outputs the line 'add wave /testbench/*' in the run.do file.
- **Log all signals in the design** - Saves and logs all signals during simulation.

Vsim Commands

- **SDF timing delays** - Select Minimum, Typical, or Maximum timing delays in the back-annotated SDF file.
- **Resolution**: The default is family-specific, but you can customize it to fit your needs.
  Some custom simulation resolutions may not work with your simulation library. For example, simulation resolutions above 1 ps will cause errors if you are using ProASIC3 devices (the simulation errors out because of an infinite zero-delay loop). Consult your simulation help for more information on how to work with your simulation library and detect infinite zero-delay loops caused by high resolution values.

Family	Default Resolution
ProASIC3	1 ps
IGLOO	1 ps
SmartFusion and Fusion	1 ps
SmartFusion2	1 ps
IGLOO2	1 ps
RTG4	1 ps

- **Additional options:** Text entered in this field is added to the vsim command.

Simulation Libraries

- **Verilog (or VHDL) library path** - Enables you to choose the default library for your device, or to specify your own library. Enter the full pathname of your own library to use it for simulation.
- **Restore Defaults**: Restores factory settings.

Selecting a Stimulus File for Simulation

Before running simulation, you must associate a testbench. If you attempt to run simulation without an associated testbench, the Libero SoC Project Manager asks you to associate a testbench or open Model*Sim* without a testbench.

To associate a stimulus:

1. Run simulation or in the Design Flow window under Verify Pre-Synthesized Design right-click **Simulate** and choose **Organize Input Files > Organize Stimulus Files**. The Organize Stimulus Files dialog box appears.
2. Associate your testbench(es):

   In the Organize Stimulus Files dialog box, all the stimulus files in the current project appear in the Source Files in the Project list box. Files already associated with the block appear in the Associated Source Files list box.
   In most cases you will only have one testbench associated with your block. However, if you want simultaneous association of multiple testbench files for one simulation session, as in the case of PCI cores, add multiple files to the Associated Source Files list.
   To add a testbench: Select the testbench you want to associate with the block in the Source Files in the Project list box and click **Add** to add it to the Associated Source Files list.
   To remove a testbench: To remove or change the file(s) in the Associated Source Files list box, select the file(s) and click **Remove**.
   To order testbenches: Use the up and down arrows to define the order you want the testbenches compiled. The top level-entity should be at the bottom of the list.
3. When you are satisfied with the Associated Source Files list, click **OK**.

Selecting Additional Modules for Simulation

Libero SoC passes all the source files related to the top-level module to simulation .

If you need additional modules in simulation, in the Design Flow window right-click **Simulate** and choose **Organize Input Files > Organize Source Files**. The Organize Files for Simulation dialog box appears.

Select the HDL modules you wish to add from the Simulation Files in the Project list and click **Add** to add them to the Associated Stimulus Files list

Performing Functional Simulation

To perform functional simulation:

1. Create your testbench.
2. Right-click **Simulate** (in Design Flow window, Implement Design > Verify Post-Synthesis Implementation > Simulate) and choose **Organize Input Files > Organize Source Files** from the right-click menu.

   In the Organize Files for Source dialog box, all the stimulus files in the current project appear in the Source Files in the Project list box. Files already associated with the block appear in the Associated Source Files list box.
   In most cases you will only have one testbench associated with your block. However, if you want simultaneous association of multiple testbench files for one simulation session, as in the case of PCI cores, add multiple files to the Associated Source Files list.
   To add a testbench: Select the testbench you want to associate with the block in the Source Files in the Project list box and click **Add** to add it to the Associated Source Files list.
   To remove a testbench: To remove or change the file(s) in the Associated Source Files list box, select the file(s) and click **Remove**.
3. When you are satisfied with the Associated Simulation Files list, click **OK**.
4. To start ModelSim AE, right-click **Simulate** in the Design Hierarchy window and choose **Open Interactively**.

   ModelSim starts and compiles the appropriate source files. When the compilation completes, the simulator runs for 1 μs and the Wave window opens to display the simulation results.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

5. Scroll in the Wave window to verify that the logic of your design functions as intended. Use the zoom buttons to zoom in and out as necessary.
6. From the **File** menu, select **Quit**.

Performing DirectCore Functional Simulation

Libero SoC overwrites all the existing files of the Core when you import a DirectCore project (including testbenches). Save copies of your project stimulus files with new names if you wish to keep them.

You must import a DirectCore BFM file into the Libero SoC in order to complete functional simulation (the BFM is a stimulus file that you can edit to extend the testbench). VEC files are generated automatically from the BFM when you run ModelSim.

The SoC Project Manager overwrites your BFM file if you re-import your project. Edit and save your BFM outside the Libero SoC project to prevent losing your changes. After you re-import your DirectCore project, you can import your modified BFM again.

To perform functional simulation of a DirectCore project:

1. Right-click a stitched module of the DirectCore project and select **Set as root**.
2. To start ModelSim AE, right-click **Simulate** in the Design Hierarchy window and choose **Open Interactively**.

   ModelSim starts and compiles the appropriate source files. When the compilation completes, the simulator runs for 1 µs and the Wave window opens to display the simulation results.
3. Scroll in the Wave window to verify that the logic of your design functions as intended. Use the zoom buttons to zoom in and out as necessary.
4. From the **File** menu, select **Quit**.

I/O Constraints - SmartFusion2, IGLOO2, and RTG4

SmartFusion2, IGLOO2, and RTG4 I/O constraints are PDC files. Note that for these devices I/O constraint PDC files are separate from Floorplan constraint PDC files; if you try to import a PDC file that contains both I/O and Floorplan constraints then Libero SoC errors out with an invalid constraint error.

Libero SoC generates an I/O PDC file automatically if you explicitly add/modify your I/O Constraints in the post-Compile I/O Editor. Your new I/O PDC file is added to the project and marked as Used.

I/O Constraints enables you to:

Import Files - If you do not have a compiled project, right-click I/O Constraints and choose Import Files to open the Import Files dialog box and import I/O constraint files (*.pdc files).

Create a New Constraint from Your Root Module - Right-click and choose **Create a New Constraint from your Root Module** to create a new constraint if you already have a compiled project.

Link Files - Right-click **I/O Constraints** and choose **Link Files** to link PDC constraint files from other projects. Linked files are not copied into your local project directory; instead the path is stored in your project, enabling you (or others) to update the file separately from Libero SoC. If your linked file is updated then the Project Manager indicates that the file has been changed and asks you if you wish to recompile, as appropriate.

Linked files appear in your **Files window** (**View > Windows > Files**), where they can be opened, deleted from the project, updated, or unlinked and copied to your local project.

Once you import an I/O Constraint file you can double-click the file in the **Design Flow** window (**Create Constraints > I/O Constraints > <filename>**) to open it in the Libero text editor, or right-click the file to:

Use for Compile - Includes the constraint file when you run Compile.

Open in Text Editor - Opens the file in the Text Editor so that you can update the code manually.

Save as - Opens the Save As dialog box, enables you to save the constraint with a different filename. This is useful if you want to preserve the settings of a particular constraint.

Delete from Project - Removes the file from the project.

Delete from Disk and Project - Removes the file from the project and deletes it from the disk.

Timing Constraints - SmartFusion2, IGLOO2, and RTG4

Timing Constraints enables you to:

Import Files - Double-click Timing Constraints to open the Import Files dialog box and import timing constraint files (*.sdc files).

Link Files - Right-click **Timing Constraints** and choose **Link Files** to link SDC constraint files from other projects. Linked files are not copied into your local project directory; instead the path is stored in your project, enabling you (or others) to update the file separately from Libero SoC. If your linked file is updated then the Project Manager indicates that the file has been changed and asks you if you wish to recompile, as appropriate.

Linked files appear in your Files window (**View > Windows > Files**), where they can be opened, deleted from the project, updated, or unlinked and copied to your local project.

Once you import or generate a Timing Constraint file, you can double-click the file in the **Design Flow** window (**Create Constraints > Timing Constraints > <filename>**) to open it in the Text Editor, right-click the file to:

Use for Synthesis - Uses the file for synthesis.

Use for Compile - Includes the file during Compile.

Open in Text Editor - Opens the file in the Project Manager Text Editor.

Save as - Opens the Save As dialog box, enables you to save the constraint in a different location and/or filename. This is useful if you want to preserve the settings of a particular constraint, or to save it outside your project.

Delete from Project - Removes the file from the project.

Delete from Disk and Project - Removes the file from the project and deletes it from the disk.

Floorplan Constraints - SmartFusion2, IGLOO2, and RTG4

SmartFusion2, IGLOO2, and RTG4 Floorplan constraints are PDC files. Note that for SmartFusion2, IGLOO2, and RTG4 devices Floorplan constraint PDC files are separate from I/O constraint PDC files; if you try to import a PDC file that contains both I/O and Floorplan constraints then Libero SoC errors out with an invalid constraint error.

Floorplan Constraints enables you to:

Import Files - Double-click Floorplan Constraints to open the Import Files dialog box and import Floorplan constraint files (*.pdc files).

Link Files - Right-click **FloorPlan Constraints** and choose **Link Files** to link PDC constraint files from other projects. Linked files are not copied into your local project directory; instead the path is stored in your project, enabling you (or others) to update the file separately from Libero SoC. If your linked file is updated then the Project Manager indicates that the file has been changed and asks you if you wish to recompile, as appropriate.

Linked files appear in your **Files window** (**View > Windows > Files**), where they can be opened, deleted from the project, updated, or unlinked and copied to your local project.

Once you import Floorplan Constraint file you can double-click the file in the **Design Flow** window (**Create Constraints > Floorplan Constraints > <filename>**) to open it in the Text Editor, or right-click the file to:

Use for Compile - Includes the constraint file when you run Compile.

Open in Text Editor - Opens the file in the Project Manager Text Editor.

Save as - Opens the Save As dialog box, enables you to save the constraint with a different filename. This is useful if you want to preserve the settings of a particular constraint.

Delete from Project - Removes the file from the project.

Delete from Disk and Project - Removes the file from the project and deletes it from the disk.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Constraints Overview

I/O Constraints (PDC Files)

The software enables you to specify the physical constraints to define the size, shape, utilization, and pin/pad placement of a design. You can specify these constraints based on the utilization, aspect ratio, and dimensions of the die. The pin/pad placement depends on the external physical environment of the design, such as the placement of the device on the board.

Timing Constraints (SDC Files)

Timing constraints represent the performance goals for your designs. Software uses timing constraints to guide the timing-driven optimization tools in order to meet these goals.

You can set timing constraints either globally or to a specific set of paths in your design.

You can apply timing constraints to:

- Specify the required minimum speed of a clock domain
- Set the input and output port timing information
- Define the maximum delay for a specific path
- Identify paths that are considered false and excluded from the analysis
- Identify paths that require more than one clock cycle to propagate the data
- Provide the external load at a specific port

To get the most effective results you need to set the timing constraints close to your design goals. Sometimes slightly tightening the timing constraint helps the optimization process to meet the original specifications.

Floorplanning Constraints (PDC files)

You can use a PDC file to control floorplanning. Import a Floorplanning PDC file to:

- Create Regions
- Assign logic to regions
- Assign nets to regions
- Floorplan a Designer Block

Note: For SmartFusion2, IGLOO2 and RTG4, do not mix I/O Constraints and Floorplanning Constraints in the same PDC file. If you do, Libero SoC errors out with an invalid constraint error.

Synthesize (Classic Constraint Flow)

Double-click **Synthesize** to run synthesis on your design with the default settings specified in the synthesis tool.

If you wish to run the synthesis tool interactively, right-click **Synthesize** and choose **Open Interactively**. If you open your tool interactively, you must complete synthesis from within the synthesis tool.

The default synthesis tool included with Libero SoC is Synplify Pro ME. If you wish to use a different synthesis tool you can change the settings in your Tool Profiles.

Libero SoC works with the following synthesis tools:

- Synplify Pro ME from Synopsys
- Precision RTL from Mentor Graphics

While Precision RTL is not part of the Libero SoC package, it can be integrated to work with Libero SoC. You can also integrate Precision RTL or different versions of Synplify by adding them to your project profile. Right-click **Synthesize** and choose **Edit Profile**.

You can organize input synthesis source files via the Organize Source Files dialog box.

Synthesize Options

Some families enable you to set or change synthesis configuration options for your synthesis tool. To do so, in the Design Flow window expand **Implement Design**, right-click **Synthesize** and choose **Configure Options**. This opens the Synthesize Options dialog box.

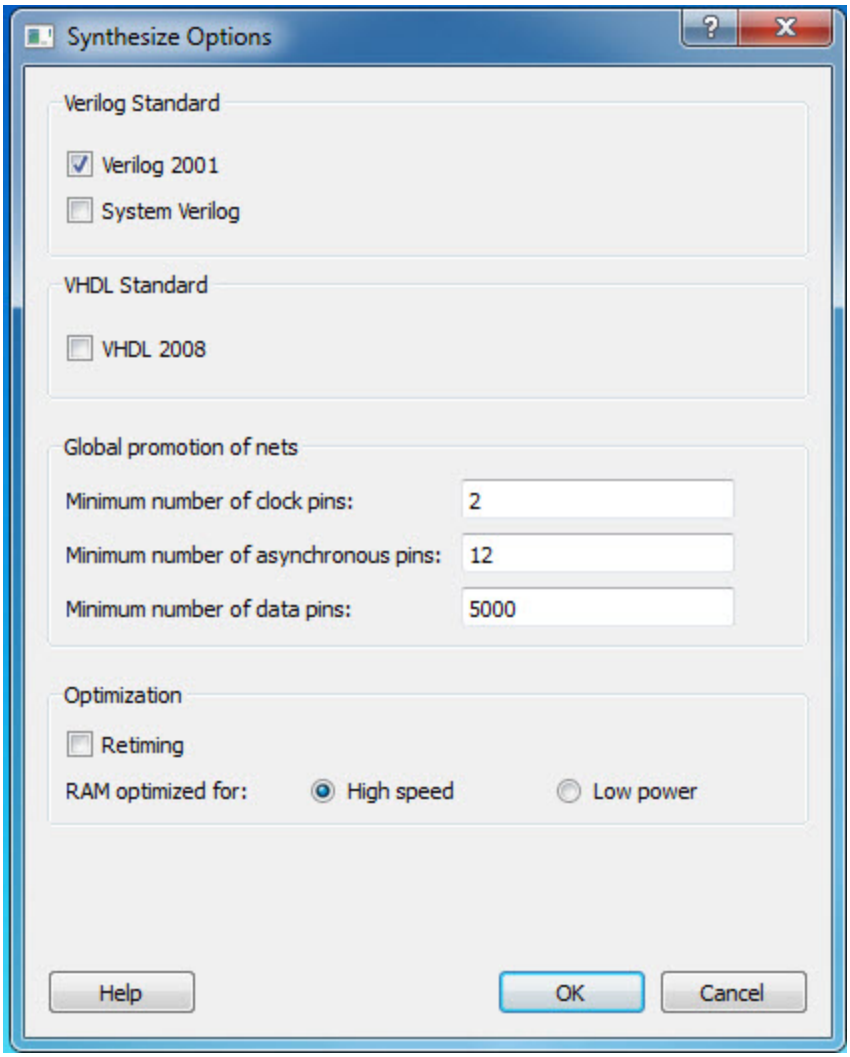

Figure 33 · Synthesize Options Dialog Box

Verilog Standard - Enables you to set your Verilog Standard.

Two selections are available:

- Verilog 2001
- System Verilog

Note: If no selection is made, the standard defaults to Verilog 95.

VHDL Standard - Enables you to set your VHDL Standard to VHDL 2008. The default is VHDL 1993.

Global Promotions

Use the following three options to specify to the Synthesis tool the threshold value beyond which the Synthesis tool promotes the pins to globals.

- Minimum Number of Clock Pins specifies the threshold value for Clock pin promotion. The Default value is 2.
- Minimum Number of Asynchronous Pins specifies the threshold value for Asynchronous pin promotion. The default is 12. This option is not available in RTG4.

- Minimum Number of data pins specifies the threshold value for data pin promotion. The default is 5000.

RAM Optimization

Use this option to guide the Synthesis tool to optimize RAMs to achieve your design goal.

- High Speed – RAM Optimization is geared towards Speed. The resulting synthesized design achieves better performance (higher speed) at the expense of more FPGA resources.
- Low Power – RAM Optimization is geared towards Low Power. RAMS are infered and configured to ensure the lowest power consumption.

Retiming

Check this box to enable Retiming during synthesis. Retiming is the process of automatically moving registers (register balancing) across combinational gates to improve timing, while ensuring identical logic behavior. The default is no retiming during synthesis.

Synplify Pro ME

Synplify Pro ME is the default synthesis tool for Libero SoC.

To run synthesis using Synplify Pro ME and default settings, right-click **Synthesize** and choose **Run**.

If you wish to use custom settings you must run synthesis interactively.

To run synthesis using Synplify Pro ME with custom settings:

1. If you have set Synplify as your default synthesis tool, right-click **Synthesize** in the Libero SoC Design Flow and choose **Open Interactively**. Synplify starts and loads the appropriate design files, with a few pre-set default values.
2. From Synplify's **Project** menu, choose **Implementation Options**.
3. Set your specifications and click **OK**.
4. Deactivate synthesis of the defparam statement. The defparam statement is only for simulation tools and is not intended for synthesis. Embed the defparam statement in between **translate_on** and **translate_off** synthesis directives as follows :
```
/* synthesis translate_off */
defparam M0.MEMORYFILE = "meminit.dat"

/*synthesis translate_on */
// rest of the code for synthesis
```
5. Click the **RUN** button. Synplify compiles and synthesizes the design into an EDIF, *.edn, file. Your EDIF netlist is then automatically translated by the software into an HDL netlist. The resulting *edn and *.vhd files are visible in the Files list, under Synthesis Files.

   Should any errors appear after you click the Run button, you can edit the file using the Synplify editor. Double-click the file name in the Synplify window showing the loaded design files. Any changes you make are saved to your original design file in your project.
6. From the **File** menu, choose **Exit** to close Synplify. A dialog box asks you if you would like to save any settings that you have made while in Synplify. Click **Yes**.

Note: See the Microsemi Attribute and Directive Summary in the Synplify online help for a list of attributes related to Microsemi devices.

Note: To add a clock constraint in Synplify you must add "n:<net_name>" in your SDC file. If you put the net_name only, it does not work.

Precision RTL

Libero SoC Classic Constraint Flow supports Precision RTL from Mentor Graphics. Libero SoC Enhanced Constraint Flow does not support Precision RTL.

To run synthesis with Precision RTL default settings, set Precision RTL as the synthesis tool for your project (as outlined below), right-click **Synthesize** and choose **Run**.

To run synthesis with custom settings, right-click **Synthesize** and choose **Open Interactively**. Precision RTL opens and enables you to change settings before you run synthesis.

If your design is not ready for synthesis then Open does not appear in your right-click menu.

To set Precision RTL as the synthesis tool for your project:

1. From the **Project** menu, choose **Tool Profiles**. The Tool Profiles dialog box appears.
2. Click **Synthesis** to choose the synthesis tool profile.
3. Click the **Add** button. The Add Profile dialog box appears.
4. Enter a name. This is the name that appears in the Tool Profile dialog box.
5. In the **Tool integration** dropdown menu choose **Precision RTL**.
6. Enter the location of Precision RTL and any additional parameters.
7. Click **OK**.
8. Select **Precision RTL** in the Tool Profile dialog box and click **OK**.
9. Double-click **Synthesize** in the Design Flow window to start Precision RTL and run synthesis.

Identify Debug Design

Libero SoC integrates the Identify RTL debugger tool. It enables you to probe and debug your FPGA design directly in the source RTL. Use Identify software when the design behavior after programming is not in accordance with the simulation results.

To open the Identify RTL debugger, in the Design Flow window under Debug Design double-click **Instrument Design**.

Identify features:

- Instrument and debug your FPGA directly from RTL source code .
- Internal design visibility at full speed.
- Incremental iteration - Design changes are made to the device from the Identify environment using incremental compile. You iterate in a fraction of the time it takes route the entire device.
- Debug and display results - You gather only the data you need using unique and complex triggering mechanisms.

You must have both the Identify RTL Debugger and the Identify Instrumentor to run the debugging flow outlined below.

To use the Identify Instrumentor and Debugger:

1. Create your source file (as usual) and run pre-synthesis simulation.
2. (Optional) Run through an entire flow (Synthesis - Compile - Place and Route - Generate a Programming File) without starting Identify.
3. Right-click **Synthesize** and choose **Open Interactively** in Libero SoC to launch Synplify.
4. In Synplify, click **Options > Configure Identify Launch** to setup Identify.
5. In Synplify, create an Identify implementation; to do so, click **Project > New Identify Implementation**.
6. In the Implementations Options dialog, make sure the Implementation Results > Results Directory points to a location under <libero project>\synthesis\, otherwise Libero SoC is unable to detect your resulting EDN file
7. From the Instumentor UI specify the sample clock, the breakpoints, and other signals to probe. Synplify creates a new synthesis implementation. Synthesize the design.
8. In Libero SoC, select the edif netlist of the Identify implementation you want to use in the flow. Right-click **Compile** and choose **Organize Input Files > Organize Source Files** and select the edif netlist of your Identify implementation.
9. Run Compile, Place and Route and Generate a Programming File with the edif netlist you created with the Identify implementation.
10. Double-click **Identify Debug Design** in the Design Flow window to launch the Identify Debugger.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

The Identify RTL Debugger, Synplify, and FlashPro must be synchronized in order to work properly. See the Release Notes for more information on which versions of the tools work together.

Verify Post-Synthesis Implementation - Simulate

The steps for performing functional (post-synthesis) and timing (post-layout) simulation are nearly identical. Functional simulation is performed before place-and-route and simulates only the functionality of the logic in the design. Timing simulation is performed after the design has gone through place-and-route and uses timing information based on the delays in the placed and routed designs.

To perform functional simulation:

1. If you have not done so, back-annotate your design and create your testbench.
2. Right-click **Simulate** (in Design Flow window, Implement Design > Verify Post-Synthesis Implementation > Simulate) and choose **Organize Input Files > Organize Source Files** from the right-click menu.

   In the Organize Files for Source dialog box, all the stimulus files in the current project appear in the Source Files in the Project list box. Files already associated with the block appear in the Associated Source Files list box.
   In most cases you will only have one testbench associated with your block. However, if you want simultaneous association of multiple testbench files for one simulation session, as in the case of PCI cores, add multiple files to the Associated Source Files list.
   To add a testbench: Select the testbench you want to associate with the block in the Source Files in the Project list box and click **Add** to add it to the Associated Source Files list.
   To remove a testbench: To remove or change the file(s) in the Associated Source Files list box, select the file(s) and click **Remove**.
   To order testbenches: Use the up and down arrows to define the order you want the testbenches compiled. The top level-entity should be at the bottom of the list.
3. When you are satisfied with the Associated Simulation Files list, click **OK**.
4. To start ModelSim AE, right-click **Simulate** in the Design Hierarchy window and choose **Open Interactively**. ModelSim starts and compiles the appropriate source files. When the compilation completes, the simulator runs for 1 µs and the Wave window opens to display the simulation results.
5. Scroll in the Wave window to verify the logic works as intended. Use the cursor and zoom buttons to zoom in and out and measure timing delays.
6. When you are done, from the **File** menu, choose **Quit**.

Compile - SmartFusion, IGLOO, ProASIC3, Fusion

See the SmartFusion2/IGLOO2 Compile options if you are using those devices.

Compile contains a variety of functions that perform legality checking and basic netlist optimization. Compile checks for netlist errors (bad connections and fan-out problems), removes unused logic (gobbling), and combines functions to reduce logic count and improve performance. Compile also verifies that your selected device has sufficient resources to fit your design.

To compile your device with default settings, right-click **Compile** in the Design Flow window and choose **Run**.

During compile, the Log window displays information about your design, including warnings and errors. Libero SoC issues warnings when your design violates recommended Microsemi design rules. Microsemi recommends that you address all warnings, if possible, by modifying your design before you continue.

If the design fails to Compile due to errors, you must modify the design to remove the errors and re-Compile.

To compile your design with custom settings, right-click **Compile** in the Design Flow window and choose **Configure Options**.

Configure Options in Compile

The configuration dialog provides options that enable you to control merge behavior during Compile .

Merge SDC file(s) with Existing Timing Constraints

Select **Merge SDC file(s) with existing timing constraints** to preserve all existing timing constraints that you have entered using either the constraints editor or in a previously imported SDC file.

If you import new SDC files and you have this checkbox selected, the software merges the existing constraints and the constraints from the new SDC files. In case of a conflict, the new constraints have priority over the existing constraints.

This option is **On** by default. When this option is **Off**, all the existing timing constraints are replaced by the constraints in the newly imported SDC files.

Merge PDC file(s) with Existing Physical Constraints

Select **Merge PDC file(s) with existing physical constraints** to preserve all existing physical constraints that you have entered using either one of the MVN tools or in a previously imported PDC file.

If you import new PDC files and you have this checkbox selected, the software merges the existing constraints and the constraints from the new PDC files. In case of a conflict, the new constraints have priority over the existing constraints.

This option is **On** by default. When this option is **Off**, all the existing physical constraints are replaced by the constraints in the newly imported PDC files.

Compile - SmartFusion2, IGLOO2, and RTG4

See the Compile options for SmartFusion, IGLOO, ProASIC3, Fusion if you are designing for those families.

Compile contains a variety of functions that perform legality checking and basic netlist optimization. Compile checks for netlist errors (bad connections and fan-out problems), removes unused logic (gobbling), and combines functions to reduce logic count and improve performance. Compile also verifies that your selected device has sufficient resources to fit your design.

To compile your device with default settings, right-click **Compile** in the Design Flow window and choose **Run**.

During compile, the Log window displays information about your design, including warnings and errors. Libero SoC issues warnings when your design violates recommended Microsemi design rules. Microsemi recommends that you address all warnings, if possible, by modifying your design before you continue.

If the design fails to compile due to errors, you must modify the design to remove the errors and re-Compile.

To compile your design with custom settings, right-click **Compile** in the Design Flow window and choose **Configure Options**.

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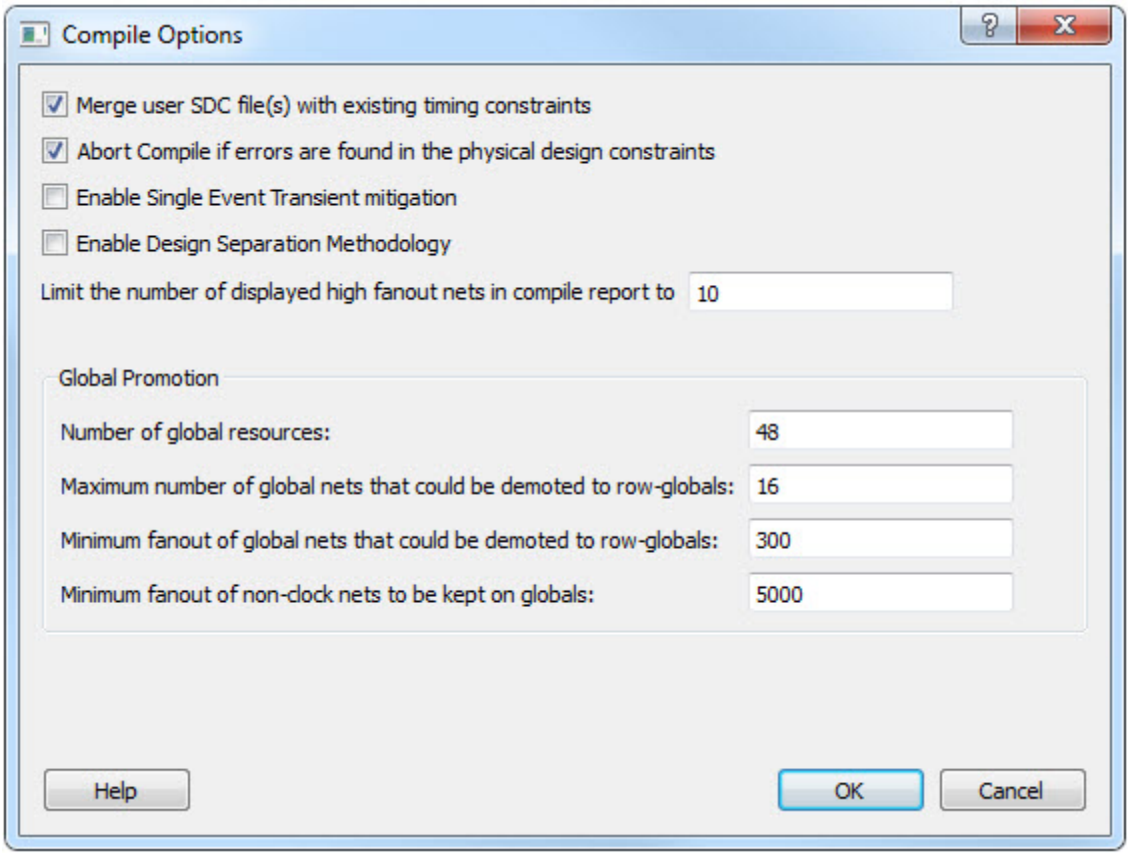

Figure 34 · Compile Options Dialog Box

Configure Options

The Compile Options dialog box enables you to control SDC file merge behavior, PDC error reporting, and limit the number of high fanout nets in the Compile Report.

Merge User SDC file(s) with Existing Timing Constraints

Select **Merge User SDC file(s) with existing timing constraints** to preserve all existing timing constraints that you have entered using either the constraints editor or in a previously imported SDC file.

If you import new SDC files and you have this checkbox selected, the software merges the existing constraints and the constraints from the new SDC files. In case of a conflict, the new constraints have priority over the existing constraints.

This option is **On** by default. When this option is **Off**, all the existing timing constraints are replaced by the constraints in the newly imported SDC files.

Abort Compile if errors are found in the physical design constraints

Controls the compile flow behavior if errors are encountered in the physical design constraints (PDC) file. Select this option to stop the flow if any error is reported in reading your PDC file. If you deselect this option, the tool skips errors when reading your PDC file and reports them as warnings. The default is ON.

This option is useful if you do not wish to debug your PDC commands before you run Compile.

Note: Compile fails even if this option is deselected if there is a PDC command syntax error (for example, the command does not exist or the syntax of the command is incorrect)

Note: Every time you invoke this dialog box, this option is reset to its default value ON. This is to ensure that your PDC file is correct.

Enable Single Event Transient mitigation (RTG4 only) - Controls the mitigation of Single Event Transient (SET) in the FPGA fabric. When this box is checked, SET filters are turned on globally to help mitigate radiation-induced transients. By default, this box is unchecked.

Enable Design Separation Methodology Checkbox – Check this box if your design is for security and safety critical applications and you want to make your design's individual subsystems (design blocks) separate and independent (in terms of physical layout and programming) to meet your design separation requirements. When checked, Libero generates a parameter file (MSVT.param) that details design blocks present in the design and the number of signals entering and leaving a design block. Microsemi provides a separate tool, known as Microsemi Separation Verification Tool (MSVT), which checks the final design place and route result against the MSVT.param file and determines whether the design separation meets your requirements.

Limit the number of displayed high fanout nets in compile report to - The number of high fanout nets to be displayed is controlled using the **Limit the number of displayed high fanout nets**; the default value is 10. This means the top 10 nets with the highest fanout will appear in the Compile Report.

Global Promotion/Demotion Options

Number of global resources - The number of available global resources for the die is reported in this field. It varies with the die size you have selected for the Libero project.

The following options allow you to set the maximum/minimum values for promotion and demotion of global routing resources.

Maximum Number of global nets that could be demoted to row-globals – Specifies the maximum number of global nets that could be demoted to row-globals. The default is 16.

Minimum fanout of global nets that could be demoted to row-globals – Specifies the minimum fanout of global nets that could be demoted to row-global. The default is 300. If you run out of global routing resources for your design, reduce this number (to allow more globals to be demoted) or select a bigger die for your design.

Minimum fanout of non-clock nets to be kept on globals – Specifies the minimum fanout of non-clock (data) nets to be kept on globals (no demotion). The default is 5000. If you run out of global routing resource for your design, increase this number or select a bigger die for your design.

Block Instantiation Compile Options

If there are multiple blocks instantiated in your design, the software uses the Compile Options to resolve the conflicts. These options appear only if you are using Blocks in your design.

Placement

Error if conflict - Compile errors out if any instance from a designer block is unplaced. This is the default option.

Resolve conflict

- **Keep non-conflicting placement** - If some instances get unplaced for any reason, the non-conflicting elements remaining are preserved but not locked (you can move them).
- **Keep and lock non-conflicting placement** - If some instances get unplaced for any reason, the remaining non-conflicting elements are preserved and locked.
- **Discard placement from all blocks** – Placement information will be discarded from all blocks even if there is no conflict.

Routing

Error if conflict - Compile errors out if any preserved net routing in a designer block is deleted.

Resolve conflict

- **Keep non-conflicting routing**- If a nets' routing is removed for any reason, the routing for the non-conflicting nets is preserved but not locked (so that they can be rerouted). This is the default option.
- **Keep and lock non-conflicting routing**- If the routing is removed for any reason, the remaining non-conflicting nets are preserved and locked; they cannot be rerouted. This is the default option.

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- **Discard routing from all blocks** – Routing information will be discarded from all blocks even if there is no conflict.

Compile Options (SmartFusion, IGLOO, ProASIC3, and Fusion)

To set custom compile options:

1. Right-click **Compile** and choose **Open Interactively**. Designer opens.
2. Click the **Compile** button. The Compile Options dialog box opens. The Options available are family specific.
3. Select your options, and click **OK**.

The Compile Options dialog box enables you to do the following:

- Set your Block Instantiation options (used for conflict resolution when you instantiate multiple blocks)
- Verify Physical Design Constraints
- Perform Globals Management
- Netlist Optimization
- Generate a Compile report in Display of Results
- Set Block Creation options (available only if you are creating a block)

Block Instantiation

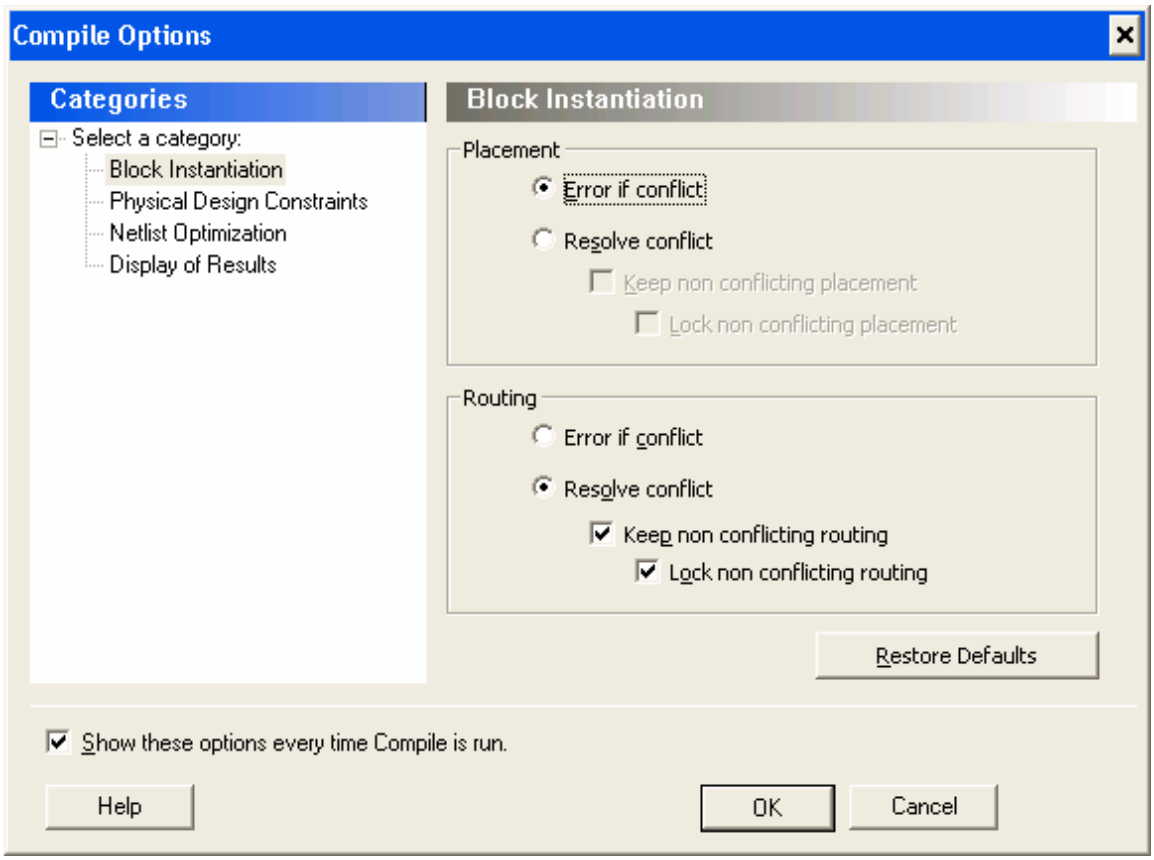

Figure 35 · Compile Options - Block Instantiation

Designer uses the Block Instantiation options to resolve conflicts between multiple blocks in your design. The default options is to return an error if there is overlapping placement between the blocks and resolve any conflict for nets.

This ensures you are aware that the blocks overlap; you can go back and set the placement to resolve the conflicts and it will Compile.

See Conflict resolution in Designer Blocks for more information.

Physical Design Constraints

This interface enables you to verify the Physical Design Constraints (PDC) file.

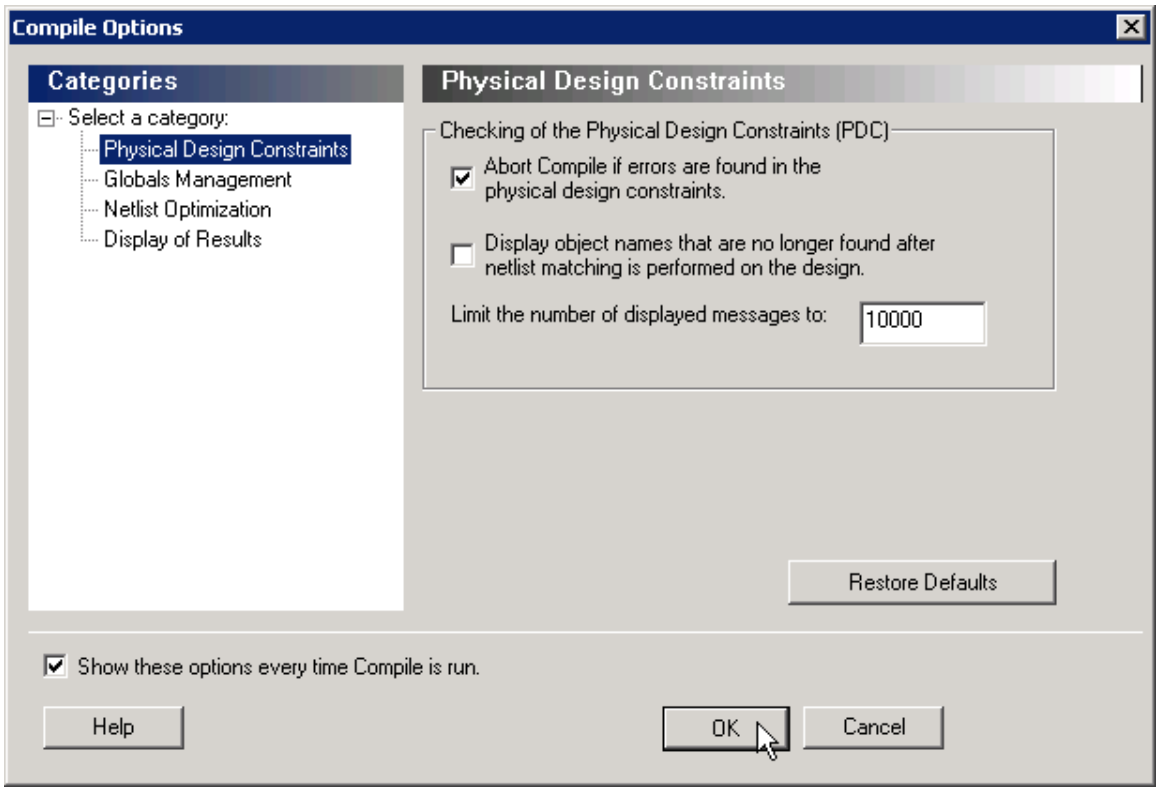

Figure 36 · Compile Options – Physical Design Constraints

Checking the Physical Design Constraint (PDC)

Abort Compile if errors are found in the physical design constraints: Changes the Abort on PDC error behavior. Select this option to stop the flow if any error is reported in reading your PDC file. If you deselect this option, the tool skips errors in reading your PDC file and just reports them as warnings. The default is ON.

Note: The flow always stops even if this option is deselected in the following two cases:

- If there is a Tcl error (for example, the command does not exist or the syntax of the command is incorrect)
- The assign_local_clock command for assigning nets to LocalClocks fails. This may happen if any floor planning DRC check fails, such as, region resource check, fix macro check (one of the load on the net is outside the local clock region). If such an error occurs, then the Compile command fails. Correct your PDC file to proceed.

Note: Every time you invoke this dialog box, this option is reset to its default value ON. This is to ensure that your PDC file is correct.

Display object names that are no longer found after netlist matching is performed on the design: Displays netlist objects in the PDC that are not found in the imported netlist during the Compile ECO mode. Select this option to report netlist objects not found in the current netlist when reading the internal ECO PDC constraints. The default is OFF.

Limit the number of displayed messages to: Defines the maximum number of errors/warnings to be displayed in the case of reading ECO constraints. The default is 10000 messages.

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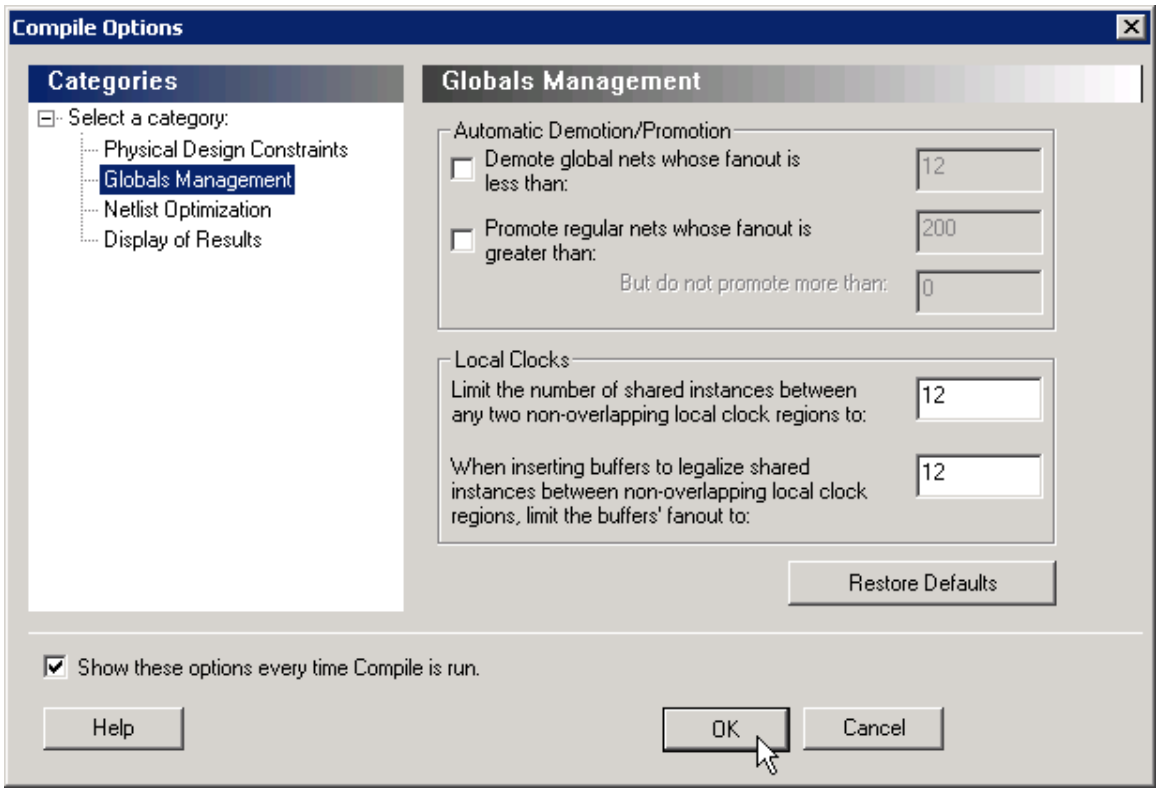
Globals Management

The interface provides a global control to the Compile component of the design flow.



Automatic Demotion/Promotion

Demote global nets whose fanout is less than: Enables the global clock demotion of global nets to regular nets.
By default, this option is OFF. The maximum fanout of a demoted net is 12.

Note: A global net is not automatically demoted (assuming the option is selected) if the resulting fanout of the demoted net is greater than the max fanout value. Microsemi recommends that the automatic global demotion only act on small fanout nets. Microsemi recommends that you drive high fanout nets with a clock network in the design to improve timing and routability.

Promote regular nets whose fanout is greater than: Enables global clock promotion of nets to global clock network. By default, this option is OFF. The minimum fanout of a promoted net is 200.

But do not promote more than: Defines the maximum number of nets to be automatically promoted to global. The default value is 0. This is not the total number as nets need to satisfy the minimum fanout constraint to be promoted. The promote_globals_max_limit value does not include globals that may have come from either the netlist or PDC file (quadrant clock assignment or global promotion).

Note: Demotion of globals through PDC or Compile is done before automatic global promotion is done.

Note: You may exceed the number of globals present in the device if you have nets already assigned to globals or quadrants from the netlist or by using a PDC file. The automatic global promotion adds globals on what already exists in the design.

Local clocks

Limit the number of shared instances between any two non-overlapping local clock regions to: Defines the maximum number of shared instances allowed to perform the legalization. It is also for quadrant clocks.

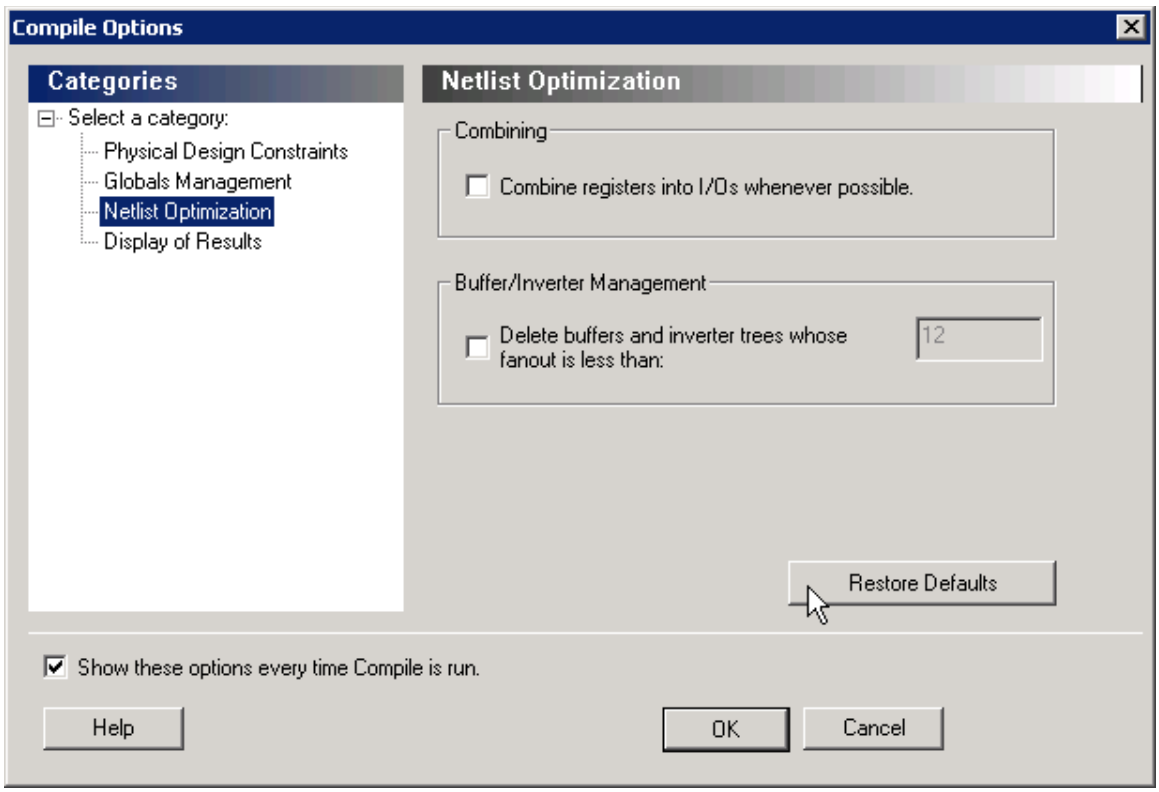
The maximum number of instances allowed to be shared by 2 local clock nets assigned to disjoint regions to perform the legalization (default is 12, range is 0-1000). If the number of shared instances is set to 0, no legalization is performed.

When inserting buffers to legalize shared instances between non-overlapping local clock regions, limit the buffers' fanout to: Defines the maximum fanout value used during buffer insertion for clock legalization. Set the value to 0 to disable this option and prevent legalization (default value is 12, range is 0-1000). If the value is set to 0, no buffer insertion is performed. If the value is set to 1, there will be one buffer inserted per pin.

Note: If you assign quadrant clock to nets using MultiView Navigator, no legalization is performed.

Netlist Optimization

This interface allows you to perform netlist optimization.



Combining

Combine registers into I/O wherever possible: Combines registers at the I/O into I/O-Registers. Select this option for optimization to take effect. By default, this option is OFF.

Buffer/Inverter Management

Delete buffers and inverter trees whose fanout is less than: Enables buffer tree deletion on the global signals from the netlist. The buffer and inverter are deleted. By default, this option is OFF. The maximum fanout of a net after buffer tree deletion is 12.

Note: A net does not automatically remove its buffer tree (assuming the option is on) if the resulting fanout of the net (if the buffer tree was removed) is greater than the max fanout value. Microsemi recomends that the automatic buffer tree deletion should only act on small fanout nets. From a routability and timing point of view, it is not recommended to have high fanout nets not driven by a clock network in the design.

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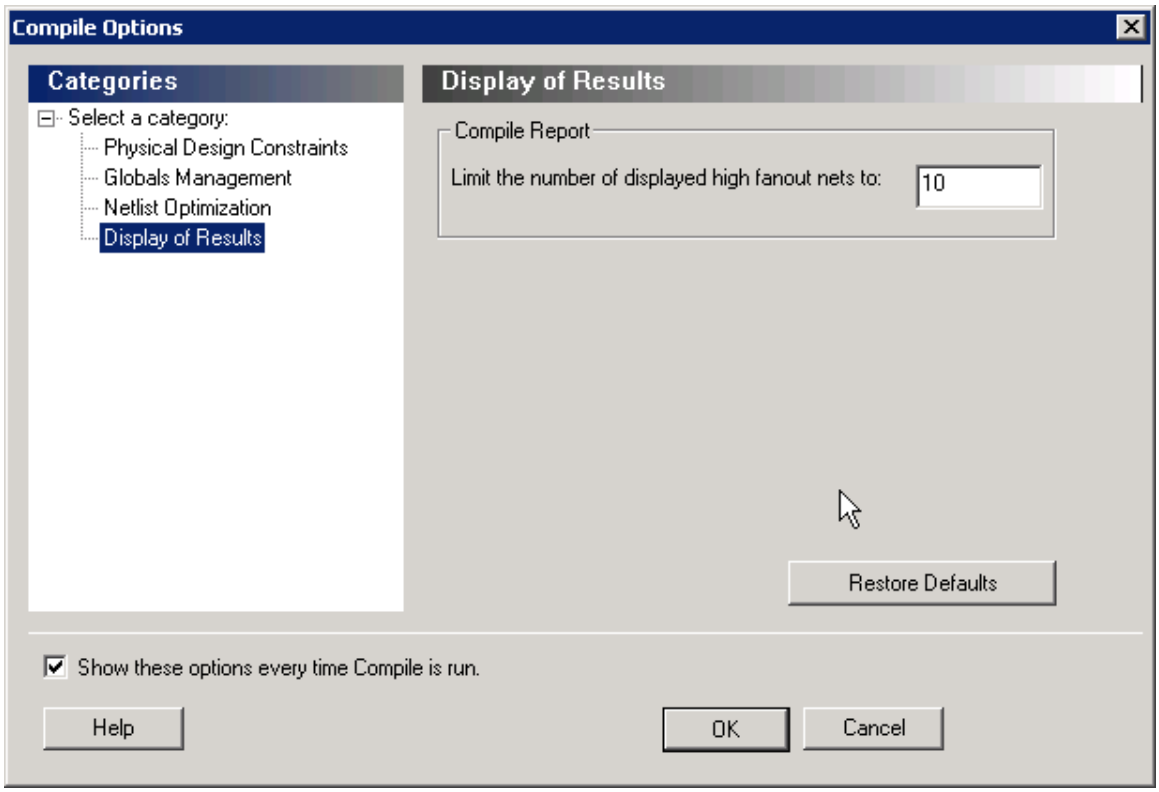
Display of Results

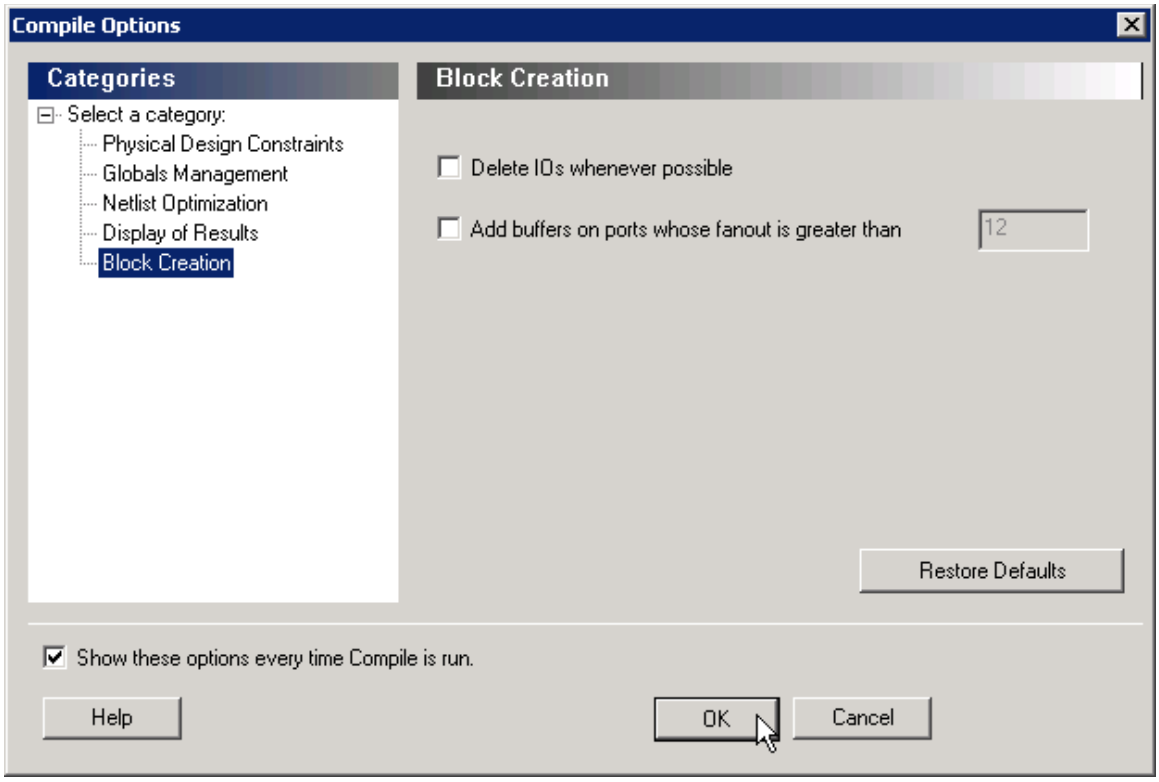
This interface lets you generate a Compile report.



Compile Report

Limit the number of displayed high fanout nets to: Enables flip-flop net sections in the compile report and defines the number of nets to be displayed in the high fanout. The default value is 10.

Block Creation (Available only when creating Designer Blocks)



Delete I/Os whenever possible - Deletes I/Os in the block during compile (except TRIBUFF and BIBUFF, because they cannot be removed). Useful if you have I/Os in your design but want to create a block anyway.

Add buffers on ports whose fanout is greater than <value> - Adds buffers on ports with a fanout greater than a value you specify. This option enables more predictable block timing. For example, if you have a net with a fanout of 100 the net will be unrouted. If you add a buffer, the output of the buffer is routed and the routing is preserved.

See Also

`compile`

Configure Flash*Freeze

Opens the Flash*Freeze Hardware Settings dialog box. For more information on the Flash*Freeze mode for SmartFusion2 see the SmartFusion2 Low Power User's Guide.

The fabric SRAMs can be put into a Suspend Mode or a Sleep Mode. This applies to both the Large SRAM (LSRAM) instances of RAM1xK18 and the Micro SRAM (uSRAM) instances of RAM64x18. These SRAMs are grouped in rows in Libero® System-on-Chip (SoC) devices

uRAM/LSRAM State

Sleep - Sets to Sleep; LSRAM and uSRAM contents are not retained.

Suspend - Sets to Suspend; LSRAM and uSRAM contents are retained.

MSS Clock Source

The lower the frequency the lower the power will be. But for some peripherals that can remain active (such as SPI or MMUART), you may need a higher MSS clock frequency (such as to meet the baud rate for MMUART).

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Options are:

- On-Chip 1 MHz RC Oscillator
- On-Chip 50 MHz RC Oscillator

Place and Route - SmartFusion2, IGLOO2, and RTG4

This topic describes Place and Route options for SmartFusion2, IGLOO2, and RTG4 devices. See the topic for SmartFusion, IGLOO (except IGLOO2), ProASIC3 and Fusion for information about Place and Route options for those devices.

To change your Place and Route settings:

Expand **Implement Design**, right-click **Place and Route** and choose **Configure Options**.

Timing-Driven

Timing-Driven Place and Route is selected by default. The primary goal of timing-driven Place and Route is to meet timing constraints, specified by you or generated automatically. Timing-driven Place and Route typically delivers better performance than Standard Place and Route.

If you do not select Timing-driven Place and Route, timing constraints are not considered by the software, although a delay report based on delay constraints entered in SmartTime can still be generated for the design.

If you have set multiple timing constraint Scenarios in SmartTime, the Scenario selected for TDPR is used in Timing-Driven layout.

Power-Driven

Select this option to run Power-Driven layout. The primary goal of power-driven layout is to reduce dynamic power while still maintaining timing constraints.

High Effort Layout

Enable this option to optimize performance; layout runtime will increase if you select this option.

Repair Minimum Delay Violations

This option is enabled by default for SmartFusion2, IGLOO2, and RTG4 devices.

Enable this option to instruct the Router engine to repair Minimum Delay violations for Timing-Driven Place and Route mode (Timing-Driven Place and Route option enabled). The Repair Minimum Delay Violations option, when enabled, performs an additional route that attempts to repair paths that have minimum delay and hold time violations. This is done by increasing the length of routing paths and inserting routing buffers to add delay to the top 100 violating paths.

When this option is enabled, Libero adjusts the programmable delays through I/Os to meet hold time requirements from input to registers. For register-to-register paths, Libero adds buffers.

Libero iteratively analyzes paths with negative minimum delay slacks (hold time violations) and chooses suitable connections and locations to insert buffers. Not all paths can be repaired using this technique, but many common cases will benefit.

Even when this option is enabled, Libero will not repair a connection or path which:

- Is a hardwired, preserved, or global net
- Has a sink pin which is a clock pin
- Is violating a maximum delay constraint (that is, the maximum delay slack for the pin is negative)
- May cause the maximum delay requirement for the sink pin to be violated (setup violations)
- Has the sink and driver pins located in the same cluster

Typically, this option is enabled in conjunction with the Incremental Layout option when a design's maximum delay requirements have been satisfied.

Every effort is made to avoid creating max-delay timing violations on worst case paths.

Min Delay Repair produces a report in the implementation directory which lists all of the paths that were considered.

If your design continues to have internal hold time violations, you may wish to rerun repair Minimum Delay Violations (in conjunction with Incremental Layout). This will analyze additional paths if you originally had more than 100 violating paths.

Incremental Layout

Choose Incremental Layout to use previous placement data as the initial placement for the next run. If a high number of nets fail, relax constraints, remove tight placement constraints, deactivate timing-driven mode, or select a bigger device and rerun Place and Route.

You can preserve portions of your design by employing Compile Points, which are RTL partitions of the design that you define before synthesis. The synthesis tool treats each Compile Point as a block which enables you to preserve its structure and timing characteristics. By executing Layout in Incremental Mode, locations of previously-placed cells and the routing of previously-routed nets is preserved. Compile Points make it easy for you to mark portions of a design as black boxes, and let you divide the design effort between designers or teams. See the Synopsys FPGA Synthesis Pro ME User Guide for more information.

Alternatively, you can employ block-based design methodologies. Small designs can be placed, routed, tuned and then turned into blocks after timing constraints have been met. These blocks can then be imported into larger designs while ensuring that timing characteristics of the individual blocks are preserved. See SmartFusion2, IGLOO2, and RTG4 Block Flow for more information.

Use Multiple Pass

Check Multiple Pass to run multiple pass of Place and Route to get the best Layout result. Click **Configure** to specify the criteria you want to use to determine the best layout result. For details, see Multiple Pass Layout Configuration (SmartFusion2, IGLOO2, and RTG4).

See Also

SmartTime Constraint Scenario - SmartFusion2, IGLOO2, and RTG4

SmartFusion2, IGLOO2, and RTG4 Block Flow

Mutiple Pass Layout Configuration (SmartFusion2, IGLOO2, and RTG4)

extended_run_lib - Libero SoC Only

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Place and Route

The following topic applies to SmartFusion, IGLOO (except IGLOO2), ProASIC3 and Fusion families. See the SmartFusion2 and IGLOO2 Place and Route topic for information specific to those families.

Place and Route runs automatically using Timing-Driven Place and Route as the default during the push-button design flow in Libero SoC.

Custom Layout options are saved when you save your ADB after place and route. You must invoke Layout in interactive mode from Libero SoC and run Layout from Designer to view your custom Layout options. When your options are saved you can run Layout from Libero, but you must set your additional Layout Options in Designer. See below for more information on setting additional Layout Options when you open Interactively.

The I/O Bank Assigner and Global Planner run automatically after you click **OK** in the **Layout Options** dialog box. The I/O Bank Assigner automatically assigns technologies to all I/O banks that have not been assigned a technology. The Global Planner automatically assigns global nets to clock conditioning circuit (CCC) locations on the chip in the design.

Note: All I/O technologies assigned to I/O banks by the I/O Bank Assigner in Layout are unlocked.

To change your Place and Route settings:

Expand **Implement Design**, right-click **Place and Route** and choose **Configure Options**.

Place and Route Options

Timing-Driven

Timing-Driven place and route is selected by default. The primary goal of timing-driven layout is to meet timing constraints, specified by you or generated automatically. Timing-driven layout typically delivers better performance than Standard layout.

If you do not select Timing-driven layout, Designer runs Standard layout. Standard layout targets efficient usage of the chip resources. Chip performance is not optimized. Timing constraints are not considered by the layout in standard mode, although a delay report based on delay constraints entered in SmartTime can still be generated for the design. This is helpful to determine if Timing-Driven layout is required.

If you have set multiple timing constraint Scenarios in SmartTime, you can select a scenario from the pull-down list to perform timing-driven layout. Timing constraints from the Scenario you select will be used in Timing-Driven layout.

Place and Route Incrementally

Select this option to use previous placement data as the initial placement for next placement run. Additionally, this will preserve previous placement data during the next incremental placement run.

Router will also be run incrementally. Select to fully route a design when some nets failed to route during a previous run. Incremental routing should only be used if a low number of nets fail to route (less than 50 open nets or shorted segments). A high number of failures usually indicates a less than optimal placement (if using manual placement through macros, for example) or a design that is highly connected and does not fit in the device. If a high number of nets fail, relax constraints, remove tight placement constraints, deactivate timing-driven mode, or select a bigger device and rerun Layout. Also, see the Advanced Layout options for your device.

You can also use it when the post-synthesis netlist has undergone a minor or incremental change.

Additional Layout Options Available if you Open Interactively

You must invoke Layout in interactive mode from Libero SoC and run Layout from Designer to view your custom Layout options. To open Additional Layout Options interactively, in the **Design Flow** window right-click **Layou**t and choose **Open Interactively**.

Lock Existing Placement (Fix)

Locks your existing placement. Use this option if you do not want any changes in your layout.

Power-Driven

Select this option to run Power-Driven Layout. The primary goal of power-driven layout is to reduce dynamic power while still maintaining timing constraints. This option is available when you select Timing Driven Layout.

To get the most out of Power-Driven Layout:

1. Enter maximum delay, minimum delay, setup, and hold constraints in SmartTime's constraint editor or in SDC.
2. Set false paths on any paths that have a constraint, but do not need one (this will help layout meet the constraints that are needed).
3. Perform Layout with **Timing-Driven**, **Run Place**, and **Run Route** options checked.
4. Resolve worst case setup and maximum delay violations.
5. Generate an SDF back-annotation file.
6. Perform a post layout back-annotated simulation using this SDF file, and export a VCD (Value Change Dump) file that will capture real activities for each net.
7. Open smartPower and import the VCD file using **Simulation > Import VCD File**.
8. Perform Layout with **Timing-Driven** and **Power-Driven** checked. Run Place and Route.
9. Verify that your timing constraints are still met with SmartTime.
10. Analyze your power with SmartPower.

In case you do not have simulation vectors for your design, the following alternative flow is recommended:

1. Enter maximum delay, minimum delay, setup, and hold constraints in SmartTime's constraint editor or in SDC.
2. Set false paths on any paths that have a constraint, but do not need one (this will help layout to meet the constraints that are needed).
3. Perform Layout with **Timing-Driven**, **Run Place**, and **Run Route** options checked.
4. Resolve worst case setup and maximum delay violations.
5. Verify that your timing constraints are still met with SmartTime.
6. Open SmartPower and set clock frequencies and toggle rates for the different clocks. Clock frequencies can be imported from your timing constraints. Refer to Initialize Frequencies for more information.
7. Perform Layout with **Timing-Driven**, and **Power-Driven** options checked. Run Place and Route.
8. Verify that your timing constraints are still met with SmartTime.
9. Analyze your power with SmartPower

Run Place

Select this option to run the placer during Layout. By default, it reflects the current Layout state. If you have not run Layout before, Run Place is selected by default. If your design has already been placed but not routed, this box is cleared by default. You can also select the following incremental placement options.

- **Incrementally**: Select to use previous placement data as the initial placement for the next place run.
- **Lock Existing Placement (fix):** Select to preserve previous placement data during the next incremental placement run.

Incremental options apply to the entire design. For more detailed control of the placer behavior (such as, to fix placement of a portion of the design), use the MultiView Navigator tools or set fixed attributes on the placed instances via PDC constraint files.

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Run Route

Select to run the router during Layout. By default, it reflects the current Layout state. If you have not run Layout before, Run Route is checked. Run Route is also checked if your previous Layout run completed with routing failures. If your design has been routed successfully, this check box is cleared.

- **Incrementally**: Select to fully route a design when some nets failed to route during a previous run. You can also use it when the incoming netlist has undergone an ECO. (Engineering Change Order). Incremental routing should only be used if a low number of nets fail to route (less than 50 open nets or shorted segments). A high number of failures usually indicates a less than optimal placement (if using manual placement through macros, for example) or a design that is highly connected and does not fit in the device. If a high number of nets fail, relax constraints, remove tight placement constraints, deactivate timing-driven mode, or select a bigger device and rerun Layout. Also, see the Advanced Layout options for your device.

There is no "Fix" option for the router. In incremental mode the router tries to preserve the existing routing; there is no guarantee that it will be preserved. Therefore the timing characteristics of the previously routed portion of the design may change, even if the placement was fixed for that portion of the design. The chance of this is quite small, and the router will print the list of nets that have fixed terminals (i.e. those nets whose every pin's macro has the placement FIX attribute).

Use Multiple Passes

Select to run layout multiple times with different seeds. Multiple Pass Layout attempts to improve layout quality by selecting from a greater number of layout results. Click **Configure** to set your Multiple Pass Configuration.

Click the Advanced button to set Timing-Driven options.

SmartFusion, IGLOO, ProASIC3 and Fusion Place and Route Advanced Options

To set these advanced options during Layout, click **Advanced** in the Layout dialog box. The Advanced Layout options are only available in timing-driven Layout mode.

High Effort Layout Mode

This option turns on netlist optimizations to obtain better performance. Layout runtime will increase when this option is selected. You can also combine this option with the Multi-Pass mode to achieve the best possible performance.

In the regular flow the compile step in Designer would modify the netlist to make use of efficient resources on the chip, such as global networks and special macros. When the **High Effort Layout** option is turned on, the placer could further change the mapping of the logic components, preserving the original functionality of the design. The changed netlist is then used in all post-layout Designer tools including back-annotation.

The names and types of the combinational core logic primitives may change. All other logic cells (such as registers, memory, I/Os or clocks) or combinational logic primitives that are assigned a physical constraint (locked at a location, assigned to a region, or part of a block component), referred in a timing constraint, or have a preserve property, will remain unchanged.

When the **Lock Existing Placement** option is also turned on, the placer runs in regular effort mode.

Note: If you change the High Effort Setting you must rerun Place and Route to complete Layout.

Sequential Optimization

This option turns on optimization of sequential cells in the High Effort Layout mode. This typically enables register retiming without disturbing timing latency. The names of registers may change unless they are assigned a physical constraint (locked at a location, assigned to a region, or part of a block component), referred in a timing constraint, or have a preserve property. Other restrictions may also apply.

The following cases are excluded from sequential optimization:

- Registers that have any timing constraint other than global FMAX, TSU (setup time) or TCO (clock to out). Registers referred by multi-cycle or exception timing constraints are not moved.

- Registers that feed asynchronous control signals on another register.
- Registers feeding the clock of another register.
- Registers feeding a register in another clock domain.
- Registers that are fed by a register in another clock domain.
- Registers connected to PLL.
- Registers that have PDC attribute “preserve”, assigned a physical constraint (locked at a location, assigned to a region, or part of a block component).
- Both registers in a direct connection from input I/O-to-register-to-register if both registers have the same clock and the first register does not fan out to anywhere else. These registers are considered synchronization registers.
- Both registers in a direct connection from register-to-register if both registers have the same clock, the first register does not fanout anywhere else, and the first register is fed by another register in a different clock domain. These registers are considered synchronization registers.

Router

Repair Minimum Delay Violations

With this option selected, layout will perform an additional route that will attempt to repair paths that have minimum delay and hold time violations. This is done by increasing the length of routing paths and inserting routing buffers to add delay to paths. Since placement will remain unchanged and no additional tiles or modules will be inserted, the amount of delay inserted is limited. As a result, this function is best suited to repair paths with small (0 to 3 ns) hold and minimum delay violations. Paths with large violations will likely improve, but for a complete repair of these paths, manual placement or source code modification may be necessary. Every effort will be made to avoid creating max-delay timing violations on worst case paths.

To get the most out of repair minimum delay violations:

1. Enter max-delay, min-delay, setup and hold constraints in SmartTime's constraint editor or in SDC.
2. Set false paths on any paths that have a constraint, but do not need one (this will help layout to meet the constraints that are needed).
3. Perform Layout with **Timing Driven**, **Run Place**, **Run Route** and optionally **Run incrementally** enabled.
4. Resolve worst case setup and max-delay violations before running minimum delay violations repair.
5. After worst case max-delay timing is resolved, evaluate timing in SmartTime’s Timing Analyzer in minimum delay analysis mode to check for hold time and minimum delay violations.
6. Run repair minimum delay violations with incremental route enabled.
   The repair minimum delay violations tool will attempt to fix all hold time and minimum delay violations by lengthening routing delay paths and inserting routing buffers. As delay is added to paths, worst case max-delay timing is verified to avoid creating new max-delay timing violations. Designer will report the worst minimum slack and the number of violating paths in the log window. In some cases, additional improvement can occur by running repair minimum delay violations multiple times with **Run Incrementally** enabled.
7. Perform both maximum and minimum delay timing analysis to check the timing. Manual placement or source code modification may be necessary to repair all minimum delay violations.
8. After making placement or source code changes, run incremental route and repair minimum delay violations, and then analyze timing again.

Additional Factors

Runtime may vary greatly with the number of paths that need repair, the number of nets in those paths, and the resources available for the tool to insert delay. Over-constraining paths will increase runtime, but will not likely improve results .

The tool will only work on paths that have min delay and hold time constraints. However, other paths that share common nets to the constrained paths may be inadvertently affected.

It is recommended to run minimum delay violations repair with incremental route. This will ensure that paths which do not have minimum delay violations are preserved.

Repair will be performed on:

- Register to register paths where both registers are on the same global or non-global clock
- Register to register paths where the registers are on different clock networks and a minimum delay constraint exists
- Input to register, register to output, clock to out, input to output paths with minimum delay or hold constraint.

You may select programmable input delays to increase delay on input to register paths for devices that support the feature.

Restore Defaults

Click Restore Defaults to run the factory default settings for Advanced options.

Simulate - Opens ModelSim AE

The back-annotation functions are used to extract timing delays from your post layout data. These extracted delays are put into a file to be used by your CAE package's timing simulator. The default simulator for Libero SoC is ModelSim AE. You can change your default simulator in your Tool Profile.

If you wish to perform pre-layout simulation: In the Design Flow Window, under Verify Pre-Synthesized design, double-click Simulate.

To perform timing simulation:

1. If you have not done so, back-annotate your design and create your testbench.
2. Right-click **Simulate** (in Design Flow window, Implement Design > Verify Post-Synthesis Implementation > Simulate) and choose **Organize Input Files > Organize Source Files** from the right-click menu.

   In the Organize Files for Source dialog box, all the stimulus files in the current project appear in the Source Files in the Project list box. Files already associated with the block appear in the Associated Source Files list box.
   In most cases you will only have one testbench associated with your block. However, if you want simultaneous association of multiple testbench files for one simulation session, as in the case of PCI cores, add multiple files to the Associated Source Files list.
   To add a testbench: Select the testbench you want to associate with the block in the Source Files in the Project list box and click **Add** to add it to the Associated Source Files list.
   To remove a testbench: To remove or change the file(s) in the Associated Source Files list box, select the file(s) and click **Remove**.
   To order testbenches: Use the up and down arrows to define the order you want the testbenches compiled. The top level-entity should be at the bottom of the list.
3. When you are satisfied with the Associated Simulation Files list, click **OK**.
4. To start ModelSim AE, right-click **Simulate** in the Design Hierarchy window and choose **Open Interactively**. ModelSim starts and compiles the appropriate source files. When the compilation completes, the simulator runs for 1 µs and the Wave window opens to display the simulation results.
5. Scroll in the Wave window to verify the logic works as intended. Use the cursor and zoom buttons to zoom in and out and measure timing delays. If you did not create a testbench with WaveFormer Pro, you may get error messages with the vsim command if the instance names of your testbench do not follow the same conventions as WaveFormer Pro. Ignore the error message and type the correct vsim command.
6. When you are done, from the **File** menu, choose **Quit**.

Generate Back Annotated Files - SmartFusion2, IGLOO2, and RTG4 Only

Generates Back Annotated files for your design.

Back Annotated files include:

- *ba.sdf - Standard Delay Format for back-annotation to the simulator.
- *ba.v/.vhd - Post-placement netlist used for back-annotated timing simulation.

To generate these files, in the Design Flow window click **Implement Design** and double-click **Generate Back Annotated Files**.

Right-click **Generate Back Annotated Files** and choose **Configure Options** to open the Generate Back Annotated Files Options dialog box.

Simulator Language Type - Set your simulator language type according to your design.

Timing: Export enhanced min delays for best case - Exports your enhanced min delays to include your best-case timing results in your Back Annotated file.

Export Back Annotated Files

Libero SoC uses post-layout files for back-annotated timing simulation.

Post-layout files include:

- *ba.sdf - Standard Delay Format for back-annotation to the simulator.
- *ba.v/vhd - Post-layout flattened netlist used exclusively for back-annotated timing simulation. May contain low level macros not immediately recognizable to you; these were added by the software to improve your design performance.

To generate a post-layout file, in the Design Flow window click **Implement Design** and double-click **Export Back Annotated Files**.

If you wish to export the Back Annotated files with options that are different than the default, right-click **Export Back Annotated Files** and choose **Open Interactively**.

Generate Bitstream - SmartFusion2, IGLOO2, and RTG4

Generates the bitstream for use with the Run PROGRAM Action tool.

The tool incorporates the Fabric design, eNVM configuration (if configured) and security settings (if configured) to generate the bitstream file. You need to configure the bitstream before you generate the bitstream. Right-click **Generate Bitstream** and choose **Configure Options** to open the Configure Bitstream dialog box to select which components you wish to program. Only features that have been added to your design are available for programming. For example, you cannot select eNVM for programming if you do not have an eNVM in your design.

Modifications to the Fabric design, eNVM configuration, or security settings will invalidate this tool and require regeneration of the bitstream file.

The Fabric programming data will only be regenerated if you make changes to the Fabric design, such as in the Create Design, Create Constraints and Implement Design sections of the Design Flow window.

This operation is completed automatically as the last step if you use the Build button.

When the process is complete a green check appears next to the operation in the Design Flow window (as shown in the figure below) and information messages appear in the Log window.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

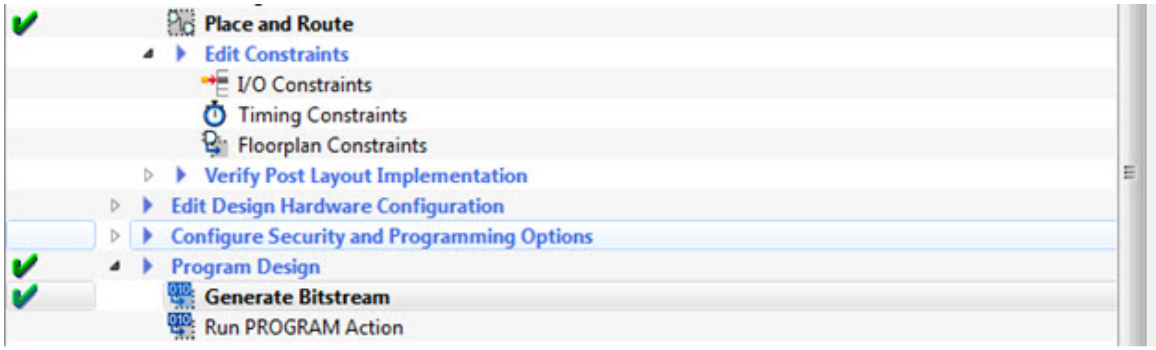

Figure 37 · Generate Bitstream (Complete)

See also

Configure Bitstream Dialog Box

Device Programming

Default Programming Data File (*.pdb file) is generated automatically as part of the Libero SoC push-button design flow.

SmartFusion, IGLOO, ProASIC3 and Fusion devices use the FlashPoint program file generator to create a programming file. For SmartFusion, IGLOO, and ProASIC3, the FlashPoint interface also enables the advanced security features.

To open FlashPoint, expand **Implement Design**, right-click **Generate Programming Data** and choose **Open Interactively**. FlashPoint allows you to generate the following programming files:

- IEEE 1532 files (*.bsd, *.isc)
- DirectC files (*.dat)
- Programming Data File (*.pdb)
- STAPL file (*.stp)
- Serial Vector Files (*.svf)

You must have completed your design to generate your programming (*.stp or STAPL) file.

See Also

Generate a DAT file

Default Programming Data (*.fdb) is generated automatically as part of the Libero SoC push-button design flow.

This step generates a FDB file that contains the FPGA array only. To add security to the design, you must use the FlashPro application. Right-click **Program Device** or **Export Programming File** to open FlashPro. When FlashPro opens, choose **Modify PDB** to add the security settings.

To generate other programming files for the Fusion devices, open FlashPro.

1. When FlashPro opens, click **File > Export > Export Single Programming File** to open the Export Programming Files dialog box.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

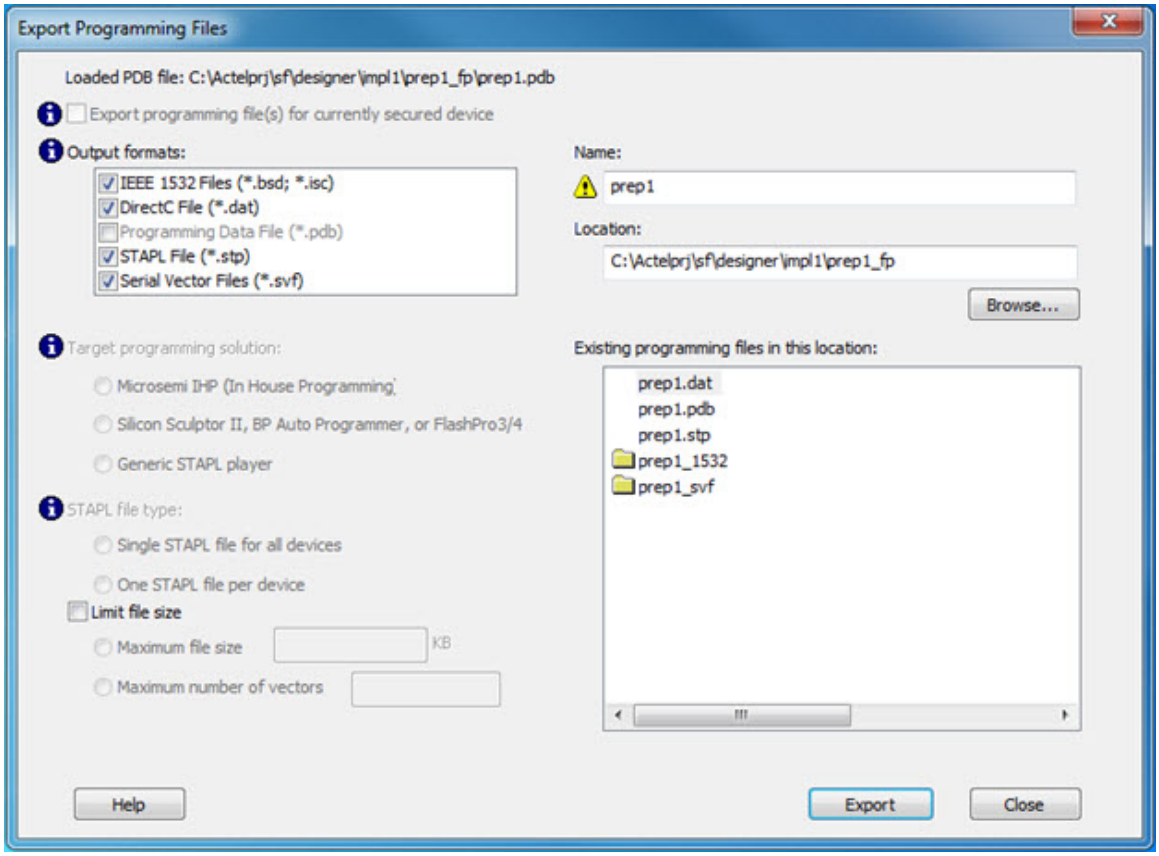

Figure 38 · Export Programming Files Dialog Box

2. Select the Programming File output format you want to generate:
- IEEE 1532 Files (*.bsd; *.isc)
- DirectC File (*.dat)
- STAPL File (*.stp)
- Serial Vector Files (*.svf)
3. Click **Export** to generate the programming files and then click **Close**.

Programming Connectivity and Interface - SmartFusion2, IGLOO2, and RTG4 Only

In the Libero SoC Design Flow window, expand **Edit Design Hardware Configuration** and double-click **Programming Connectivity and Interface** to open the Programming Connectivity and Interface window. The Programming Connectivity and Interface window displays the physical chain from TDI to TDO or SPI Slave configuration.

The Programming Connectivity and Interface view enables the following actions:

- **Select Programming Mode** – Select JTAG or SPI Slave mode. SPI Slave mode is only supported by FlashPro5.
- **Construct Chain Automatically** - Automatically construct the physical chain
- **Add Microsemi Device** – Add a Microsemi Device to the chain
- **Add Non-Microsemi Device** – Add a non-Microsemi Device to the chain
- **Add Microsemi Devices From Files** – Add a Microsemi Device from a programming file

- **Delete Selected Device** – Delete selected devices in the grid
- **Scan and Check Chain** – Scan the physical chain connected to the programmer and check if it matches the chain constructed in the grid
- **Zoom In** – Zoom into the grid
- **Zoom Out** – Zoom out of the grid

Hover Information

The device tooltip displays the following information if you hover your pointer over a device in the grid:

- **Name** - Editable field for a user-specified device name. If you have two or more identical devices in your chain you can use this field to give them unique names.
- **Device** - Device name.
- **File** - Path to programming file.
- **Programming action** – When a programming file is loaded, the user can select a programming action for any device which is not the Libero design device.
- **IR Length** - Device instruction length.
- **TCK** - Maximum clock frequency in MHz to program a specific device; Libero uses this information to ensure that the programmer operates at a frequency lower than the slowest device in the chain.

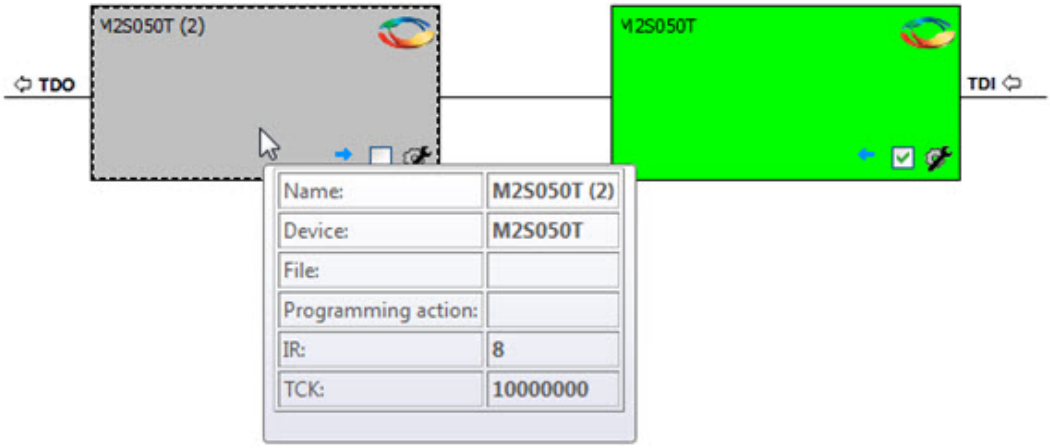

Figure 39 · Device Information

Device Chain Details

The device within the chain has the following details:

- **Libero design device** – Has a red circle within Microsemi logo. Libero design device cannot be disabled.
- **Left/right arrow** – Move device to left or right according to the physical chain.
- **Enable Device** - Select to enable the device for programming; enabled devices are green, disabled devices are gray.
- **Name** - Displays your specified device name.
- **File** - Path to programming file.

Right-Click Properties

- **Set as Libero Design Device** - The user needs to set Libero design device when there are multiple identical Libero design devices in the chain.

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- **Enable Device** - Select to enable the device for programming; enabled devices are green, disabled devices are gray.
- **HIGH-Z** - Sets disabled Microsemi SoC ProAsic3, IGLOO, Fusion, and SmartFusion devices in the chain to HIGH-Z (tri-states all the I/Os) during chain programming of enabled Microsemi devices in the daisy chain (Not supported for Libero SoC target design device)
- **Configure Device** – Ability to reconfigure the device (for a Libero SoC target device the dialog appears but only the device name is editable)
- **Load Programming File** – Load programming file for selected device (Not supported for Libero SoC target design device)
- **Enable Serial** - Select to enable serialization when you have loaded a serialization programming file (not supported in software version 11.0)
- **Serial Data** - Opens the Serial Settings dialog box; enables you to set your serialization data.
- **Select Program Procedure/Actions** (Not supported for Libero SoC target design device):
    - **Actions** - List of programming actions for your device.
    - **Procedures** - Advanced option; enables you to customize the list of recommended and optional procedures for the selected Action.
- **Move Device Left/Right** – Move device in the chain to left or right.

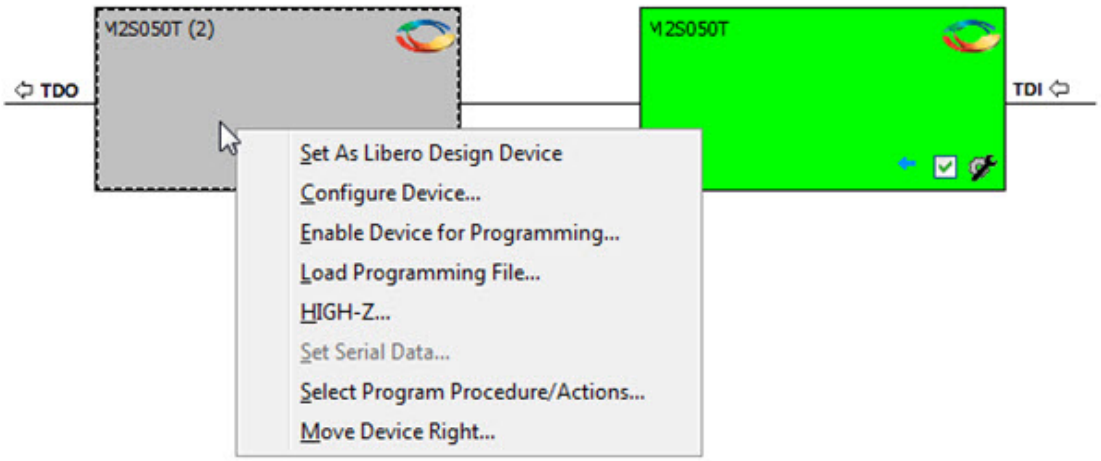


Figure 40 · Right-click Properties

Programmer Settings - SmartFusion2, IGLOO2, and RTG4 Only

In the Libero SoC Design Flow window, expand **Edit Design Hardware Configuration** and double-click **Programmer Settings** to view the name, type, and port. The dialog box displays information about your programmer if it is connected.

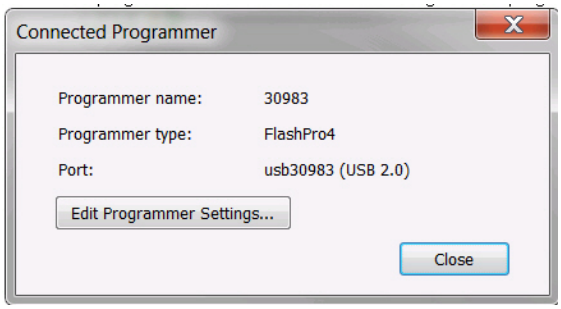


Figure 41 · Programmer Settings for Connected Programmer

Click **Edit Programmer Settings** to view the Programmer Settings dialog box. You can set specific voltage and force TCK frequency values for your programmer in this dialog box.

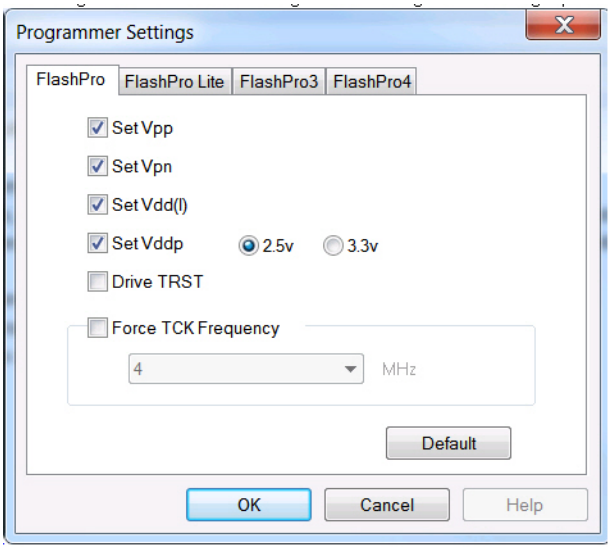


Figure 42 · Programmer Settings Dialog Box

The Programmer Settings dialog box includes setting options for FlashPro5/4/3/3X, FlashPro Lite and FlashPro.

Set the TCK setting in your PDB/STAPL file by selecting the TCK frequency in the Programmer Settings dialog box. TCK frequency limits by programmer:

- FlashPro supports 1-4 MHz
- FlashPro Lite is limited to 1, 2, or 4 MHz only.
- FlashPro5/4/3/3X supports 1-4 MHz.

TCK frequency limits by target device:

- SmartFusion2, IGLOO2, and RTG4 - 20MHz

• IGLOO, ProASIC3, Fusion, SmartFusion and SmartFusion2 – 10MHz to 20MHz

• ProASICPLUS and ProASIC – 10 MHz.

During execution, the frequency set by the FREQUENCY statement in the PDB/STAPL file overrides the TCK frequency setting selected by you in the Programmer Settings dialog box unless you also select the Force TCK Frequency checkbox.

FlashPro Programmer Settings

Choose your programmer settings for FlashPro (see the above figure). If you choose to add the Force TCK Frequency, select the appropriate MHz frequency. After you have made your selection(s), click **OK**.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Default Settings

- The Vpp, Vpn, Vdd(l), and Vddp options are checked (Vddp is set to 2.5V) to instruct the FlashPro programmer(s) to supply Vpp, Vpn, Vdd(l) and Vddp.
- The Driver TRST option is unchecked to instruct the FlashPro programmer(s) NOT to drive the TRST pin.
- The Force TCK Frequency option is unchecked to instruct FlashPro to use the TCK frequency specified by the Frequency statement in the STAPL file(s).

FlashPro Lite Programmer Settings

If you choose to add the Force TCK Frequency, select the appropriate MHz frequency. After you have made your selection(s), click **OK**.

Default Settings

- The Vpp and Vpn options are checked to instruct the FlashPro Lite programmer(s) to supply Vpp and Vpn.
- The Driver TRST option is unchecked to instruct the FlashPro Lite programmer(s) NOT to drive the TRST pin.
- The Force TCK Frequency option is unchecked to instruct the FlashPro Lite to use the TCK frequency specified by the Frequency statement in the STAPL file(s).

FlashPro5/4/3/3X Programmer Settings

For FlashPro5/4/3/3X, you can choose the Set Vpump setting or the Force TCK Frequency. If you choose the Force TCK Frequency, select the appropriate MHz frequency. For FlashPro4/3X settings, you can switch the TCK mode between Free running clock and Discrete clocking. After you have made your selections(s), click **OK**.

Default Settings

- The Vpump option is checked to instruct the FlashPro5/4/3/3X programmer(s) to supply Vpump to the device.
- The Force TCK Frequency option is unchecked to instruct the FlashPro5/4/3/3X to use the TCK frequency specified by the Frequency statement in the PDB/STAPL file(s).
- FlashPro5/4/3/3X default TCK mode setting is Free running clock.

Device I/O States During Programming

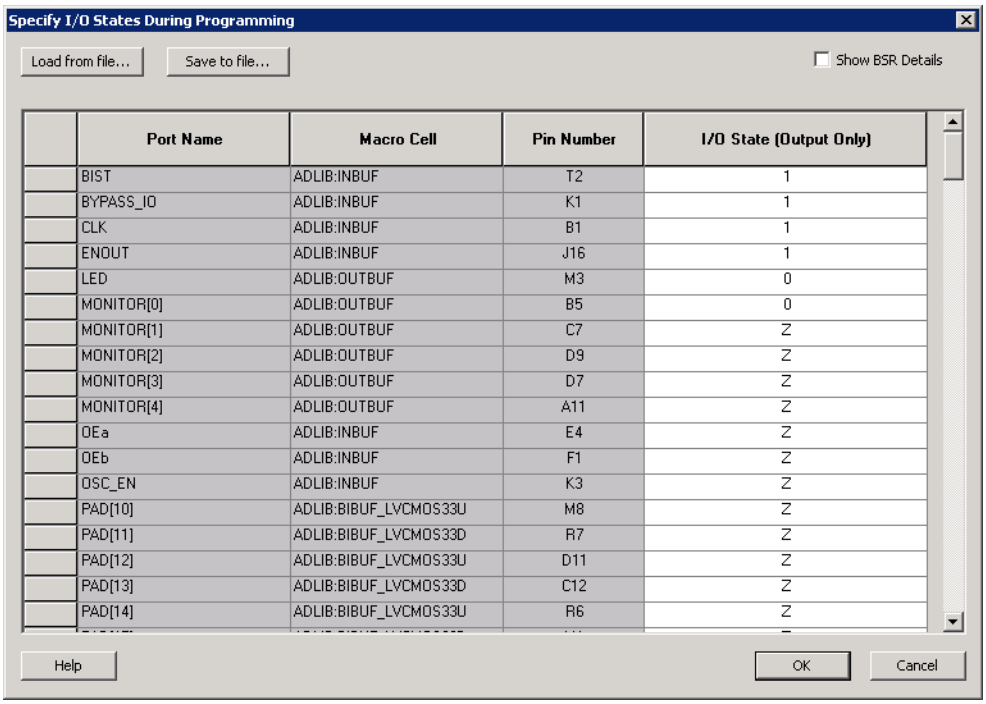
In the Libero SoC Design Flow window expand **Edit Design Hardware Configuration** and double-click **Device I/O states during programming** to specify the I/O states prior to programming. In Libero SoC, this feature is only available once Layout is completed.

The default state for all I/Os is Tri-state.

To specify I/O statues during programming:

1. Sort the pins as desired by clicking any of the column headers to sort the entries by that header. Select the I/Os you wish to modify (as shown in the figure below).
2. Set the I/O Output state. You can set Basic I/O settings if you want to use the default I/O settings for your pins, or use Custom I/O settings to customize the settings for each pin. See the Specifying I/O States During Programming - I/O States and BSR Details help topic for more information on setting your I/O state and the corresponding pin values. Basic I/O state settings are:
    - 1 – I/O is set to drive out logic High
    - 0 – I/O is set to drive out logic Low
    - Last Known State: I/O is set to the last value that was driven out prior to entering the programming mode, and then held at that value during programming

- Z - Tri-State: I/O is tristated



Port Name	Macro Cell	Pin Number	I/O State (Output Only)
BIST	ADLIB:INBUF	T2	1
BYPASS_IO	ADLIB:INBUF	K1	1
CLK	ADLIB:INBUF	B1	1
ENOUT	ADLIB:INBUF	J16	1
LED	ADLIB:OUTBUF	M3	0
MONITOR[0]	ADLIB:OUTBUF	B5	0
MONITOR[1]	ADLIB:OUTBUF	C7	Z
MONITOR[2]	ADLIB:OUTBUF	D9	Z
MONITOR[3]	ADLIB:OUTBUF	D7	Z
MONITOR[4]	ADLIB:OUTBUF	A11	Z
OEa	ADLIB:INBUF	E4	Z
OEb	ADLIB:INBUF	F1	Z
OSC_EN	ADLIB:INBUF	K3	Z
PAD[10]	ADLIB:BIBUF_LVCMOS33U	M8	Z
PAD[11]	ADLIB:BIBUF_LVCMOS33D	R7	Z
PAD[12]	ADLIB:BIBUF_LVCMOS33U	D11	Z
PAD[13]	ADLIB:BIBUF_LVCMOS33D	C12	Z
PAD[14]	ADLIB:BIBUF_LVCMOS33U	R6	Z

Figure 43 · I/O States During Programming Window

6. Click **OK** to save your settings.

Note: I/O States During programming will be used during programming or when exporting the bitstream.

Configure User Programming Data

Sets your Design Version and Silicon Signature.

Design name is a read-only field that identifies your design.

Design Version (number between 0 and 65535) - Specifies the design version to be programmed to the device. This field is also used for Back-level protection in Update Policy of the Security Policy Manager and in Enable Auto Update in the Programming Recovery tool.

Silicon signature (max length is 8 HEX chars) - 32-bit user configurable silicon signature to be programmed into the device. This field can be read from the device using the JTAG (IEEE 1149-1) USERCODE instruction or by running the DEVICE_INFO programming action.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

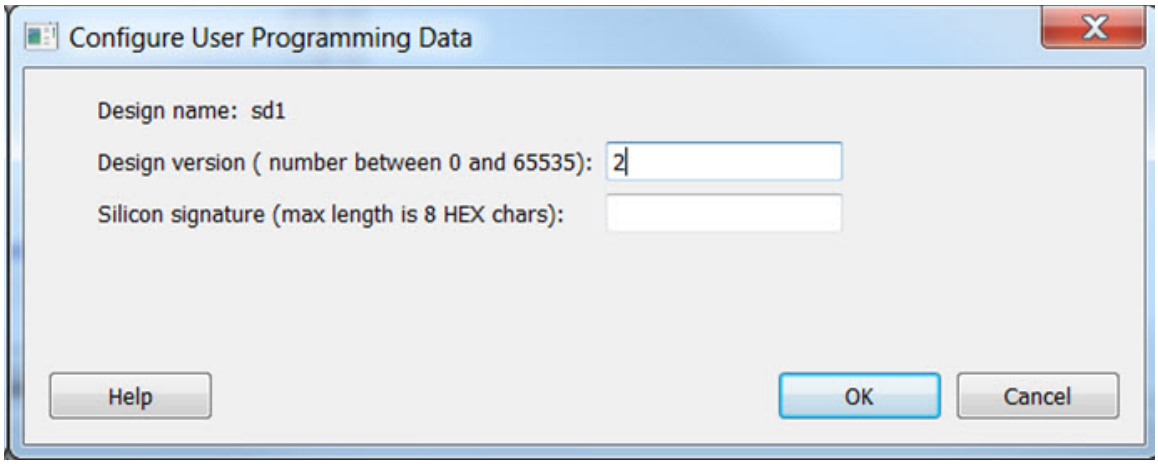


Figure 44 · Configure User Programming Data Dialog Box

Notes:

Programming Recovery cannot be updated with _UEK1 or _UEK2 programming files. Only the master programming file can be used.

SPI file programming for Auto Programming, Auto Update (IAP), Programming Recovery, and IAP/ISP Services currently can only program security once with the master file. Update files cannot update the security settings. In addition, Programming Recovery, Silicon Signature, Firewall, and Tamper Macro can only be programmed with the master file and cannot be updated.

Configure Programming Recovery

The Programming Recovery dialog box enables you to set your Auto Update and Programming Recovery options for programming.

Auto Update takes place during power-up and compares your Update SPI image Design Version against the Design Version programmed in the device. It performs Auto Update programming on your SPI update Image if:

- The device has been programmed AND
- The Update SPI image Design Version is greater than the Design Version on the device

Auto Recovery enables the device to automatically reprogram itself if there is a power failure during programming.

Design version - The Design Version used for Auto Update Programming or for Backlevel protection within the SPM update policy. This is a read-only field that must be configured within the tool Configure User Programming Data.

Enable Auto Update - Click the checkbox to auto update the SPI update image at power up. Auto-update occurs only when the SPI update image Design Version is greater than the Design Version already on the device. When enabling Auto Update, Programming Recovery must also be enabled and this checkbox will be disabled.

Enable Programming Recovery - Click the checkbox to enable programming recovery in the event of a power failure during programming.

SPI clock frequency - Sets your SPI clock frequency. SPI is a full duplex, four-wire synchronous transfer protocol that supports programmable clock polarity (SPO) and clock phase (SPH).The state of SPO and SPH control bits decides the data transfer modes. See the SmartFusion2 Microcontroller Subsystem User's Guide or the IGLOO2 High Performance Memory Subsystem User's Guide for more information.

SPI data transfer mode - Sets your SPI data transfer mode for SPO and SPH. The SPO control bit determines the polarity of the clock and SPS defines the slave select behavior. SPS is hardcoded to b'1 and cannot be changed. The SPH control bit determines the clock edge that captures the data. See the SmartFusion2 Microcontroller Subsystem User's Guide or the IGLOO2 High Performance Memory Subsystem User's Guide for more information.

Notes:

Programming Recovery cannot be updated with _UEK1 or _UEK2 programming files. Only the master programming file can be used.

SPI file programming for Auto Programming, Auto Update (IAP), Programming Recovery, and IAP/ISP Services currently can only program security once with the master file. Update files cannot update the security settings. In addition, Programming Recovery, Silicon Signature, Firewall, and Tamper Macro can only be programmed with the master file and cannot be updated.

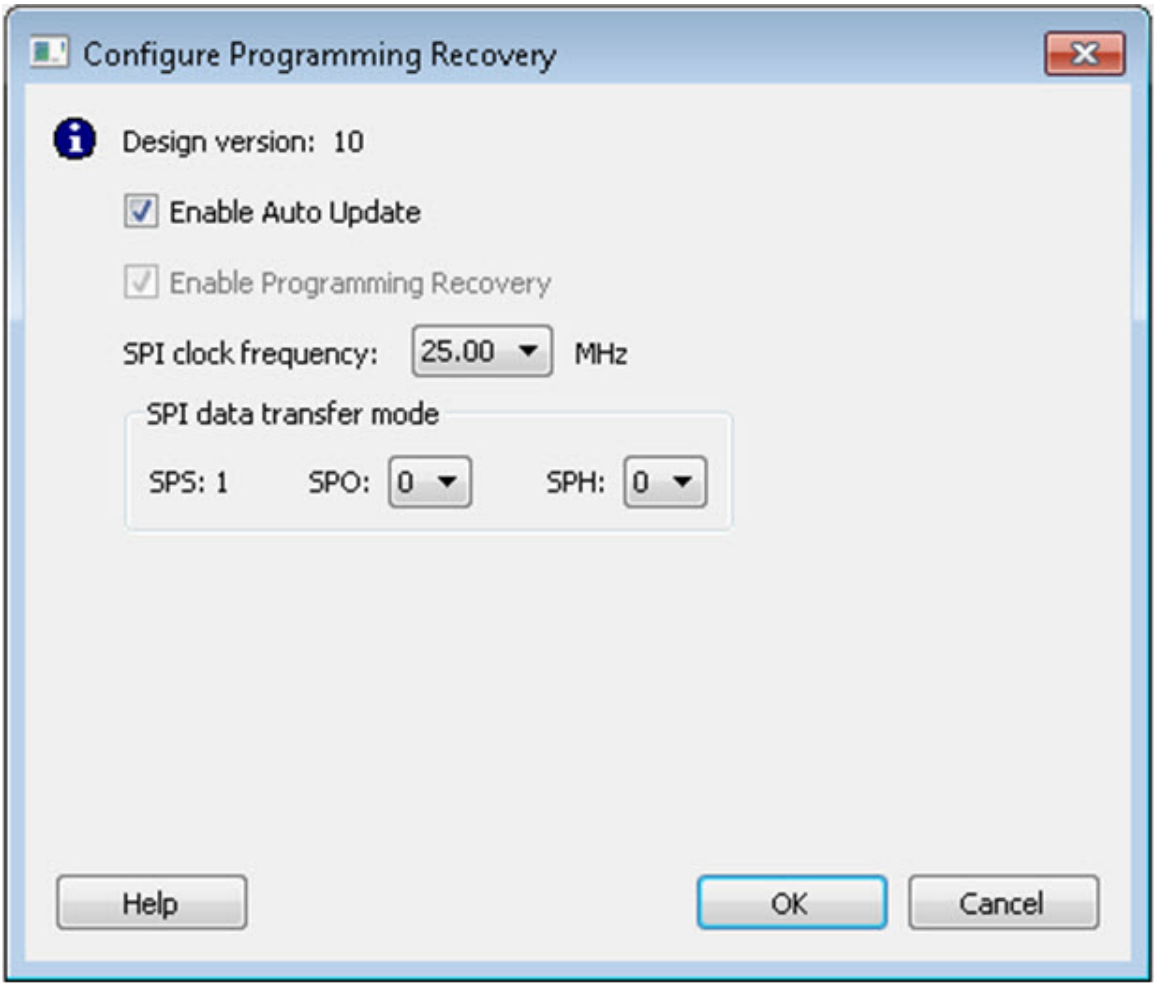


Figure 45 · Configure Programming Recovery Dialog Box

Security Features Frequently Asked Questions

The following Frequently Asked Questions address the most common queries related to managing and programming SmartFusion2 and IGLOO2 Security Features.

I have configured the Security Policy Manager and enabled security in my design but I do not want to program my design with the Security Policy Manager features enabled. What do I do?

Go to Configure Bitstream and un-check Security.

What is programmed when I click Program Device?

All features configured in your design and enabled in the Configure Bitstream tool. Any features you have configured (such as eNVM or Security) are enabled for programming by default.

When I click Program Device is the programming file encrypted?

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

All programming files are encrypted. To generate programming files encrypted with UEK1 or UEK2 you must generate them from Export Bitstream for field updates.

Note: Once security is programmed, you must erase the security before attempting to reprogram the security.

How do I generate encrypted programming files with User Encryption Key 1/2?

- Configure the Security Policy Manager and specify a User Key Set 1 and User Key Set 2 (User Key Set 2 is available if you select Field Update Broadcast mode). Ensure the Security programming feature is enabled in Configure Bitstream; it is enabled by default once you configure the Security Policy Manager.
- Export Bitstream from Handoff Design for Production - <filename>_uek1.(stp/svf/spi/dat) and <filename>_uek2.(stp/svf/spi/dat) files are encrypted with UEK1 and UEK2 respectively. See Security Programming File Descriptions below for more information on programming files.

What are Security Programming Files?

See the Security Programming Files topic for more information.

Security Programming Files

Export Bitstream (expand Handoff Design for Production in the Design Flow window) creates the following files:

<filename>_master.(stp/svf/spi/dat) - Created when Enable custom security options is specified in the Security Policy Manager. This is the master programming file; it includes all programming features enabled, User Key Set 1, User Key Set 2 (optionally if specified), and your security policy settings.

<filename>_security_only_master.(stp/svf/spi/dat) – Created when Enable custom security options is specified in the Security Policy Manager. Master security programming file; includes User Key Set 1, User Key Set 2 (optionally if specified), and your security policy settings.

<filename>_uek1.(stp/svf/spi/dat) – Programming file encrypted with User Encryption Key 1 used for field updates; includes all your features for programming except security .

<filename>_uek2.(stp/svf/spi/dat) – Programming file encrypted with User Encryption Key 2 used for field updates; includes all your features for programming except security.

Security Policy Manager (SPM)

Expand **Configure Security and Programming Options**, double-click **Configure Security** to customize the security settings in your design.

Use this dialog box to set your User Keys, Security Policies and Microsemi factory test mode access level.

Note: Microsemi enabled default bitstream encryption key modes are disabled after user security is programmed.

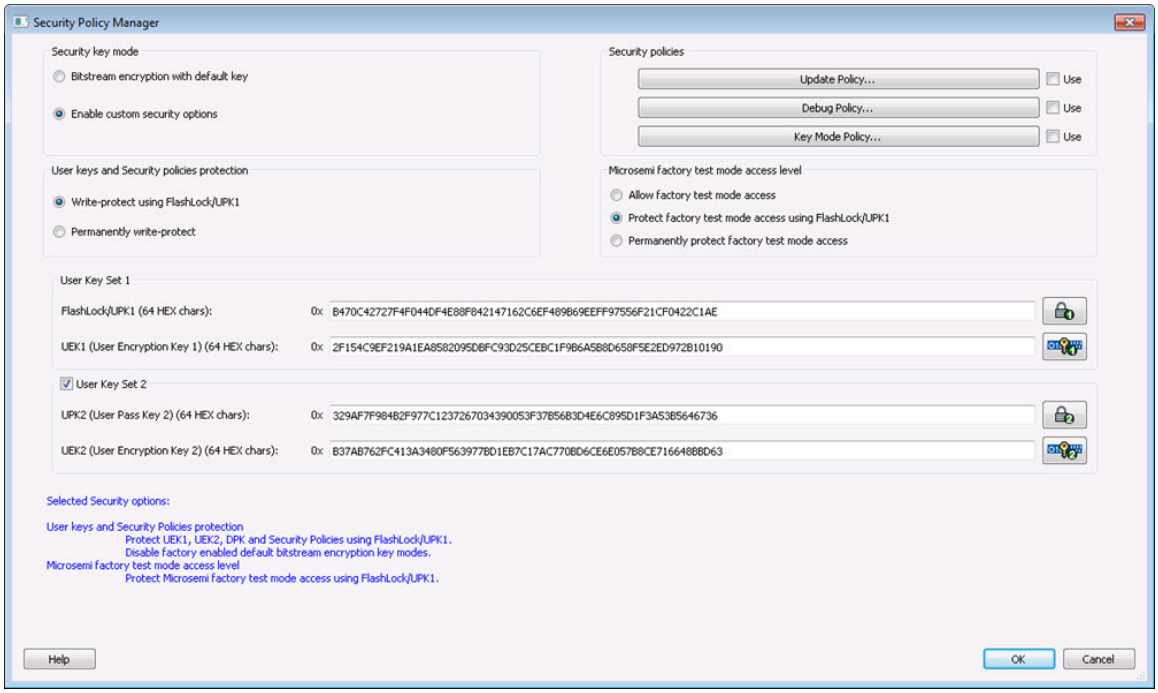


Figure 46 · Security Policy Manager Dialog Box

Security Key Mode

Bitstream encryption with default key - Encrypt bitstream files with Microsemi default key (pre-placed key in silicon). When this option is selected, user keys, security and Microsemi factory test mode access level configurations are disabled.

Enable custom security options - Enables you to set User Keys, Security Policies and Microsemi factory test mode access level (see below for a description).

User keys and Security policies protection

Write-protect using FlashLock/UPK1 - Protect UEK1 (User Encryption Key 1), DPK (Debug Pass Key) and Security Policies using FlashLock/ UPK1.

Note: UEK2 (User Encryption Key2) is protected by UPK2 (User Pass Key 2).

Permanently write-protect - Permanently protect UEK1 (User Encryption Key 1), UPK2 (User Pass Key 2), UEK2 (User Encryption Key 2), DPK (Debug Pass Key), Security Policies, and Microsemi factory test mode access level. This setting, once programmed will not be modified in the device. Microsemi enabled default bitstream encryption key modes are permanently disabled as well.

Note: When this option is selected, you cannot specify the FlashLock/UPK 1 and UPK2 (User Pass Key 2) value, since the value cannot be used to unlock the corresponding protected features.

Microsemi Factory Test Mode Access Level

Protect factory test mode access using FlashLock/UPK1 - Protects access to Microsemi factory test mode using Flashlock/ UPK1.

Permanently protect factory test mode access - Permanently locks access to Microsemi factory test mode.

Note: When this option is selected, User Key Set 2 is permanently write-protected. Once programmed, User Key Set 2 cannot be changed in the device. You can specify UEK2 (User Encryption Key 2). However, you cannot specify UPK2 (User Pass Key 2), since the value cannot be used to unlock User Key Set 2.

Allow factory test mode access - Allows access to Microsemi factory test mode.

Security Policies

Update Policy - Sets your Fabric, eNVM and Back Level protections. See the Update Policy topic for more information.

Debug Policy - Enables and sets your Debug Pass Key and debug options. See the Debug Policy topic for more information.

Key Mode Policy - Configures the key mode to enable or disable. See the Key Mode Policy topic for more information.

Configuring User Keys

User Key Set 1 is required. User Key Set 1 includes FlashLock/UPK1 (User Pass Key 1) and UEK1 (User Encryption Key 1)..

User Key Set 2 is optional. User Key Set 2 includes UPK2 (User Pass Key 2) and UEK2 (User Encryption Key 2).

Note that User Pass Key 2 (UPK2) protects only User Encryption Key 2 (UEK2).

Update Policy

This dialog box enables you to specify components that can be updated in the field, and their field-update protection parameters.

Choose your protection options from the drop-down menus; click the appropriate checkbox to set your programming protection preferences.

Fabric update protection

- **Use FlashLock/UPK1 to unlock Erase/Write/Verify operations**- Select this option to require UPK1 to erase, write, or verify the Fabric.
- **Updates allowed using UEK1 or UEK2; FlashLock/UPK1 is not required for updates** - Encrypted update is allowed with either UEK1 or UEK2 (if enabled).

eNVM update protection

- **Use FlashLock/UPK1 to unlock Write/Verify/Read operations**- Select this option to require UPK1 to write, verify or read to the eNVM.
- **Updates allowed using UEK1 or UEK2; Flashlock/UPK1 is not required for updates** - Encrypted update is allowed with either UEK1 or UEK2 (if enabled).

Back Level protection - When enabled, a design being loaded must be of a version higher than the Back Level version value in the programmed device.

- **Back Level Protection**- Limits the design versions that the device can update. Only programming bitstreams with Designer Version greater than the Back Level version are allowed for programming.
- **Design version** - Displays the current Design version (set in the Configure User Programming Data tool). Back level uses the Design version value to determine which bitstreams are allowed for programming.
- **Back Level Bypass** - If selected, design is programmed irrespective of Back Level version.

Note: Back Level Bypass should be set if you allow programming recover with recovery image lower than the Back Level version selected. Alternatively, you should update the design version of the recovery image so that it is always greater than the Back Level version. (Refer to the Configure Programming Recovery section for details.)

Disable access to the following programming interfaces:

These settings protect the following programming interfaces:

- Auto Programming
- IAP/ISP services
- JTAG (use FlashLock to/UPK1 to unlock)
- SPI Slave (use FlashLock/UPK1 to unlock)

For more technical information on the Protect Programming Interface with Pass Key option see the SmartFusion2 Programming User's Guide.

Note that when the Permanently write-protect option is selected for User keys and Security policies protection in SPM, the dialog box informs you of features that are no longer reprogrammable. In this case, if

Use FlashLock/UPK1 to unlock option is selected for Fabric/eNVM update protection then Fabric/eNVM will be One Time Programmable.

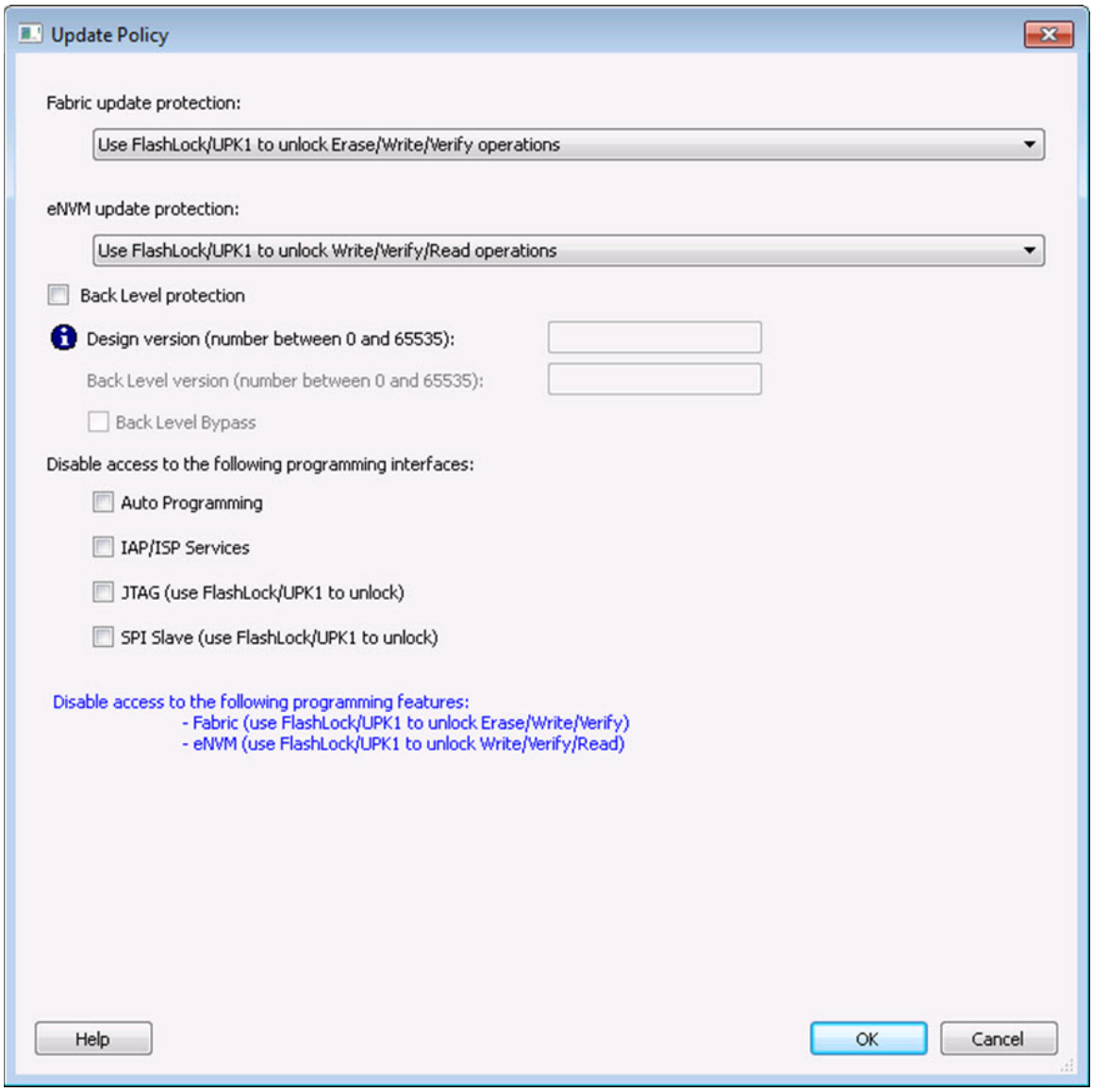


Figure 47 · Update Policy Dialog Box

Debug Security Policy

Debug access to the embedded systems can be controlled via the customer Debug Policy.

Protect Embedded Debug with DPK (Debug Pass Key)

Restrict UJTAG access - Restrict access to UJTAG; DPK is required for access.

Restrict Cortex M3 debug (SmartFusion2 Only) - Restrict Cortex M3 debug; DPK is required for debug.

SmartDebug access control

Access control available during debug mode.

Full Access (No restrictions to SmartDebug architecture; DPK is not required)- Enables full debug access to eNVM, uSRAM, LSRAM, eSRAM0/1, DDRAM and Fabric probing.

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No debug (Restrict read/write access to SmartDebug architecture; DPK is required for read/write access) - Blocks all debug access to eNVM, uSRAM, LSRAM, eSRAM0/1, DDRAM and Fabric probing.

DPK (Debug Pass Key) (length is 64 HEX characters)

Specify a Debug Pass Key to unlock features protected by DPK.

Restrict external Fabric/eNVM design digest check request via JTAG and SPI. Use FlashLock/UPK1 to allow digest check- Protects design digest check request with FlashLock/UPK1.

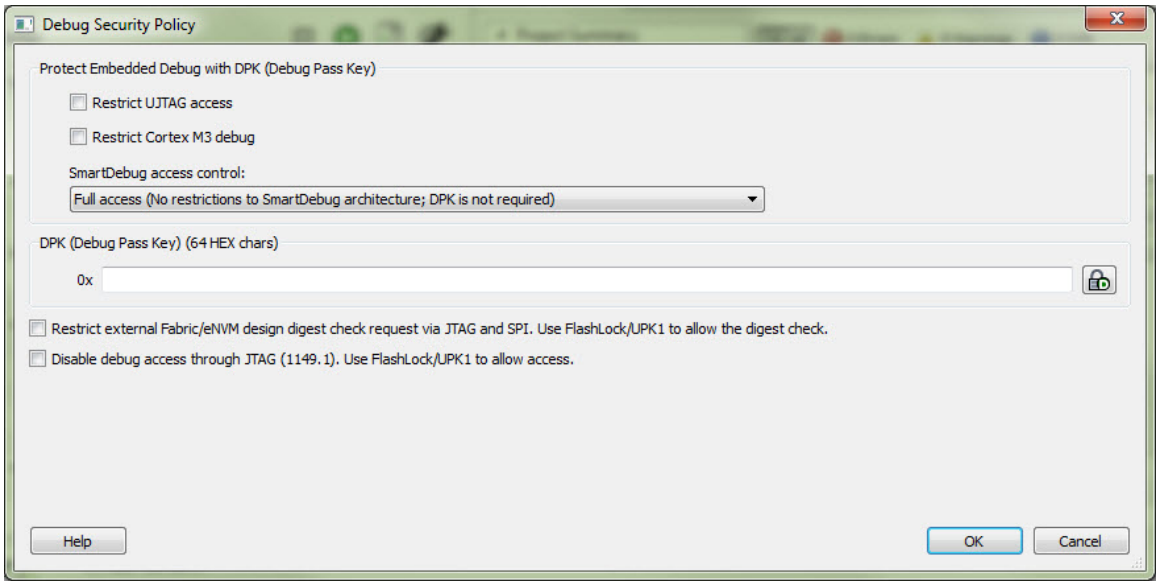

Figure 48 · Debug Security Policy Dialog Box

Key Mode Policy

Protect user encryption key modes with FlashLock/UPK1. If a key mode is disabled, then FlashLock/UPK1 is required to program with that key mode.

Two key modes can be disabled:

- UEK1 (User Encryption Key 1)
- UEK2 (User Encryption Key 2)

If both key modes are disabled then device update is impossible. A warning message is displayed in this case.

Note: If a key mode is disabled then the corresponding bitstream file will be disabled.

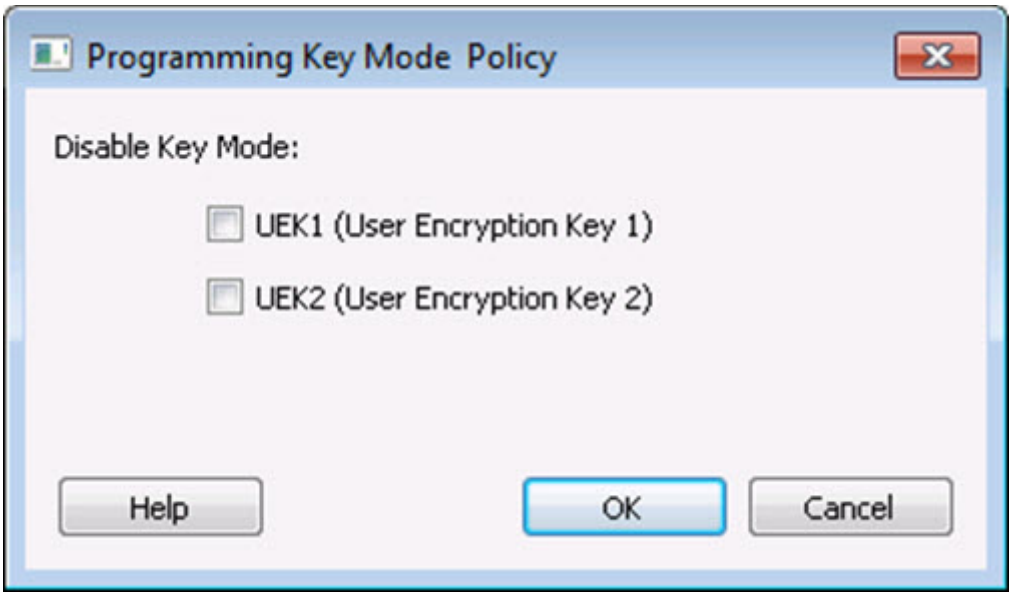

Figure 49 · Programming Key Mode Policy Dialog Box

Update eNVM Memory Content (SmartFusion2 and IGLOO2)

Right-click **Update eNVM Memory Content** and choose **Configure Options** (**eNVM Memory Content > Configure Options**) or double-click **Update eNVM Memory Content** to open the dialog box and modify your eNVM content.

The Update eNVM Memory Content dialog box enables you to update your eNVM content for programming without having to rerun Compile and Place and Route. It is useful if you have reserved space in the eNVM configurator within the MSS for firmware development, for example. Use the Update eNVM Memory Content dialog box when you have completed your firmware development and wish to incorporate your updated firmware image file into the project.

Note: To disable a client for programming, you must modify the client and select “No Content (Client is a placeholder and will not be programmed)”. The content from the memory file, serialization data file, or auto-incremented serialization content will be preserved if you later decide to enable this client for programming. Clients disabled for programming will not be included in the generated bitstream and will not be programmed.

Modify Data Storage Client

Double-click the Storage Client to open the Modify Data Storage Client dialog box.

Note: You cannot add, delete or rename a data storage client in the Modify Data Storage Client dialog box. To make these changes, go to the eNVM configurator inside the MSS/HPMS Configurator or navigate to the System Builder’s Memory page (eNVM tab).

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

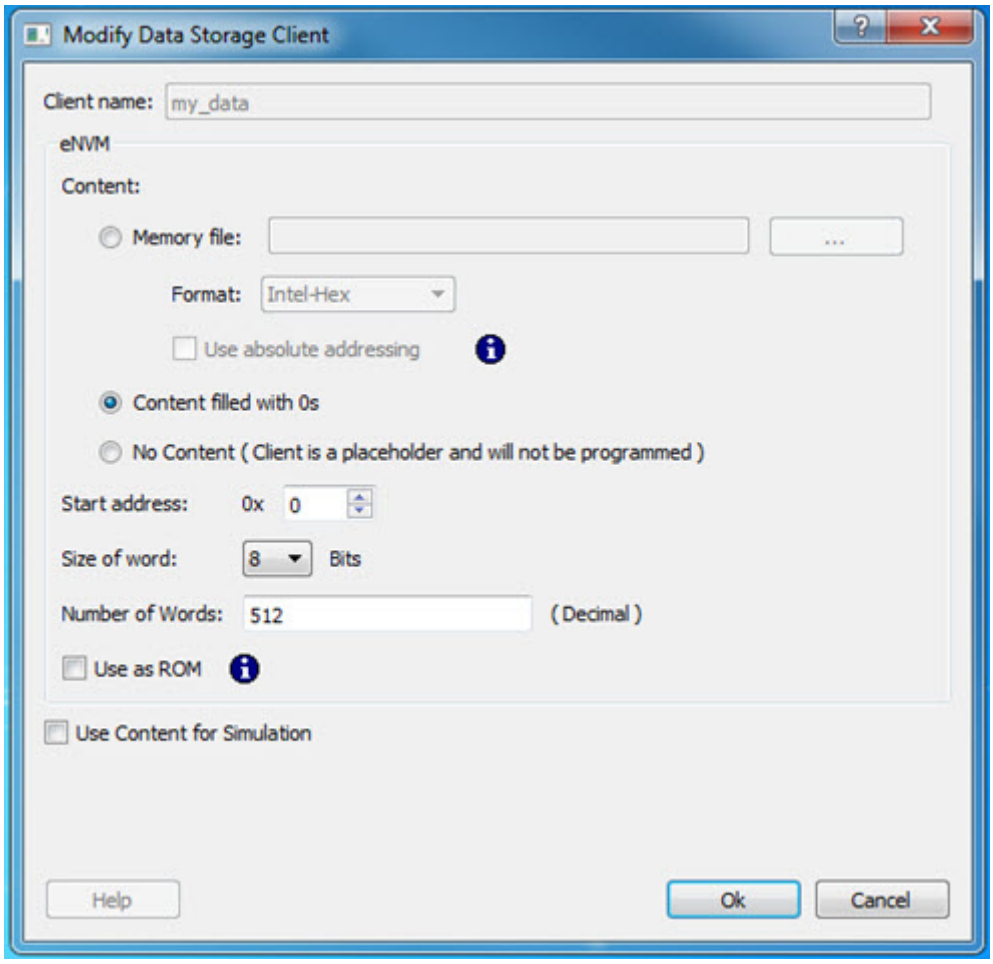

Figure 50 · Modify Data Storage Client Dialog Box

You have three options to specify the eNVM content:

- Import a Memory File
- Fill eNVM content with Zero's
- Assign No Content (eNVM as a Placeholder). The client will not be included in the programming bitstream and will not be programmed

If you have completed Place and Route and you import a memory file for the eNVM content, you do not have to rerun Compile or Place and Route. You can program or export your programming file directly. Programming will generate a new programming file that includes your updated eNVM content.

You can also specify the start address where the data for that client starts, the word size and the number of words to reserve for the data storage client.

Modify Serialization Client

Double-click the Serialization Client to open the Modify Serialization Client dialog box.

Note: You cannot add, delete or rename a Serialization Client in the Modify Serialization Client dialog box. Go to the eNVM configurator inside the MSS/HPMS Configurator or the System Builder Memory page (eNVM tab) to make these changes.

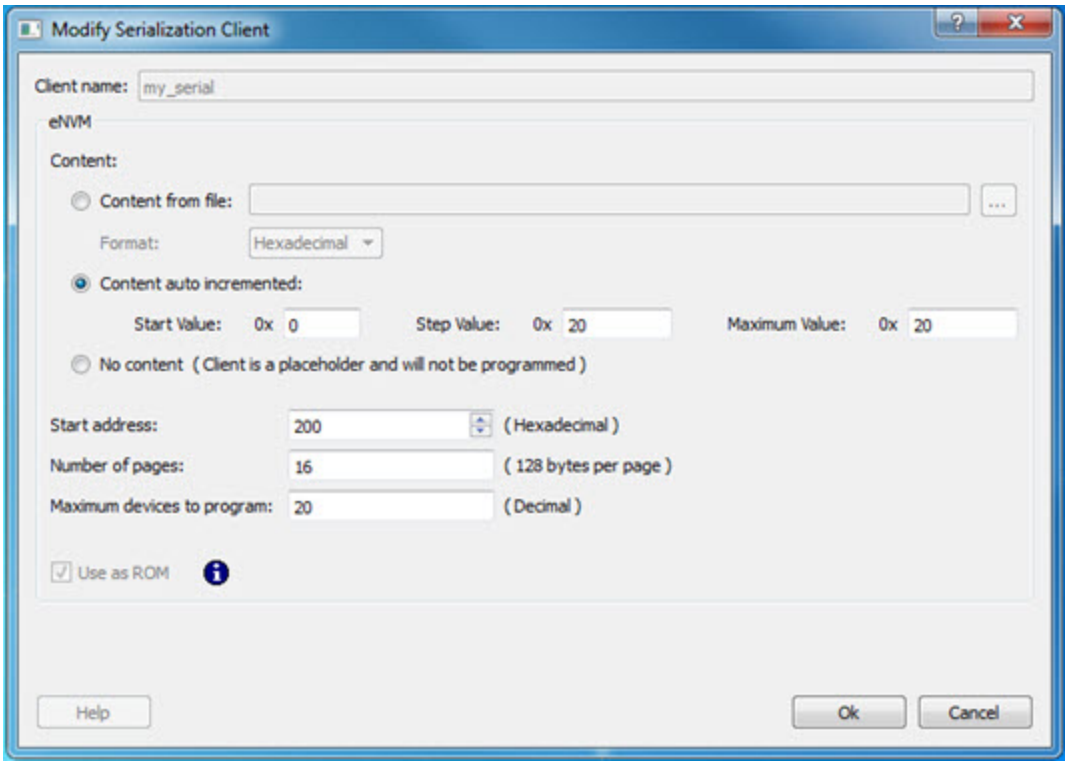

Figure 51 · Modify Serialization Client Dialog Box

You have three options to specify the eNVM content:

- Import a Memory File
- Increment values automatically
- Assign No Content (eNVM as a Placeholder). The client will not be included in the programming bitstream and will not be programmed

If you have completed Place and Route and you import a memory file for the eNVM content, you do not have to rerun Compile or Place and Route. You can program or export your programming file directly. Programming will generate a new programming file that includes your updated eNVM content.

You can also specify the start address where the data for the Serialization Client starts, the number of pages and the maximum number of devices you want to program serialization data into.

Setting a maximum number of devices to program for Serialization clients will generate a programming bitstream file that has serialization content for the number of devices specified. The maximum number of devices to program must match for all serialization clients. If the user would like to program a subset of the devices during production programming, this can be done within the FlashPro Express tool, which allows you to select a range of indices desired for programming for that serialization programming job session. Refer to the FlashPro Express User's Guide for more information.

Update uPROM Memory Content - RTG4 Only

Use the Update uPROM Memory Content tool if you have reserved space in the uPROM Configurator and, after Place and Route, you want to make changes to the uPROM clients. After you have updated the uPROM Memory Content, there is no need to rerun Place and Route.

To update the uPROM Memory Content from the Design Flow Window:

1. Right-click Update uPROM Memory Content in the Design Flow window and choose **Configure Options**.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

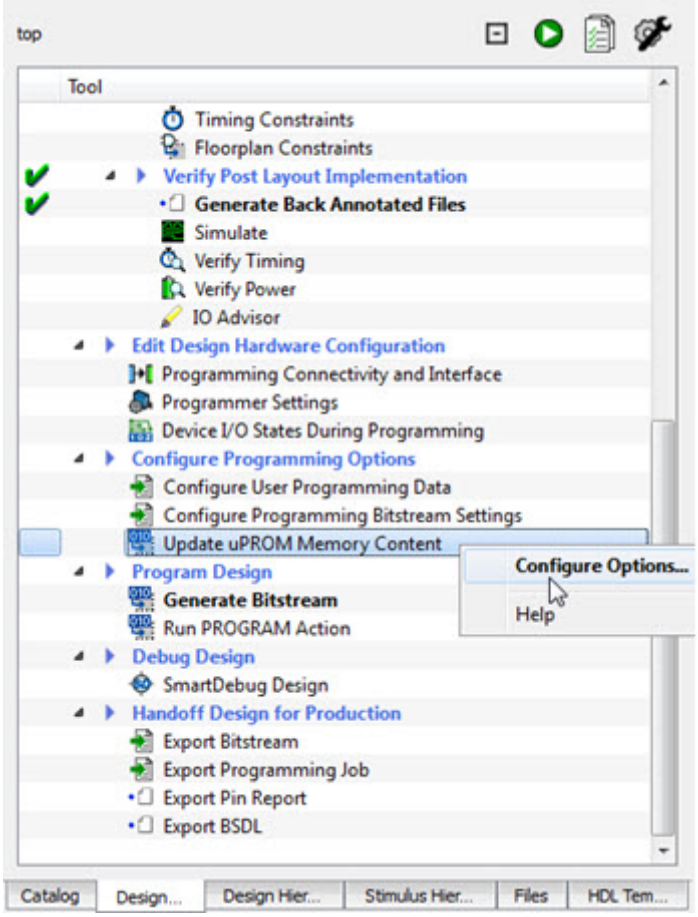

Figure 52 · Update uPROM Memory Content

2. When the uPROM Update Tool appears, right-click the Memory Client you want to update and choose **Edit**.

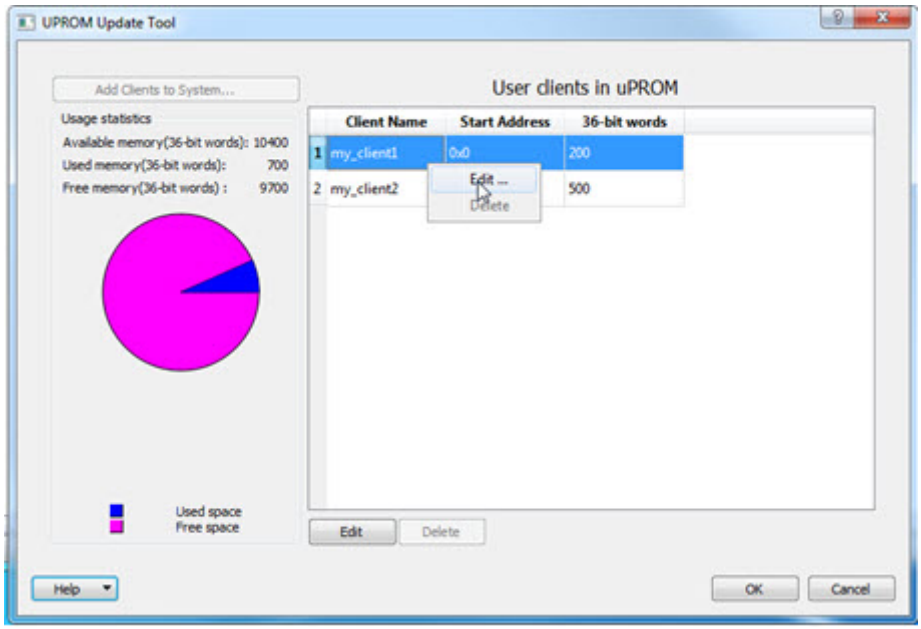

Figure 53 · uPROM Update Tool

The Edit Data Storage Client dialog box appears.

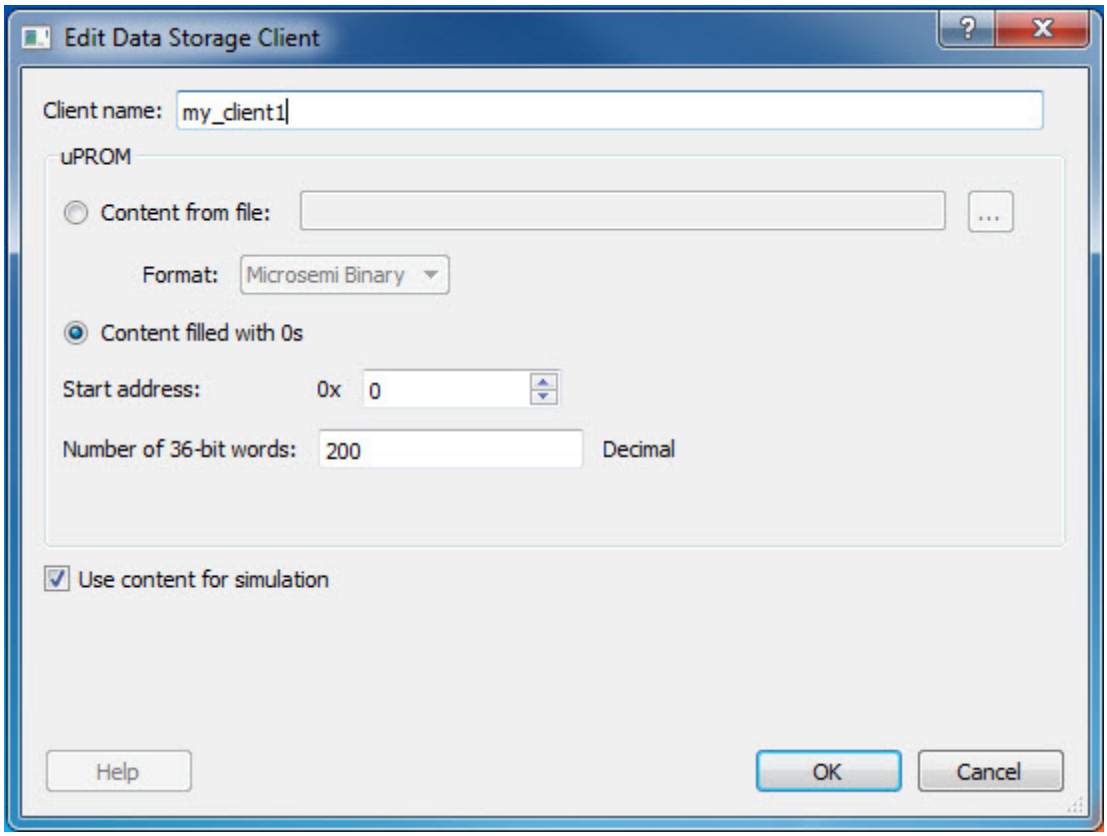

Figure 54 · Edit Data Storage Client Dialog Box

You can make the following changes to the uPROM client:

- Rename a Client
- Change the memory content, memory size and start address of the client
- Reverse your decision on whether or not to use Content for Simulation

Note: You cannot use the Update uPROM tool to add or delete a client. To add or delete a client, you must use the uPROM Configurator to reconfigure your Clients and regenerate your uPROM component and your design.

Serialization Client Editor

Serialization enables you to have a client in the eNVM whose value is different for each device that is programmed. You can program n number of devices with values that are configured as either Auto Incremented (AUTO_INC) or Read from File (READ_FROM_FILE).

The Serialization Client Editor is available from within the Update eNVM Memory Core dialog box. Double-click **eNVM** in your MSS (SmartFusion) or System Builder (IGLOO2) to view the eNVM Memory Core dialog box.

The Serialization Client Editor enables you to specify your serialization type. You must use eNVM Configuration to reserve a client for serialization - see the eNVM Configuration help and the tutorial topic for more information.

Content Type

Content from file

The number of lines in the file is the number of devices desired for serialization programming. The first line is the first serial index to be used for programming, the second line is the second serial index to be used for

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programming and the last line is the last serial index to be used for programming. Blank lines and comments (lines that begin with a # character) will be ignored.

Two file formats:

- **DEC**: An unsigned 64-bit decimal value.
- **HEX**: Hexadecimal value to be programmed into the device. If one page is specified for the serialization client, then a maximum of 256HEX characters can be placed on each line. The data orientation is MSB -> LSB, where the least significant byte is all the way to the right. If the data does not complete a page, then the page will be padded with 0's. If serialization client is larger than one page then the data format is as follows:

<Page N><PageN-1>.....<Page1><Page0>

Where each Page X is a maximum of 256HEX characters

Content auto incremented

- **Start Value (Hex)** - The first 64-bit unsigned value to program to the device.
- **Step Value (Hex)** - The step value to use for each subsequent device to be programmed.
- **Maximum Value (Hex)** - The maximum value to be programmed on the last device.

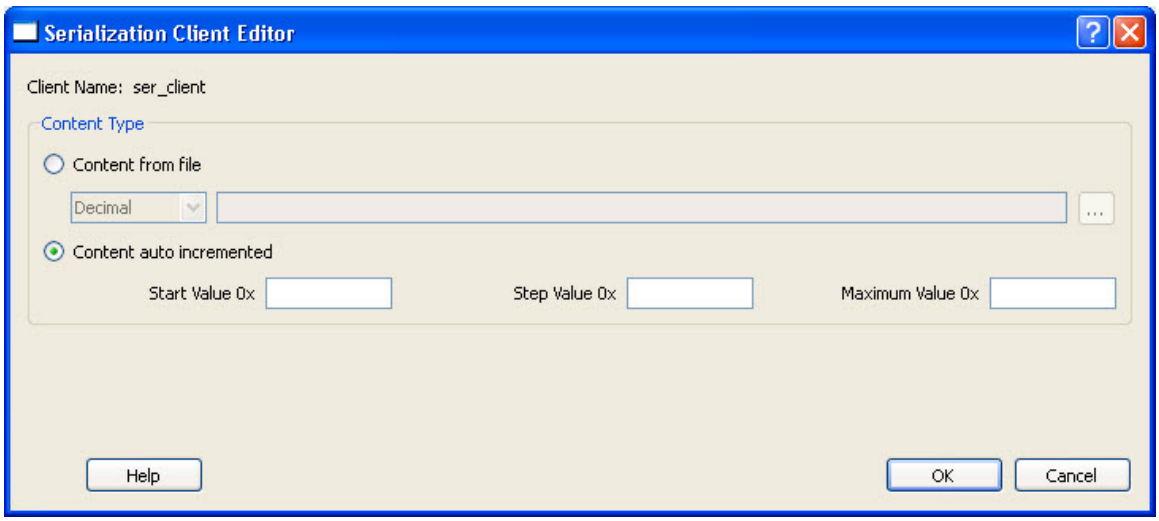


Figure 55 · Serialization Client Editor Dialog Box

Configure Bitstream Dialog Box - SmartFusion2, IGLOO2, and RTG4

Right-click **Generate Bitstream** in the Design Flow window and choose **Configure Options** to open the Configure Bitstream dialog box.

The Configure Bitstream dialog box enables you to select which components you wish to program. Only features that have been added to your design are available for programming. For example, you cannot select eNVM for programming if you do not have an eNVM in your design.

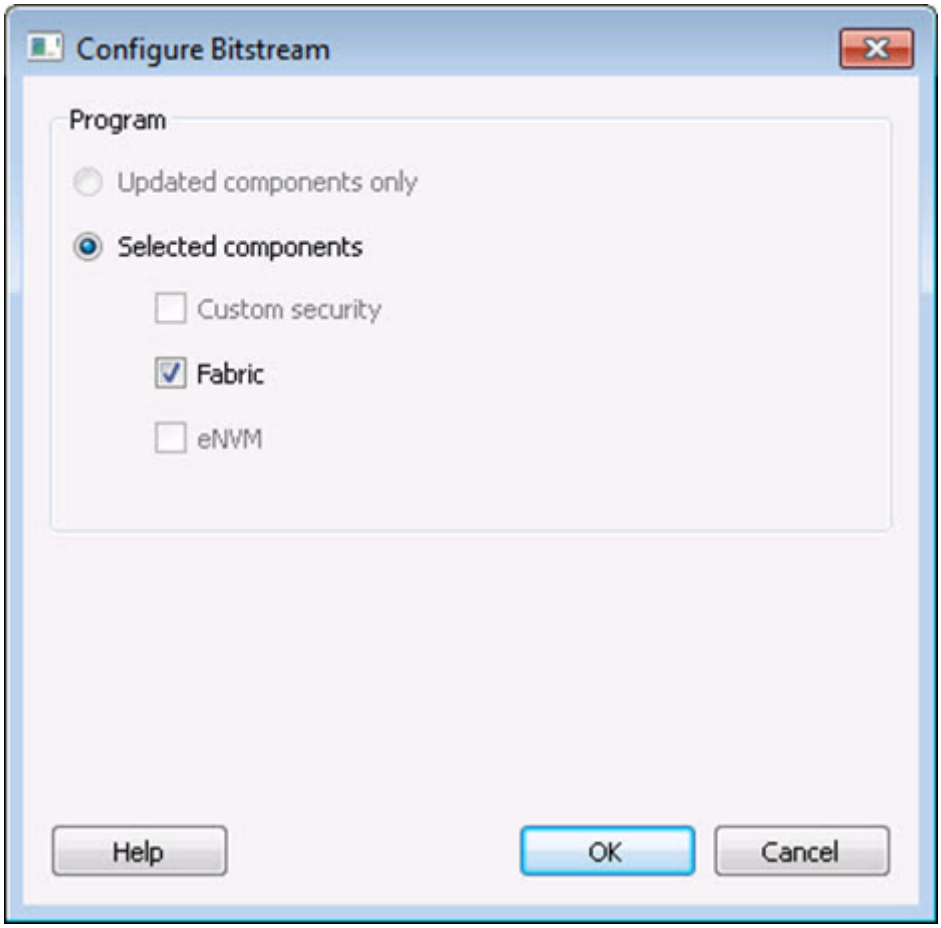


Figure 56 · Configure Bitstream Dialog Box - SmartFusion2 and IGLOO2

Updated components only (not supported in this release) - Updates only the components that have changed since your last programming.

Selected components - Updates the components you select, regardless of whether or not they have changed since your last programming.

Note: The Custom security and eNVM components are not available for RTG4 devices.

Generate Bitstream - SmartFusion2, IGLOO2, and RTG4

Generates the bitstream for use with the Run PROGRAM Action tool.

The tool incorporates the Fabric design, eNVM configuration (if configured) and security settings (if configured) to generate the bitstream file. You need to configure the bitstream before you generate the bitstream. Right-click **Generate Bitstream** and choose **Configure Options** to open the Configure Bitstream dialog box to select which components you wish to program. Only features that have been added to your design are available for programming. For example, you cannot select eNVM for programming if you do not have an eNVM in your design.

Modifications to the Fabric design, eNVM configuration, or security settings will invalidate this tool and require regeneration of the bitstream file.

The Fabric programming data will only be regenerated if you make changes to the Fabric design, such as in the Create Design, Create Constraints and Implement Design sections of the Design Flow window.

This operation is completed automatically as the last step if you use the Build button.

When the process is complete a green check appears next to the operation in the Design Flow window (as shown in the figure below) and information messages appear in the Log window.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

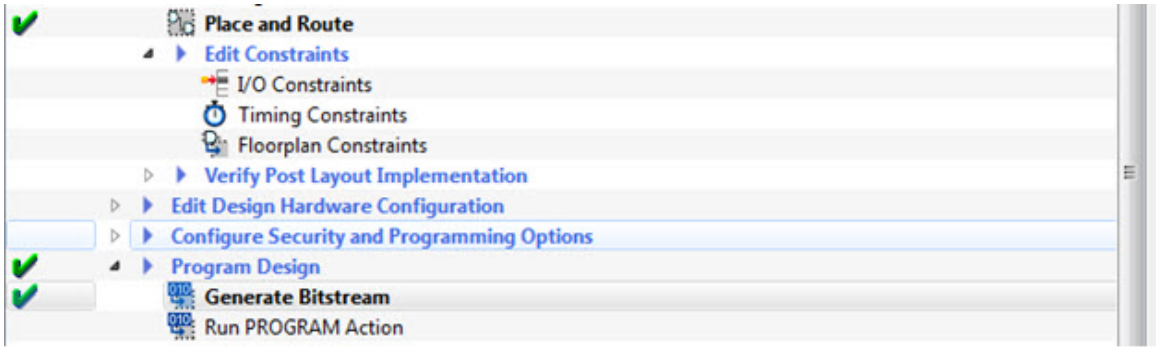


Figure 57 · Generate Bitstream (Complete)

See also

Configure Bitstream Dialog Box

Run PROGRAM Action - SmartFusion2, IGLOO2, and RTG4 Only

If you have a device programmer connected, you can double-click **Run PROGRAM Action** to execute your programming in batch mode with default settings.

If your programmer is not connected, or if your default settings are invalid, the Reports view lists the error(s).

Right-click **Run PROGRAM Action** and choose **Configure Action/Procedures** to open the Select Action and Procedures dialog box.

Program Device - SmartFusion, IGLOO, ProASIC3, and Fusion

Double-click **Program Device** in the Design Flow window to create a programming file (if necessary) and program your device with default settings. A programming file will be generated prior to programming, if it has not already been generated.

To change the programming action, configure the JTAG chain, modify the programmer settings, or make any other programming changes, you will need to configure these changes with the FlashPro tool.

1. Right-click **Program Device** and choose **Open Interactively** to open FlashPro to change the programming action, configure the JTAG chain, modify the programmer settings, or make any other programming changes.
2. Make your changes.
3. Save your changes and continue programming with Libero, or you can program directly from FlashPro.

For the SmartFusion device, Libero only exports the FDB file. Inside the FlashPro tool , you can add the eNVM or FlashROM if it has not been added or modify the eNVM or FlashROM if it has been added. For Security, you must add it in FlashPro. To open FlashPro interactively, right-click **Program Device** or **Export Programming File** and choose **Open Interactively**.

SmartFusion2 and IGLOO2 Programming - Default Settings

To view your default settings, from the **Project** menu choose **Project Settings**.

To program your SmartFusion2 or IGLOO2 device with default settings:

1. Create a Libero Soc project using any SmartDesign component. For example, you can create a project using a SmartDesign component, such as a simple fabric module and a MSS block with Flash Memory module.
2. Click the Build button to complete Synthesis, Place and Route and program the device with default settings. The default settings do not contain any security settings; use the Security Policy Manager (SPM) to manage your settings prior to programming your device.

SmartFusion2 and IGLOO2 Programming - Custom Settings

Custom Programming Settings enable you to build the JTAG chain, define programmer settings, set I/O states during programming and run scan chain.

1. To create a JTAG chain, in the Design Flow window expand **Edit Design Hardware Configuration**, right-click **Programming Connectivity and Interface** and choose **Open Interactively**. It opens a schematic view of the devices connected in a JTAG chain; all the devices are targeted by default.

   The Programming and Connectivity Interface detects and constructs the JTAG chain automatically. Use the interface to add devices manually.
   When you add Microsemi devices you can either load the STP or PDB file or add the device from a drop-down list. You must provide the IR length and Max TCK frequency OR load the BSDL file for non-Microsemi devices.
2. Right-click **Programmer Settings** and choose **Open Interactively** to view your programmer settings. If necessary, click Edit Programmer Settings to specify custom settings for your programmer.
3. Right-click **Device I/O States During Programming** and choose **Open Interactively** to open the Specify I/O States During Programming dialog box and set your device I/O states. Click OK to save your settings and continue.
4. Expand Configure Security, right-click **Security Policy Manager** and choose **Open Interactively** to specify your Secured Programming Use Model, User Key Entry and Security Policies.

Exit Codes (SmartFusion2 and IGLOO2)

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
	0	Passed (no error)	-	-
0x8001	-24	Failure to read DSN	Device is in System Controller Suspend Mode Check board connections	TRSTB should be driven High or disable "System Controller Suspend Mode".
0x8002	5	Failure to configure device programming at 1.2/1.0 VCC voltage	Unstable voltage level Signal integrity issues on JTAG pins	Monitor related power supplies that cause the issue during programming; check for transients outside of Microsemi specifications. See your device datasheet for more information on transient specifications. Monitor JTAG supply pins during

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
				programming; measure JTAG signals for noise or reflection.
0x8032	5	Device is busy	Unstable VDDIx voltage level	Monitor related power supplies that cause the issue during programming; check for transients outside of Microsemi specifications. See your device datasheet for more information on transient specifications.
0x8003	5	Failed to enter programming mode	Unstable voltage level Signal integrity issues on JTAG pins DEVRST_N is tied to LOW	Monitor related power supplies that cause the issue during programming; check for transients outside of Microsemi specifications. See your device datasheet for more information on transient specifications. Monitor JTAG supply pins during programming; measure JTAG signals for noise or reflection. Tie DEVRST_N to HIGH prior to programming the device.

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
0x8004	6	Failed to verify IDCODE	Incorrect programming file Incorrect device in chain Signal integrity issues on JTAG pins	Choose the correct programming file and select the correct device in the chain. Measure JTAG pins and noise for reflection. If TRST is left floating then add pull-up to pin. Reduce the length of Ground connection.
0x8005 0x8006	10	Failed to program eNVM	Unstable voltage level. Signal integrity issues on JTAG pins.	Monitor related power supplies that cause the issue during programming; check for transients outside of Microsemi specifications. See your device datasheet for more information on transient specifications. Monitor JTAG supply pins during programming; measure JTAG signals for noise or reflection.
0x8007	11	Failed to verify FPGA Array Failed to verify Fabric Configuration Failed to verify	Device is programmed with a different design or the component is blank. Unstable	Verify the device is programmed with the correct data/design. Monitor related power supplies

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
		Security	voltage level. Signal integrity issues on JTAG pins.	that cause the issue during programming; check for transients outside of Microsemi specifications. See your device datasheet for more information on transient specifications. Monitor JTAG supply pins during programming; measure JTAG signals for noise or reflection.
0x8008 0x8009	11	Failed to verify eNVM	Device is programmed with a different design. Unstable voltage level. Signal integrity issues on JTAG pins.	Verify the device is programmed with the correct data/design. Monitor related power supplies that cause the issue during programming; check for transients outside of Microsemi specifications. See your device datasheet for more information on transient specifications. Monitor JTAG supply pins during programming; measure JTAG signals for noise or

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
				reflection.
0x8010	-35	Failed to unlock User Pass Key 1	Pass key in file does not match device	Provide a programming file with a pass key that matches pass key programmed into the device.
0x8011	-35	Failed to unlock User Pass Key 2	Pass key in file does not match device	Provide a programming file with a pass key that matches pass key programmed into the device.
0x8012	-35	Failed to unlock debug pass key	Pass key in file does not match device	Provide a programming file with a pass key that matches pass key programmed into the device.
0x8013	-18	Digest request from SPI/JTAG is protected by User Pass Key 1	Digest request from SPI/JTAG is protected by user pass key 1. Lock bit has been configured in the Debug Policy within SPM (Security Policy Manager)	Provide a programming file with a pass key that matches pass key programmed into the device.
0x8014	-19	Failed to verify digest	Unstable voltage level Signal integrity issues on JTAG pins	Monitor related power supplies that cause the issue during programming; check for transients outside of Microsemi specifications. See your device

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
				datasheet for more information on transient specifications. Monitor JTAG supply pins during programming; measure JTAG signals for noise or reflection.
0x8015	-20	FPGA Fabric digest verification: FAIL	Programming bitstream components do not match components programmed FPGA Fabric is either erased or the data has been corrupted or tampered with	Use the same programming file that was used to program the device.
0x8016	-20	eNVM_0 digest verification: FAIL	Programming bitstream components do not match components programmed eNVM_0 data has been corrupted or tampered with	Use the same programming file that was used to program the device.
0x8017	-20	eNVM_1 digest verification: FAIL	Programming bitstream components do not match components programmed eNVM_1 data has been corrupted or tampered with	Use the same programming file that was used to program the device.
0x8018	-20	User security policies segment digest verification: FAIL	Programming bitstream components do not match	Use the same programming file that was used to

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
			components programmed User security policy segment data has been corrupted or tampered with	program the device.
0x8019	-20	User key set 1 segment digest verification: FAIL	Programming bitstream components do not match components programmed User key set 1 segment data has been corrupted or tampered with	Use the same programming file that was used to program the device.
0x801A	-20	User key set 2 segment digest verification: FAIL	Programming bitstream components do not match components programmed User key set 2 segment data has been corrupted or tampered with	Use the same programming file that was used to program the device.
0x801B	-20	Factory row and factory key segment digest verification: FAIL	Programming bitstream components do not match components programmed Factory row and factory key segment data has been corrupted or tampered with	Use the same programming file that was used to program the device.
0x801C	-20	Fabric configuration segment digest verification: FAIL	Programming bitstream components do not match components programmed. Fabric	Use the same programming file that was used to program the device.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
			configuration segment data has been corrupted or tampered with	
0x801D 0x801E	-21	Device security prevented operation	The device is protected with user pass key 1 and the bitstream file does not contain user pass key 1. User pass key 1 in the bitstream file does not match the device.	Run DEVICE_INFO to view security features that are protected. Provide a bitstream file with a user pass key 1 that matches the user pass key 1 programmed into the device.
0x801F 0x8020	-22	Authentication Error Bitstream or data is corrupted or noisy	Running VERIFY action on a blank device. Bitstream file has been corrupted Bitstream was incorrectly generated	Program the device prior to running VERIFY action Regenerate bitstream file.
0x8021 0x8022	-23	Authentication Error Invalid/Corrupted encryption key	File contains an encrypted key that does not match the device Attempting to erase a device with no security using master security file File contains user encryption key, but device has not been programmed with the user encryption key Device has user encryption key 1/2 enforced and	Provide a programming file with an encryption key that matches that on the device. Run DEVICE_INFO action to verify that the device has no security. If the device does not have secuirty, you cannot erase it. First program security with master programming file, then program with

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
			you are attempting to reprogram security settings	user encryption 1/2 field update programming files. You must first ERASE security with the master security file, then you can reprogram new security settings.
0x8023 0x8024	-24	Authentication Error Back level not satisfied	Design version is not higher than the back-level programmed device	Generate a programming file with a design version higher than the back level version.
0x8025 0x8026	-25	Authentication Error DSN binding mismatch	DSN specified in programming file does not match the device being programmed	Use the correct programming file with a DSN that matches the DSN of the target device being programmed.
0x8027 0x8028	-26	Authentication Error Insufficient device capabilities	Device does not support the capabilities specified in programming file	Generate a programming file with the correct capabilities for the target device.
0x8029 0x802A	-27	Authentication Error Incorrect DEVICEID	Incorrect programming file Incorrect device in chain Signal integrity issues on JTAG pins	Choose the correct programming file and select the correct device in chain. Measure JTAG pins and noise or reflection. If TRST is left floating, then add pull-up to pin. Reduce the length of ground

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
				connection.
0x802B 0x802C	-28	Authentication Error Programming file is outdated, please regenerate	Programming file version is out of date	Generate programming file with latest version of Libero SoC.
0x802F	-30	JTAG interface is protected by UPK1	Invalid or no UPK1 is provided	User needs to provide correct UPK1 to unlock device.
0x8030 0x8031	-31	Authentication Error Invalid or inaccessible Device Certificate	M2S090 Rev. A or M2S150 Rev. A: Either certificate is corrupted or the user hasn't provided the application code in the eNVM or provided invalid application code FAB_RESET_N is tied to ground	User can program a valid application code. This can be done with SoftConsole. FAB_RESET_N should be tied to HIGH.
0x8032 0x8033 0x8034 0x8035 0x8036 0x8037 0x8038 0x8039	-32	Instruction timed out	Unstable voltage level Signal integrity issues on JTAG pins	Monitor related power supplies that cause the issue during programming; check for transients outside of Microsemi specifications. See your device datasheet for more information on transient specifications. Monitor JTAG supply pins during programming; measure JTAG signals for

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
				noise or reflection.
0x8040	-22	Authentication Error Bitstream or data is corrupted or noisy	Running VERIFY action on a blank device. Bitstream file has been corrupted Bitstream was incorrected generated	Program the device prior to running VERIFY action Regenerate bitstream file.
0x8041	-23	Authentication Error Invalid/Corrupted encryption key	File contains an encrypted key that does not match the device File contains user encryption key, but device has not been programmed with the user encryption key Attempting to erase a device with no security using master security file Device has user encryption key 1/2 enforced and you are attempting to reprogram security settings	Provide a programming file with an encryption key that matches that on the device. Run DEVICE_INFO action to verify that the device has no security. If the device does not have secuirty, you cannot erase it. First program security with master programming file, then program with user encryption 1/2 field update programming files. You must first ERASE security with the master security file, then you can reprogram new security settings.
0x8042	-24	Authentication Error Back level not	Design version is not higher than the back-level	Generate a programming file with a design version

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
		satisfied	programmed device	higher than the back level version.
0x8043	-25	Authentication Error DSN binding mismatch	DSN specified in programming file does not match the device being programmed	Use the correct programming file with a DSN that matches the DSN of the target device being programmed.
0x8044	-26	Authentication Error Insufficient device capabilities	Device does not support the capabilities specified in programming file	Generate a programming file with the correct capabilities for the target device.
0x8045	-27	Authentication Error Incorrect DEVICEID	Incorrect programming file Incorrect device in chain Signal integrity issues on JTAG pins	Choose the correct programming file and select the correct device in chain. Measure JTAG pins and noise or reflection. If TRST is left floating, then add pull-up to pin. Reduce the length of ground connection.
0x8046	-28	Authentication Error Unsupported bitstream protocol version	Old programming file	Generate programming file with latest version of Libero SoC.
0x8048	-31	Authentication Error Invalid or inaccessible Device Certificate	M2S090 Rev. A or M2S150 Rev. A: Either certificate is corrupted or the user hasn't provided the application	User can program a valid application code. This can be done with SoftConsole. FAB_RESET_N should be tied

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
			code in the eNVM or provided invalid application code FAB_RESET_N is tied to ground	to HIGH.
0x8049	11	Failed to verify eNVM	Device is programmed with a different design. Unstable voltage level. Signal integrity issues on JTAG pins.	Verify the device is programmed with the correct data/design. Monitor related power supplies that cause the issue during programming; check for transients outside of Microsemi specifications. See your device datasheet for more information on transient specifications. Monitor JTAG supply pins during programming; measure JTAG signals for noise or reflection.
8x804A	10	Failed to program eNVM	Unstable voltage level. Signal integrity issues on JTAG pins.	Monitor related power supplies that cause the issue during programming; check for transients outside of Microsemi specifications. See your device datasheet for more

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
				information on transient specifications. Monitor JTAG supply pins during programming; measure JTAG signals for noise or reflection.
0x804B	-21	Device security prevented operation	The device is protected with user pass key 1 and the bitstream file does not contain user pass key 1. User pass key 1 in the bitstream file does not match the device.	Run DEVICE_INFO to view security features that are protected. Provide a bitstream file with a user pass key 1 that matches the user pass key 1 programmed into the device.
0x804C	11	Failed to verify FPGA Array Failed to verify Fabric Configuration Failed to verify Security	Device is programmed with a different design or the component is blank. Unstable voltage level. Signal integrity issues on JTAG pins.	Verify the device is programmed with the correct data/design. Monitor related power supplies that cause the issue during programming; check for transients outside of Microsemi specifications. See your device datasheet for more information on transient specifications. Monitor JTAG supply pins during programming; measure JTAG

Error Code	Exit Code	Exit Message	Possible Cause	Possible Solution
				signals for noise or reflection.
0x804D	-36	<HSM related error message based on scenario>	HSM communication error. HSM call returns error.	Check if HSM the communication path to HSM is up. Make sure project is loaded properly and that HSM tickets have not been cleaned.

Programming File Actions - SmartFusion2 and IGLOO2

Libero SoC enables you to program security settings, FPGA Array, and eNVM features for SmartFusion2 and IGLOO2 device support.

You can program these features separately using different programming files or you can combine them into one programming file.

In the Design Flow window, expand **Program Design**, click **Run PROGRAM Action**, and right-click **Configure Actions/Procedures**.

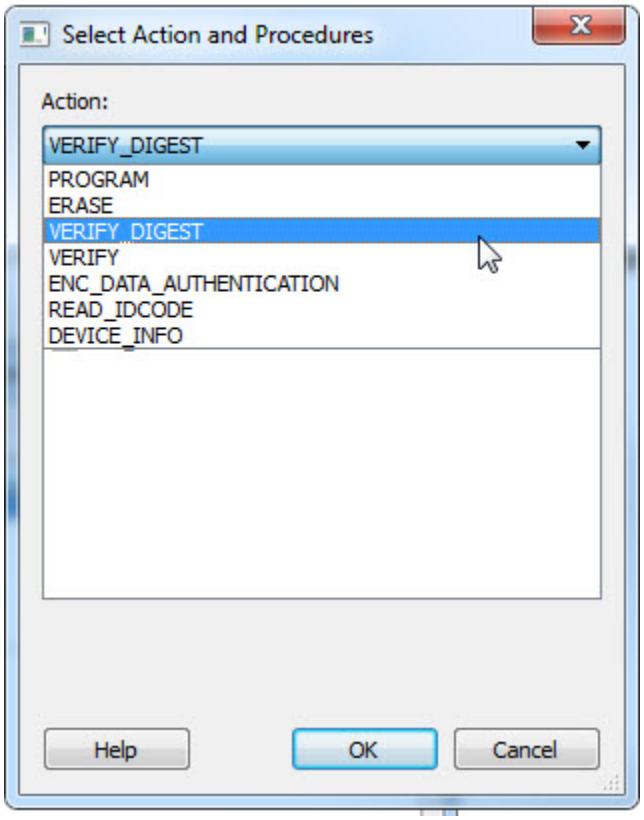


Figure 58 · Programming File Actions

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Programming File Actions

Action	Description
PROGRAM	Programs all selected family features: FPGA Array, targeted eNVM clients, and security settings.
ERASE	Erases the selected family features: FPGA Array and Security settings.
VERIFY_DIGEST	Calculates the digests for the components (Custom Security, Fabric, or eNVM) included in the bitstream and compares them against the programmed values.
VERIFY	Verifies all selected family features: FPGA Array, targeted eNVM clients, and security settings.
ENC_DATA_AUTHENTICATION	Encrypted bitstream authentication data.
READ_IDCODE	Reads the device ID code from the device.
DEVICE_INFO	Displays the IDCODE, the design name, the checksum, and device security settings and programming environment information programmed into the device.

Options Available in Programming Actions

The table below shows the options available for specific programming actions.

Table 2 · Programming File Actions - Options

Action	Option and Description
PROGRAM	DO_VERIFY - Enables or disables programming verification

Bitstream Encryption with Default Key in Security Policy Manager - SmartFusion2 and IGLOO2

See the Export Bitstream topic for more information on exporting your bitstream.

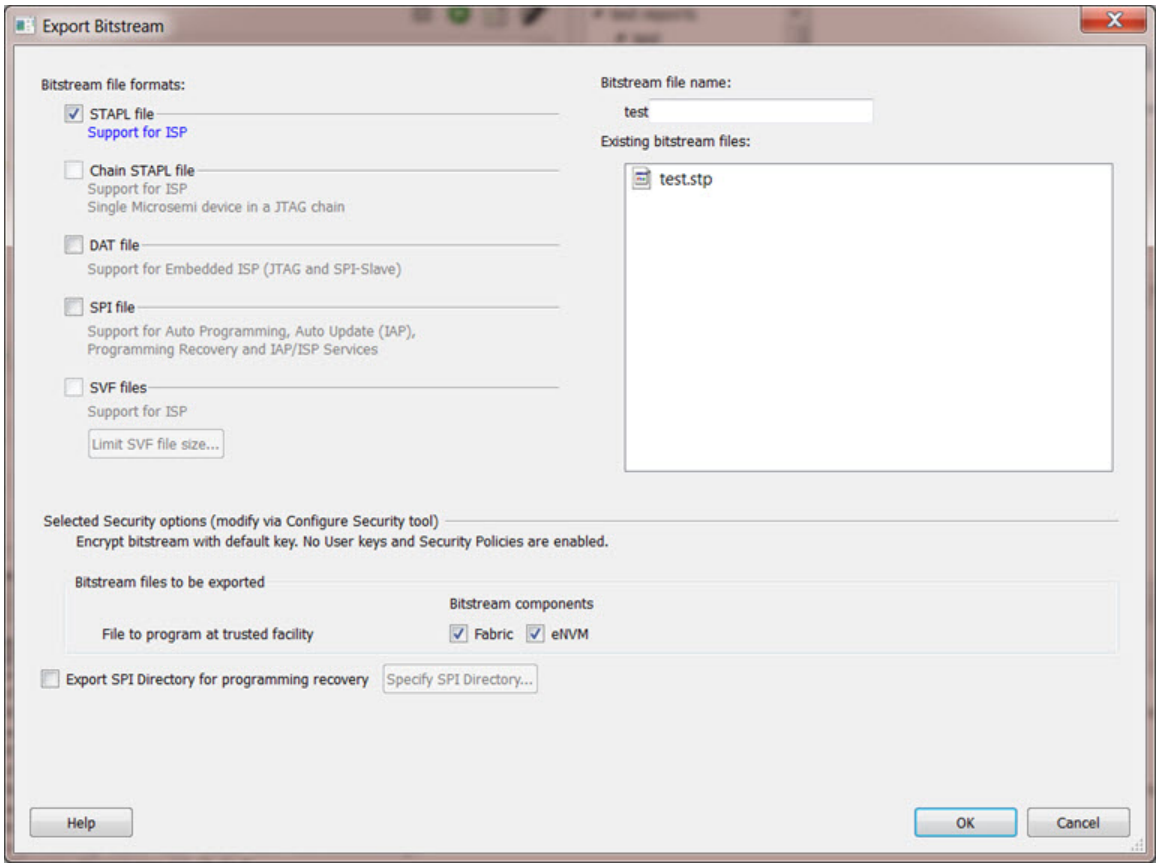


Figure 59 · Export Bitstream Dialog Box

Bitstream file name - Sets the name of your bitstream file. The prefix varies depending on the name of your top-level design.

Existing bitstream files - Lists bitstream files you created already.

Bitstream File Formats:

Select the Bitstream File format you want to export:

- STAPL file
- Chain STAPL file (Enabled only when there are two or more devices in the chain)
- DAT file
- SPI file

Selected Security options (modify via Security Policy Manager) – Gives a brief description of current security options.

Bitstream files to be exported – Lists all the bitstream files that will be exported.

File to program at trusted facility – Click to include Fabric and/or eNVM into the bitstream files to be programmed at a trusted facility.

Note: Only features that have been added to your design are available for programming. For example, you cannot select eNVM for programming if you do not have an eNVM in your design.

Export SPI Directory for programming recovery – Allows you to export SPI directory containing Golden and Update SPI image addresses and design versions, used in Auto-update and Programming Recovery flow. Check this option and click Specify SPI Directory to set the required information (see figure below).

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

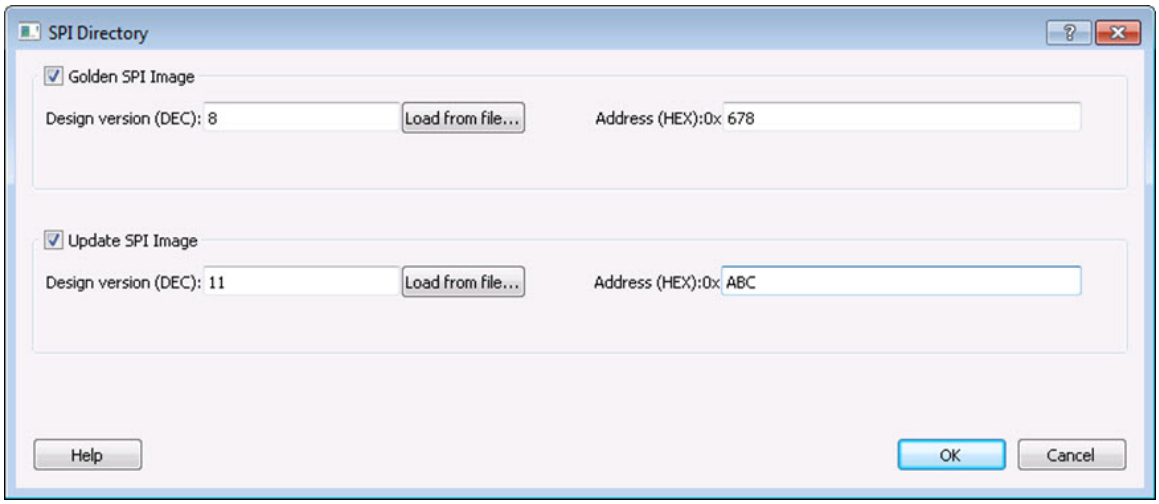


Figure 60 · SPI Directory Dialog Box

Enable Custom Security Options in the Security Policy Manager - SmartFusion2 and IGLOO2

See the Export Bitstream topic for information on exporting your bitstream.

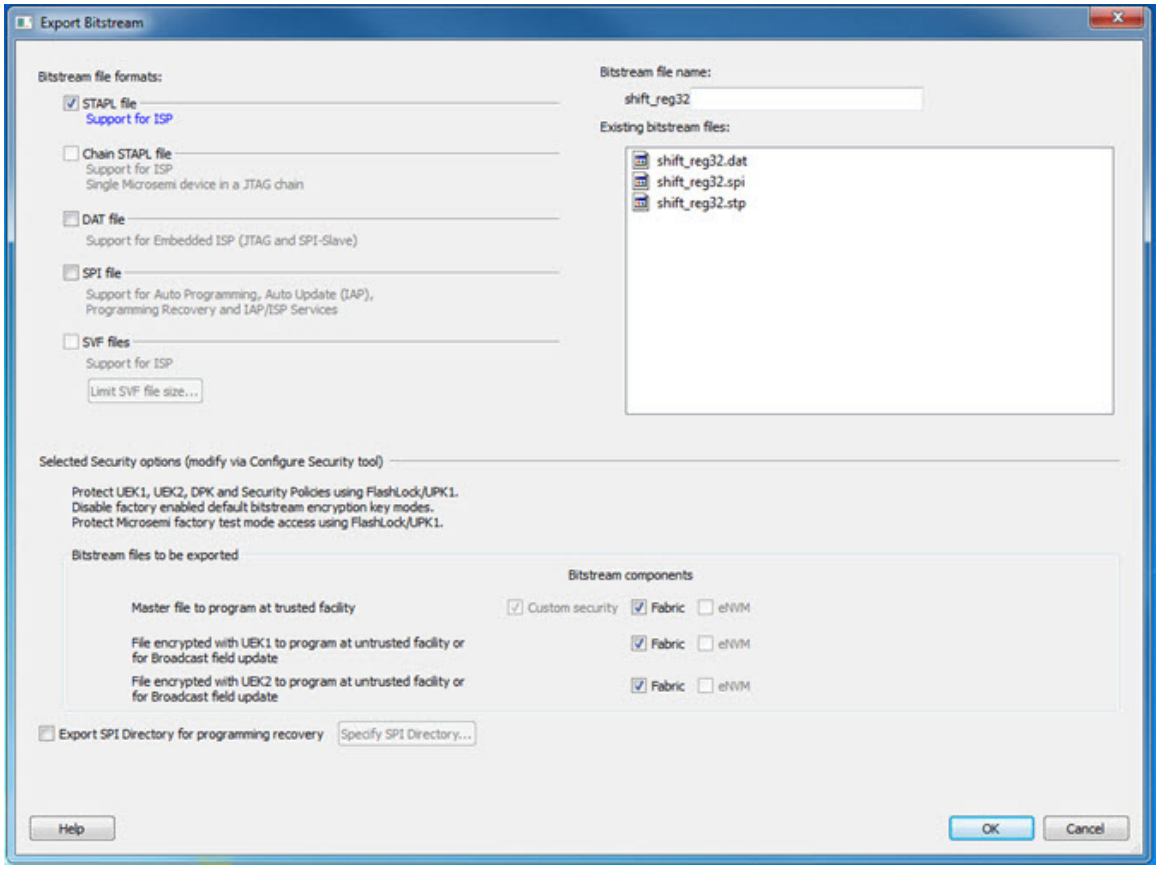


Figure 61 · Export Bitstream Dialog Box with Enable Custom Security Options in the Security Policy Manager

Bitstream file name - Sets the name of your bitstream file. The prefix varies depending on the name of your top-level design.

Existing bitstream files - Lists bitstream files you created already.

Bitstream File Format:

Select the Bitstream File format you want to export:

- STAPL file
- Chain STAPL file (Enabled only when there are two or more devices in the chain)
- DAT file
- SPI file

Selected Security options (modify via Configure Security tool) – Gives a brief description of current security options.

Bitstream files to be exported – Lists all the bitstream files that will be exported.

Note: If a component (for example, eNVM) is not present in design then it will be disabled in the bitstream component selection.

Master file to program at trusted facility – Click to include Fabric and/or eNVM into the bitsream files to be programmed at a trusted facility. Note that Security is always programmed in Master file.

File encrypted with UEK1 to program at untrusted facility or for Broadcast field update – Click to include Fabric and/or eNVM into the bitsream files to be programmed. If the selected features is not protected by UPK1, the bitstream can be programmed at untrusted location, since it is encrypted with UEK1 that is preprogrammed into the device.

File encrypted with UEK2 to program at untrusted facility or for Broadcast field update - Click to include Fabric and/or eNVM into the bitsream files to be programmed. If the selected features is not protected by UPK1, the bitstream can be programmed at untrusted location, since it is encrypted with UEK2 that is preprogrammed into the device.

Note: If the eNVM/Fabric is protected with UPK1 and included in the bitstream, UPK1 will be added to the STAPL and DAT file, and cannot be used at untrusted location.

Note: If eNVM/Fabric is One Time Programmable, it precluded from bitstream encrypted with UEK1/2.

Export SPI Directory for programming recovery – Allows you to export SPI directory containing Golden and Update SPI image addresses and design versions, used in Auto-update and Programming Recovery flow. Check this option and click Specify SPI Directory to set the required information (see figure below).

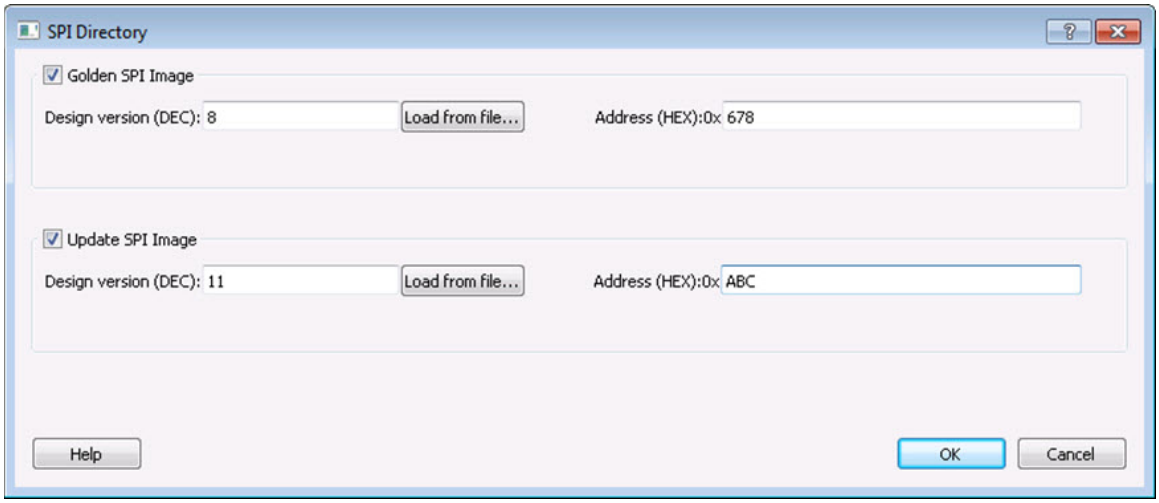


Figure 62 · SPI Directory Dialog Box

Programming SmartFusion in the Libero SoC

Double-click **Program Device** to create a programming file (if necessary) and program your device with default settings.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Right-click **Program Device** and choose **Open Interactively** to open FlashPro.

SmartFusion only exports the FDB file via Libero SoC. Inside the FlashPro tool, you can add the eNVM or FlashROM if it has not been added or modify the eNVM or FlashROM if it has been added. For Security, you must add it in FlashPro.

To open FlashPro interactively, right-click **Program Device** or **Export Programming File** and choose **Open Interactively**.

1. When FlashPro opens, click **File > Export > Export Single Programming File** to open the Export Programming Files dialog box.

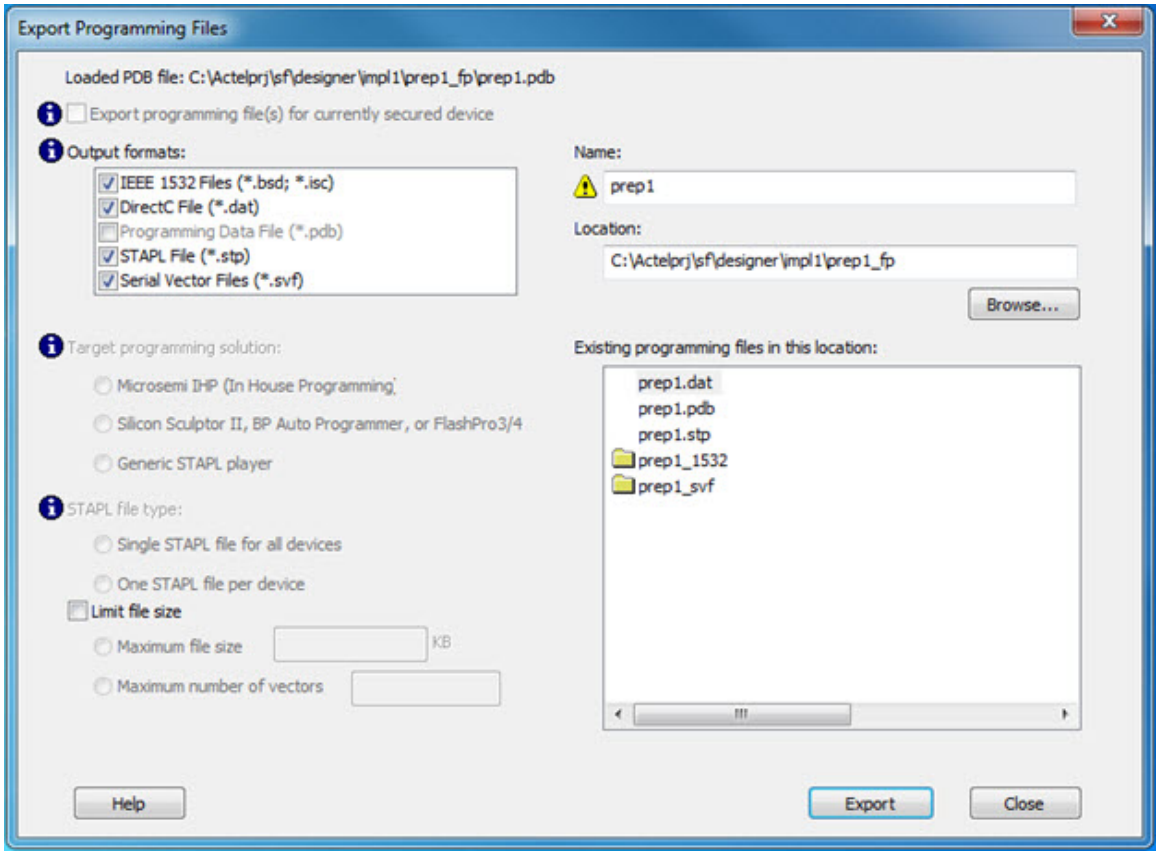


Figure 63 · Export Programming Files Dialog Box

2. Select the Programming File output format you want to generate:

- IEEE 1532 Files (*.bsd; *.isc)
- DirectC File (*.dat)
- STAPL File (*.stp)
- Serial Vector Files (*.svf)

3. Click **Export** to generate the programming files and then click **Close**.

Generating Programming Files

Generate a Programming File in FlashPoint

FlashPoint enables you to program security settings, FPGA Array, and FlashROM features for SmartFusion, IGLOO, ProASIC3, Fusion family devices. You can program these features separately using different programming files or you can combine them into one programming file. Each feature is listed as a silicon feature in the GUI.

Note: You can generate a programming file with one, two, or all of the silicon features from the Programming File Generator first page.

To generate a programming file:

1. Select the **Silicon feature(s)** you want to program.

- Security settings
- FPGA Array
- FlashROM

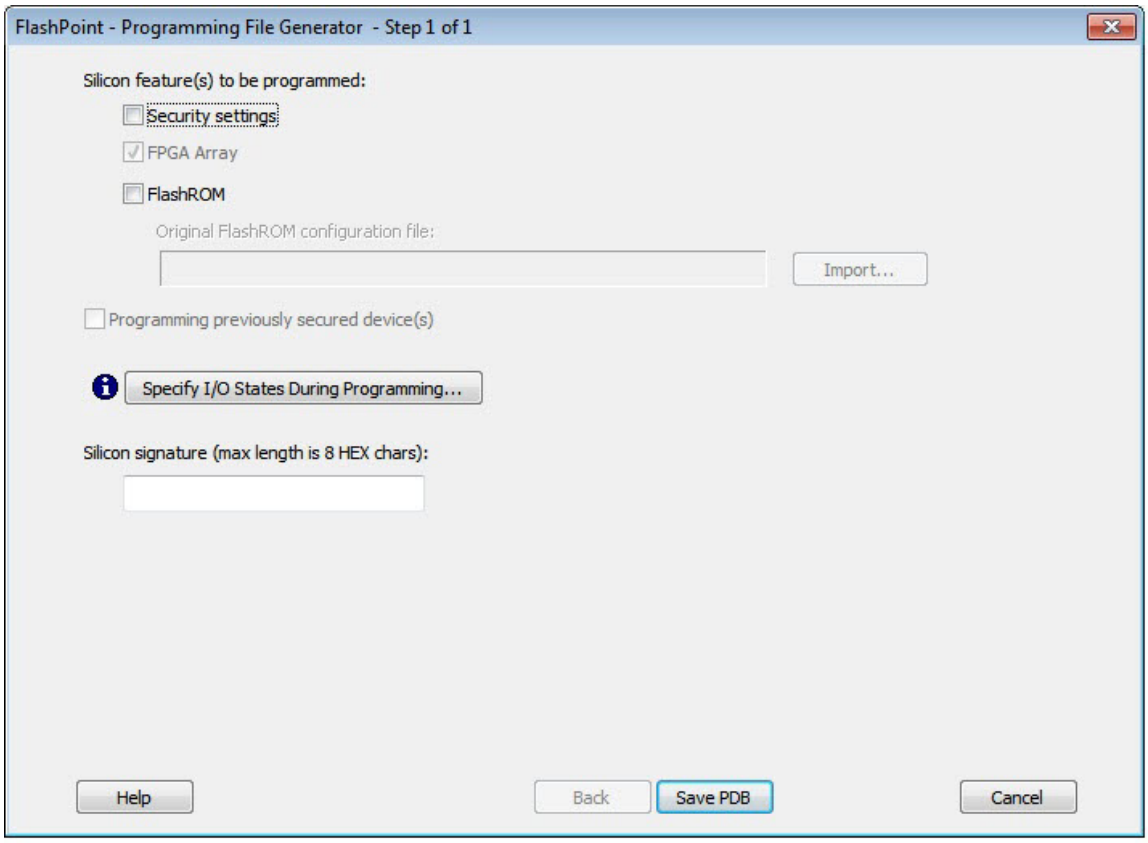


Figure 64 · Programming File Generator – Step 1 of 1

Note: When FlashPoint is invoked for the first time, after netlist files are imported and the design is in post-layout state, the software retrieves the FlashROM and EFM blocks configuration files from the imported netlists and imports the configuration files. Otherwise, you need to import configuration files.

2. Click the **Programming previously secured device(s)** check box if you are reprogramming a device that has been secured.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Because the SmartFusion, IGLOO, ProASIC3, Fusion families enable you to program the Security Settings separately from the FPGA Array and/or FlashROM, you must indicate if the Security Settings were previously programmed into the target device. This requirement also applies when you generate programming files for reprogramming.

3. Enter the silicon signature (0-8 HEX characters). See Silicon Signature for more information.
4. Click **Save PDB**.

Programming File Types

The table below summarizes the Microsemi SoC programming file types and programmers.

Unless otherwise noted, listing an individual device indicates the device family and all its derivatives. For example, IGLOO indicates IGLOO, IGLOOe, IGLOO nano and IGLOO plus. See the Supported Families topic for more information. See the list of programming file type descriptions below for more details.

Programming File Type	Device Support	Programmer
PDB (*.pdb)	See device specifications	FlashPro 4/3/3x
STAPL (*.stp)		FlashPro 4/3/3x, FlashPro Lite, FlashPro, Silicon Sculptor III/II
SVF (*.svf)		Third party programmer
IEEE 1532 (*.isc or *.bsd)		Third party programmer

The following programming-related files are required if you use the related functional block elements in your enabled devices. See the appropriate sections of the FlashPro help for more information on creating these files.

File Type	Device Support	Function
FDB (*.fdb)	See device specifications	Contains your FPGA array data
UFC (*.ufc)		Contains your FlashROM data
EFC (*.efc)		Contains your Embedded Flash Memory file

PDB Files

A proprietary Microsemi programming data file.

STAPL Files

The Standard Test And Programming Language (STAPL) is designed to support the programming of programmable devices and testing of electronic systems, using the IEEE Standard 1149.1: “Standard Test Access Port and Boundary Scan Architecture” (commonly referred to as JTAG) interface. As a STAPL file is executed, signals are produced on the IEEE 1149.1 interface, as described in the STAPL file. STAPL operates on a single IEEE 1149.1 chain. STAPL supports the programming of any IEEE 1149.1-compliant programmable device.

STAPL has support for programming and test systems with user interface features. A single STAPL file may perform several different functions, such as programming, verifying, and erasing a programmable device.

Bitstream Files

Proprietary Microsemi programming data file.

SVF Files

Courtesy Serial Vector Format Specification from ASSET InterTech, 1999:

Serial Vector Format (SVF) is the media for exchanging descriptions of high-level IEEE 1149.1 bus operations. In general, IEEE 1149.1 bus operations consist of scan operations and movements between different stable states on the IEEE 1149.1 state diagram. SVF does not explicitly describe the state of the IEEE 1149.1 bus at every Test Clock.

The SFV file is defined as an ASCII file that consists of a set of SVF statements. The maximum number of characters on a line is 256, although one SVF statement can span more htan one line. Each statement consists of a command and associated parameters. Each SVF statement is terminated by a semicolon. SVF is not case sensitive.

IEEE 1532 Files

Courtesy ieee.org:

The IEEE 1532 files implement programming capabilities within programmable integrated circuit devices, utilizing (and compatible with) the 1149.1 communication protocol. This standard allows the programming of one or more compliant devices concurrently, while mounted on a board or embedded in a system, known as In-System Configuration.

Generate a Programming File for SmartFusion

You can configure and generate a new PDB file from FlashPoint.

If you are using Single Mode, click **Create** to add a new PDB, or click **Modify** to make changes to a loaded PDB.

In Chain Mode, if you have not already done so, construct a chain and click **Create PDB** to create a new PDB for programming, or click **Modify PDB** to make changes to a loaded PDB.

FlashPoint enables you to specify your security settings and silicon features when you generate your programming file in SmartFusion. You can specify your FPGA Array, FlashROM, and Embedded Flash Memory by importing FDB, UFC and EFC files, respectively (as shown in the figure below). If you have imported a FlashROM and Embedded Flash Memory file you can click **Modify** to configure these feature before saving your PDB file.

Click Specify I/O States During Programming to set custom I/O states.

Note: You must import an FDB to populate Port Name and Macro Cell columns.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

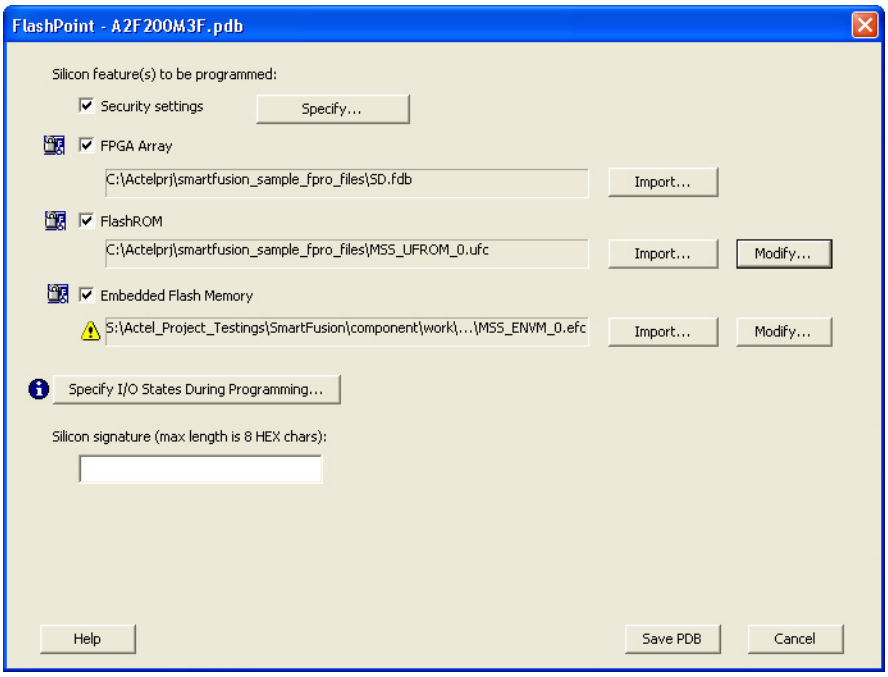


Figure 65 · FlashPoint Programming Settings for SmartFusion

Generate a Programming File for CoreMP7/Cortex-M1 Device Support

FlashPoint enables you to program FPGA Array and FlashROM features for CoreMP7/Cortex-M1 devices. You can program these features separately using different programming files or you can combine them into one programming file. Each feature is listed as a silicon feature in the GUI. You can generate a programming file with one, two, or all of the silicon features from the **Programming File Generator** first page. For CoreMP7/Cortex-M1 device support, you cannot select your own security settings. The generated programming file always has the encrypted FPGA Array content. The programming file generation is the same as the ProASIC3 family devices.

To generate a programming file:

1. Select the Silicon feature(s) you want to program.

   FPGA Array
   FlashROM

2. Click **Next** or **Finished** depending on the silicon features you selected.

   If you click **Next**, follow the instructions in the appropriate dialog box. If you click **Finish**, the **Generate Programming Files** dialog box appears. Use this dialog box box to specify the programming file name, location, and output format (STAPL file, SVF file, PDB file, DirectC DAT file, 1532 file).

For more information on DAT files, refer to the Data File Generator (DatGen) section of the *DirectC User's Guide*.

CoreMP7/Cortex-M1 Device Security

CoreMP7/Cortex-M1 devices are shipped with the following security enabled:

- FPGA Array enabled for AES encrypted programming and verification.
- FlashROM enabled for plain text read and write.

You cannot select your own security settings. The generated programming file includes the encrypted FPGA Array content.

Programming FlashROM and FPGA Array

For CoreMP7/Cortex-M1 device support, the programming generation for FlashROM and FPGA Array is the same as the programming generation for ProASIC3 and ProASIC family devices.

Generate a Programming File for AFS Device Support - Designer Only

FlashPoint enables you to program Security Settings, FPGA Array, Embedded Flash Memory Blocks, and FlashROM features for AFS device support. You can program these features separately using different programming files or you can combine them into one programming file. Each feature is listed as a silicon feature in the GUI. You can generate a programming file with one, two, or all of the silicon features from the **Programming File Generator** first page.

AFS Programming

In addition to FPGA Array, FlashROM and security setting, the Fusion devices provide Embedded Flash Memory

Blocks (FB) for both Analog configuration initialization and regular memory storage. Depending on the targeted AFS device, you may have one, two, or four FBs available to you. FlashPoint enables you to initialize the FB Instance(s), as desribed in the Embedded Flash Memory help.

To generate a programming file:

1. Select the **Silicon feature(s)** you want to program.

   Security Settings
   FPGA Array
   FlashROM
   Embedded Flash Memory Block

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

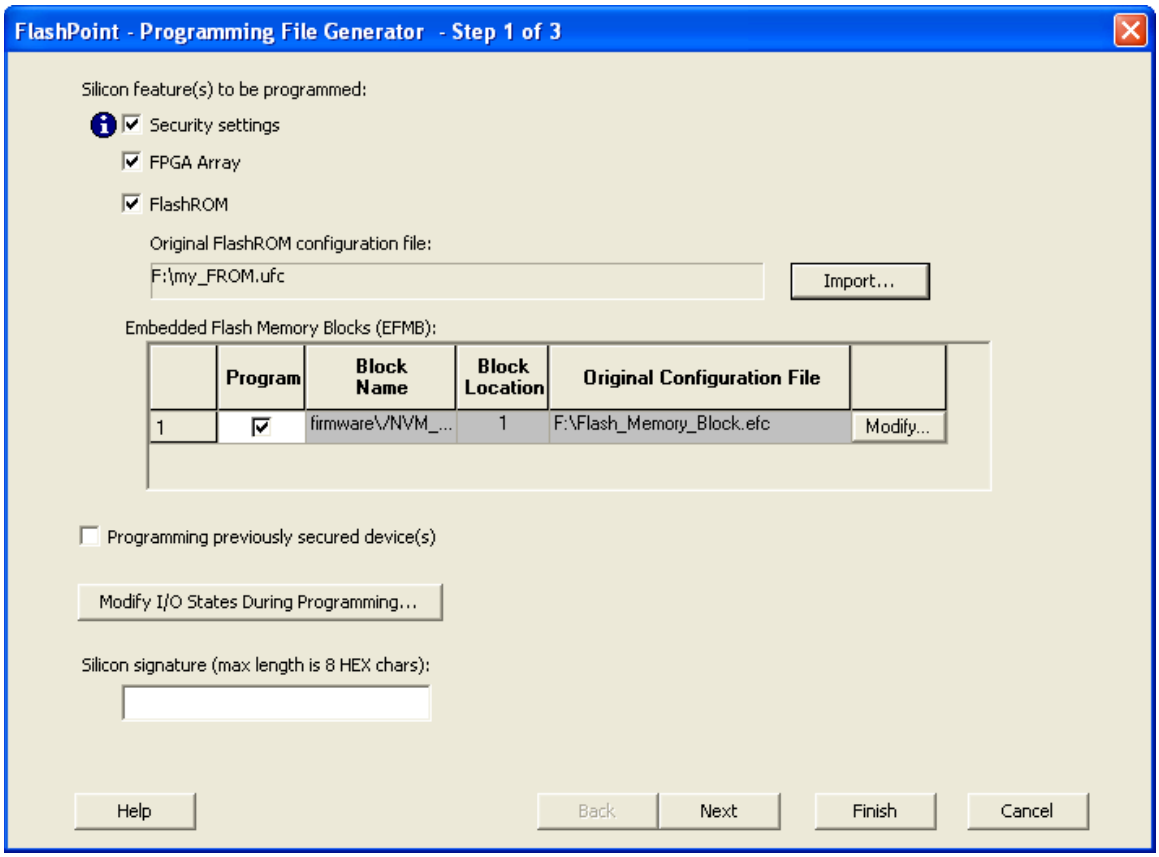


Figure 66 · FlashPoint- Programming File Generator for AFS

Note: Check the check box in the Program column to enable block modification.

2. Check the **Programming previously secured devices(s)** box if you want to program previously secured devices.
3. Enter the **Silicon signature**.
4. Depending upon the Silicon features you selected, click **Finish** or **Next**.

   If you click **Next**, follow the instructions in the appropriate dialog box. If you click **Finish**, the **Generate Programming Files** dialog box appears. Use this dialog box box to specify the programming file name, location, and output format (STAPL file, SVF file, PDB file, DirectC DAT file, 1532 file).
   For more information on DAT files, refer to the Data File Generator (DatGen) section of the *DirectC User's Guide*.

Programming Security Settings, FlashROM, and FPGA Array

For AFS device support, the programming generation for Security Settings, FlashROM and FPGA Array is the same as the programming generation for ProASIC3 family devices.

Generate a Programming File for Serialization Support in In House Programming (IHP)

FlashPoint allows you to program security settings, FPGA Array, and FlashROM features for SmartFusion, IGLOO, ProASIC3, Fusion family devices. You can program these features separately using different programming files or you can combine them into one programming file. Each feature is listed as a silicon feature in the GUI.

SVF Serialization Support in IHP

In addition to FPGA Array, FlashROM, and security setting, FlashPoint supports generating SVF files with serialization support in IHP.

To generate SVF with serialization support:

1. Select the **Silicon feature(s)** you want to program.
   - Security settings
   - FPGA Array
   - FlashROM
   - Programming Embedded Flash Memory Block
2. Import the UFC file which contains serialization data to FlashROM. Click **Next**.
3. Type in the number of devices to program (as shown in the figure below).

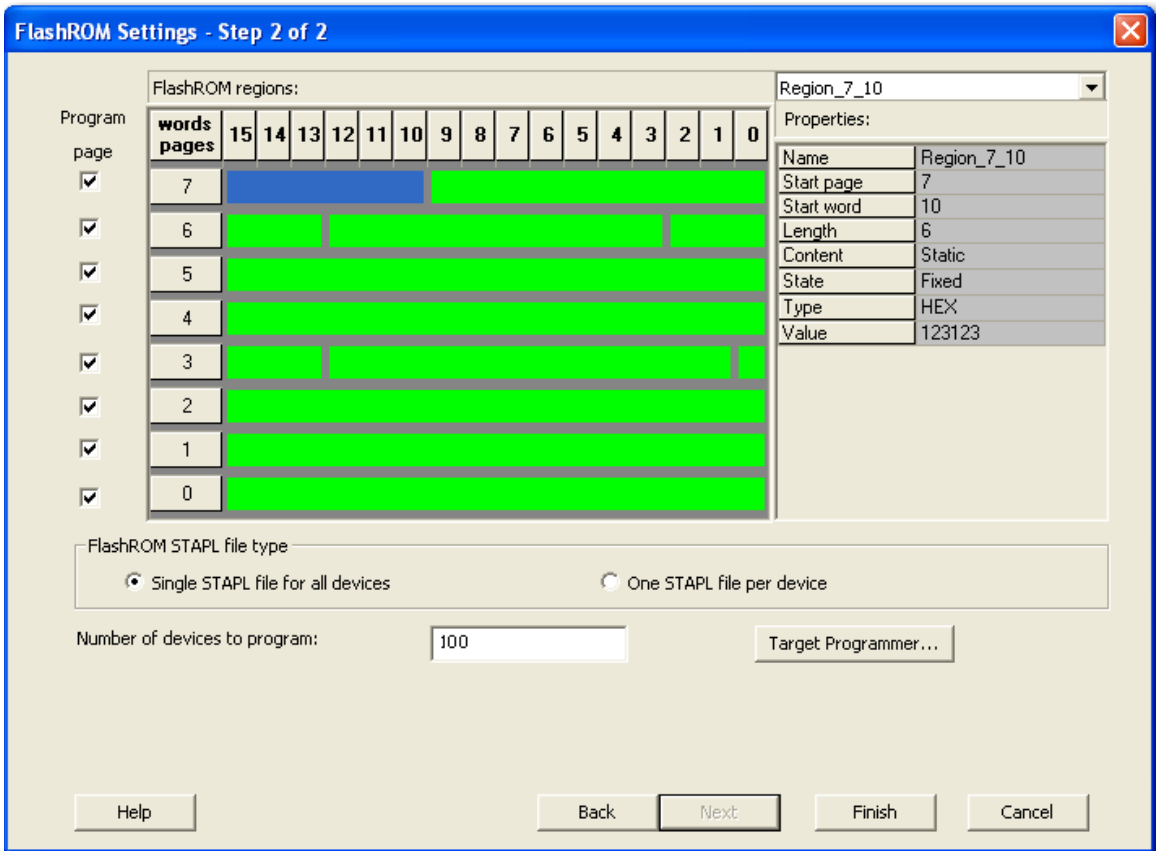


Figure 67 · Type Number of Devices

4. Click **Target Programmer** and select **Microsemi IHP**.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

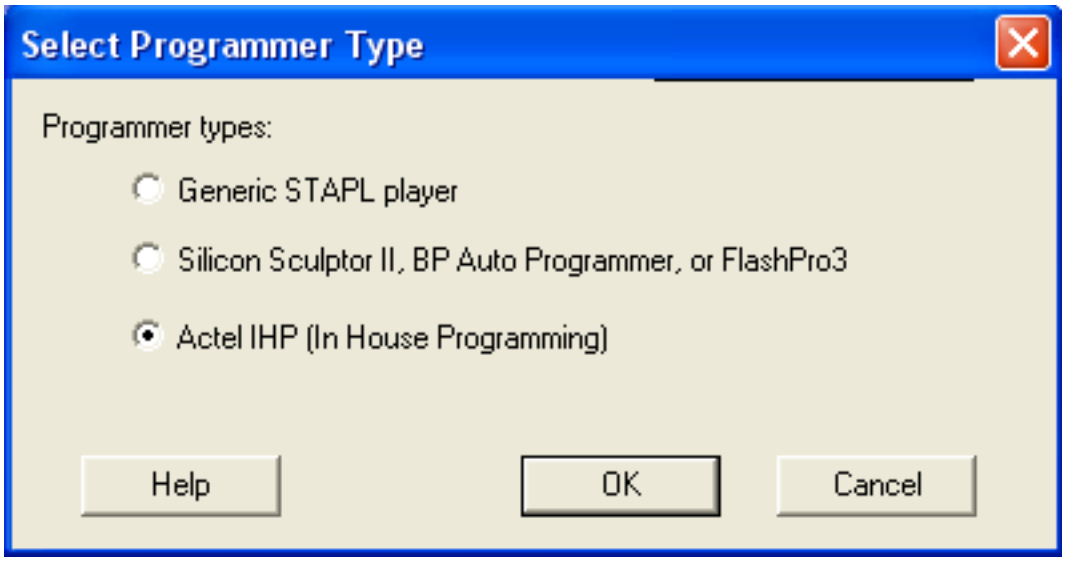


Figure 68 · Select Microsemi IHP

5. Click **OK**. The Generate Programming Files window appears (as shown in the figure below). Select **Serial Vector Files (*.svf)**.

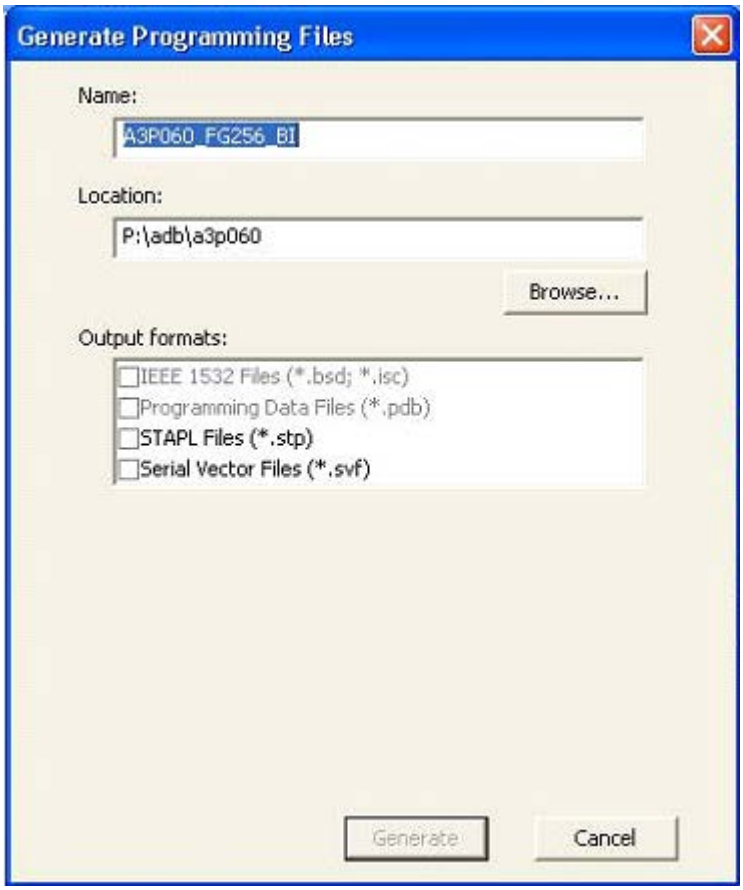


Figure 69 · Select Serial Vector Files

6. Click **Generate**. An Microsemi-specific SVF file will be generated with a corresponding serialization data file.

Note: Generated SVF files will only work with IHP.

Creating a Programming Database (PDB) File in Designer

The programming database (PDB) file supports SmartFusion, IGLOO, ProASIC3 and Fusion devices only. This allows reconfiguration of the security settings, FlashROM, FPGA Array, and Embedded Flash Memory Blocks. You create the file in Designer using FlashPoint and you modify the file in FlashPro.

You must create programming files for SmartFusion in FlashPro; see the Generate a Programming File for SmartFusion topic for more information.

1. From the Designer main window, click the **Programming File** button. This brings up FlashPoint (see figure below).

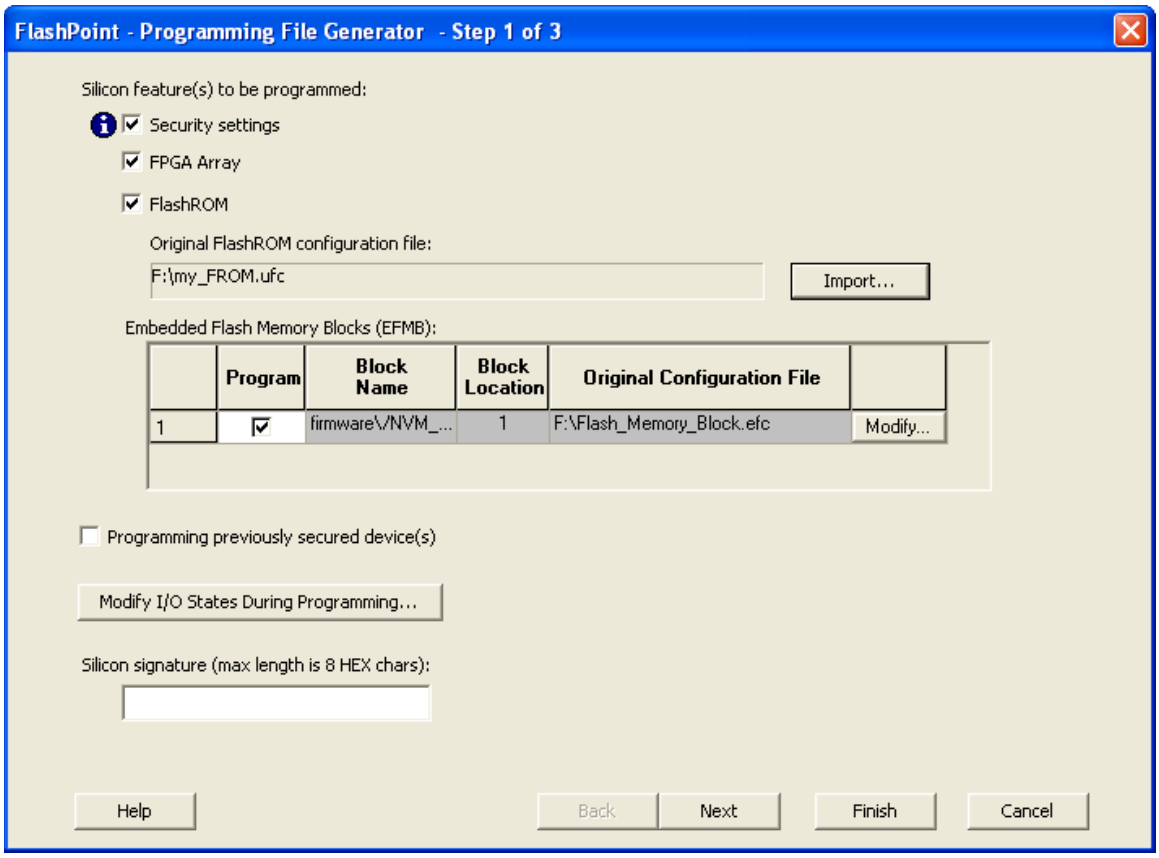


Figure 70 · FlashPoint Programming File Generator - PDB File

2. Select the silicon feature(s) to be programmed: Security Settings, FPGA array, FlashROM, and Embedded Flash Memory Block. If you are programming a previously secured device, check the Programming previously secured device(s) and enter the silicon signature.
3. Click **Finish** to create the PDB file.

See Also

Configuring security and FlashROM settings in FlashPro

Configuring security settings in FlashPro

Configuring FPGA array settings

Configuring FlashROM settings in FlashPro

Configuring Embedded Flash Memory Block settings in FlashPro

Programming Embedded Flash Memory Block

For more information about the Embedded Flash Memory Block, see the Flash Memory System Builder online help.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

To program the Embedded Flash Memory Block:

1. Check the **Program** box to enable Embedded Flash Memory Block modification.
2. Click the **Modify** button to import Embedded Flash Memory Block configuration and memory content.

The **Modify Embedded Flash Memory Block** dialog box appears.

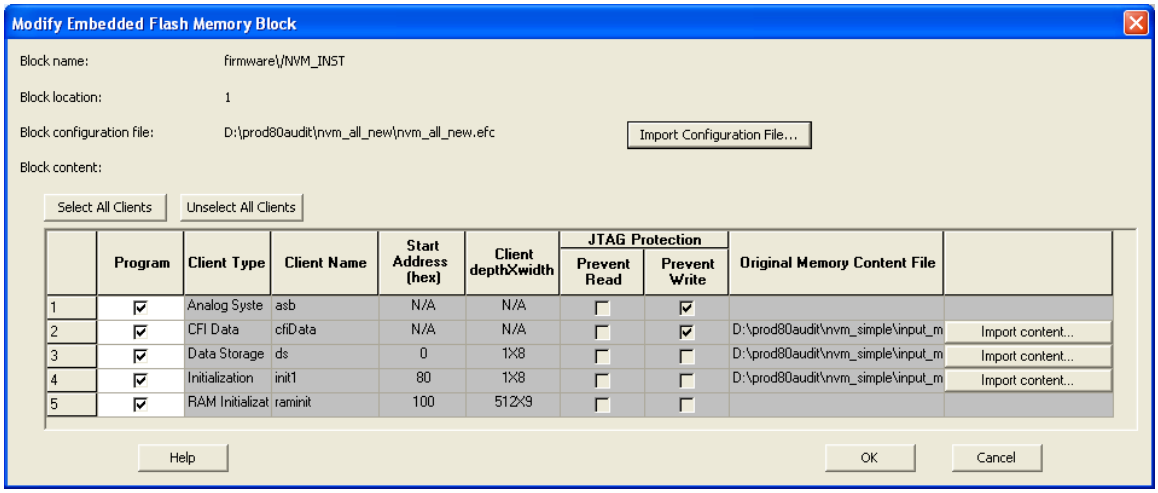


Figure 71 · Modify Embedded Flash Memory Block Content Dialog Box

3. Click the **Import Configuration File** button (if available) to import the Embedded Flash Memory Block configuration and memory content from the EFC file. This will populate the client table below. All clients that belong to this block will be selected by default.
4. Click the **Import content** button if you want to change the client memory content.
5. Click **OK**.

Note: FlashPoint audits original configuration and memory content files and warns you if the files cannot be located or if they have been updated.

Programming the FlashROM

You can program selected memory pages and specify the region values of the FlashROM.

- **Single STAPL file for all devices**: generates one programming file with all the generated increment values or with values in the custom serialization file.
- **One STAPL file per device**: generates one programming file for each generated increment value or for each value in the custom serialization file.

1. Select your target **Programmer type**.
   - Select Generic STAPL Player when generating STAPL files for generic STAPL players.
   - Select Silicon Sculptor II, BP Auto Programmer, or FlashPro5/4/3x/3 when generating programming files for those programmers.
   - Select Microsemi IHP (In House Programming) when generating STAPL or SVF files for Microsemi SoC (formerly Actel) IHP.
2. Click **OK**.
   FlashPoint generates your programming file.

Note: You cannot change the FlashROM region configuration from FlashPoint. You can only change the configuration from the FlashROM core generator.

For more information, click the Help button in FlashROM.

To program FlashROM:

1. Select **FlashROM** from the **Generate Programming File** page.
2. Enter the location of the FlashROM configuration file. The **FlashROM Settings** page appears (see figure below).

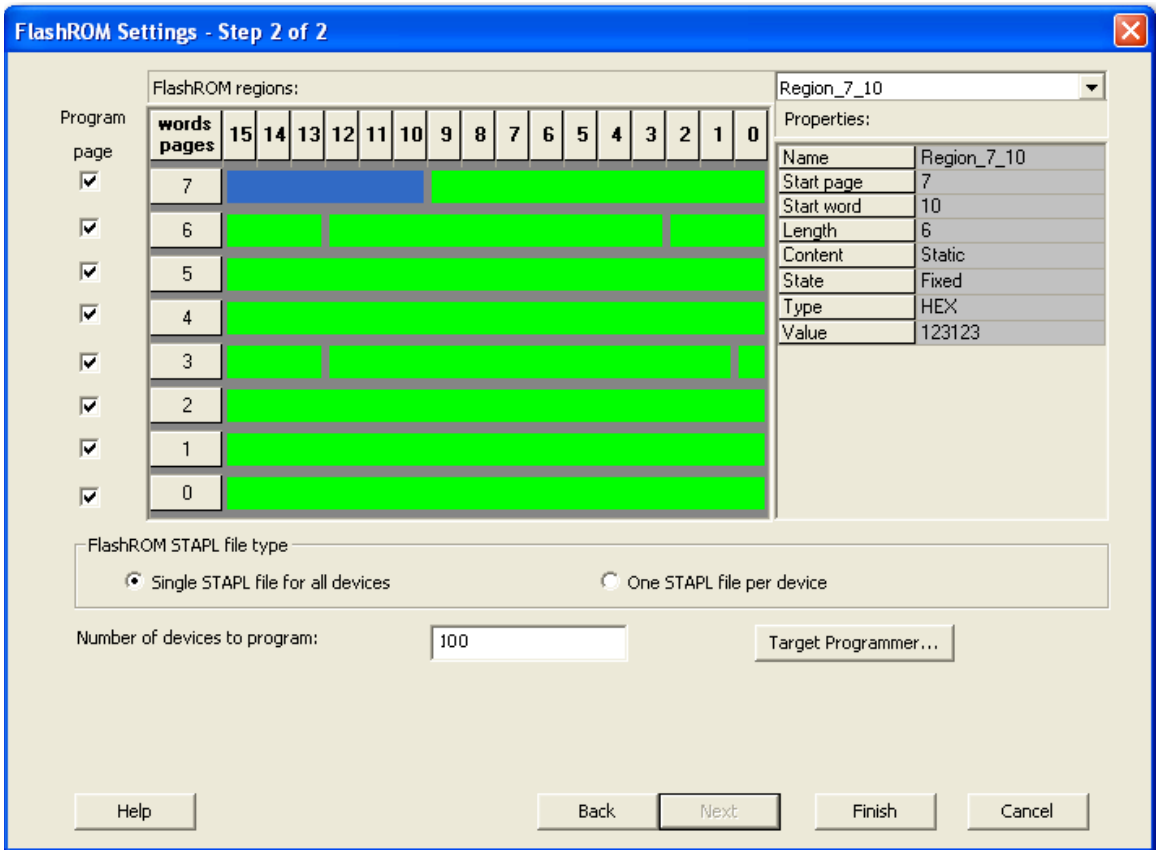


Figure 72 · FlashROM Settings

3. Select the FlashROM memory page that you want to program.
4. Enter the data value for the configured regions.
5. If you selected the region with a **Read From File**, specify the file location.
6. If you selected the **Auto Increment** region, specify the **Start** and **Max** values.

   Enter the number of devices you want to program.

   Select your target Programmer Type.

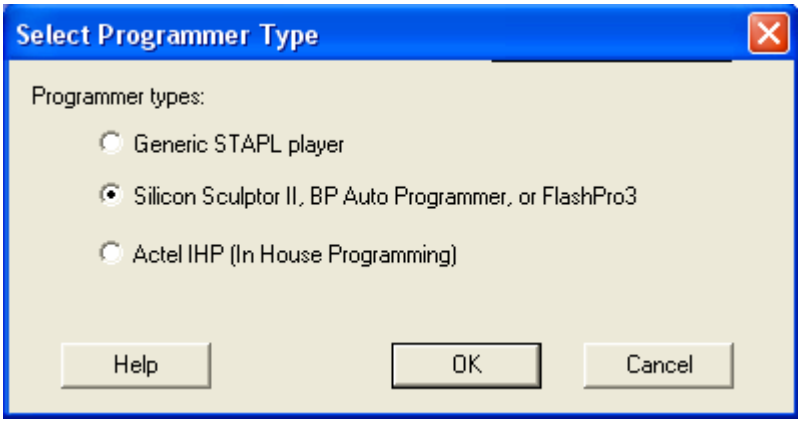


Figure 73 · Select Programmer

7. Click **Finish**.
   FlashPoint generates your programming file.

Note: You cannot change the FlashROM region configuration from FlashPoint. You can only change the configuration from the FlashROM core generator.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Silicon Signature

With Libero SoC tools, you can use the silicon signature to identify and track Microsemi designs and devices. When you generate a programming file, you can specify a unique silicon signature to program into the device. This signature is stored in the design database and in the programming file, and programmed into the device during programming.

The silicon signature is accessible through the USERCODE JTAG instruction.

Note: If you set the security level to high, medium, or custom, you must program the silicon signature along with the Security Setting. If you have already programmed the Security Setting into the target device, you cannot reprogram the silicon signature without reprogramming the Security Setting.

Note: The previously programmed silicon signature will be erased if:

- You have already programmed the silicon signature and
- You are programming the security settings, but you do not have an entry in the silicon signature field

Programming Security Settings

FlashPoint allows you to set a security level of high, medium, or none (SmartFusion uses radio buttons and the option Clear Security instead of None).

To program Security Settings on the device:

1. If you choose to program Security Settings on the device from the **Generate Programming File** page, the wizard takes you to the **Security Settings** page.

   Your Security Settings page depends on your family.
2. Set the security level for FPGA, FlashROM, and EFMB (see the table below for a description of the security levels).

Table 3 · FPGA, FlashROM, and EFMB Security Settings

Security Level	Security Option	Description
High	Protect with a 128-bit Advanced Encryption Standard (AES) key and a Pass Key	Access to the device is protected by an AES Key and the Pass Key. The Write and Verify operations of the FPGA Array use a 128-bit AES encrypted bitstream. From the JTAG interface, the Write and Verify operations of the FlashROM use a 128-bit AES encrypted bitstream. Read back of the FlashROM content via the JTAG interface is protected by the Pass Key. Read back of the FlashROM content is allowed from the FPGA Array. The Read and Verify operations of the EFMB module are protected by Pass Key from the JTAG interface. The Write operations of the EFMB module use a 128-bit AES encrypted bitstream.
Medium	Protect with Pass Key	The Write and Verify operations of the FPGA Array require a Pass Key. From the JTAG interface, the Read and Write operations on the FlashROM content require a Pass Key. You can Verify the FlashROM content via the JTAG interface without a Pass Key. Read back of the FlashROM content is allowed from the FPGA Array. The Read, Write, and Verify

Security Level	Security Option	Description
		operations of the EFMB module are protected by Pass Key from the JTAG interface.
None	No security	The Write and Verify operations of the FPGA Array do not require keys. The Read, Write, and Verify operations of the FlashROM content also do not require keys. The Read, Write, and Verify operations of the EFMB module content do not require keys. This option is available for SmartFusion; to choose it, de-select the Security Settings checkbox.

Note: When a Device is programmed with a Pass key and AES key, only the Pass key is required for reprogramming since re-entering the correct Pass key unlocks the bits that restrict programming to require AES encryption and also unlocks the bits that prohibit reprogramming altogether (if locked); thus both plaintext and encrypted programming are [re-] enabled.

3. **Enable eNVM client JTAG protection -** Enables eNVM client JTAG protection in the event you have not set Medium or High security. Enables you to protect specific clients with a user pass key and then leave others unprotected. This can be advantageous if you want to protect your IP, but give another user access to the rest of the eNVM for storage. You can also set custom security levels for your eNVM.
NOTE: EFMB (Fusion) is called eNVM for SmartFusion devices.
4. Enter the **Pass Key** and/ or the **AES Key** as appropriate. You can generate a random key by clicking the **Generate random key** button.

The **Pass Key** protects all the Security Settings for the FPGA Array, FlashROM, and/or EFMB.
The **AES Key** decrypts the FPGA Array, FlashROM, and/or EFMB programming file content. Use the AES Key if you intend to program the device at an unsecured site or if you plan to update the design at a remote site in the future.

You can also customize the security levels by clicking the **Custom Level** button. For more information, see the Custom Security Levels section.

To change or disable your security keys you must run the ERASE_SECURITY action code. This erases your security settings and enables you to generate the programming file with new keys and reprogram, or to generate a programming file that has no security key.

Custom Security Levels

For advanced use, you can customize your security levels.

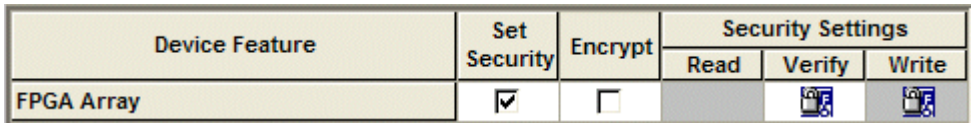
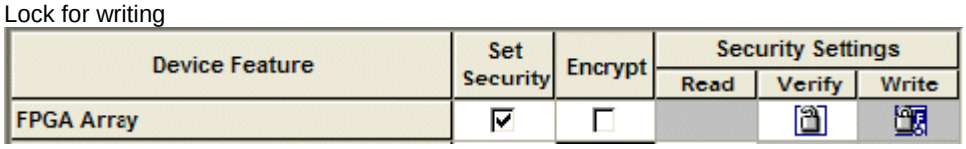
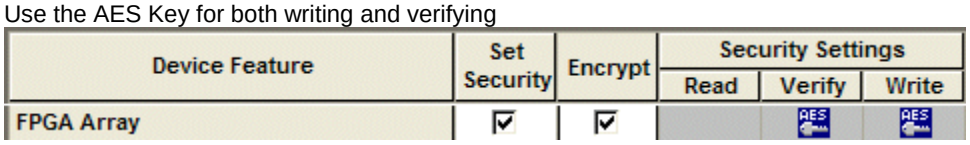
To set custom security levels:

1. Click the **Custom Level** button in the **Security Settings** page. The **Custom Security Level** dialog box appears.
2. Select the **FPGA Array Security** and the **FlashROM Security** levels. For SmartFusion and Fusion devices, you can also choose the Embedded Flash Memory Block level of security. The FPGA Array and the FlashROM can have different Security Settings. See the tables below for a description of the custom security option levels for FPGA Array and FlashROM.

Table 4 · FPGA Array

Security Option	Description
Lock for both writing and verifying	Allows writing/erasing

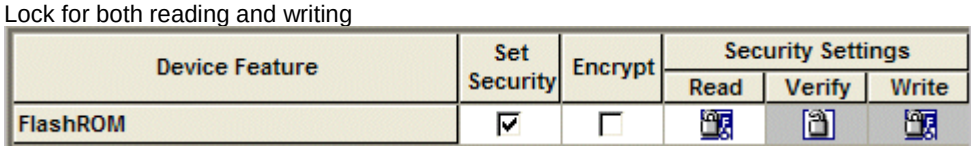
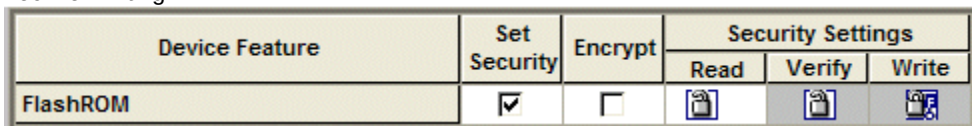
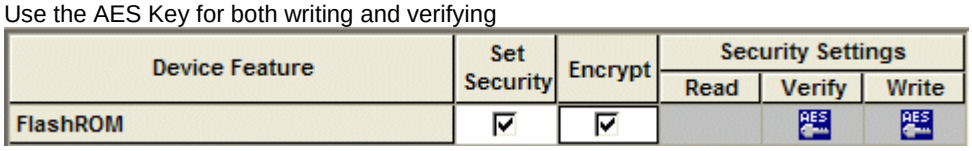
NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Security Option	Description
	and verification of the FPGA Array via the JTAG interface only with a valid Pass Key.
Lock for writing 	Allows the writing/erasing of the FPGA Array only with a valid Pass Key. Verification is allowed without a valid Pass Key.
Use the AES Key for both writing and verifying 	Allows the writing/erasing and verification of the FPGA Array only with a valid AES Key via the JTAG interface. This configures the device to accept an encrypted bitstream for reprogramming and verification of the FPGA Array. Use this option if you intend to complete final programming at an unsecured site or if you plan to update the design at a remote site in the future. Accessing the device security settings requires a valid Pass Key.
Allow write and verify	Allows writing/erasing

Security Option	Description
	and verification of the FPGA Array with plain text bitstream and without requiring a Pass Key or an AES Key. Use this option when you develop your product in-house.

Note: The ProASIC3 family FPGA Array is always read protected regardless of the Pass Key or the AES Key protection.

Table 5 · FlashROM

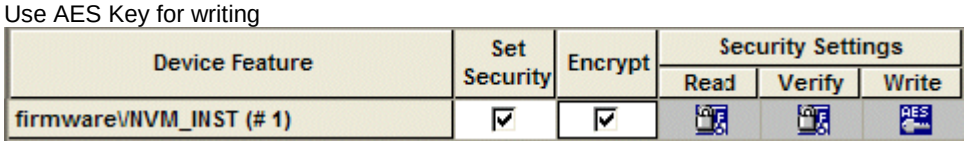
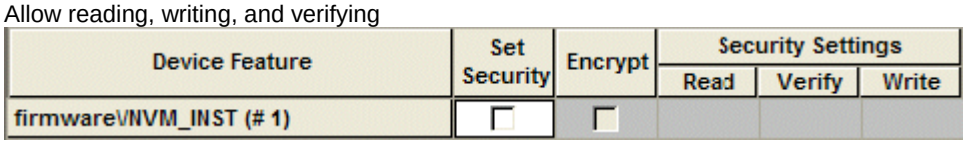
Security Option	Description
Lock for both reading and writing 	Allows the writing/erasing and reading of the FlashROM via the JTAG interface only with a valid Pass Key. Verification is allowed without a valid Pass Key.
Lock for writing 	Allows the writing/erasing of the FlashROM via the JTAG interface only with a valid Pass Key. Reading and verification is allowed without a valid Pass Key.
Use the AES Key for both writing and verifying 	Allows the writing/erasing and verification of the FlashROM via the JTAG interface only with a valid AES Key. This configures the device to accept an encrypted bitstream for reprogramming and verification of

Security Option	Description
	the FlashROM. Use this option if you complete final programming at an unsecured site or if you plan to update the design at a remote site in the future. Note: The bitstream that is read back from the FlashROM is always unencrypted (plain text).
Allow reading, writing, and verifying Device Feature: FlashROM; Set Security: ☐; Encrypt: ☐; Security Settings: Read, Verify, Write	Allows writing/erasing, reading and verification of the FlashROM content with a plain text bitstream and without requiring a valid Pass Key or an AES Key.

Note: The FPGA Array can always read the FlashROM content regardless of these Security Settings.

Table 6 · Embedded Flash Memory Block

Security Option	Description
Lock for reading, verifying, and writing Device Feature: firmwareVNVM_INST (# 1); Set Security: ☑; Encrypt: ☐; Security Settings: Read, Verify, Write	Allows the writing and reading of the Embedded Flash Memory Block via the JTAG interface only with a valid Pass Key. Verification accomplished by reading back and compare.
Lock for writing Device Feature: firmwareVNVM_INST (# 1); Set Security: ☑; Encrypt: ☐; Security Settings: Read, Verify, Write	Allows the writing of the Embedded Flash Memory Block via the JTAG interface only with a valid Pass Key. Reading and verification is allowed without a

Security Option	Description
	valid Pass Key.
Use AES Key for writing  	Allows the writing of the Embedded Flash Memory Block via the JTAG interface only with a valid AES Key. This configures the device to accept an encrypted bitstream for reprogramming of the Embedded Flash Block. Use this option if you complete final programming at an unsecured site or if you plan to update the design at a remote site in the future. The bitstream that is read back from the Embedded Flash Memory Block is always unencrypted (plain text), when a valid pass key is provided.
Allow reading, writing, and verifying  	Allows writing, reading and verification of the Embedded Flash Memory Block content with a plain text bitstream and without requiring a valid Pass Key or an AES Key.

3. To make the Security Settings permanent, select **Permanently lock the security settings** check box. This option prevents any future modifications of the Security Setting of the device. A Pass Key is not required if you use this option.

   Note: When you make the Security Settings permanent, you can never reprogram the Silicon Signature. If you Lock the write operation for the FPGA Array or the FlashROM, you can never reprogram the FPGA Array or the FlashROM, respectively. If you use an AES key, this key cannot be changed once you permanently lock the device.

4. (SmartFusion Only) Enable M3 Debugger option enables access to the M3 debugger even if security is enforced. Select the **Enable M3 debugger** checkbox if you want to access the M3 debugger after programming.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

5. To use the Permanent FlashLock™ feature (One-time programmable or OTP), select **Lock for both writing and verifying** for FPGA Array, **Lock for both reading and writing** for FlashROM, **Lock for reading, writing, and verifying** each Embedded Flash Memory Block (for Fusion and SmartFusion), if present, and select the **Permanently lock the security settings** checkbox as shown in the figure below. This will make your device one-time programmable.

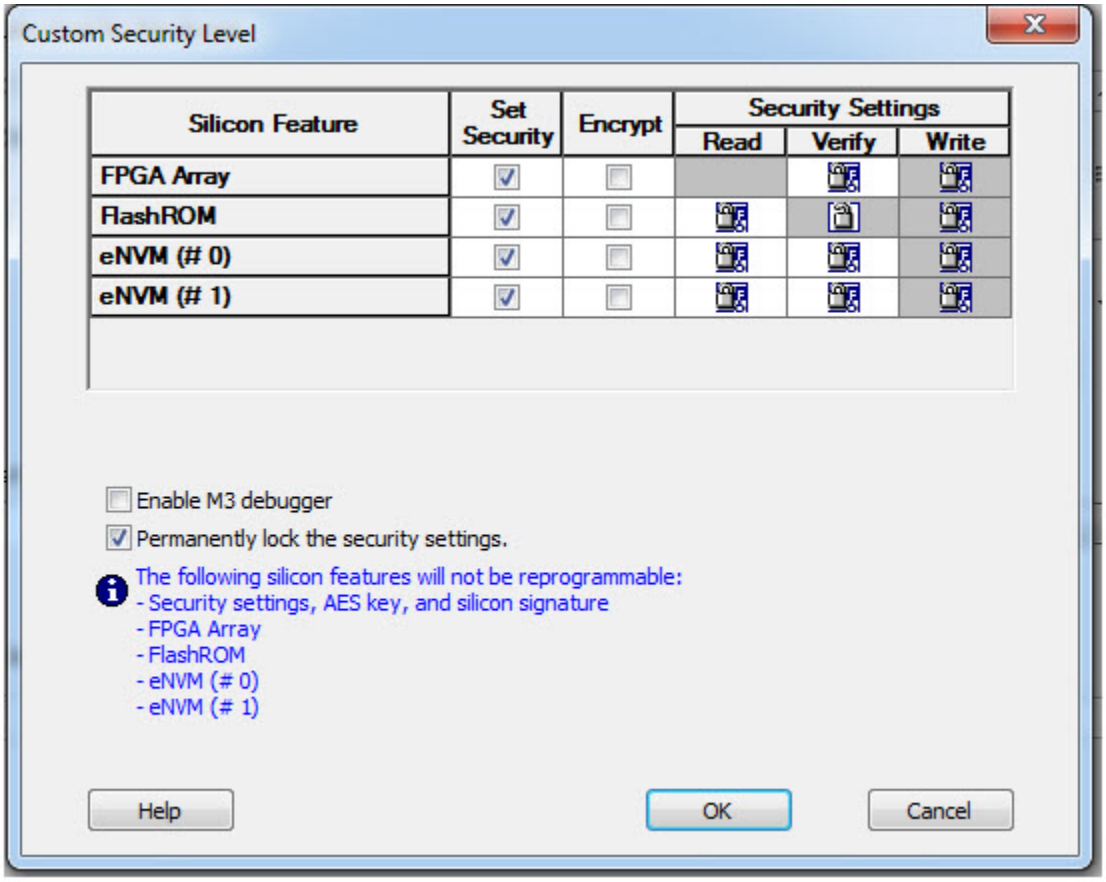


Figure 74 · Custom Security Level

6. Click the **OK** button. The **Security Settings** page appears with the **Custom security settings** information as shown in the figure below.

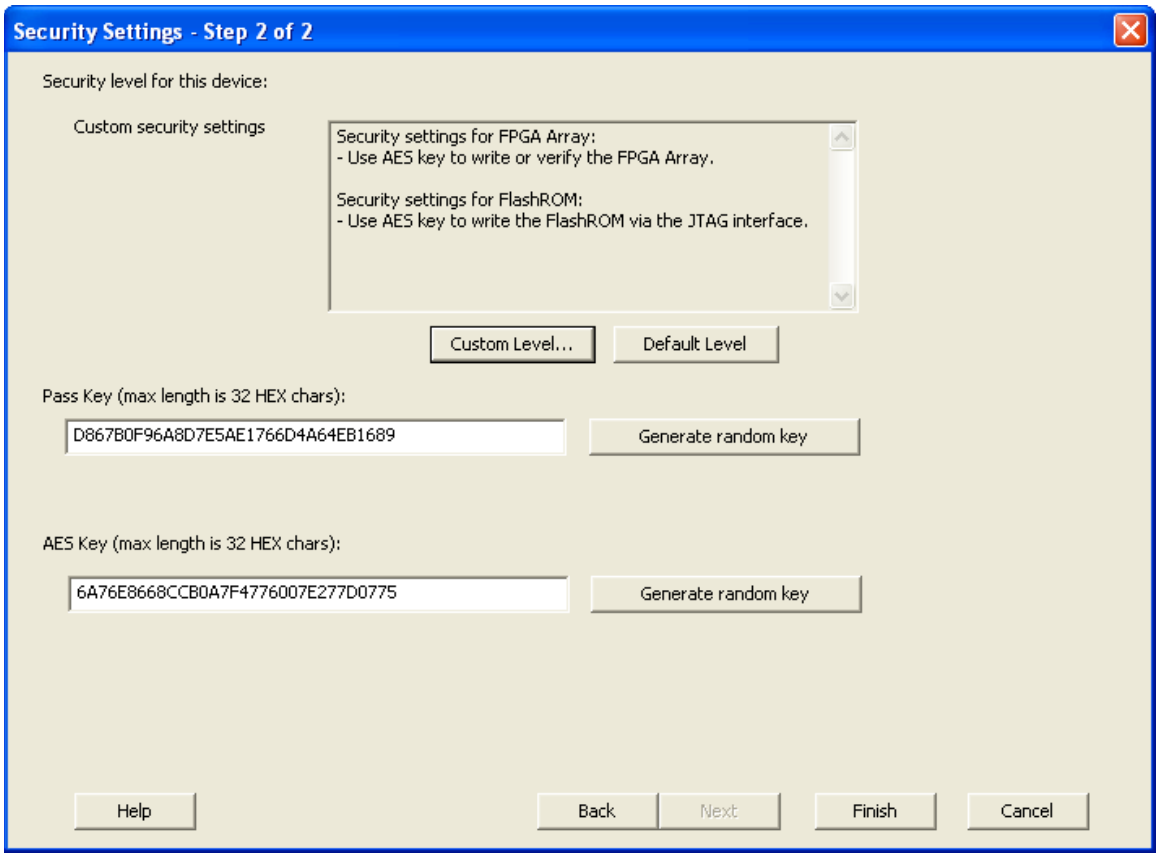


Figure 75 · Security Settings

Reprogramming a Secured Device

You must know the previous Security Settings of the device before you can reprogram a device with Security Settings.

To program a secured device:

1. In the Generate Programming File window, click the **Programming previously secured devices(s)** check box (see figure below).

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

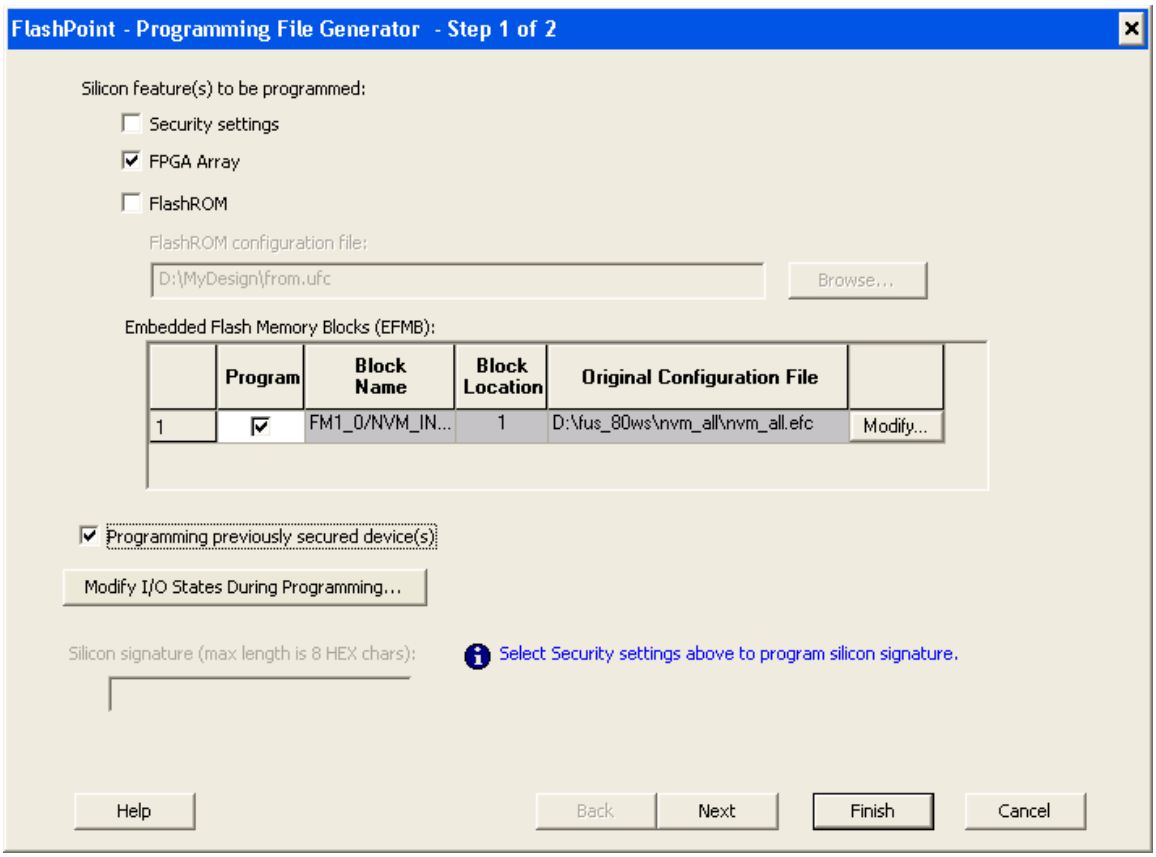


Figure 76 · Generate Programming File

2. Specify the previously programmed security setting for the FlashROM and/or the FPGA Array. To generate a programming file for encrypted programming please ensure that the Security settings checkbox is unchecked.
3. If you programmed the device with a custom security level, click the **Custom Level** button to open the Custom security dialog box, and select the **Security Settings for the FPGA Array** or the FlashROM that you programmed (see figure below).

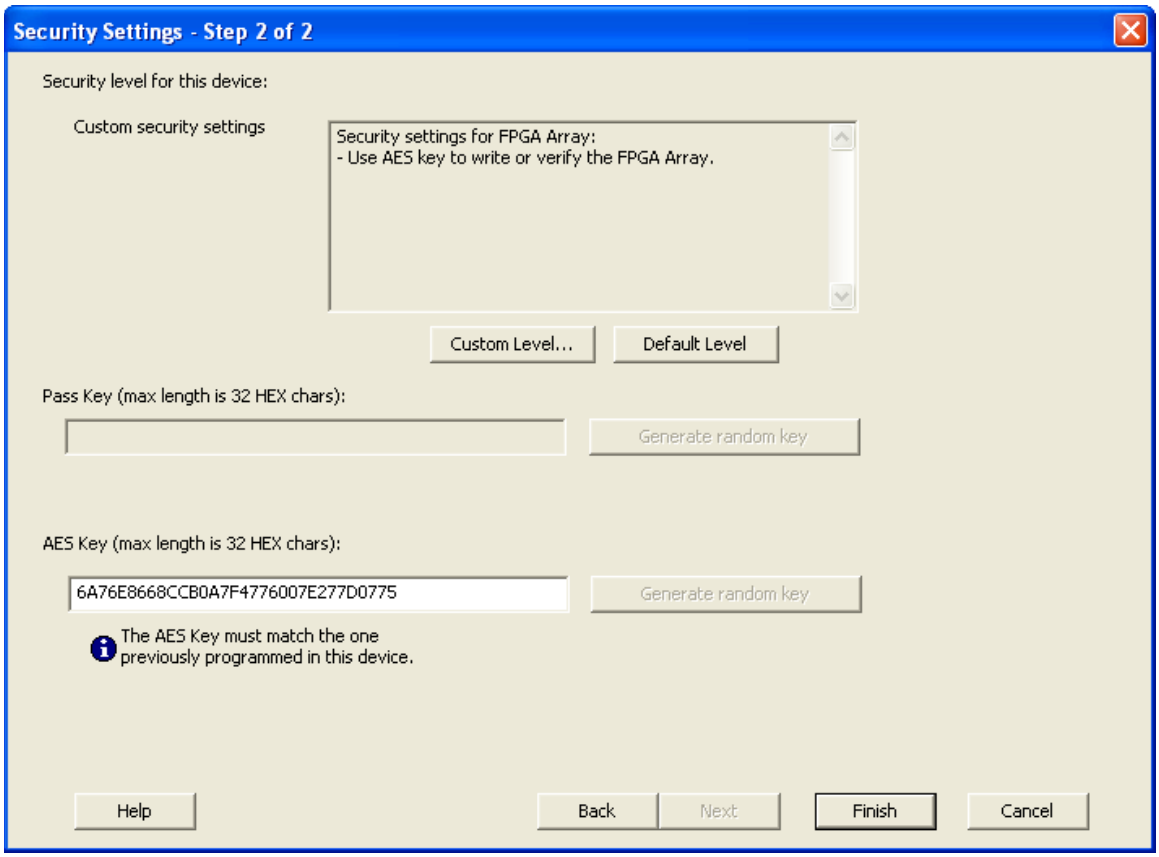


Figure 77 · Security Settings

4. Enter the previously programmed Pass Key and/or the AES Key.
5. Click **Finish**.

Note: Enter the AES Key only if you want to perform encrypted programming.

Programming a Secured SmartFusion Device

After you create a PDB you may wish to export a programming file for a secured device. To do so:

1. Create a PDB file (as explained above) with security set to **High** or **Medium**. Save the PDB file.
2. From the **File** menu, choose **Export Single Programming File**. The Export Programming Files dialog box appears.
3. Click the **Export programming file(s) for currently secured device** checkbox. This exports programming files for devices that already have security settings programmed.
4. Choose your outputs and enter your output file **Name** and **Location**.
5. Click **Export** to create the file(s). Your updated secured programming files are in the directory you specified.

Custom Serialization Data for FlashROM Region

FlashPoint enables you to specify a custom serialization file as a source to provide content for programming into a Read from file FlashROM region. You can use this feature for serializing the target device with a custom serialization scheme.

To specify a FlashROM region:

1. From the Properties section in the FlashROM Settings page, select the file name of the custom serialization file (see figure below). For more information on custom serialization files, see Custom Serialization Data File Format.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

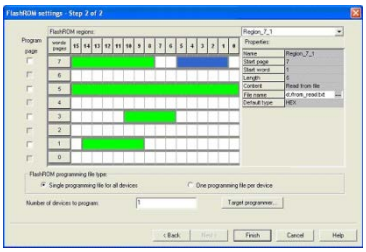


Figure 78 · FlashROM Settings

2. Select the FlashROM programming file type you want to generate from the two options below:
   - Single programming file for all devices option: generates one programming file with all the values in the custom serialization file.
   - One programming file per device: generates one programming file for each value in the custom serialization file.
3. Enter the number of devices you want to program.
4. Click the **Target Programmer** button.
5. Select your target Programmer type.
6. Click **OK**.

Custom Serialization Data File Format

FlashPoint supports custom serialization data files that specify the data in binary, HEX, decimal, or ASCII text. The custom serialization data files may contain multiple data with the Line Feed (LF) character as the delimiter. You can create a file by entering serialization data into any type of text editor. Depending on the serialization data format (hex, ASCII, binary, decimal), input the serialization data according to the size of the region you specified in the FlashROM settings page.

Semantics

Each custom serialization file has only one type of data format (binary, decimal, Hex or ASCII text). For example, if a file contains two different data formats (i.e. binary and decimal) it is considered an invalid file.

The length of each data file must be shorter or equal to the selected region length. If the data is shorter then the selected region length, the most significant bits shall be padded with 0's. If the specified region length is longer then the selected region length, it is considered an invalid file.

The digit / character length is as follows:

```
-Binary digit: 1 bit
-Decimal digit: 4 bits
-Hex digit: 4 bits
-ASCII Character: 8 bits
```

If you wanted to use, for example, device serialization for three devices with serialization data 123, 321, and 456, you would create file name from_read.txt. Each line in from_read.txt corresponds to the serialization data that will be programmed on each device. For example, the first line corresponds to the first device to be programmed, the second line corresponds to the second device to be programmed, and so on.

Hex serialization data file example

The following example is a Hex serialization data file for a 40-bit region. Enter the serialization data below into file created by any text editor:

```
123AEd210
AeB1
0001242E
```

Note: If you enter an invalid Hex digit such as 235SedF1, an error occurs. An error will also occur if you enter data that is out of range, i.e. 4300124EFE.

The following is an example of programming "AeB1" into Region_7_1 located on page 7, from Word 5 to Word 1 in the FlashROM settings page. See Custom serialization data for FlashROM region for more information.

	Table 15	...		Word 5	Word 4	Word 3	Word 2	Word 1	Word 0
Page 7	...	...	...	00	00	00	AE	B1	...

Binary serialization data file example

The following example is a binary serialization data file for a 16-bit region:

1100110011010001

```
100110011010011
11001100110101111 (This is an error: data out of range)
1001100110110111
1001100110110112 (This is an error: invalid binary digit)
```

Decimal serialization data file example

The following example is a decimal serialization data file for a 16-bit region:

```
65534
65535
65536 (This is an error: data out of range)
6553A (This is an error: invalid decimal digit)
```

Text serialization data file example

The following example is a text serialization data file for a 32-bit region:

```
AESB
A )e
ASE3 23 (This is an error: data out of range)
65A~
1234
AEbF
```

Syntax

Indentations in the syntax below indicate a wrapped line. If a line wraps and is not indented, then it should appear on one line; you may need to expand your help window to view the syntax correctly.

```
Custom serialization data file =
        <hex region data list> | <decimal region data list> |
        <binary region data list> | <ascii text data list>
Hex region data list = <hex data> <new line> { < hex data> <new line> }
Decimal region data list = <decimal data> <new line> {<decimal data><new line> }
Binary region data list = <binary data> <new line> { <binary data> <new line> }
ASCII text region data list = < ascii text data> <new line> { < ascii text data> <new
line> }
hex data = <hex digit> {<hex digit>}
decimal data = < decimal digit> {< decimal digit>}
binary data = < binary digit> {< binary digit>}
ASCII text data = <ascii character> {< ascii character >}
new line = LF
binary digit = ‘0’|‘1’
decimal digit = ‘0’|‘1’|‘2’|‘3’|‘4’|‘5’|‘6’|‘7’|‘8’| ‘9’
hex digit = ‘0’|‘1’|‘2’|‘3’|‘4’|‘5’|‘6’|‘7’|‘8’|‘9’|‘A’|‘B’|‘C’|‘D’ | ‘E’| ‘F’ |
```

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**


```
        'a'| 'b' | 'c'| 'd' | 'e'| 'f'
ascii character = characters from SP(0x20) to'~'(0x7E).
```

File Format Limitations

The read from file data size cannot exceed the size of the region. The maximum size supported for each format is described below:

HEX - limited to the size of the FlashROM page. Maximum size of 128-bits

DEC - 32-bit unsigned numbers. Maximum decimal value is: 4294967295

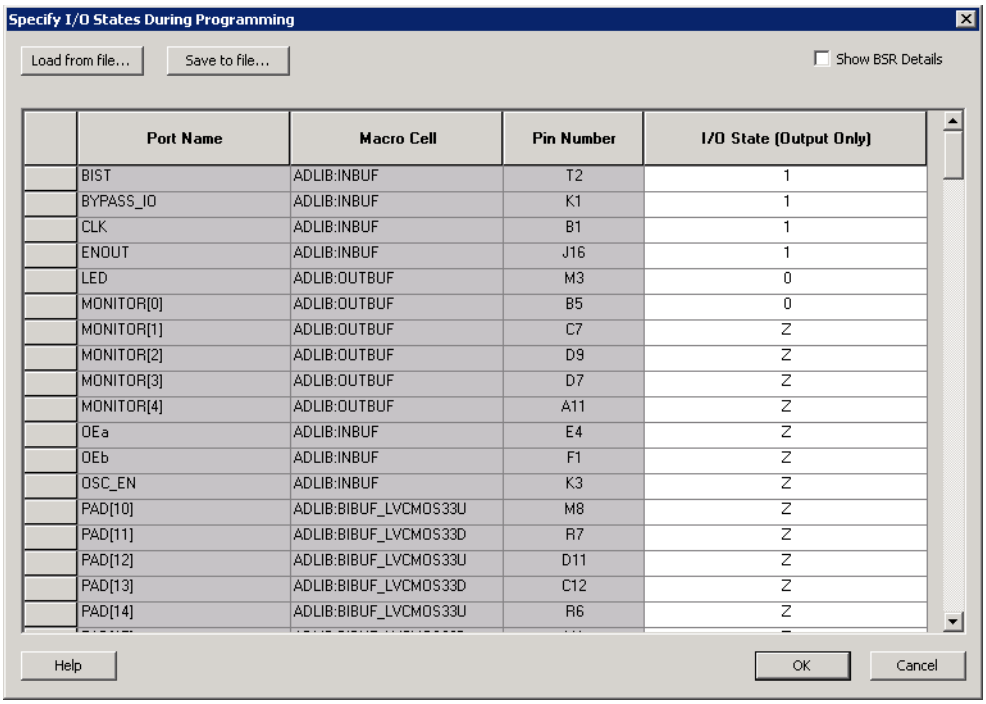
BIN - limited to the size of the FlashROM page. Maximum size of 128-bits

TEXT - limited to the size of the FlashROM page. Maximum size of 128-bits

Specifying I/O States During Programming

In Libero SoC, the I/O states can be set prior to programming, and held at the set values during programming. This feature is only available after layout is completed.

1. From the Designer GUI, click **Modify I/O States During Programming** . The Programming File Generator window appears.
2. Click **Specify I/O States During Programming** to display the Specify I/O States During Programming dialog box.
3. Sort the pins as desired by clicking any of the column headers to sort the entries by that header. Select the I/Os you wish to modify (as shown in the figure below).
4. Set the I/O Output state. You can set Basic I/O settings if you want to use the default I/O settings for your pins, or use Custom I/O settings to customize the settings for each pin. See Specifying I/O States During Programming - I/O States and BSR Details for more information about setting your I/O state and the corresponding pin values. Basic I/O state settings are:
    - 1 – I/O is set to drive out logic High
    - 0 – I/O is set to drive out logic Low
    - Last Known State: I/O is set to the last value that was driven out prior to entering the programming mode, and then held at that value during programming
    - Z - Tri-State: I/O is tristated



	Port Name	Macro Cell	Pin Number	I/O State (Output Only)
	BIST	ADLIB:INBUF	T2	1
	BYPASS_IO	ADLIB:INBUF	K1	1
	CLK	ADLIB:INBUF	B1	1
	ENOUT	ADLIB:INBUF	J16	1
	LED	ADLIB:OUTBUF	M3	0
	MONITOR[0]	ADLIB:OUTBUF	B5	0
	MONITOR[1]	ADLIB:OUTBUF	C7	Z
	MONITOR[2]	ADLIB:OUTBUF	D9	Z
	MONITOR[3]	ADLIB:OUTBUF	D7	Z
	MONITOR[4]	ADLIB:OUTBUF	A11	Z
	OEa	ADLIB:INBUF	E4	Z
	OEb	ADLIB:INBUF	F1	Z
	OSC_EN	ADLIB:INBUF	K3	Z
	PAD[10]	ADLIB:BIBUF_LVCMOS33U	M8	Z
	PAD[11]	ADLIB:BIBUF_LVCMOS33D	R7	Z
	PAD[12]	ADLIB:BIBUF_LVCMOS33U	D11	Z
	PAD[13]	ADLIB:BIBUF_LVCMOS33D	C12	Z
	PAD[14]	ADLIB:BIBUF_LVCMOS33U	R6	Z

Figure 79 · I/O States During Programming Window

6. Click **OK** to return to the FlashPoint – Programming File Generator window.

Note: I/O States During Programming are saved to the ADB and resulting programming files after completing programming file generation.

Custom I/O Settings and Boundary Scan Registers

Each I/O in your device is comprised of an Input, Output and Output Enable Boundary Scan Register (BSR) cell..

The BSR cells enable you to define I/O states during programming and control the individual states for each Input, Output, and Output Enable register.

The Specify I/O States During Programming dialog box enables access to each of these BSR cells for control over the individual states. You can use the I/O State (Output Only) settings to set a specific output state and ignore the other values for the individual BSR elements, or you can click the Show BSR Details checkbox for control over the settings for each Input, Output Enable, and Output as you exit programming.

Specifying I/O States During Programming - I/O States and BSR Details

The I/O States During Programming dialog box enables you to set custom I/O states prior to programming.

I/O State (Output Only)

Sets your I/O states during programming to one of the values shown in the list below.

- 1 – I/Os are set to drive out logic High
- 0 – I/Os are set to drive out logic Low
- Last Known State: I/Os are set to the last value that was driven out prior to entering the programming mode, and then held at that value during programming
- Z - Tri-State: I/Os are tristated

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

When you set your I/O state, the Boundary Scan Register cells are set according to the table below. Use the Show BSR Details option to set custom states for each cell.

Table 7 · Default I/O Output Settings

Output State	Settings		
	Input	Control (Output Enable)	Output
Z (Tri-State)	1	0	0
0 (Low)	1	1	0
1 (High)	0	1	1
Last_Known_State	Last_Known_State	Last_Known_State	Last_Known_State

Table Key:

- 1 – High: I/Os are set to drive out logic High
- 0 – Low: I/Os are set to drive out logic Low
- Last_Known_State - I/Os are set to the last value that was driven out prior to entering the programming mode, and then held at that value during programming

Boundary Scan Registers - Enabled with Show BSR Details

Sets your I/O state to a specific output value during programming AND enables you to customize the values for the Boundary Scan Register (Input, Output Enable, and Output). You can change any Don't Care value in Boundary Scan Register States without changing the Output State of the pin (as shown in the table below).

For example, if you want to Tri-State a pin during programming, set Output Enable to 0; the Don't Care indicates that the other two values are immaterial.

If you want a pin to drive a logic High and have a logic 1 stored in the Input Boundary scan cell during programming, you may set all the values to 1.

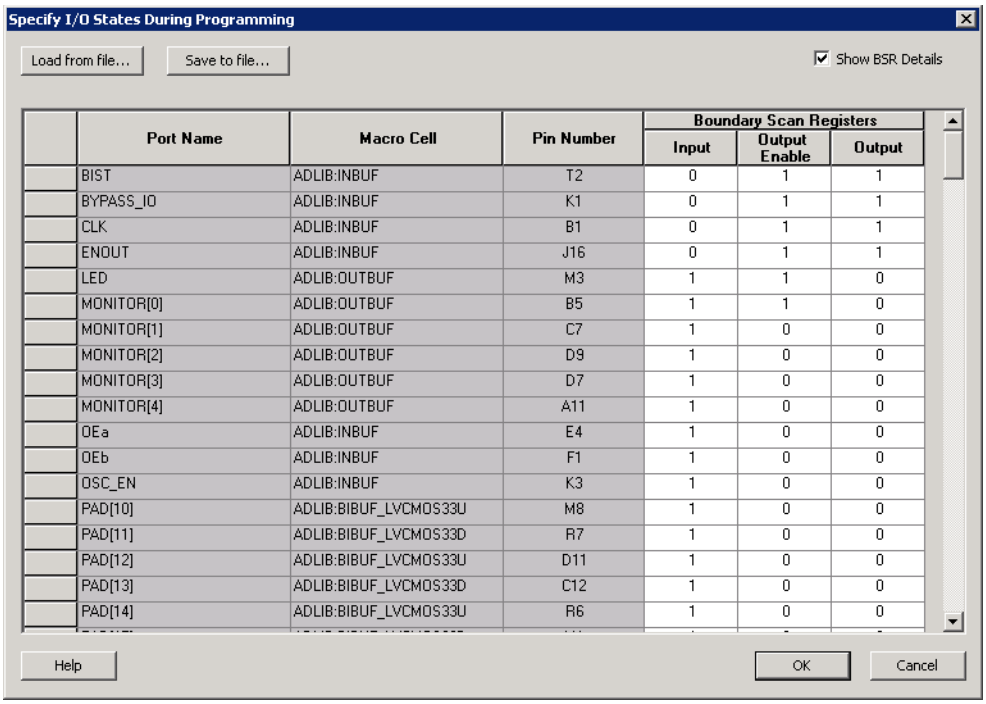
Table 8 · BSR Details I/O Output Settings

Output State	Settings		
	Input	Output Enable	Output
Z (Tri-State)	Don't Care	0	Don't Care
0 (Low)	Don't Care	1	0
1 (High)	Don't Care	1	1
Last Known State	Last State	Last State	Last State

Table Key:

- 1 – High: I/Os are set to drive out logic High
- 0 – Low: I/Os are set to drive out logic Low
- Don't Care – Don’t Care values have no impact on the other settings.
- Last_Known_State – Sampled value: I/Os are set to the last value that was driven out prior to entering the programming mode, and then held at that value during programming

The figure below shows an example of Boundary Scan Register settings.



Port Name	Macro Cell	Pin Number	Boundary Scan Registers		
			Input	Output Enable	Output
BIST	ADLIB:INBUF	T2	0	1	1
BYPASS_IO	ADLIB:INBUF	K1	0	1	1
CLK	ADLIB:INBUF	B1	0	1	1
ENOUT	ADLIB:INBUF	J16	0	1	1
LED	ADLIB:OUTBUF	M3	1	1	0
MONITOR[0]	ADLIB:OUTBUF	B5	1	1	0
MONITOR[1]	ADLIB:OUTBUF	C7	1	0	0
MONITOR[2]	ADLIB:OUTBUF	D9	1	0	0
MONITOR[3]	ADLIB:OUTBUF	D7	1	0	0
MONITOR[4]	ADLIB:OUTBUF	A11	1	0	0
OEa	ADLIB:INBUF	E4	1	0	0
OEb	ADLIB:INBUF	F1	1	0	0
OSC_EN	ADLIB:INBUF	K3	1	0	0
PAD[10]	ADLIB:BIBUF_LVCMOS33U	M8	1	0	0
PAD[11]	ADLIB:BIBUF_LVCMOS33D	R7	1	0	0
PAD[12]	ADLIB:BIBUF_LVCMOS33U	D11	1	0	0
PAD[13]	ADLIB:BIBUF_LVCMOS33D	C12	1	0	0
PAD[14]	ADLIB:BIBUF_LVCMOS33U	R6	1	0	0

Figure 80 · Boundary Scan Registers

Specify I/O States During Programming Dialog Box

The I/O States During Programming dialog box enables you to specify custom settings for I/Os in your programming file. This is useful if you want to set an I/O to drive out specific logic, or if you want to use a custom I/O state to manage settings for each Input, Output Enable, and Output associated with an I/O.

Load from file

Load from file enables you to load an I/O Settings (*.ios) file. You can use the IOS file to import saved custom settings for all your I/Os. The exported IOS file have the following format:

- Used I/Os have an entry in the IOS file with the following format:

```
set_prog_io_state -portName {<design_port_name>} -input <value> -outputEnable <value> -
output <value>
```

- Unused I/Os have an entry in the IOS file with the following format:

```
set_prog_io_state -pinNumber {<device_pinNumber>} -input <value> -outputEnable <value> -
output <value>
```

Where <value> is:

- 1 – I/O is set to drive out logic High
- 0 – I/O is set to drive out logic Low
- Last_Known_State: I/O is set to the last value that was driven out prior to entering the programming mode, and then held at that value during programming
- Z - Tri-State: I/O is tristated

Save to file

Saves your I/O Settings File (*.ios) for future use. This is useful if you set custom states for your I/Os and want to use them again later in conjunction with a PDC file.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Port Name

Lists the names of all the ports in your design.

Macro Cell

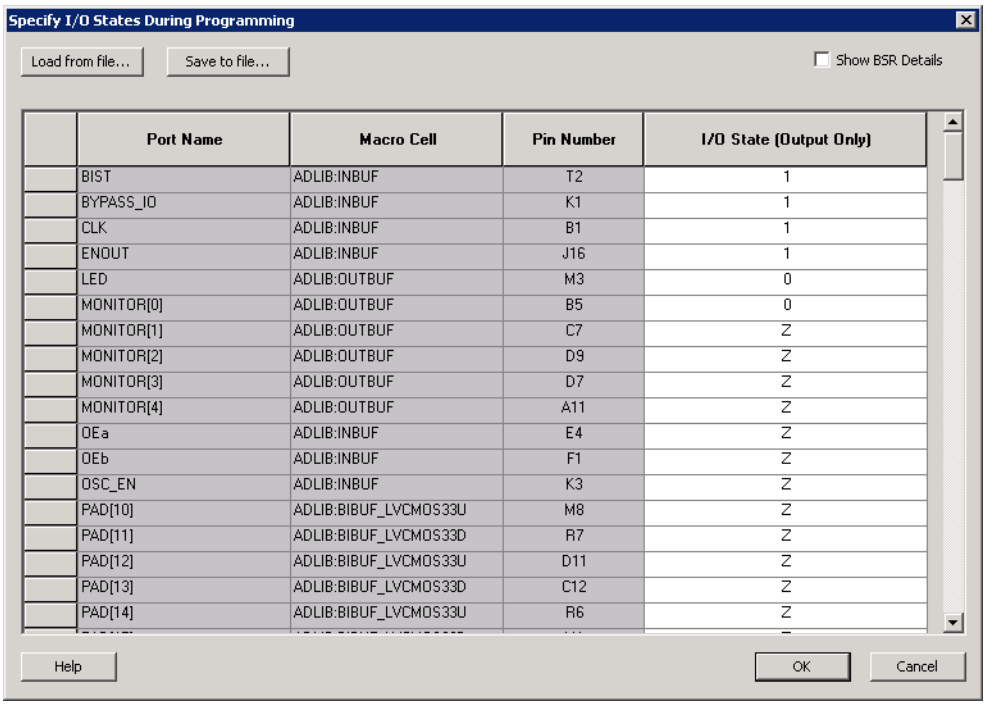
Lists the I/O type, such as INBUF, OUTBUF, PLLs, etc.

Pin Number

The package pin associate with the I/O.

I/O State (Output Only)

Your custom I/O State set during programming. This heading changes to Boundary Scan Register if you select the BSR Details checkbox; see the Specifying I/O States During Programming - I/O States and BSR Details help topic for more information on the BSR Details option.



	Port Name	Macro Cell	Pin Number	I/O State (Output Only)
	BIST	ADLIB:INBUF	T2	1
	BYPASS_IO	ADLIB:INBUF	K1	1
	CLK	ADLIB:INBUF	B1	1
	ENOUT	ADLIB:INBUF	J16	1
	LED	ADLIB:OUTBUF	M3	0
	MONITOR[0]	ADLIB:OUTBUF	B5	0
	MONITOR[1]	ADLIB:OUTBUF	C7	Z
	MONITOR[2]	ADLIB:OUTBUF	D9	Z
	MONITOR[3]	ADLIB:OUTBUF	D7	Z
	MONITOR[4]	ADLIB:OUTBUF	A11	Z
	OEa	ADLIB:INBUF	E4	Z
	OEb	ADLIB:INBUF	F1	Z
	OSC_EN	ADLIB:INBUF	K3	Z
	PAD[10]	ADLIB:BIBUF_LVCMOS33U	M8	Z
	PAD[11]	ADLIB:BIBUF_LVCMOS33D	R7	Z
	PAD[12]	ADLIB:BIBUF_LVCMOS33U	D11	Z
	PAD[13]	ADLIB:BIBUF_LVCMOS33D	C12	Z
	PAD[14]	ADLIB:BIBUF_LVCMOS33U	R6	Z

Figure 81 · I/O States During Programming Dialog Box

Generate a DAT file

DAT files are generated via the Generate Programming Files dialog box.

To access the Generate Programming Files dialog box from Libero SoC and generate a DAT file:

1. In the Design Flow window, expand **Implement Design**, right-click **Generate Programming Data** and choose **Open Interactively**. This opens Designer.
2. Click **Programming File** to start FlashPoint.
3. Set your feature and I/O options if necessary. Click **Finish**. This opens the Generate Programming File dialog box, as shown in the figure below.

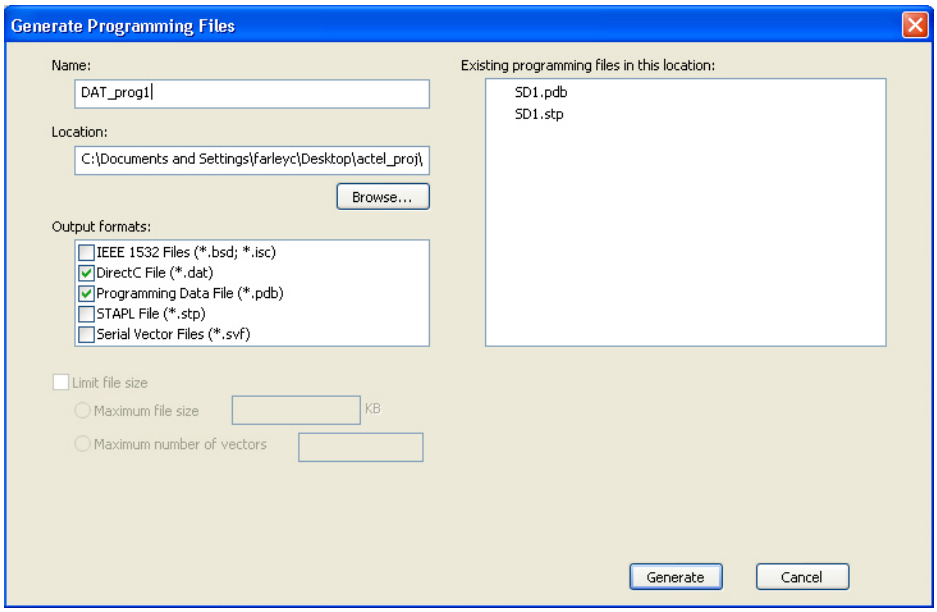


Figure 82 · Generate Programing Files Dialog Box - DirectC File (*.dat)

4. Set your output file **Name** and **Location**.
5. Set your Output Formats to **DirectC file (*.dat)** and **Programming Data File (*.pdb)**.
6. Click **Generate** to create your file.

FlashLock®

Microsemi's SmartFusion devices contain FlashLock circuitry to lock the device by disabling the programming and readback capabilities after programming. Care has been taken to make the locking circuitry very difficult to defeat through electronic or direct physical attack.

FlashLock has three security options: No Lock, Permanent Lock, and Keyed Lock.

No Lock

Creates a programming file which does not secure your device.

Permanent Lock

The permanent lock makes your device one time programmable. It cannot be unlocked by you or anyone else.

Keyed Lock

Within each device, there is a multi-bit security key user key. The number of bits depends on the size of the device. Once secured, read permission and write permission can only be enabled by providing the correct user key to first unlock the device. The maximum security key for the device is shown in the dialog box.

Generating Bitstream and STAPL files

Bitstream allows you to generate a STAPL file for SmartFusion, IGLOO, ProASIC3, Fusion devices. Please consult the Program Files table to find out which file type you should choose.

To generate a STAPL file:

1. From the **Tools** menu, choose **Programming File**.
2. Select **Bitstream** or **STAPL** from the **File Type** drop-down list box. Bitstream files are not available for SmartFusion, IGLOO, ProASIC3 and Fusion devices.
3. **FlashLock**. Select one of the following options:

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

- **No Locking:** Creates a programming file which does not secure your device.
- **Use Keyed Lock:** Creates a programming file which secures your device with a FlashLock key. The maximum security key for the device is shown in the dialog box. The maximum security key for the device is shown in the dialog box.
- **Use Permanent Lock:** Creates a one-time programmable device.

4. Click **OK**. Designer validates the security key and alerts you to any concerns.

Note: The bitstream file header contains the security key.

SPI Programming Tutorial Overview

SmartFusion2 and IGLOO2 devices can be programmed using multiple programming methods.

Refer to the Programming User Guide for your respective device for details on different programming methods.

The following tutorials describe programming methods that involve the MSS/HPMS SPI_0 ports:

- Auto Programming
- In Application Programing (IAP) Tutorial
- Programming Recovery - Auto Update

Auto Programming

Auto programming uses the Microcontroller Subsystem SPI port (SPI_0) to fetch the bitstream from the external SPI flash (pre-programmed) connected to the same port and then program the FPGA Fabric and eNVM. The transaction between the System controller and the external SPI flash happens in SPI master mode.

The SPI_0 port is enabled to operate as a SPI master at power-on reset or DEVRST_N assertion if the FLASH_GOLDEN_N pin is pulled low. The Auto Programming can be protected in the Security Policy Manager > Update Policy.

1. Right-click **Configure Security and Programming > Configure Security** and choose **Configure Options** (as shown in the figure below).

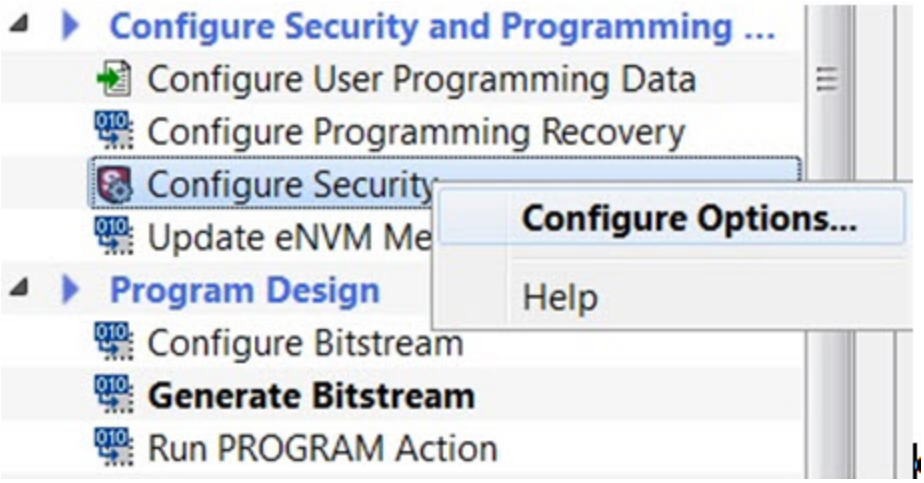


Figure 83 · Launch Security Policy Manager

2. In Security key mode select **Enable customer security options**.
3. In Security policies click the checkbox to enable **Update Policy**.
4. Click the **Update Policy** button and click to enable **Auto Programming**.

Auto programming uses a *.spi programming file. You must export a *.spi file using Export Bitstream (under Handoff Design for Production).

Note: SPI file programming for Auto Programming, Auto Update (IAP), Programming Recovery, and IAP/ISP Services currently can only program security once with the master file. Update files cannot update the security settings. In addition, Programming Recovery, Silicon Signature, Firewall, and Tamper Macro can only be programmed with the master file and cannot be updated.

DEVICE_INFO programming

When the DEVICE_INFO programming action is run with a STAPL file for SmartFusion2 and IGLOO2 devices, you will see the following message:

"Info: Algorithm Version, Programmer, Software Version, Programming Software, Programming Interface Protocol, and Programming File Type information do not get programmed with Auto Programming, Auto Update (IAP), Programming Recovery, or IAP/ISP Services and should be ignored."

In Application Programming (IAP) Tutorial

In Application Programming (IAP) is a two-step process. In the first step, the intended bitstream is written to an external SPI flash connected to SPI_0 port of MSS. In the second step, Cortex-M3(SmartFusion2) or user logic in Fabric (IGLOO2) calls the IAP programming service of the system controller to program the FPGA fabric and eNVM with the bitstream fetched from the external SPI flash.

In order to perform IAP, the required functional blocks must be configured by pre-programming the chip.

To enable SmartFusion2/IGLOO2 device for IAP, you must configure the following components in Libero SoC:

- **Source of application image**: eSRAM, eNVM or DDR/SDR memories or Fabric
- **Source of programming bitstream**: MSS peripherals including SPI_0 port
- **Interface between System Controller and Cortex-M3**: COMM_BLK

To create a programming file with IAP configuration (SmartFusion2 steps shown):

1. Create a Libero SoC project targeting the desired SmartFusion2 device. Select **SmartFusion2 Microcontroller**. Click the checkbox to enable **Use Design Tool** and select the **SmartFusion2 Microcontroller Subsystem (MSS)**. Click OK to continue. A dialog box appears to name your new component.
2. Name the component **IAP_Setup_MSS_0**.
3. Double-click **IAP_Setup_MSS_0** to configure the blocks:

- **ENVM** stores the two step IAP application code.
- **USB** is the interface used to read the programming bitstream and download it to the External SPI flash.
- **MSS_CCC** is the Cortex-M3 Clock
- **RESET** Controller is the Chip reset
- **SPI_0** is connected with External SPI flash
- **MMUART_1** is the Host PC communication to get status

See the SmartFusion2 Microcontroller Subsystem User Guide section on How to Use Blocks for details on how to configure them.

4. Click **SmartDesign > Generate Component**.
5. Complete the design flow up to Place and Route and export the firmware to enable the MSS component.
6. Click Generate Bitstream or Export Bitstream to export a programming file you can use to program your device.

Note: Libero SoC will error out if SPI_0 routs to the fabric instead of a package pin.

DEVICE_INFO programming

When the DEVICE_INFO programming action is run with a STAPL file for SmartFusion2 and IGLOO2 devices, you will see the following message:

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

"Info: Algorithm Version, Programmer, Software Version, Programming Software, Programming Interface Protocol, and Programming File Type information do not get programmed with Auto Programming, Auto Update (IAP), Programming Recovery, or IAP/ISP Services and should be ignored."

Programming Recovery Tutorial

If programming recovery is enabled, SmartFusion2/IGLOO2 device automatically recovers from a power failure during a programming operation. Programming recovery requires an external SPI flash to be connected to the MSS SPI_0 port. The FPGA must be pre-programmed with the programming recovery settings. Programming recovery settings define the location of the image and how to recovery will take place.

For a blank device the image location is set to MSS SPI_0 port where an external SPI flash must be connected.

Notes:

Programming Recovery cannot be updated with _UEK1 or _UEK2 programming files. Only the master programming file can be used.

SPI file programming for Auto Programming, Auto Update (IAP), Programming Recovery, and IAP/ISP Services currently can only program security once with the master file. Update files cannot update the security settings. In addition, Programming Recovery, Silicon Signature, Firewall, and Tamper Macro can only be programmed with the master file and cannot be updated.

To configure Programming Recovery:

1. Under **Configure Security and Programming Options** double-click **Configure Programming Recovery**.
2. Select **Enable Programming Recovery**. If Auto update is selected then Design version is mandatory. You must enter the design version in the Configure User Programming Data menu.
3. Check **Enable Programming Recovery** and set the SPI clock frequency and data transfer mode. Refer to the table below for SPI data transfer options. For a blank device SPO and SPH are defaulted to 1.

Table 9 · SPI Signal Polarity Modes

SPO	SPH	SPI Clock in Idle	Sample Edge	Shift Edge	SPI Select in Idle	SPI Select Between Frames
0	0	Low	Rising	Falling	High	Stays active until all the frames set by frame counter have been transmitted
0	1	Low	Falling	Rising	High	
1	0	High	Falling	Rising	High	
1	1	High	Rising	Falling	High	

Note: SPO = SPI clock polarity; SPH = SPI clock phase

If Enable Auto Update is checked, Programming recovery is automatically enabled. In this scenario when the device is powering up, it will be auto programmed with the bitstream stored in SPI_0 port if the update SPI image design version is greater than the design version currently programmed in the device.

During programming recovery, if there is a programming failure due to power failure, then the the device will be recovered with the golden image.

Back Level protection - If you enable Back Level protection it provides bitstream replay protection. The BACKLEVEL value limits the design versions that the device can update. So, only programming bitstreams with DESIGNER > BACKLEVEL are allowed for programming

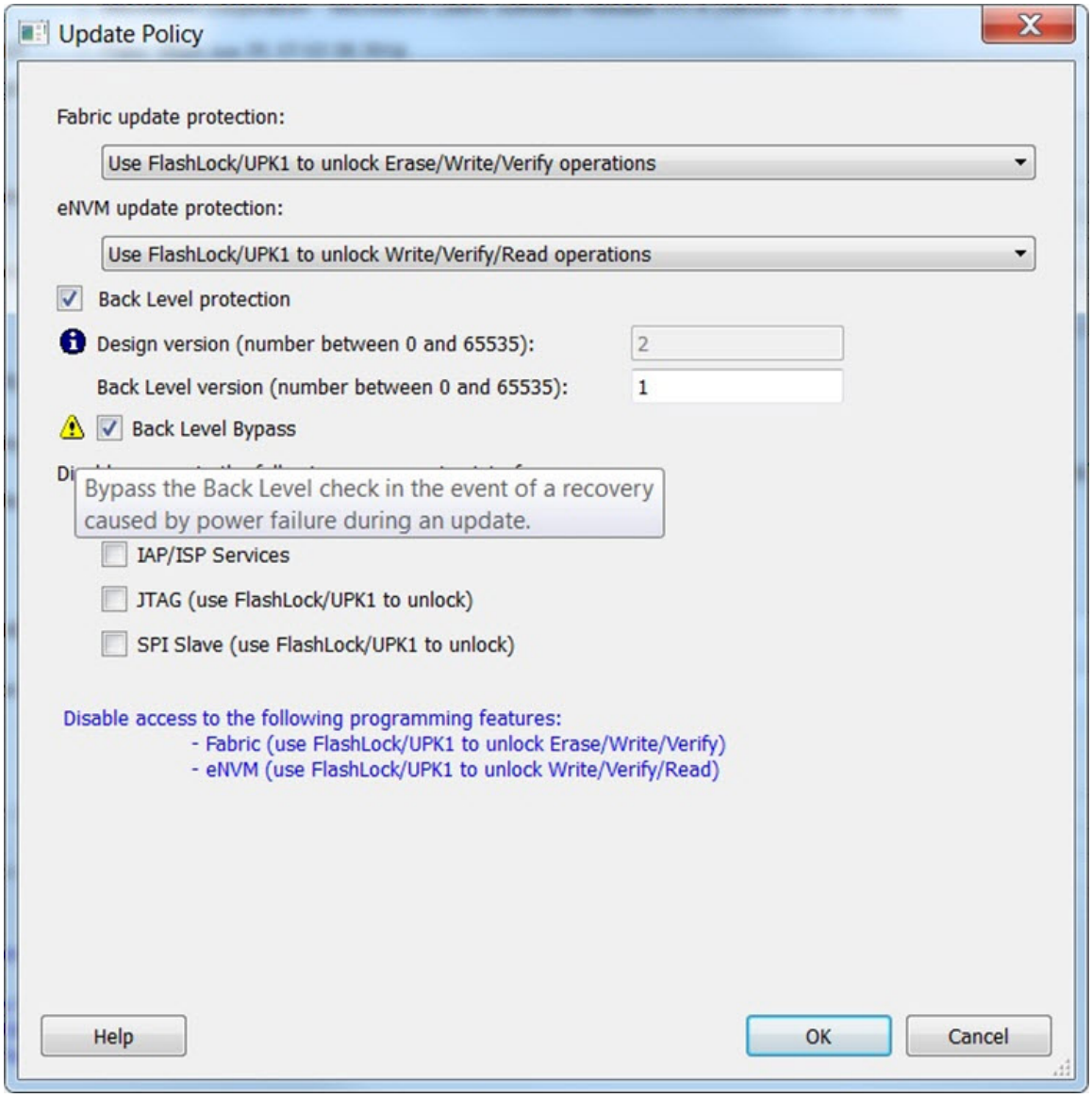


Figure 84 · Bypass Back Level Version Check

4. In the Update Policy dialog box click the checkbox to enable **Back Level Protection**, as shown in the figure above. Note that in order to use Back Level Protection you must enter the Design version in the Configure User Programming Data dialog box. By default the Back Level bypass is checked in order to continue with programming recovery with current/golden image in the event of power failure. This allows the golden SPI image to be programmed even if the design version is less than the backlevel version without the need of a pass key.

   Consider an instance where the device is programmed with a golden image first which has DESIGNVER = 2 and BACKLEVEL = 1. Now you want to program the device with an update image that has DESIGNVER = 3 and BACKLEVEL = 2. If the Back Level bypass is not checked and power fails, the programming recovery will stop and the device will be left inoperable because the golden image DESIGNVER is not greater than the BACKLEVEL of update image.

5. Export the SPI directory for Programming recovery. The flash device on the MSS SPI_0 port contains a directory at address 0 with the information shown in the table below.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Offset	Name	Description
0	GOLDEN_IMAGE_ADDRESS[3:0]	Contains the address where the golden image starts
4	GOLDEN_IMAGE_DESIGNVER[1:0]	Contains the design version of the golden image
6	UPDATE_IMAGE_ADDRESS[3:0]	Contains the address where the update image starts
10	UPDATE_IMAGE_DESIGNVER[1:0]	Contains the design version of the update image

6. Right-click **Export Programming File** and choose **Configure Options**.
7. In the Export Bitstream dialog box, click the checkbox to enable **Export SPI directory for programming recovery** and click the **Specify SPI Directory** button.
8. In the SPI Directory dialog box enter the **Design version** and browse to the location of the Golden SPI Image and/or Update SPI Image. You must enter the **Address** of the bitstream manually (as shown in the figure below).

DEVICE_INFO programming

When the DEVICE_INFO programming action is run with a STAPL file for SmartFusion2 and IGLOO2 devices, you will see the following message:

"Info: Algorithm Version, Programmer, Software Version, Programming Software, Programming Interface Protocol, and Programming File Type information do not get programmed with Auto Programming, Auto Update (IAP), Programming Recovery, or IAP/ISP Services and should be ignored."

SmartFusion2 Programming Tutorial Overview

The SmartFusion2 Programming Tutorial describes the basic steps for SmartFusion2 programming.

Only the bold steps in the Design Flow window are required to complete and program your design. Note that the bold steps are completed automatically if you use the Build button.

1. MSS Configuration - eNVM

   eNVM configuration enables you to configure eNVM as a ROM so that it can be included in the eNVM digest calculations.

   Data Security Configuration controls which masters have access to which memory region within the MSS.

2. Generate Bitstream

   Generate bitstream for programming within Libero.

3. Edit Design Hardware Configuration

   Configures Device I/O States During Programming.

4. Configure Security and Programming Options
   - Security Policy Manager
   - Configure Bitstream
   - Update eNVM Memory Content

5. Program Design

   Configure Actions/Procedures (sets programming options) and programs your device.

6. Handoff Design for Production
    - Export Bitstream
    - Export BSDL

MSS Configuration - eNVM

eNVM Configuration

You must create a MSS to configure your eNVM. Use System Builder to configure your eNVM for IGLOO2.

eNVM configuration enables you to configure eNVM as a ROM so that it can be included in the eNVM digest calculations. To do so:

1. Open your MSS and double-click the **eNVM block** to open the **eNVM configuration dialog box**, as shown in the figure below.

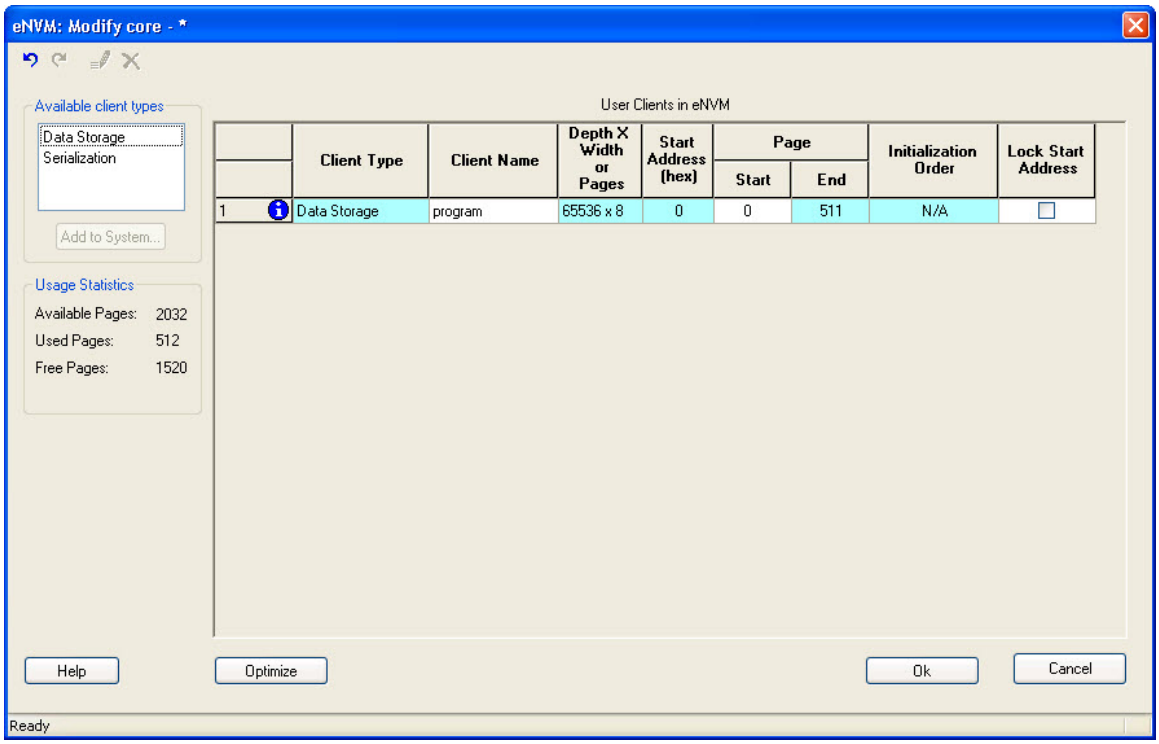


Figure 85 · eNVM Configuration Dialog Box

The example design shown in the figure above already has a Data Storage Client.

2. Double-click the **Data Storage Client** to open the **Modify Data Storage Client dialog box**, as shown in the figure below.

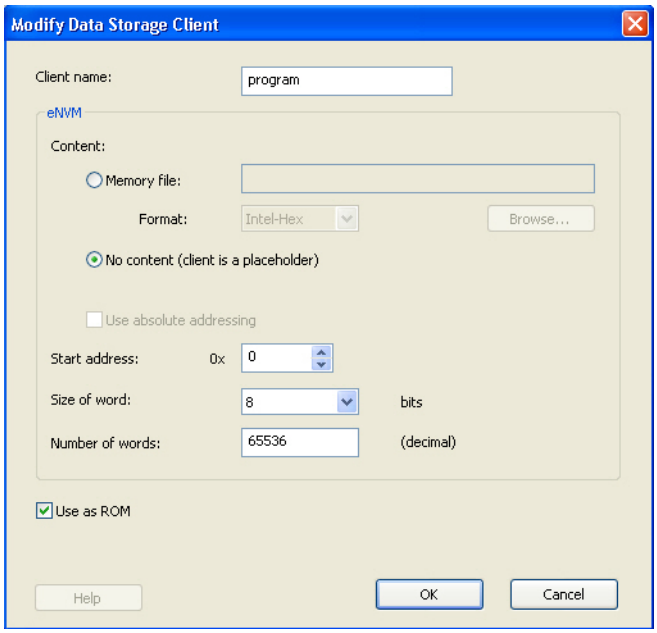


Figure 86 · Modify Data Storage Client Dialog Box - Use as ROM Selected

3. Click **Use as ROM** (as shown in the figure above) to configure the memory region as a ROM and include the eNVM digest calculations.
4. Click **OK** in the Modify Data Storage Client dialog box to continue.
5. Double-click **Serialization** to open the **Add Serialization Client dialog box** (as shown in the figure below) and reserve a client for serialization. Add your Client name and eNVM Start address and Number of pages, as appropriate. You can configure the content of your serialization client in the Serialization Client Editor, available from the Update eNVM Memory Content dialog box.

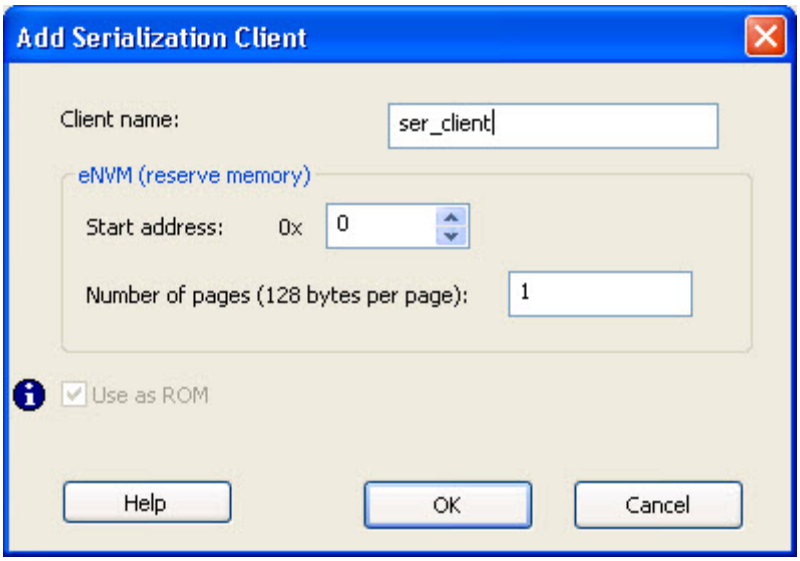


Figure 87 · Add Serialization Client Dialog Box

6. Click **OK** in the Add Serialization Client dialog box to continue.
7. Click **OK** in the eNVM Configuration dialog box to return to the MSS.

Enable Data Security

The Data Security Configuration controls which masters have access to which memory region within the MSS. To configure your data security:

Double-click the **Security** block in the MSS to open the **MSS Security Policies Configurator**, as shown in the figure below.

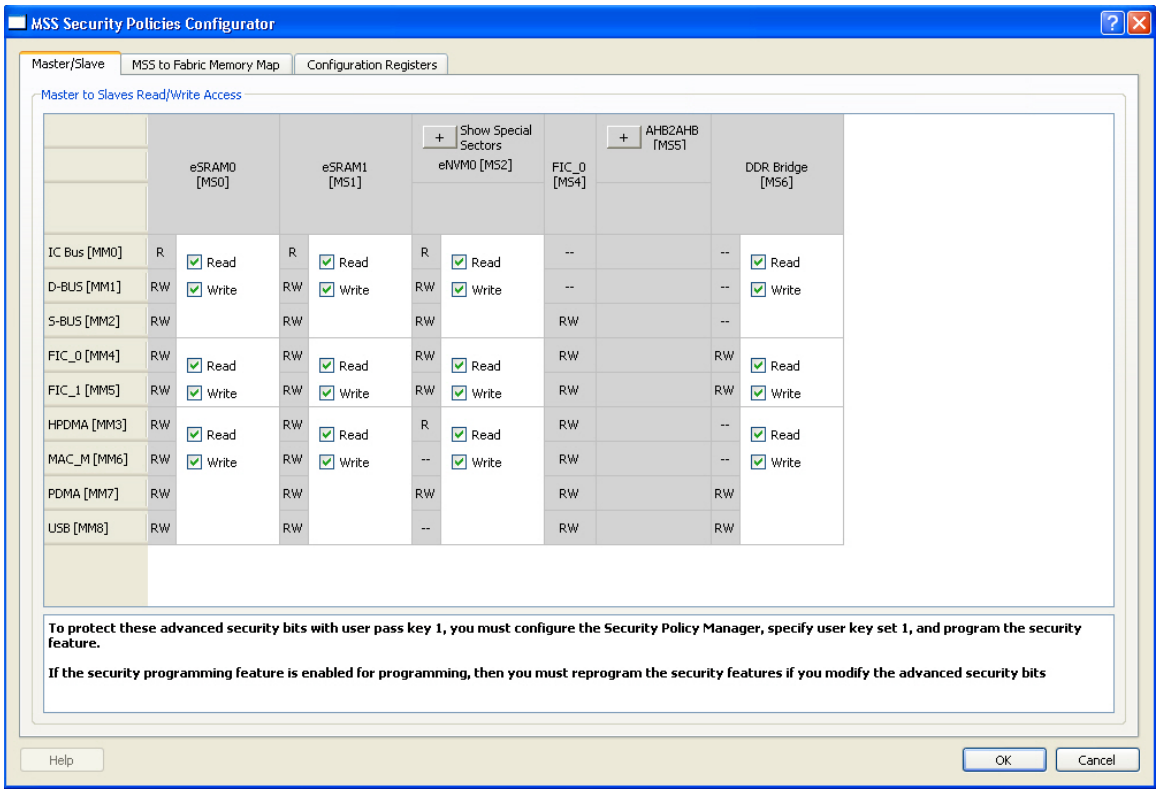


Figure 88 · MSS Security Policies Configurator

Masters are listed on the left, and slaves are shown at the top. All masters have access to all slaves by default; click to enable or disable Read/Write access for specific masters and slaves.

Restrict your master/slave Read/Write access according to your preference and click **OK** to continue.

Note: SPI file programming for Auto Programming, Auto Update (IAP), Programming Recovery, and IAP/ISP Services currently can only program security once with the master file. Update files cannot update the security settings. In addition, Programming Recovery, Silicon Signature, Firewall, and Tamper Macro can only be programmed with the master file and cannot be updated.

Generate Bitstream - SmartFusion2, IGLOO2, and RTG4

Generates the bitstream for use with the Run PROGRAM Action tool.

The tool incorporates the Fabric design, eNVM configuration (if configured) and security settings (if configured) to generate the bitstream file. You need to configure the bitstream before you generate the bitstream. Right-click **Generate Bitstream** and choose **Configure Options** to open the Configure Bitstream dialog box to select which components you wish to program. Only features that have been added to your design are available for programming. For example, you cannot select eNVM for programming if you do not have an eNVM in your design.

Modifications to the Fabric design, eNVM configuration, or security settings will invalidate this tool and require regeneration of the bitstream file.

The Fabric programming data will only be regenerated if you make changes to the Fabric design, such as in the Create Design, Create Constraints and Implement Design sections of the Design Flow window.

This operation is completed automatically as the last step if you use the Build button.

When the process is complete a green check appears next to the operation in the Design Flow window (as shown in the figure below) and information messages appear in the Log window.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

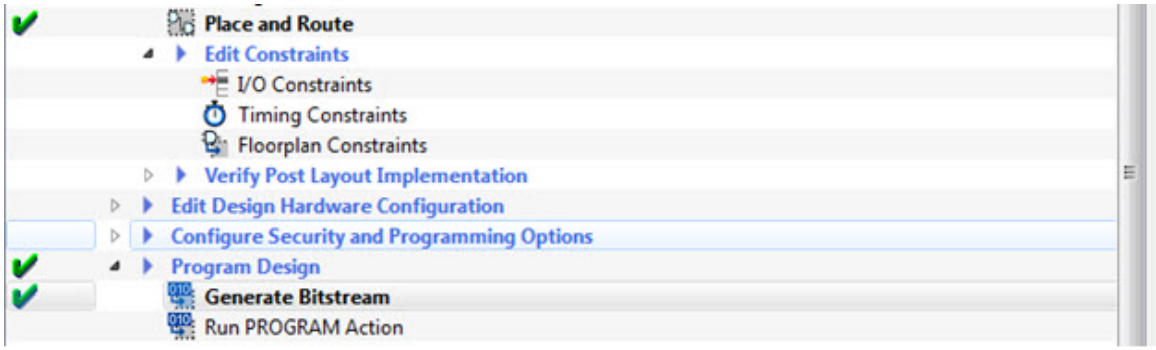


Figure 89 · Generate Bitstream (Complete)

See also

Configure Bitstream Dialog Box

Edit Design Hardware Configuration - Device I/O States During Programming

You can configure your FPGA I/Os while the device is being programmed using Device I/O States During Programming.

In the Design Flow window, expand **Edit Design Hardware Configuration** and double-click **Device I/O States During Programming**.

The Device I/O States During Programming dialog box appears.

Click a value in the I/O State (Output Only) column to set your I/O State options according to your preference, as shown in the figure below.

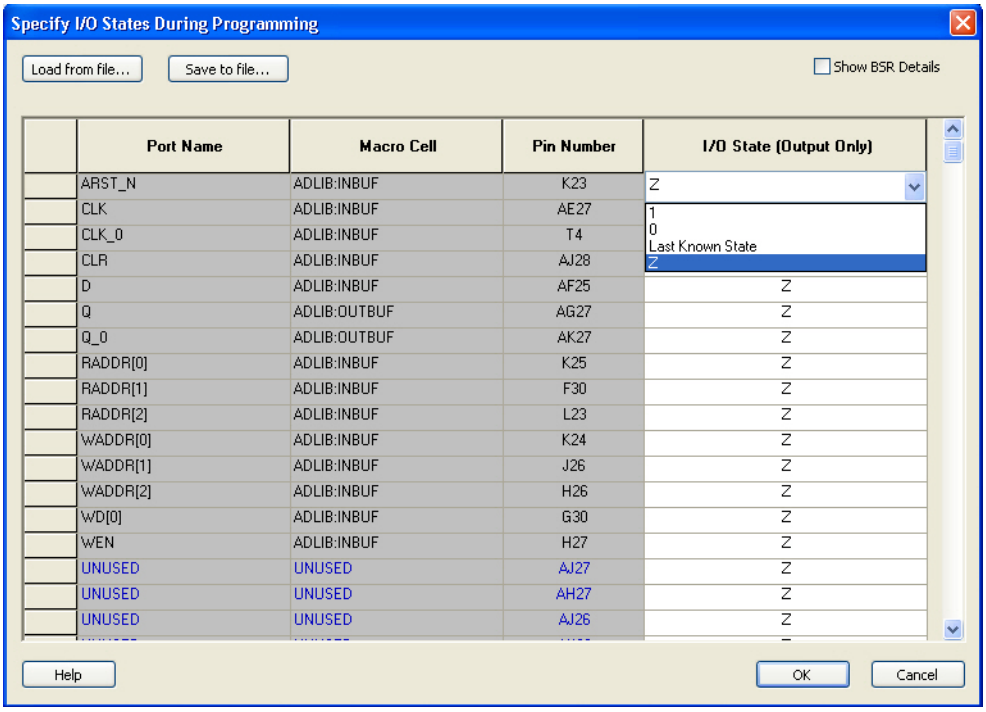


Figure 90 · Set I/O State

Security Policy Manager (SPM)

Expand **Configure Security and Programming Options**, double-click **Configure Security** to customize the security settings in your design.

Use this dialog box to set your User Keys, Security Policies and Microsemi factory test mode access level.

Note: Microsemi enabled default bitstream encryption key modes are disabled after user security is programmed.

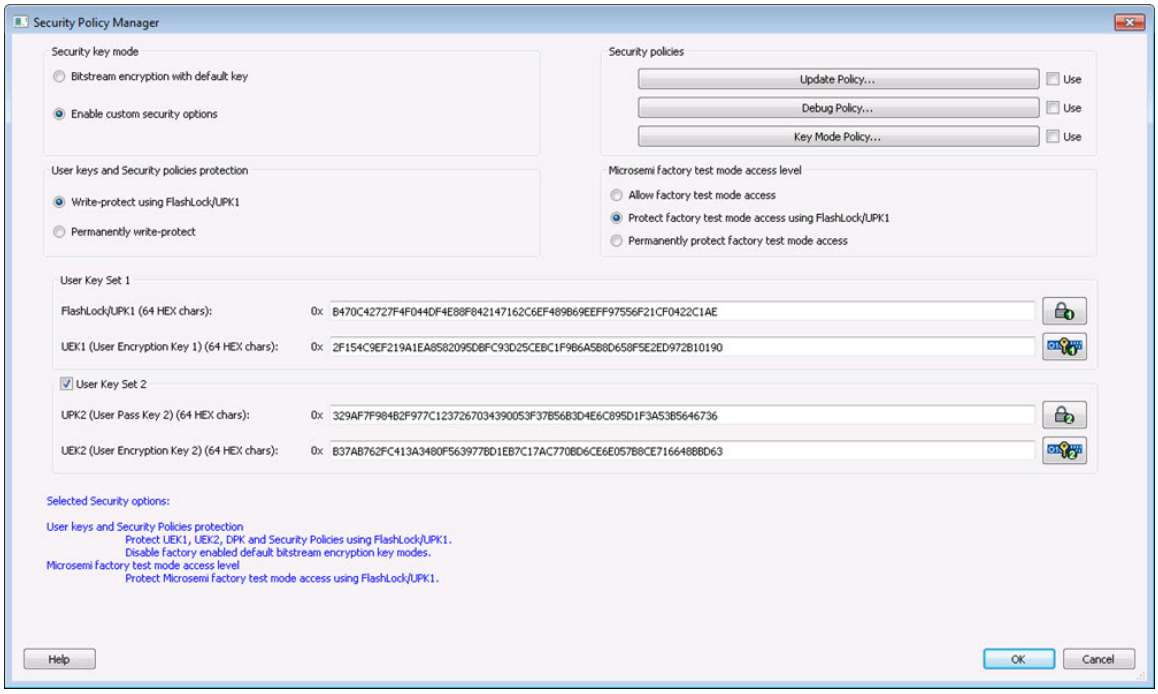


Figure 91 · Security Policy Manager Dialog Box

Security Key Mode

Bitstream encryption with default key - Encrypt bitstream files with Microsemi default key (pre-placed key in silicon). When this option is selected, user keys, security and Microsemi factory test mode access level configurations are disabled.

Enable custom security options - Enables you to set User Keys, Security Policies and Microsemi factory test mode access level (see below for a description).

User keys and Security policies protection

Write-protect using FlashLock/UPK1 - Protect UEK1 (User Encryption Key 1), DPK (Debug Pass Key) and Security Policies using FlashLock/ UPK1.

Note: UEK2 (User Encryption Key2) is protected by UPK2 (User Pass Key 2).

Permanently write-protect - Permanently protect UEK1 (User Encryption Key 1), UPK2 (User Pass Key 2), UEK2 (User Encryption Key 2), DPK (Debug Pass Key), Security Policies, and Microsemi factory test mode access level. This setting, once programmed will not be modified in the device. Microsemi enabled default bitstream encryption key modes are permanently disabled as well.

Note: When this option is selected, you cannot specify the FlashLock/UPK 1 and UPK2 (User Pass Key 2) value, since the value cannot be used to unlock the corresponding protected features.

Microsemi Factory Test Mode Access Level

Protect factory test mode access using FlashLock/UPK1 - Protects access to Microsemi factory test mode using Flashlock/ UPK1.

Permanently protect factory test mode access - Permanently locks access to Microsemi factory test mode.

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Note: When this option is selected, User Key Set 2 is permanently write-protected. Once programmed, User Key Set 2 cannot be changed in the device. You can specify UEK2 (User Encryption Key 2). However, you cannot specify UPK2 (User Pass Key 2), since the value cannot be used to unlock User Key Set 2.

Allow factory test mode access - Allows access to Microsemi factory test mode.

Security Policies

Update Policy - Sets your Fabric, eNVM and Back Level protections. See the Update Policy topic for more information.

Debug Policy - Enables and sets your Debug Pass Key and debug options. See the Debug Policy topic for more information.

Key Mode Policy - Configures the key mode to enable or disable. See the Key Mode Policy topic for more information.

Configuring User Keys

User Key Set 1 is required. User Key Set 1 includes FlashLock/UPK1 (User Pass Key 1) and UEK1 (User Encryption Key 1)..

User Key Set 2 is optional. User Key Set 2 includes UPK2 (User Pass Key 2) and UEK2 (User Encryption Key 2).

Note that User Pass Key 2 (UPK2) protects only User Encryption Key 2 (UEK2).

Bitstream Configuration

Expand Configure Security and Programming Options and double-click Bitstream Configuration to open the Bitstream Configuration dialog box, as shown in the figure below.

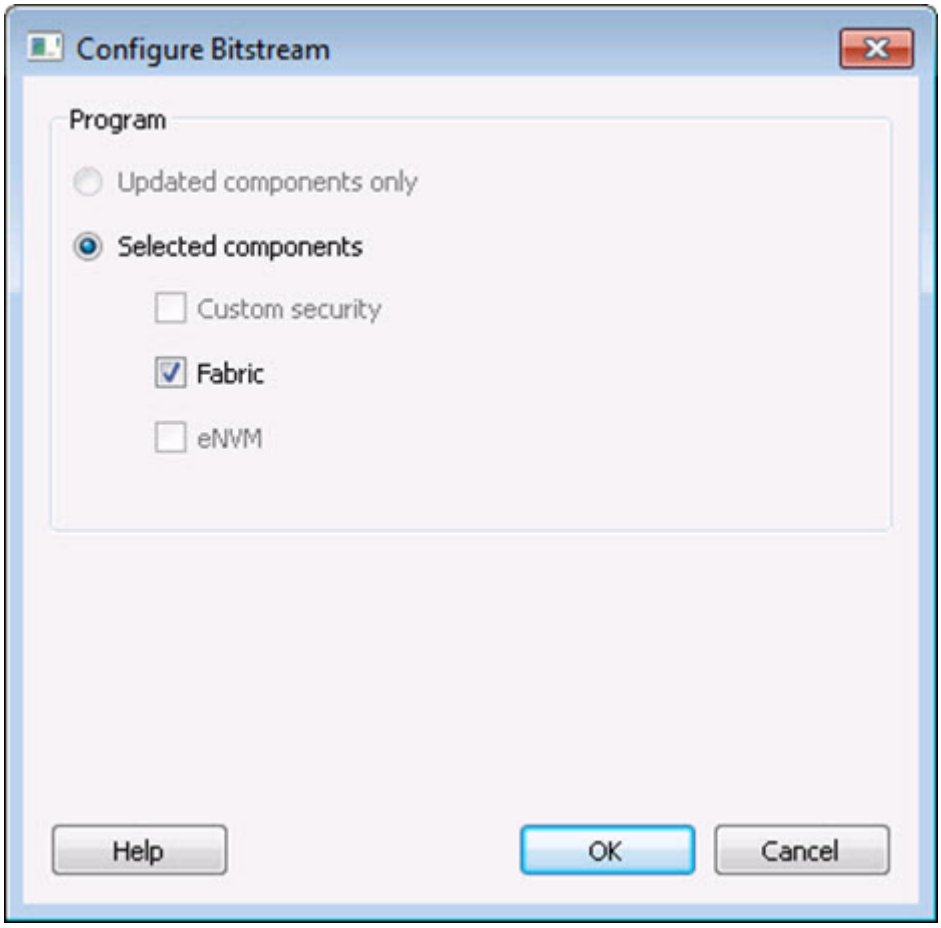

Figure 92 · Configure Bitstream Dialog Box

You can program your Security, Fabric, eNVM or any combination.

Features (Security, Fabric, eNVM) are enabled for programming by default when you add them to your design. If you manually disable a feature in this dialog box then you must re-enable it here if you want it included during programming.

Update eNVM Memory Content (SmartFusion2 and IGLOO2)

Right-click **Update eNVM Memory Content** and choose **Configure Options** (**eNVM Memory Content > Configure Options**) or double-click **Update eNVM Memory Content** to open the dialog box and modify your eNVM content.

The Update eNVM Memory Content dialog box enables you to update your eNVM content for programming without having to rerun Compile and Place and Route. It is useful if you have reserved space in the eNVM configurator within the MSS for firmware development, for example. Use the Update eNVM Memory Content dialog box when you have completed your firmware development and wish to incorporate your updated firmware image file into the project.

Note: To disable a client for programming, you must modify the client and select “No Content (Client is a placeholder and will not be programmed)”. The content from the memory file, serialization data file, or auto-incremented serialization content will be preserved if you later decide to enable this client for programming. Clients disabled for programming will not be included in the generated bitstream and will not be programmed.

Modify Data Storage Client

Double-click the Storage Client to open the Modify Data Storage Client dialog box.

Note: You cannot add, delete or rename a data storage client in the Modify Data Storage Client dialog box. To make these changes, go to the eNVM configurator inside the MSS/HPMS Configurator or navigate to the System Builder’s Memory page (eNVM tab).

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

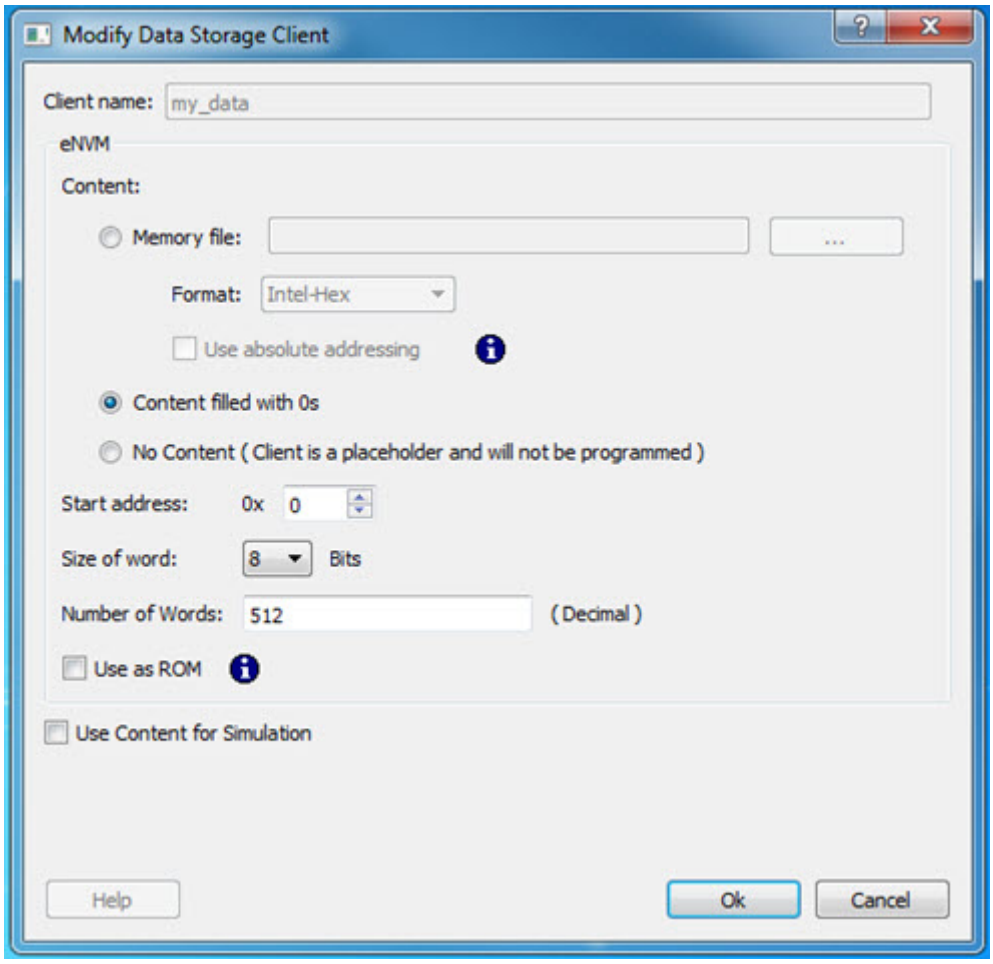

Figure 93 · Modify Data Storage Client Dialog Box

You have three options to specify the eNVM content:

- Import a Memory File
- Fill eNVM content with Zero's
- Assign No Content (eNVM as a Placeholder). The client will not be included in the programming bitstream and will not be programmed

If you have completed Place and Route and you import a memory file for the eNVM content, you do not have to rerun Compile or Place and Route. You can program or export your programming file directly. Programming will generate a new programming file that includes your updated eNVM content.

You can also specify the start address where the data for that client starts, the word size and the number of words to reserve for the data storage client.

Modify Serialization Client

Double-click the Serialization Client to open the Modify Serialization Client dialog box.

Note: You cannot add, delete or rename a Serialization Client in the Modify Serialization Client dialog box. Go to the eNVM configurator inside the MSS/HPMS Configurator or the System Builder Memory page (eNVM tab) to make these changes.

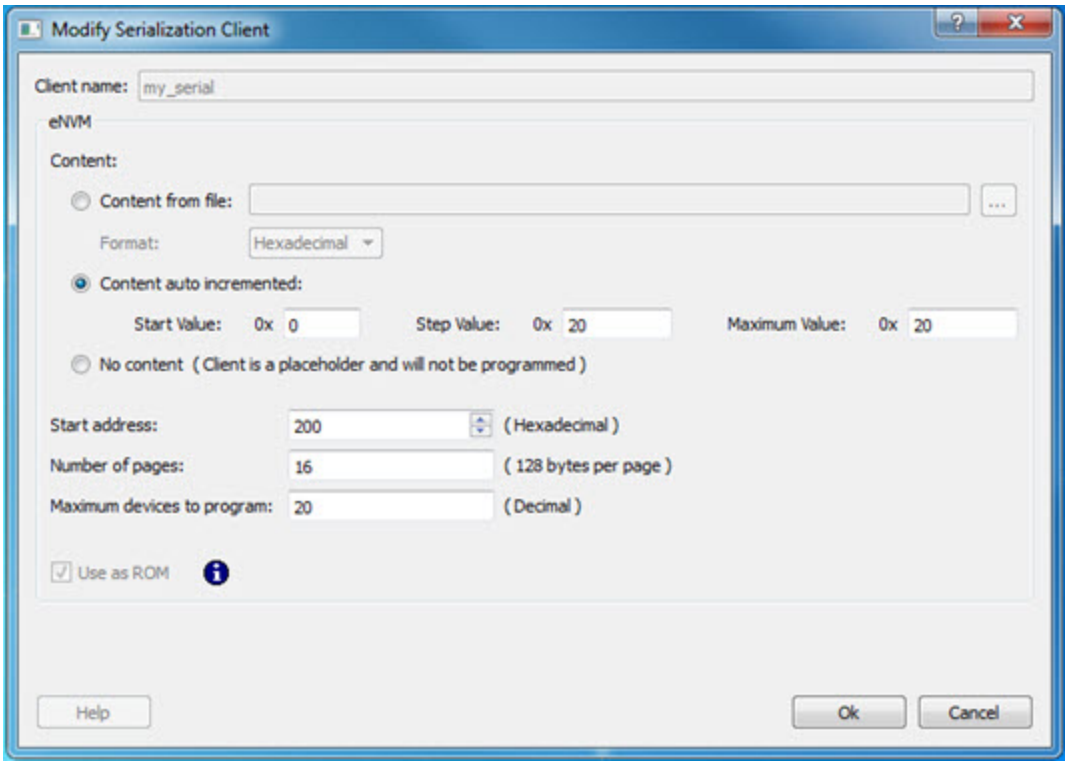

Figure 94 · Modify Serialization Client Dialog Box

You have three options to specify the eNVM content:

- Import a Memory File
- Increment values automatically
- Assign No Content (eNVM as a Placeholder). The client will not be included in the programming bitstream and will not be programmed

If you have completed Place and Route and you import a memory file for the eNVM content, you do not have to rerun Compile or Place and Route. You can program or export your programming file directly. Programming will generate a new programming file that includes your updated eNVM content.

You can also specify the start address where the data for the Serialization Client starts, the number of pages and the maximum number of devices you want to program serialization data into.

Setting a maximum number of devices to program for Serialization clients will generate a programming bitstream file that has serialization content for the number of devices specified. The maximum number of devices to program must match for all serialization clients. If the user would like to program a subset of the devices during production programming, this can be done within the FlashPro Express tool, which allows you to select a range of indices desired for programming for that serialization programming job session. Refer to the FlashPro Express User's Guide for more information.

Program Design - Run PROGRAM Action

Expand Program Design and double-click **Run PROGRAM Action** to program your device with default settings, as shown in the figure below.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

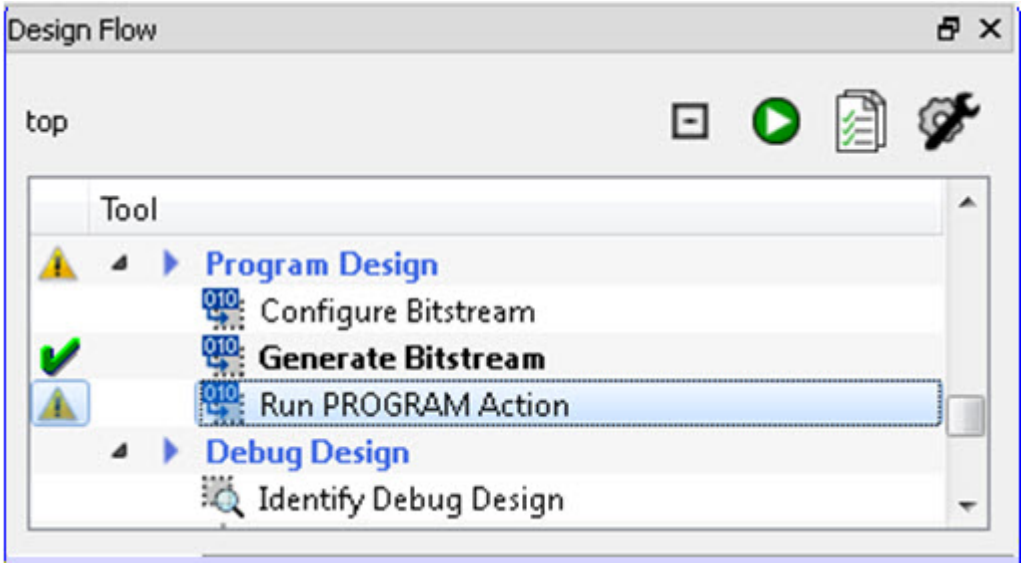

Figure 95 · Program Device in the Design Flow Window

Right-click **Run PROGRAM Action** and choose from the following menu options:

- **Clean and Run All** - Cleans all tools, deletes all reports and output files and runs through programming. All logs will be updated with new files.
- **Clean** - deletes only reports and output files associated with this tool; the other tool files and reports are unaffected.
- **Configure Actions/Procedures** - Enables you to set the specific Action you wish to program. Select your programming action from the dropdown menu.

Handoff Design for Production

In order to handoff your design for production you must export a programming file or generate a BSDL file.

See the Export Bitstream - SmartFusion2, IGLOO2, and RTG4 topic for complete instructions on how to handoff your design for production.

You can also export your programming job.

Export BSDL File

Double-click **Export BSDL File** to generate a BSDL file for your project.

Right-click **Export BSDL File** and choose **Clean and Run All** to remove all data and output from tools run previously and rerun the Design Flow up through this point.

Identify Debug Design

Libero SoC integrates the Identify RTL debugger tool. It enables you to probe and debug your FPGA design directly in the source RTL. Use Identify software when the design behavior after programming is not in accordance with the simulation results.

To open the Identify RTL debugger, in the Design Flow window under Debug Design double-click **Instrument Design**.

Identify features:

- Instrument and debug your FPGA directly from RTL source code .
- Internal design visibility at full speed.
- Incremental iteration - Design changes are made to the device from the Identify environment using incremental compile. You iterate in a fraction of the time it takes route the entire device.

- Debug and display results - You gather only the data you need using unique and complex triggering mechanisms.

You must have both the Identify RTL Debugger and the Identify Instrumentor to run the debugging flow outlined below.

To use the Identify Instrumentor and Debugger:

1. Create your source file (as usual) and run pre-synthesis simulation.
2. (Optional) Run through an entire flow (Synthesis - Compile - Place and Route - Generate a Programming File) without starting Identify.
3. Right-click **Synthesize** and choose **Open Interactively** in Libero SoC to launch Synplify.
4. In Synplify, click **Options > Configure Identify Launch** to setup Identify.
5. In Synplify, create an Identify implementation; to do so, click **Project > New Identify Implementation**.
6. In the Implementations Options dialog, make sure the Implementation Results > Results Directory points to a location under <libero project>\synthesis\, otherwise Libero SoC is unable to detect your resulting EDN file
7. From the Instumentor UI specify the sample clock, the breakpoints, and other signals to probe. Synplify creates a new synthesis implementation. Synthesize the design.
8. In Libero SoC, select the edif netlist of the Identify implementation you want to use in the flow. Right-click **Compile** and choose **Organize Input Files > Organize Source Files** and select the edif netlist of your Identify implementation.
9. Run Compile, Place and Route and Generate a Programming File with the edif netlist you created with the Identify implementation.
10. Double-click **Identify Debug Design** in the Design Flow window to launch the Identify Debugger.

The Identify RTL Debugger, Synplify, and FlashPro must be synchronized in order to work properly. See the Release Notes for more information on which versions of the tools work together.

Device Debug

Device Debug / SmartDebug enables you to use JTAG to interrogate and view embedded silicon features and device status (FlashROM, Security Settings, Embedded Flash Memory (NVM) and Analog System).

It provides tools to help troubleshoot some of the common issues related to the Embedded Flash Memory and Analog System.

Device Debug supports IGLOO, ProASIC3, SmartFusion and Fusion devices. SmartDebug supports SmartFusion2 and ProASIC3 devices.

The user support is separated into two sections:

- Using Device Debug to Find Solutions to Common Issues - Contains common issues and troubleshooting instructions that will enable you to solve your problems as quickly as possible.
- Frequently Asked Questions - Answers to the most frequently asked questions about the tools and silicon features related to your solution.

If you are unfamiliar with Device Debug, you may find it helpful to review the Getting Started with SmartDebug topic. You can view descriptions of the Device Debug interface in the Reference section of the help.

Getting Started with SmartDebug

Note: SmartDebug is referred to as Device Debug in some older families.

This topic introduces the basic elements and features of SmartDebug. If you are already familiar with the user interface, proceed to the Solutions to Common Issues Using SmartDebug or Frequently Asked Questions sections.

SmartDebug (Device Debug for some older families) enables you to use JTAG to interrogate and view embedded silicon features and device status (FlashROM, Security Settings, Embedded Flash Memory (NVM) and Analog System). SmartDebug is available as a part of the FlashPro programming tool.

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See the Using SmartDebug topic for an overview of the use flow.

You can use the debugger to:

- Get device status and view diagnostics
- Use the FlashROM debug GUI to read out and compare content
- Use the Embedded Flash Memory Debug GUI to read out and compare your content with your original files
- Use the Analog System Debug to read out and compare your analog block configuration with your original file

Using SmartDebug with SmartFusion and Fusion

Note: SmartDebug is referred to as Device Debug in some older families.

The most common flow for SmartDebug is:

1. Start FlashPro. If necessary, create a new project.
2. Set up your FlashPro Project with or without a PDB file. If you are in single-device mode you will need a PDB file. You can create a PDB file in both Single Device and Chain mode.

   With a PDB, you will get additional information such as FlashROM and Embedded Flash Memory partitions when debugging the silicon features. Best practice is to use a PDB with a valid-use design to start a debug session.
3. Select the target device from your chain and click **Inspect Device**.
4. Click **Device Status** to get device status and check for issues
5. Examine individual silicon features (FlashROM, Embedded Flash Memory Block and Analog System) on the device.

Solutions to Common Issues Using SmartDebug

Embedded Flash Memory (NVM) - Failure when Programming/Verifying

If the Embedded Flash Memory failed verification when executing the PROGRAM_NVM, VERIFY_NVM or PROGRAM_NVM_ACTIVE_ARRAY action, the failing page may be corrupted. To confirm and address this issue:

1. In the **Inspect Device** window click **View Flash Memory Content**.
2. Select the Flash Memory block and client (or page range) to retrieve from the device.
3. Click **Read from Device**; the retrieved data appears in the lower part of the window.
4. Click **View Detailed Status** to check the NVM Status.

   Note: You can use the check_flash_memory and read_flash_memory Tcl commands to perform diagnostics similar to the commands outlined above.

5. If the NVM is corrupted you must reset the affected NVM pages.

   To reset the affected NVM pages, either re-program the pages with your original data or 'zero-out' the pages by using the Tcl command recover_flash_memory.

If the Embedded Flash Memory failed verification when executing a VERIFY_NVM or VERIFY_NVM_ACTIVE_ARRAY action, the failure may be due to the change of content in your design. To confirm this, repeat steps 1-3 above.

Note: NVM corruption is still possible when writing from user design. Check NVM status for confirmation.

Analog System Not Working as Expected

If the Analog System is not working correctly, it may be due the following:

1. System supply issue. To troubleshoot:

- Physically verify that all the supplies are properly connected to the device and they are at the proper level. Then confirm by running the Device Status.
- Physically verify that the relevant channels are correctly connected to the device.

2. Analog system is not properly configured. You can confirm this by examining the Analog System.

ADC Not Sampling the Correct Value

If the ADC is sampling all zero values then the wrong analog pin may be connected to the system, or the analog pin is disconnected. If that is not the case and the ADC is not sampling the correct value, it may be due to the following:

1. System supply issues - Run the device status to confirm.
2. Analog system is not configured at all - To confirm, read out the ACM configuration and verify if the ACM content is all zero.
3. Analog system is not configured correctly - To confirm, read out the ACM configuration and verify that the configuration is as expected .

   Once analog block configuration has been confirmed, you can use the `sample_analog_channel` Tcl

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command for debug sampling of the analog channel with user-supplied sampling parameters.

If you have access to your Analog System Builder settings project (<Libero IDE project>/Smartgen/AnalogBlock), you may use the compare function provided by the tool.

Frequently Asked Questions

How do I unlock the device security so I can debug?

You must provide the PDB file with a User Pass Key in order to unlock the device and continue debugging.

If you do not have a PDB with User Pass Key, you can create a PDB file in FlashPro (if you know the Pass Key value).

How do I export a report?

You can export three reports from the SmartDebug GUI: Device Status, Client Detailed Status from the NVM, or the Compare Client Content report from the NVM. Each of those reports can be saved and printed.

If using a Tcl command, you can use the `-file <filename>` option for the following commands:

`read_flash_memory`
`check_flash_memory`
`compare_memory_client`
`read_device_status`
`read_flashrom`
`read_analog_block_config`
`sample_analog_channel`
`compare_flashrom_client`
`compare_analog_config`

For example, you can use the following command to export the content of the client 'datastore1' in NVM block 0 to the report file datastore1_content.txt:

```
read_flash_memory -client "datastore1" -file {C:\temp\datastore1_content.txt}
```

For more information about Tcl commands supported by SmartDebug, see SmartDebug Tcl Commands.

How do I generate diagnostic reports for my target device?

A set of diagnostic reports can be generated for your target device depending on which silicon feature you are debugging. A set of Tcl commands are available to export those reports. The following is a summary of those Tcl commands based on the silicon features.

When using the –file parameter, ensure that you use a different file name for each command so you do not overwrite the report content. If you do not specify the –file option in the Tcl, the output results will be directed to the FlashPro log window.

For the overall device:

`read_device_status`
`read_id_code`

For FlashROM:

`compare_flashrom_client`
`read_flashrom`

For Embedded Flash Memory (NVM):

`compare_memory_client`
`check_flash_memory`
`read_flash_memory`

For Analog Block:

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`read_analog_block_config`
`compare_analog_config`
`sample_analog_channel`

To execute the Tcl command, from the **File** menu choose **Run Script**.

Where can I find files to compare my contents/settings?

FlashROM

You can compare the FlashROM content in the device with the data in the PDB file. You can find the PDB in the <Libero IDE project>/Designer/Impl directory.

Embedded Flash Memory (NVM)

You can compare the Embedded Flash Memory content in the device with the data in the PDB file. You can find the PDB in the <Libero IDE project>/Designer/Impl directory.

Analog System

You can compare the Analog System configuration in the device with the data in the loaded PDB file or in the Analog System folder. Go to:

- Fusion devices - <Libero IDE project>/Smartgen/AnalogBlock
- SmartFusion devices - <Libero IDE Project>/component/<SmartDesign Project>/MSS_ACE_0

The tool automatically identifies the necessary files in the selected folder for comparison.

What is a UFC file? What is an EFC file?

UFC is the User FlashROM Configuration file, generated by the FlashROM configurator; it contains the partition information set by the user. It also contains the user-selected data for region types with static data.

However, for AUTO_INC and READ_FROM_FILE, regions the UFC file contains only:

- Start value, end value, and step size for AUTO_INC regions, and
- File directory for READ_FROM_FILE regions

EFC is the Embedded Flash Configuration file, generated by the Flash Memory Builder in the Project Manager Catalog; it contains the partition information and data set by the user.

Both UFC and EFC information is embedded in the PDB when you generate the PDB file.

Is my FPGA fabric enabled?

When your FPGA fabric is programmed, you will see the following statement under Device State in the Device Status report:

```
FPGA Array Status: Programmed and Enabled
```

If the FPGA fabric is not programmed, the Device State shows:

```
FPGA Array Status: Not Enabled
```

Embedded Flash Memory (NVM) Frequently Asked Questions

Is my Embedded Flash Memory (NVM) programmed?

To figure out if your NVM is programmed, read out and view the NVM content or perform verification with the PDB file.

To examine the NVM content, see the FlashROM Memory Content Dialog Box.

To verify the NVM with the PDB select the VERIFY or VERIFY_NVM action in FlashPro.

How do I display Embedded Flash Memory (NVM) content in the Client partition?

You must load your PDB into your FlashPro project in order to view the Embedded Flash Memory content in the Client partition. To view NVM content in the client partition:

1. Load your PDB into your FlashPro project.
2. Click **Inspect Device**.
3. Click **View Flash Memory Content**.
4. Choose a block from the drop-down menu.
5. Select a client.
6. Click **Read from Device**. The Embedded Flash Memory content from the device appears in the Flash Memory dialog box.

See the Flash Memory Dialog Box topic for more description on viewing the NVM content.

How do I know if I have Embedded Flash Memory (NVM) corruption?

When Embedded Flash Memory is corrupted, checking Embedded Flash Memory may return with any or all of the following page status:

- ECC1/ECC2 failure
- Page write count exceeds the 10-year retention threshold
- Page write count is invalid
- Page protection is set illegally (set when it should not be)

See the How do I interpret data in the Flash Memory (NVM) Status Report? topic for details.

If your Embedded Flash Memory is corrupted, you can recover by reprogramming with original design data. Alternatively, you can 'zero-out' the pages by using the Tcl command `recover_flash_memory`.

Why does Embedded Flash Memory (NVM) corruption happen?

Embedded Flash Memory corruption occurs when Embedded Flash Memory programming is interrupted due to:

- Supply brownout; monitor power supplies for brownout conditions. For SmartFusion monitor the VCC_ENVM/VCC_ROSC voltage levels; for Fusion, monitor VCC_NVM/VCC_OSC.
- Reset signal is not properly tied off in your design. Check the Embedded Memory reset signal.

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How do I recover from Embedded Flash Memory corruption?

Reprogram with original design data or 'zero-out' the pages by using the Tcl command `recover_flash_memory`.

What is a JTAG IR-Capture value?

JTAG IR-Capture value contains private and public device status values. The public status value in the value read is ISC_DONE, which indicates if the FPGA Array is programmed and enabled.

The ISC_DONE signal is implemented as part of IEEE 1532 specification.

What does the ECC1/ECC2 error mean?

ECC is the Error Correction Code embedded in each Flash Memory page.

ECC1 – One bit error and correctable.

ECC2 – Two or more errors found, and not correctable.

How can I tell if my FlashROM is programmed?

To verify that your FlashROM is programmed, read out and view the FlashROM content or perform verification with the PDB file by selecting the VERIFY or VERIFY_FROM action in FlashPro.

Can I compare serialization data?

To compare the serialization data, you can read out the FlashROM content and visually check data in the serialization region. Note that a serialization region can be an AUTO_INC or READ_FROM_FILE region.

For serialization data in the AUTO_INC region, check to make sure that the data is within the specified range for that region.

For READ_FROM_FILE region, you can search for a match in the source data file.

Can I tell what security options are programmed in my device?

To determine the programmed security settings, run the Device Status option from the Inspect Device dialog and examine the Security Section in the report.

This section lists the security status of the FlashROM, FPGA Array and Flash Memory blocks.

Is my analog system configured?

To determine if the analog block is configured, run the Device Status option from the Inspect Device dialog and examine the Analog Block Section in the report. For example, the excerpt from the Device Status report below shows that the analog block status is operational:

```
Analog Block:
  OABTR Register (HEX): 0dbe37b
  3.3V (vdd33): PASS
  1.5V (vdd15): PASS
  Bandgap: PASS
  -3.3V (vddn33): PASS
  ADC Reference: PASS
  FPGA_Good: PASS
  Status: Analog Block is operational
```

If you read out an all zero value when examining the Analog System Configuration, it is possible that the Analog System is not configured.

You need to compare your analog system configuration with the design configuration from the Analog System Builder.

The -3.3V (vddn33) voltage is optional.

How do I interpret data in the Device Status report?

The Device Status Report generated from the FlashPro SmartDebug Feature contains the following sections:

- IDCode (see below)
- User Information
- Device State
- Analog Block (SmartFusion and Fusion only)
- Factory Data
- Security Settings

Device Status Report: IDCode

The IDCode section shows the raw IDCode read from the device. For example, in the Device Status report for an AFS600 device, you will find the following statement:

```
IDCode (HEX): 233261cf
```

The IDCode is compliant to IEEE 1149.1. The following table lists the IDCode bit assignments:

Table 10 · IDCode Bit Assignments

Bit Field (little endian)	Example Bit Value for AFS600 (HEX)	Description
Bit [31-28] (4 bits)	2	Silicon Revision
Bit [27-12] (16 bits)	3326	Device ID
Bit [11-0] (12 bits)	1cf	IEEE 1149.1 Manufacturer ID for Microsemi

Device Status Report: User Info

The User Information section reports the information read from the User ROW (UROW) of IGLOO, ProASIC3, SmartFusion and Fusion devices. The User Row includes user design information as well as troubleshooting information, including:

- Design name (10 characters max)
- Design check sum (16-bit CRC)
- Last programming setup used to program/erase any of the silicon features.
- FPGA Array / Fabric programming cycle count

For example:

```
User Information:
UROW data (HEX): 603a04e0a1c2860e59384af926fe389f
Programming Method: STAPL
Programmer: FlashPro3
Programmer Software: FlashPro vX.X
Design Name: ABCBASICTO
```

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```
Design Check Sum: 603A
Algorithm Version: 19
Array Prog. Cycle Count: 19
```

Table 11 · Device Status Report User Info Description

Category	Field	Description
User Row Data	(Example) UROW data (HEX): 603a04e0a1c2860e59384af926fe389f	Raw data from User Row (UROW)
Programming Troubleshooting Info	(Example) Programming Method: STAPL Programmer: FlashPro3 Programmer Software: FlashPro v8.6 Algorithm Version: 19	Known programming setup used. This includes: Programming method/file, programmer and software. It also includes programming Algorithm version used.
Design Info	(Example) Design Name: ABCASICTO Design Check Sum: 603A	Design name (limited to 10 characters) and check sum. Design check sum is a 16-bit CRC calculated from the fabric (FPGA Array) datastream generated for programming. If encrypted datastream is generated selected, the encrypted datastream is used for calculating the check sum.

Device Status Report: Device State

The device state section contains:.

- IR-Capture register value, and
- The FPGA status

The IR-Capture is the value captured by the IEEE1149.1 instruction register when going through the IR-Capture state of the IEEE 1149.1 state machine. It contains information reflecting some of the states of the devices that is useful for troubleshooting.

One of the bits in the value captured is the ISC_DONE value, specified by IEEE 1532 standard. When the value is ‘1’ it means that the FPGA array/fabric is programmed and enabled. This is available for IGLOO, ProASIC3, SmartFusion and Fusion devices.

For example:

```
Device State:
IRCapture Register (HEX): 55
FPGA Array Status: Programmed and enabled
```

For a blank device:

```
Device State:
IRCapture Register (HEX): 51
FPGA Array Status: Not enabled
```

Device Status Report: Analog Block

The Analog block of the SmartFusion and Fusion devices monitors some of the key power supplies needed by the device to function. These power supply status is captured in the OABTR test register in the Analog block.

For example, if you run Device Status when the Fabric and Analog configuration is programmed and powered up successfully the report indicates:

```
Analog Block:
OABTR Register (HEX): 0dbe3bb
3.3V (vdd33): PASS
1.5V (vdd15): PASS
Bandgap: PASS
-3.3V (vddn33): PASS
ADC Reference: PASS
FPGA_Good: PASS
Status: Analog Block is operational
```

Table 12 · Device Status Report - Analog Block Description

Analog Block Status	Description
OABTR Register	RAW data captured from the device
3.3V (vdd33)	Vcc33a supply status
1.5V (vdd15)	Vccnvm supply status
Bandgap	Internal bandgap supply status
ADC Reference	ADC reference voltage status
-3.3V (vddn33)	Vddn33 supply status (optional voltage)
FPGA Good	FPGA array or Fabric status

If the Fusion device is erased, the report indicates:

```
Analog Block:
OABTR Register (HEX): 188e3ba
3.3V (vdd33): PASS
1.5V (vdd15): PASS
Bandgap: PASS
-3.3V (vddn33): FAIL
ADC Reference: FAIL
FPGA_Good: FAIL
Status: Analog Block is non-operational
Analog Block is not programmed
```

Device Status Report: Factory Data

The Factory Data section lists the Factory Serial Number (FSN).

Each of the IGLOO, ProASIC3, SmartFusion and Fusion devices has a unique 48-bit FSN.

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Device Status Report: Security

The security section shows the security options for the FPGA Array, FlashROM and Flash Memory (NVM) block that you programmed into the device.

For example, using a Fusion AFS600 device:

```
Security:
Security Register (HEX): 0000000088c01b
FlashROM
Write/Erase protection: Off
Read protection: Off
Encrypted programming: Off
FPGA Array
Write/Erase protection: Off
Verify protection: Off
Encrypted programming: Off
FlashMemory Block 0
Write protection: On
Read protection: On
Encrypted programming: Off
FlashMemory Block 1
Write protection: On
Read protection: On
Encrypted programming: Off
```

Table 13 · Device Status Report - Security Description

Security Status Info	Description
Security Register (HEX)	Raw data captured from the device's security status register
Write/Erase Protection	Write protection is applicable to FlashROM, FPGA Array (Fabric)and Flash Memory (NVM) blocks. When On, the Silicon feature is write/erase protected by user passkey.
Read Protection	Read protection is applicable to FlashROM and Flash Memory (NVM) blocks. When On, the Silicon feature is read protected by user passkey.
Verify Protection	Verify Protection is only applicable to FPGA Array (Fabric) only. When On, the FPGA Array require user passkey for verification. Reading back from the FPGA Array (Fabric) is not supported. Verification is accomplished by sending in the expected data for verification.
Encrypted Programming	Encrypted Programming is supported for FlashROM, FPGA Array (Fabric) and Flash Memory (NVM) blocks. When On, the silicon feature is enable for encrypted programmed. This allows field design update with encrypted datastream so the user design is protected.

Encrypted Programming

To allow encrypted programming of the features, the target feature cannot be Write/Erase protected by user passkey.

The security settings of each silicon feature when they are enabled for encrypted programming are listed below.

FPGA Array (Fabric)

```
Write/Erase protection: Off
Verify protection: Off
Encrypted programming: On
```

Set automatically by Designer or FlashPro when you select to enable encrypted programming of the FPGA Array (Fabric). This setting allows the FPGA Array (Fabric) to be programmed and verified with an encrypted datastream.

FlashROM

```
Write/Erase protection: Off
Read protection: On
Encrypted programming: On
```

Set automatically by Designer or FlashPro when you select to enable encrypted programming of the FlashROM. This setting allows the FlashROM to be programmed and verified with an encrypted datastream.

FlashROM always allows verification. If encrypted programming is set, verification has to be performed with encrypted datastream.

Designer and FlashPro automatically set the FlashROM to be read protected by user passkey when encrypted programming is enabled. This protects the content from being read out of the JTAG port after encrypted programming.

Flash Memory (NVM) Block

```
Write/Erase protection: Off
Read protection: On
Encrypted programming: On
```

The above setting is set automatically set by Designer or FlashPro when you select to enable encrypted programming of the Flash Memory (NVM) block. This setting allows the Flash Memory (NVM) block to be programmed with an encrypted datastream.

The Flash Memory (NVM) block does not support verification with encrypted datastream.

Designer and FlashPro automatically set the Flash Memory (NVM) block to be read protected by user passkey when encrypted programming is enabled. This protects the content from being read out of the JTAG port after encrypted programming.

How do I interpret data in the Flash Memory (NVM) Status Report?

The Embedded Flash Memory (NVM) Status Report generated from the FlashPro SmartDebug feature consists of the page status of each NVM page. For example:

```
Flash Memory Content [ Page 34 to 34 ]
FlashMemory Page #34:
Status Register(HEX): 00090000
Status ECC2 check: Pass
Data ECC2 Check: Pass
Write Count: Pass (2304 writes)
Total number of pages with status ECC2 errors: 0
Total number of pages with data ECC2 errors: 0
Total number of pages with write count out of range: 0
FlashMemory Check PASSED for [ Page 34 to 34 ]
The 'check_flash_memory' command succeeded.
```

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```
The Execute Script command succeeded.
```

Table 14 · Embedded Flash Memory Status Report Description

Flash Memory Status Info	Description
Status Register (HEX)	Raw page status register captured from device
Status ECC2 Check	Check for ECC2 issue in the page status
Data ECC2 Check	Check for ECC2 issue in the page data
Write Count	Check if the page-write count is within the expected range. The expected write count is greater than or equal to: 6,384 - SmartFusion devices 2,288 - Fusion devices Note: Write count, if corrupted, cannot be reset to a valid value within the customer flow;invalid write count will not prevent device from being programmed with the FlashPro tool. The write count on all good eNVM pages is set to be 2288 instead of 0 in the manufacturing flow. The starting count of the eNVM is 2288. Each time the page is programmed or erased the count increments by one. There is a Threshold that is set to 12288, which equals to 3 * 4096. Since the threshold can only be set in multiples of 4096 (2^12), to set a 10,000 limit, the Threshold is set to 12288 and the start count is set to 2288; and thus the eNVM has a 10k write cycle limit. After the write count exceeds the threshold, the STATUS bit goes to 11 when attempting to erase/program the page.

Create Standalone SmartDebug Project

A standalone SmartDebug project can be configured in two ways:

- Import DDC files exported from Libero
- Construct Automatically

From the SmartDebug main window, click **Project** and choose **New Project**. The Create SmartDebug Project dialog box opens.

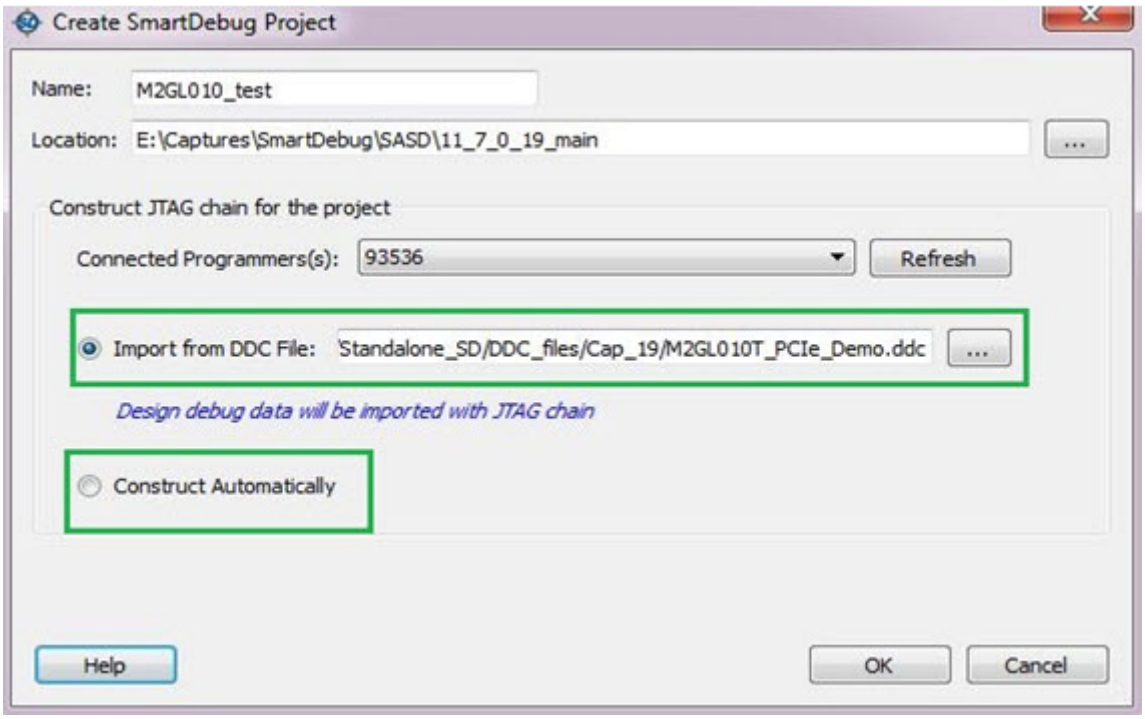

Figure 96 · Create SmartDebug Project Dialog Box

Import from DDC File (created from Libero)

When you select the **Import from DDC File** option in the Create SmartDebug Project dialog box, the Design Debug Data of the target device and all hardware and JTAG chain information present in the DDC file exported in Libero are automatically inherited by the SmartDebug project. The programming file information loaded onto other Microsemi devices in the chain, including ProAsic3/E, SmartFusion, and Fusion devices, are also transferred to the SmartDebug project.

Debug data is imported from the DDC file (created through Export SmartDebug Data in Libero) into the debug project, and the devices are configured using data from the DDC file.

Construct Automatically

When you select the **Construct Automatically** option, a debug project is created with all the devices connected in the chain for the selected programmer. This is equivalent to Construct Chain Automatically in FlashPRO.

Configuring a Generic Device

For Microsemi devices having the same JTAG IDCODE (i.e., multiple derivatives of the same Die—for example, M2S090T, M2S090TS, and so on), the device type must be configured for SmartDebug to enable relevant features for debug. The device can be configured by loading the programming file, by manually selecting the device using Configure Device, or by importing DDC files through Programming Connectivity and Interface. When the device is configured, all debug options are shown.

For debug projects created using Construct Automatically, you can use the following options to debug the devices:

- Load the programming file – Right-click the device in Programming Connectivity and Interface.
- Import Debug Data from DDC file – Right-click the device in Programming Connectivity and Interface.

The appropriate debug features of the targeted devices are enabled after the programming file or DDC file is imported.

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Connected FlashPRO Programmers

The drop-down lists all FlashPro programmers connected to the device. Select the programmer connected to the chain with the debug device. At least one programmer must be connected to create a standalone SmartDebug project.

Before a debugging session or after a design change, program the device through Programming Connectivity and Interface.

See Also

Programming Connectivity and Interface

View Device Status

Export SmartDebug Data (from Libero)

Import from DDC File (created from Libero)

When you select the **Import from DDC File** option in the Create SmartDebug Project dialog box, the Design Debug Data of the target device and all hardware and JTAG chain information present in the DDC file exported in Libero are automatically inherited by the SmartDebug project. The programming file information loaded onto other Microsemi devices in the chain, including ProAsic3/E, SmartFusion, and Fusion devices, are also transferred to the SmartDebug project.

Debug data is imported from the DDC file (created through Export SmartDebug Data in Libero) into the debug project, and the devices are configured using data from the DDC file.

Construct Automatically

When you select the **Construct Automatically** option, a debug project is created with all the devices connected in the chain for the selected programmer. This is equivalent to Construct Chain Automatically in FlashPRO.

Configuring a Generic Device

For Microsemi devices having the same JTAG IDCODE (i.e., multiple derivatives of the same Die—for example, M2S090T, M2S090TS, and so on), the device type must be resolved for SmartDebug to enable relevant features for debug. The device can be resolved by loading the programming file, manually selecting the device using Configure Device, or by importing DDC files through Programming Connectivity and Interface. When the device is resolved, all debug options are shown.

For debug projects created using Construct Automatically, you can use the following options to debug the devices:

- Load the programming file – Right-click the device in Programming Connectivity and Interface.
- Import Debug Data from DDC file – Right-click the device in Programming Connectivity and Interface.

The appropriate debug features of the targeted devices are enabled after the programming file or DDC file is imported.

Programming Connectivity and Interface

To open the Programming Connectivity and Interface dialog box, from the standalone SmartDebug Tools menu, choose **Programming Connectivity and Interface**. The Programming Connectivity and Interface dialog box displays the physical chain from TDI to TDO.

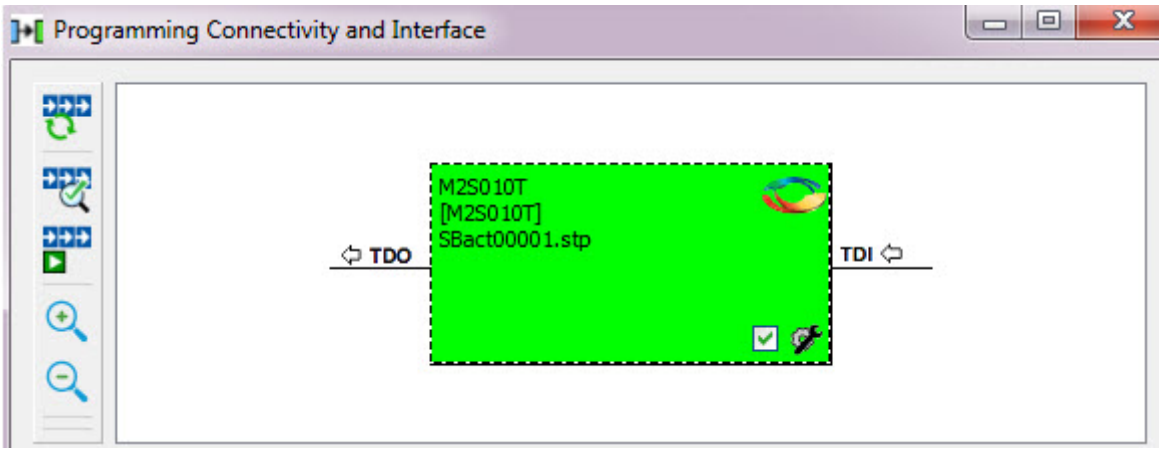

Figure 97 · Programming Connectivity and Interface Dialog Box – Project created using Import from DDC File

All devices in the chain are disabled by default when a standalone SmartDebug project is created using the **Construct Automatically** option in the Create SmartDebug Project dialog box.

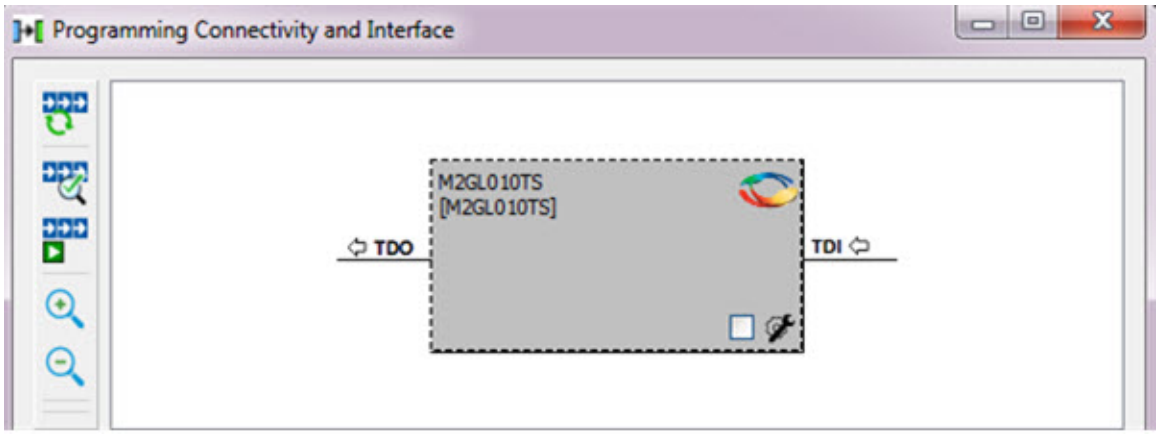

Figure 98 · Programming Connectivity and Interface window – Project created using Construct Automatically

The Programming Connectivity and Interface dialog box includes the following actions:

- **Construct Chain Automatically** - Automatically construct the physical chain.

  Running Auto-Construct in Programming Connectivity and Interface removes all existing debug/programming data included using DDC/programming files. The project is the same as a new project created using the Construct Automatically option.

- **Scan and Check Chain** – Scan the physical chain connected to the programmer and check if it matches the chain constructed in the scan chain block diagram.
- **Run Programming Action** – Option to program the device with the selected programming procedure.

  When two devices are connected in the chain, the programming actions are independent of the device. For example, if M2S090 and M2GL010 devices are connected in the chain, and the M2S090 device is to be programmed and the M2GL010 device is to be erased, both actions can be done at the same time using the Run Programming Action option.

- **Zoom In** – Zoom into the scan chain block diagram.
- **Zoom Out** – Zoom out of the scan chain block diagram.

Hover Information

The device tooltip displays the following information if you hover your cursor over a device in the scan chain block diagram:

- **Name:** User-specified device name. This field indicates the unique name specified by the user in the Device Name field in Configure Device (right-click **Properties**).

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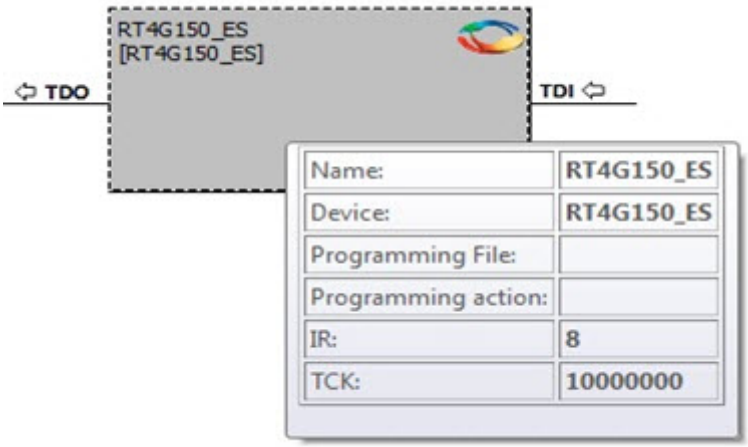
- **Device:** Microsemi device name.
- **Programming File:** Programming file name.
- **Programming action:** The programming action selected for the device in the chain when a programming file is loaded.
- **IR:** Device instruction length.
- **TCK:** Maximum clock frequency in MHz to program a specific device; standalone SmartDebug uses this information to ensure that the programmer operates at a frequency lower than the slowest device in the chain.

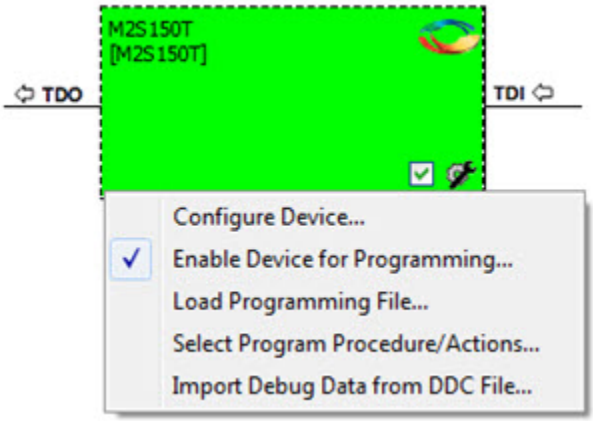


Device Chain Details

The device within the chain has the following details:

- User-specified device name
- Device name
- Programming file name
- Programming action – Select **Enable Device for Programming** to enable the device for programming. Enabled devices are green, and disabled devices are grayed out.

Right-click Properties



Configure Device - Ability to reconfigure the device.

- **Family and Die**: The device can be explicitly configured from the Family, Die drop-down.

- **Device Name**: Editable field for providing user-specified name for the device.

Enable Device for Programming - Select to enable the device for programming. Enabled devices are shown in green, and disabled devices are grayed out.

Load Programming File - Load the programming file for the selected device.

Select Programming Procedure/Actions- Option to select programming action/procedures for the devices connected in the chain.

- **Actions**: List of programming actions for your device.
- **Procedures**: Advanced option; enables you to customize the list of recommended and optional procedures for the selected action.

Import Debug Data from DDC File - Option to import debug data information from the DDC file.

The DDC file selected for import into device must be created for a compatible device. When the DDC file is imported successfully, all current device debug data is removed and replaced with debug data from the imported DDC file.

The JTAG Chain configuration from the imported DDC file is ignored in this option.

If a programming file is already loaded into the device prior to importing debug data from the DDC file, the programming file content is replaced with the content of the DDC file (if programming file information is included in the DDC file).

Debug Context Save

Debug context refers to the user selections in debug options such as Debug FPGA Array, Debug SERDES, and View Flash Memory Content. In standalone SmartDebug, the debug context of the current session is saved or reset depending on the user actions in Programming Connectivity and Interface.

The debug context of the current session is retained for the following actions in Programming Connectivity and Interface:

- Enable Device for Programming
- Select Programming Procedure/Actions
- Scan and Check Chain
- Run Programming Action

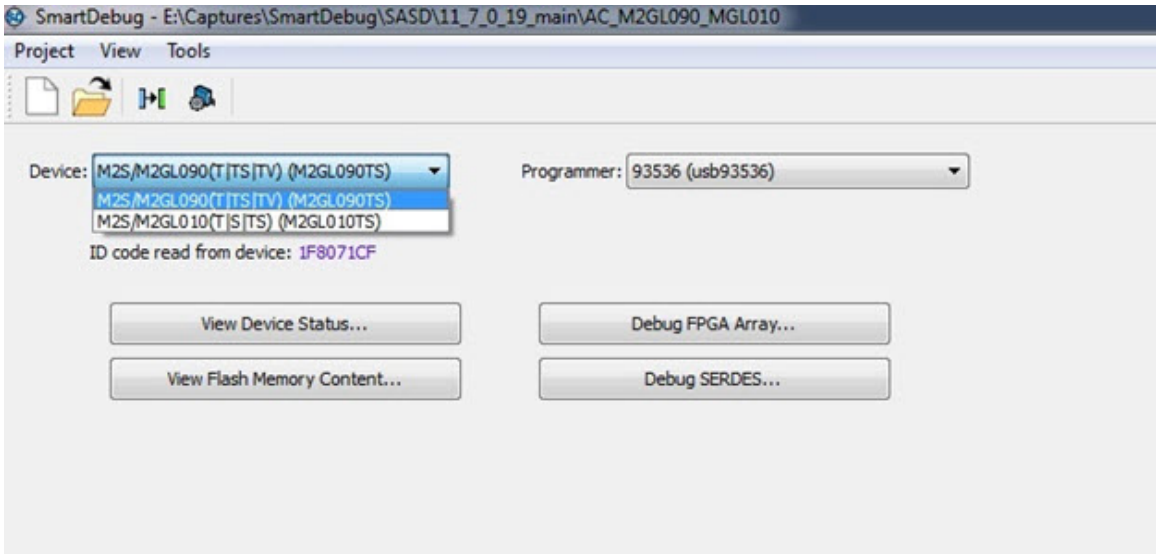
The debug context of the current session is reset for the following actions in Programming Connectivity and Interface:

- Auto Construct – Clears all the existing debug data. You need to reimport the debug data from DDC file.
- Import Debug Data from DDC file
- Configure Device – Renaming the device in the chain
- Configure Device – Family/Die change
- Load Programming File

Selecting Devices for Debug

Standalone SmartDebug provides an option to select the devices connected in the JTAG chain for debug. The device debug context is not saved when another debug device is selected.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**



Probe Insertion (Post-Layout) - SmartFusion2, IGLOO2, and RTG4

Introduction

Probe insertion is a post-layout debug process that enables internal nets in the FPGA design to be routed to unused I/Os. Nets are selected and assigned to probes using the Probe Insertion window in SmartDebug. The rerouted design can then be programmed into the FPGA, where an external logic analyzer or oscilloscope can be used to view the activity of the probed signal.

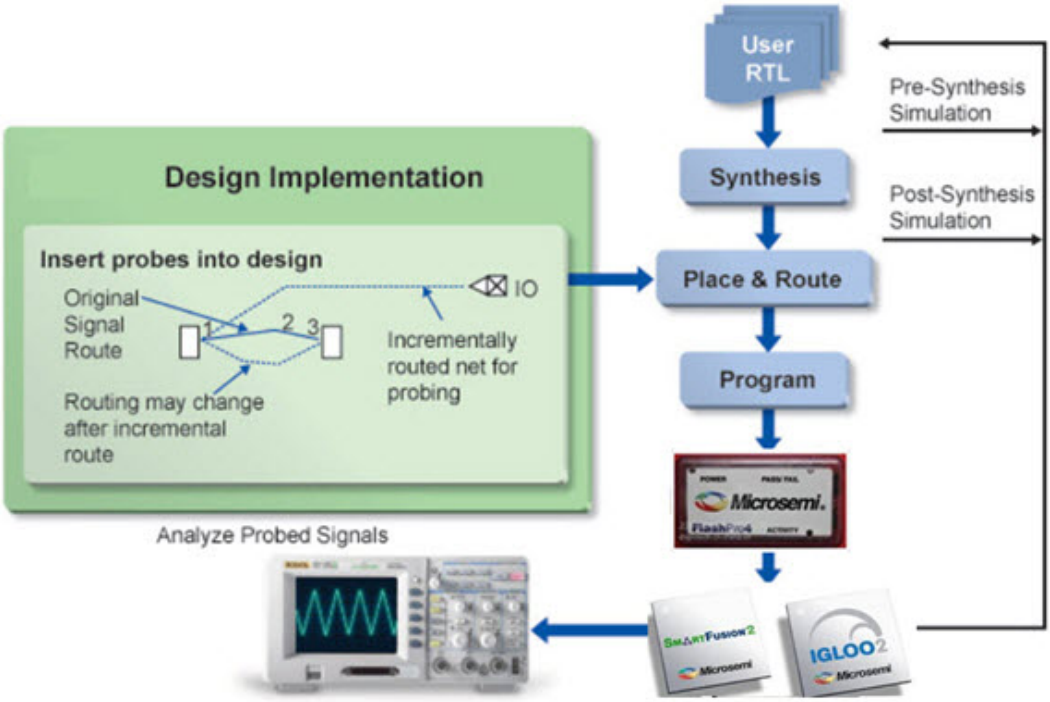


Figure 99 · Probe Insertion in the Design Process

The Probe Insertion debug feature is complementary to Live Probes and Active Probes. Live Probes and Active Probes use a special dedicated probe circuitry.

Probe Insertion

1. Double-click **SmartDebug Design** in the Design Flow window to open the SmartDebug main window.

Note: FlashPro Programmer must be connected for SmartDebug.

2. Select **Debug FPGA Array** and then select the Probe Insertion tab.

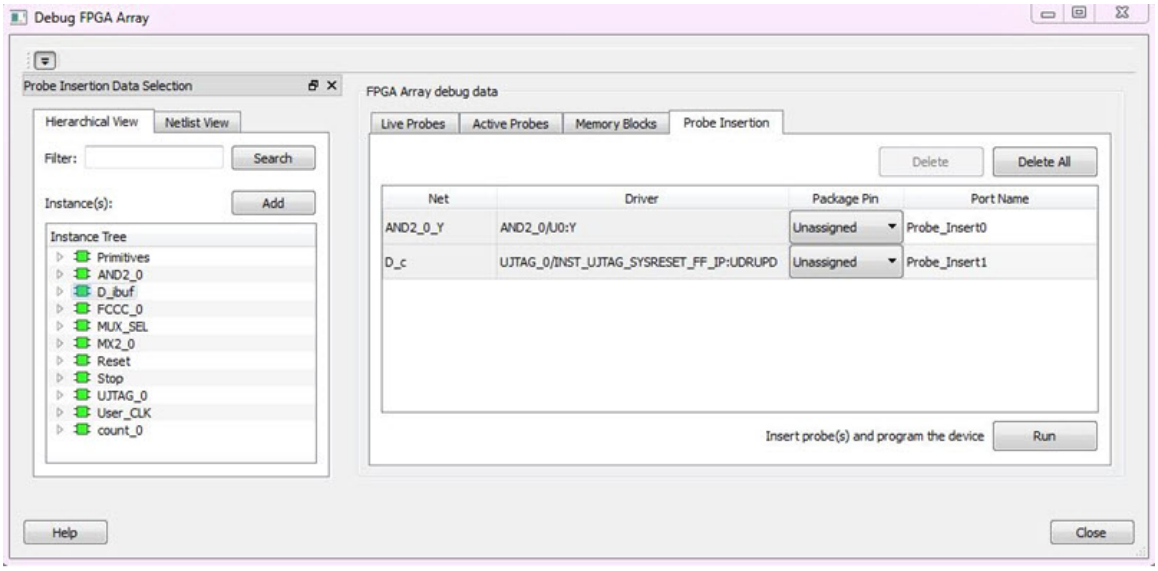


Figure 100 · Probe Insertion Tab

In the left pane of the Probe Insertion tab, all available Probe Points are listed in instance level hierarchy in the Hierarchical View. All Probe Names are shown with the Name and Type in the Netlist View.

3. Select probe points from the Hierarchical View or Netlist View, right-click and choose **Add** to add them to the Active Probes UI. You can also add the selected probe points by clicking the **Add** button. The probes list can be filtered by using the Filter box.

   Each entry has a Net and Driver name which identifies that probe point.
   The selected net(s) appear in the Probes table in the Probe Insertion tab, as shown in the figure below. SmartDebug automatically generates the Port Name for the probe. You can change the Port Name from the default if desired.

4. Assign a package pin to the probe using the drop-down list in the Package Pin column. You can assign the probe to any unused package pin (spare I/O).

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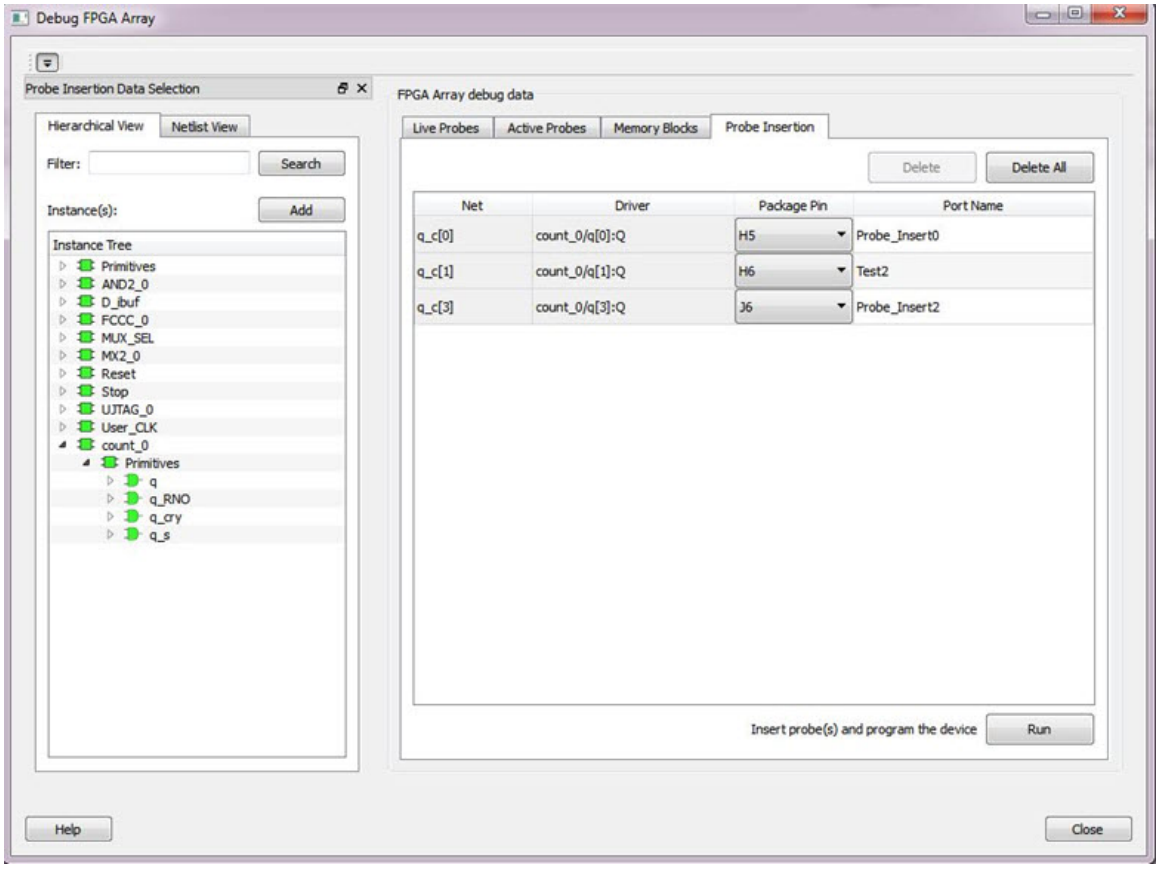

Figure 101 · Debug FPGA Array > Probe Insertion > Add Probe

5. Click **Run**.

   This triggers Place and Route in incremental mode, and the selected probe nets are routed to the selected package pin. After incremental Place and Route, Libero automatically reprograms the device with the added probes.
   The log window shows the status of the Probe Insertion run.

Probe Deletion

To delete a probe, select the probe and click **Delete**. To delete all the probes, click **Delete All**.

Note: Deleting probes from the probes list without clicking **Run** does not automatically remove the probes from the design.

Reverting to the Original Design

To revert to the original design after you have finished debugging:

1. In SmartDebug, click **Delete All** to delete all probes.
2. Click **Run**.
3. Wait until the action has completed by monitoring the activity indicator (spinning blue circle). Action is completed when the activity indicator disappears.
4. Close SmartDebug.

Active Probes (SmartFusion2, IGLOO2, and RTG4)

In the left pane of the Active Probes tab, all available Probe Points are listed in instance level hierarchy in the Hierarchical View. All Probe Names are listed with the Name and Type (which is the physical location of the flip-flop) in the Netlist View.

Select probe points from the Hierarchical View or Netlist View, right-click and choose **Add** to add them to the Active Probes UI. You can also add the selected probe points by clicking the **Add** button. The probes list can be filtered by using the Filter box.

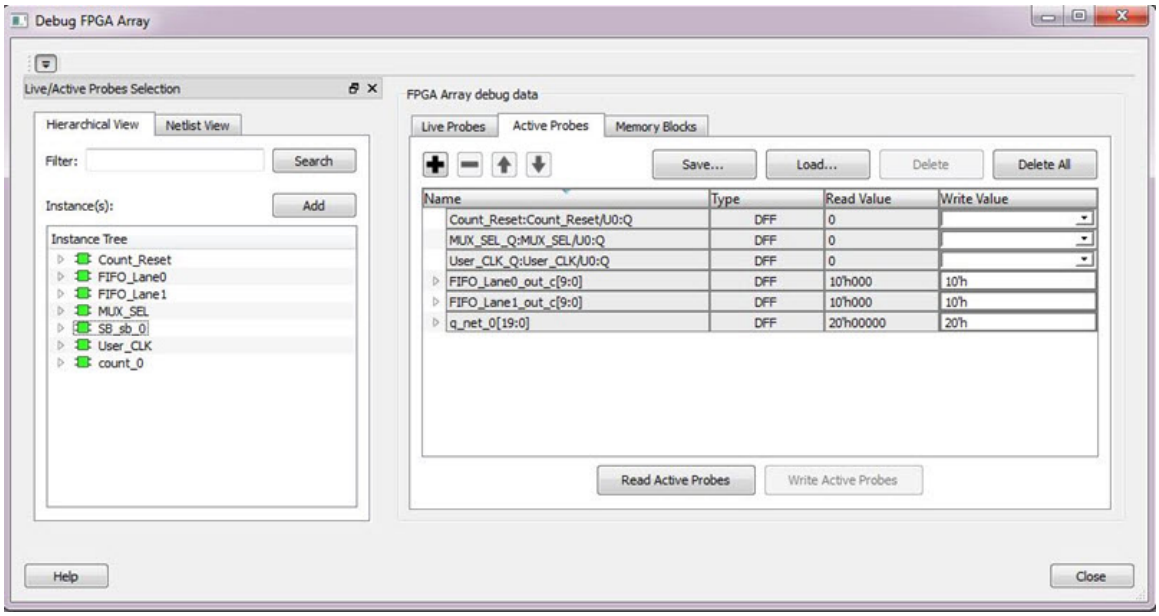

Figure 102 · Active Probes Tab in SmartDebug FPGA Array Dialog Box

When you have selected the desired probe, points appear in the Active Probe Data chart and you can read and write multiple probes (as shown in the figure below).

You can use the following options in the Write Value column to modify the probe signal added to the UI:

- Drop-down menu with values ‘0’ and ‘1’ for individual probe signals
- Editable field to enter data in hex or binary for a probe group or a bus

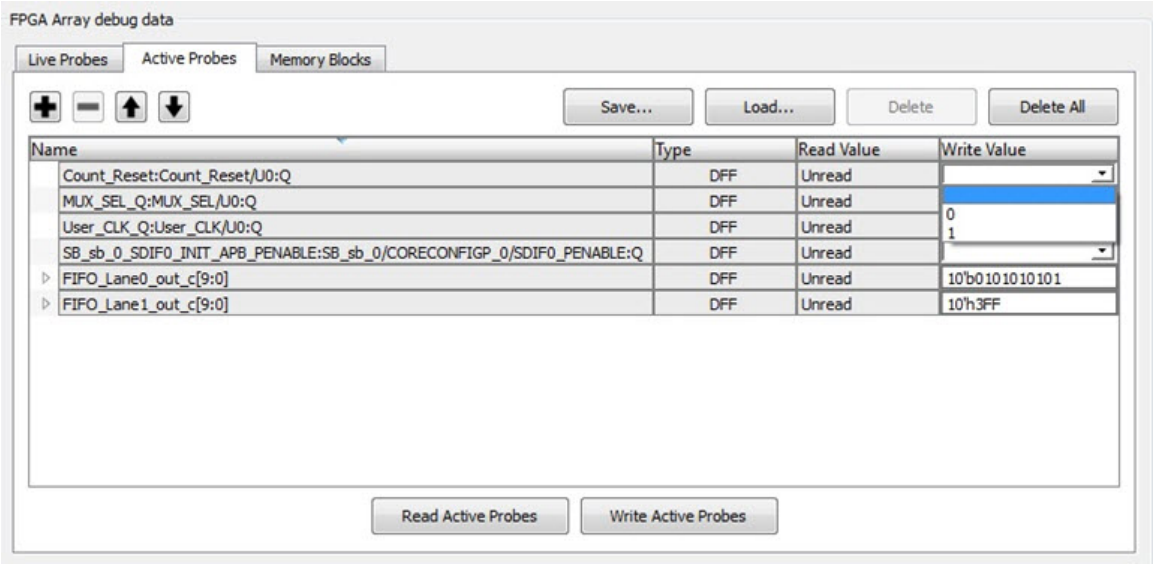

Figure 103 · Active Probes Tab - Write Value Column Options

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Live Probes (SmartFusion2, IGLOO2, and RTG4)

The Live Probes tab displays a table with the probe name and pin type.

Note: SmartFusion2 and IGLOO2 support two probe channels, and RTG4 supports one probe channel.

SmartFusion2 and IGLOO2

Two probe channels (ChannelA and ChannelB) are available. When a probe name is selected, it can be assigned to either ChannelA or ChannelB.

You can assign a probe to a channel by doing either of the following:

- Right-click a probe in the table and choose **Assign to Channel A** or **Assign to Channel B**.
- Click the **Assign to Channel A** or **Assign to Channel B** button to assign the probe selected in the table to the channel. The buttons are located below the table.

When the assignment is complete, the probe name appears to the right of the button for that channel, and SmartDebug configures the ChannelA and ChannelB I/Os to monitor the desired probe points. Because there are only two channels, a maximum of two internal signals can be probed simultaneously.

Click the **Unassign Channels** button to clear the live probe names to the right of the channel buttons and discontinue the live probe function during debug.

Note: At least one channel must be set; if you want to use both probes, they must be set at the same time.

The Active Probes READ/WRITE overwrites the settings of Live Probe channels (if any).

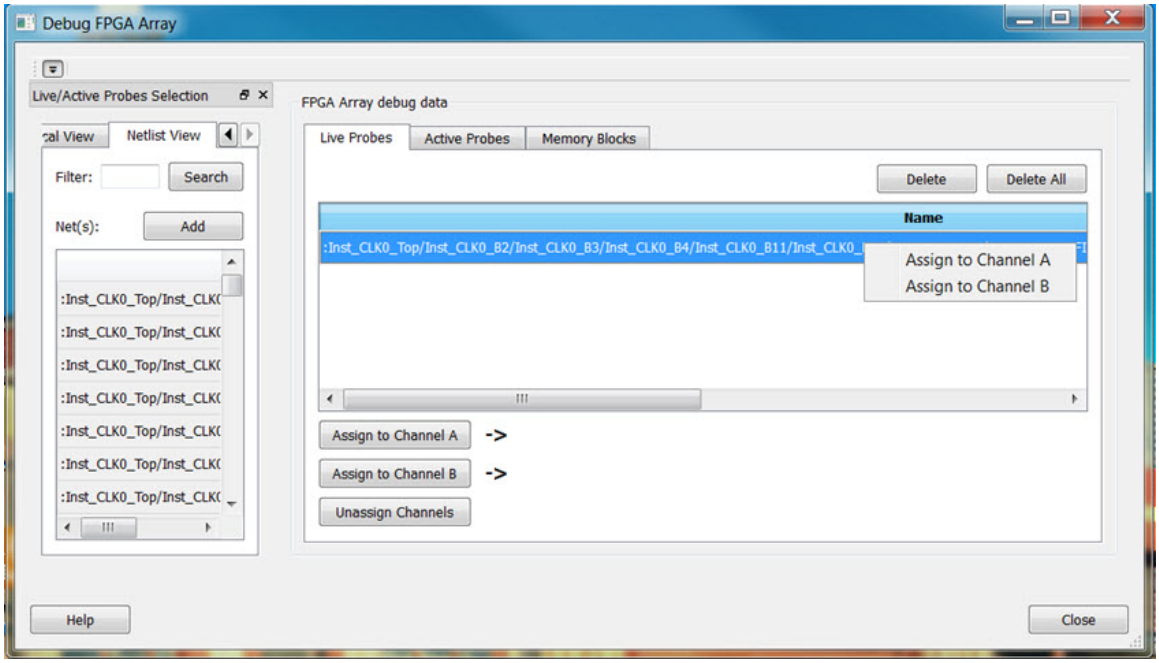

Figure 104 · Live Probes Tab (SmartFusion2 and IGLOO2) in SmartDebug FPGA Array Dialog Box

RTG4

One probe channel (Probe Read Data Pin) is available for RTG4 for debug. When a probe name is selected, it can be assigned to the Probe Channel (Probe Read Data Pin).

You can assign a probe to a channel by doing either of the following:

- Right-click a probe in the table and choose **Assign to Probe Read Data Pin**.
- Click the **Assign to Probe Read Data Pin** button to assign the probe selected in the table to the channel. The button is located below the table.

Click the **Unassign probe read data pin** button to clear the live probe name to the right of the channel button and discontinue the live probe function during debug.

The Active Probes READ/WRITE overwrites the settings of Live Probe channels (if any).

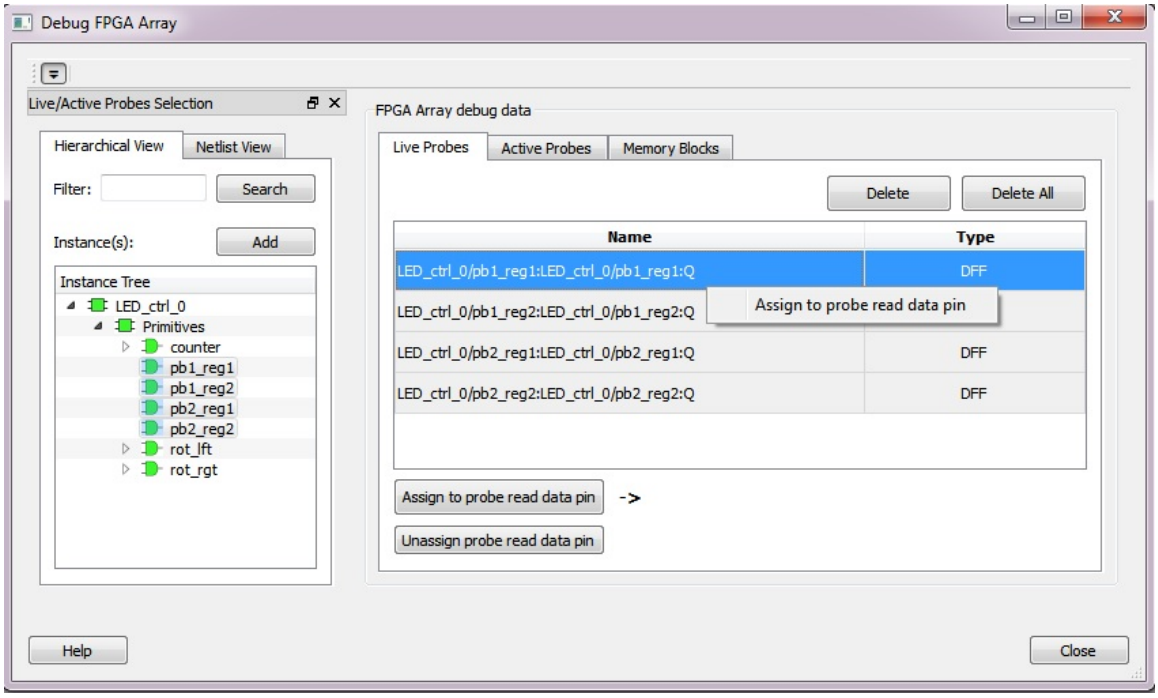

Figure 105 · Live Probes Tab (RTG4) in SmartDebug FPGA Array Dialog Box

Inspect Device Dialog Box (SmartFusion, Fusion, and ProASIC3 Only)

Inspect Device is available as a part of the FlashPro programming tool. Refer to Using SmartDebug for information about how to configure FlashPro to access this feature.

In the Inspect Device dialog box, you can access all SmartDebug features, such as the FlashROM, Embedded Flash Memory (NVM), and Analog Block. If you have multiple devices and programmers connected, choose your target device/programmer from the drop-down menu, and use the ID code to verify that you are inspecting the correct device.

View Device Status - Displays the Device Status Report. The Device Status Report is a summary of your device state, analog block test values, user information, factory data, and security information. You can save or print your information for future reference.

View Analog Block Configuration - Opens the Analog Block Configuration dialog box. You can view the channel configuration for your analog block and compare the channel configuration with any other analog block file.

View Flash Memory Content - Opens the Flash Memory dialog box. You can view the details for each flash memory block in your device.

View FlashROM Content - Opens the FlashROM data dialog box. You can view a list of the physical blocks in your FlashROM and the client partitions in FlashROM configuration files.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

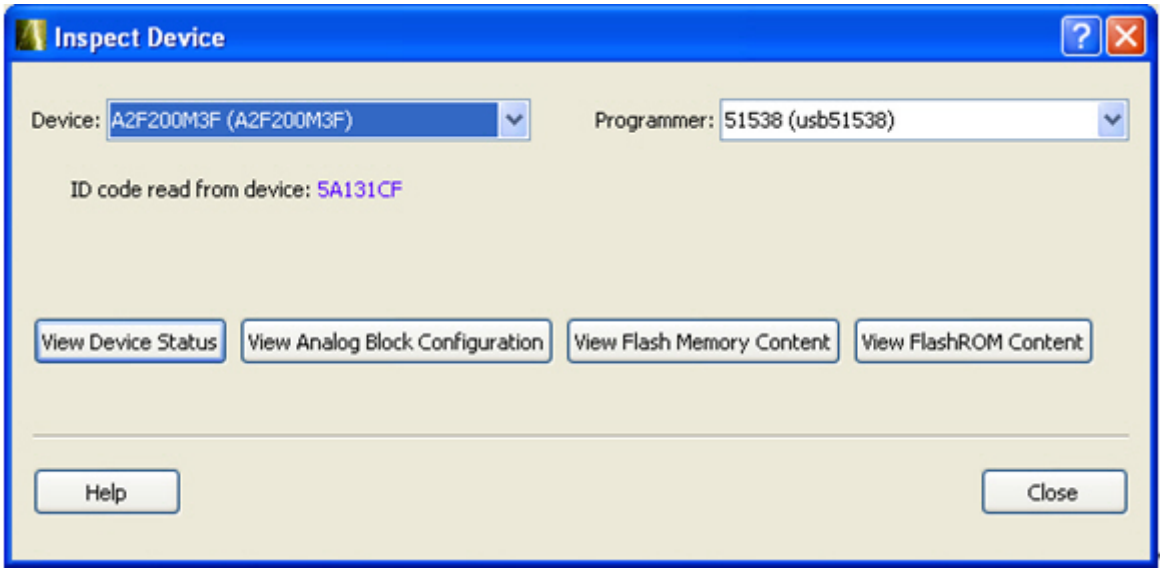

Figure 106 · Inspect Device Dialog Box

Analog Block Configuration Dialog Box (SmartFusion and Fusion Only)

In the Analog Block Configuration dialog box, you can:

- View the channel configuration on your analog system and identify if/how the channels are configured.
- Compare with the design configuration from the Analog System Builder for Fusion and SmartDesign MSS Configurator for SmartFusion.

The values displayed for each channel vary depending on the device family and channel you select; the Channel configuration register read from the ACM is shown for each analog channel. Individual, decoded bit fields of the register are listed immediately beneath (as described in the Fusion and SmartFusion handbook). The dialog box may display the following values:

Fusion Device:

- Analog MUX select
- Internal chip T monitor
- Scaling factor control
- Current monitor switch
- Current monitor drive control
- Direct analog input switch
- Pad polarity - G, T, V, C pad polarity, positive or negative
- Select low/high drive
- Prescaler op amp mode

SmartFusion Device:

- Gain select
- Channel state
- Direct Input state
- Current Monitor state
- Current monitor strobe state
- Comparator state
- Hysteresis select

- Analog MUX select
- DAC input select
- Temperature monitor state
- Temperature monitor strobe state
- Vref switch state

To use the compare feature, select the **Compare with** checkbox. If the loaded PDB file contains Analog Block configuration information, the comparison appears automatically.

To use a specific Project File, click **Browse** and navigate to the Analog System Builder directory for Fusion or SmartDesign for SmartFusion. In a typical IDE project, this directory is located at:

- Fusion - <project_root>/smartgen/<analog_block_core_name>
- SmartFusion - <project root>/component/work/<SmartDesign project>/MSS_ACE_0

After specifying the compare directory, the differences (if any) are indicated in red on a channel by channel basis, as shown in the figure below.

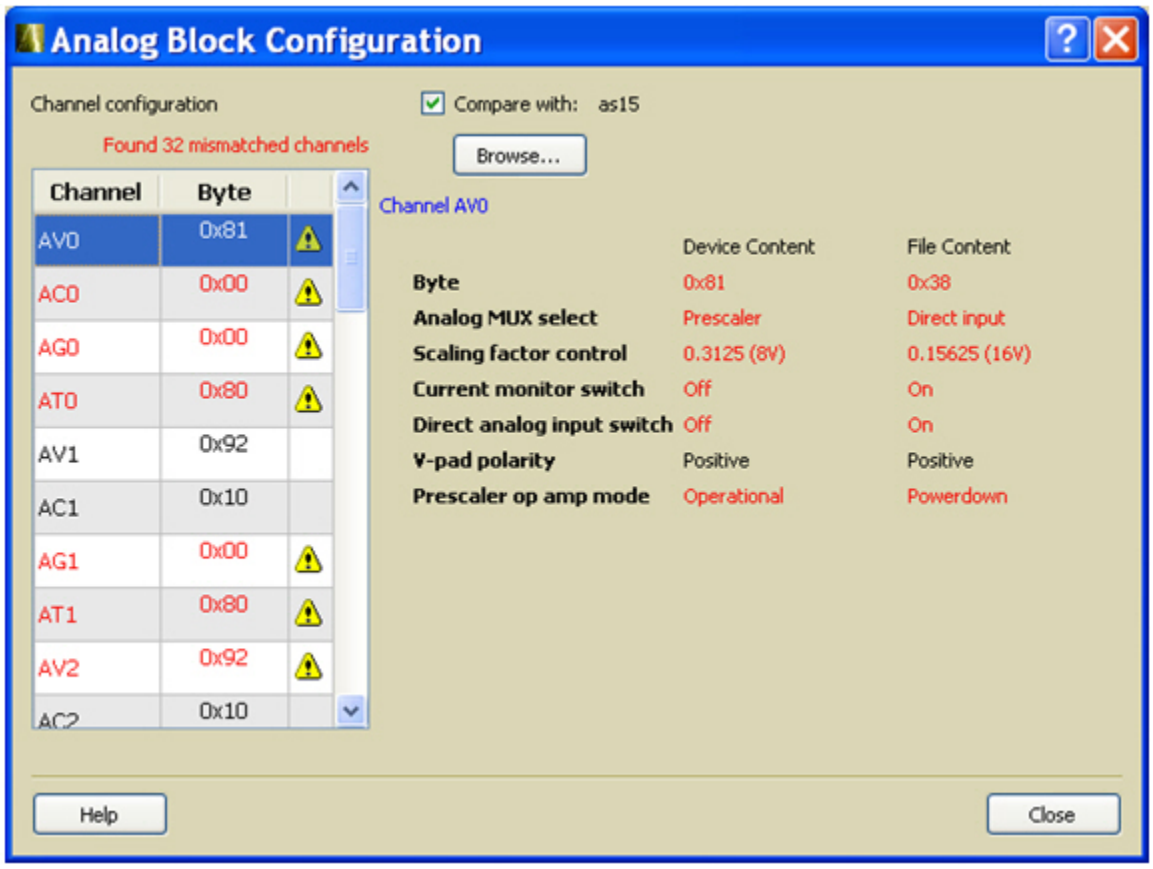

Figure 107 · Analog Block Configuration Dialog Box for a Fusion Device (Differences in Red)

View Device Status (SmartFusion2, IGLOO2, and RTG4 Only)

Click **View Device Status** in the standalone SmartDebug main window to display the Device Status Report. The Device Status Report is a complete summary of IDCode, device certificate, design information, programming information, digest, and device security information. Use this dialog box to save or print your information for future reference.

Note: This information is available for SmartFusion2 and IGLOO2 devices only. For RTG4 devices, View Device Status displays IDCode information only.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

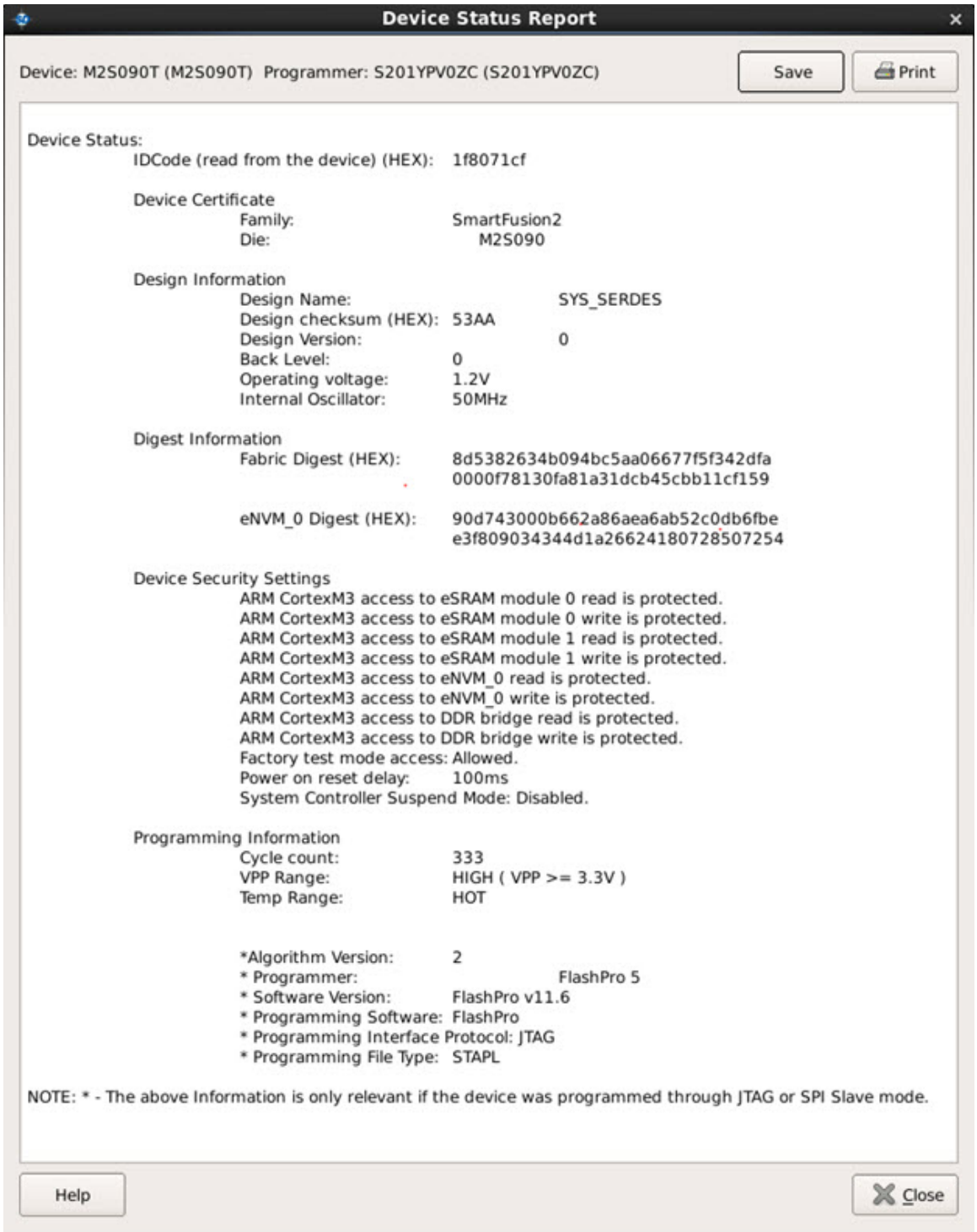

Figure 108 · Device Status Report

IdCode

IDCode read from the device under debug.

Device Certificate

Device certificate displays Family and Die information if device certificate is installed on the device.

If the device certificate is not installed on the device, a message indicating that the device certificate may not have been installed is shown.

Design Information

Design Information displays the following:

- Design Name
- Design Checksum
- Design Version
- Back Level
- Operating Voltage
- Internal Oscillator

Digest Information

Digest Information displays Fabric Digest, eNVM_0 Digest and eNVM_1 Digest (for M2S090 and M2S150 devices only) computed from the device during programming. eNVM digest is shown when eNVM is used in the design.

Device Security Settings

Device Security Settings indicate the following:

- Factory test mode access
- Power on reset delay
- System Controller Suspend Mode

In addition, if custom security options are used, Device Security Settings indicate:

- User Lock segment is protected
- User Pass Key 1/2 encrypted programming is enforced for the FPGA Array
- User Pass Key 1/2 encrypted programming is enforced for the eNVM_0 and eNVM_1
- SmartDebug write access to Active Probe and AHB mem space
- SmartDebug read access to Active Probe, Live Probe & AHB mem space
- UJTAG access to fabric

Programming Information

Programming Information displays the following:

- Cycle Count
- VPP Range
- Temp Range
- Algorithm Version
- Programmer
- Software Version
- Programming Software
- Programming Interface Protocol
- Programming File Type

Embedded Flash Memory (NVM) Content Dialog Box (SmartFusion and Fusion Only)

You can do the following in the NVM content dialog box:

- View content of Flash Memory pages (as shown in the figure below)

- Compare device content with original design content (requires a PDB that contains your EFC data)
- Check page status and identify if a page is corrupted or if the write count limit has exceeded the 10-year retention threshold

Fusion Devices: Choose your block from the **From block** drop-down list This action populates the Select drop-down list with the names of the clients in the selected block that is configured in the Flash Memory System Builder.

SmartFusion Devices: Block selection is unused and unavailable.

Choose a client name from the Select drop-down list and click **Read from Device** to view the values. You can also view a specific page range by selecting the <Page Range> option in the Select drop-down list and then specifying the start page and the end page.

You must click **Read from Device** each time you specify a new page range to update the view.

If you do not have your original design programming database (PDB) file, you can examine and retrieve a range of pages. Specify a page range if you wish to examine a specific set of pages. Page Status information appears to the right.

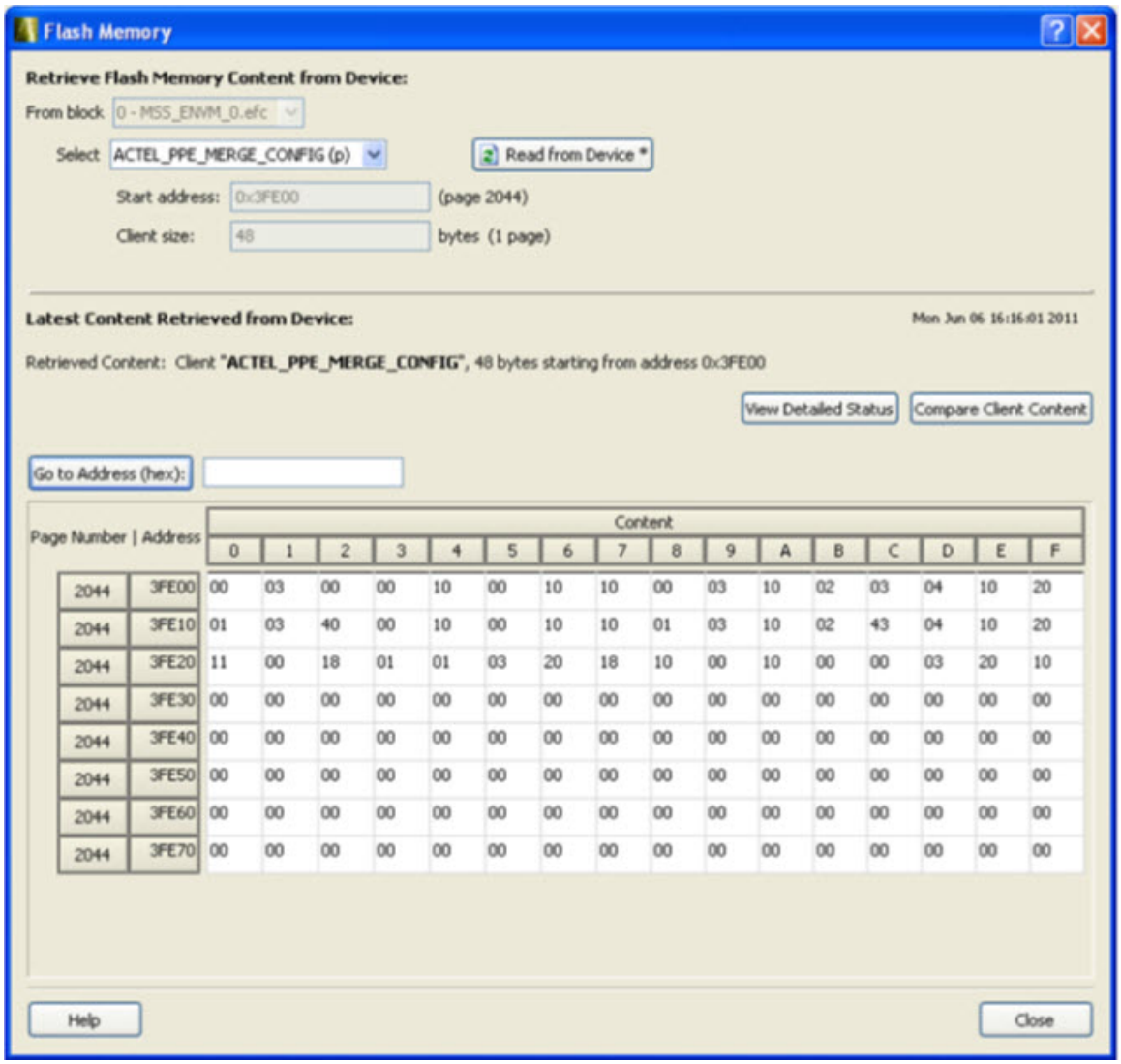

Figure 109 · Flash Memory Content Dialog Box for a SmartFusion Device (SmartDebug)

Embedded Flash Memory: Browse Retrieved Data (SmartFusion and Fusion Only)

The retrieved data table displays the content of the selected client or the page range selection. Corrupted page content is displayed in red. Read-only page content, corresponding to clients defined with the Prevent read option in Flash Memory System Builder, is displayed with a gray background. If content cannot be read (for example, pages are read-protected, but security has been erased), the content is displayed as XX. The mouse tooltip summarizes abnormal content status (as shown in the figure below).

The corresponding page number and address (relative to the current block) are displayed in the left column. The client size specified in the Flash Memory System Builder is shown at the top of the content table.

In the Retrieved Data View, you can enter an Address value (such as 0010) in the Go to Address field and click the corresponding button to go directly to that address.

Click **View Detailed Status** for a detailed report on the page range you have selected.

For example, if you want to view a report on pages 1-3, set the **Start Page** to 1, set the **End Page** to 3, and click **Read from Device**. Then click **View Detailed Status** The figure below is an example of the data for a specific page range.

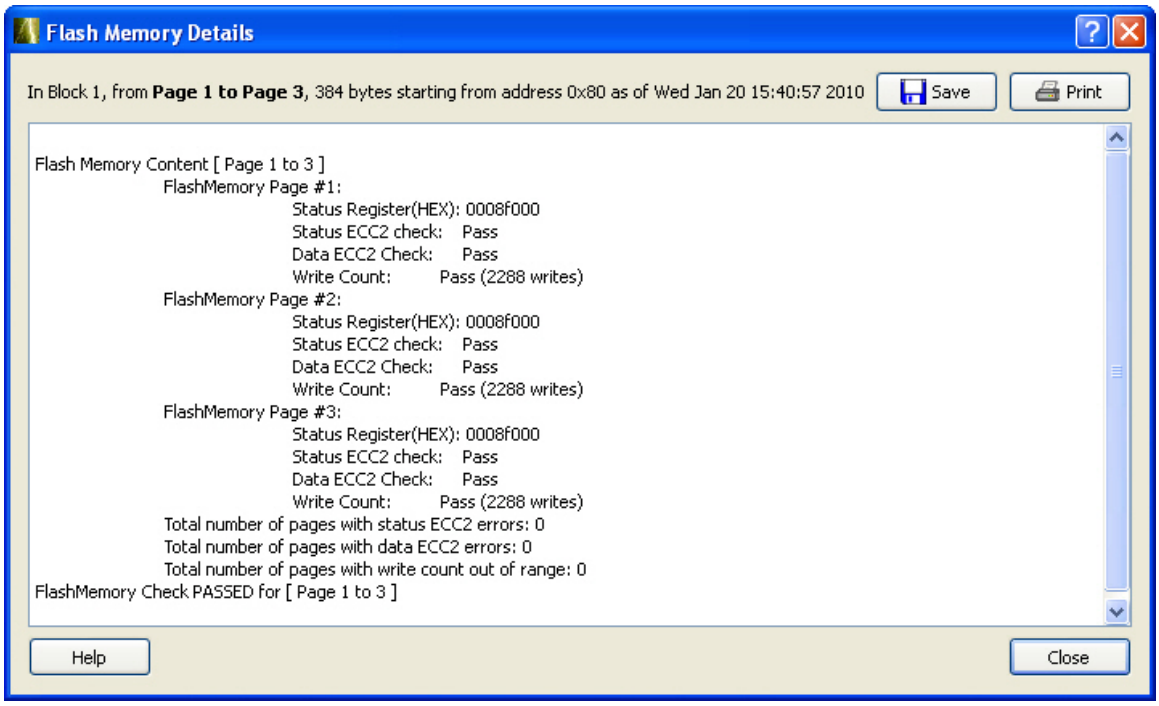

Figure 110 · Flash Memory Details Dialog Box (SmartDebug)

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

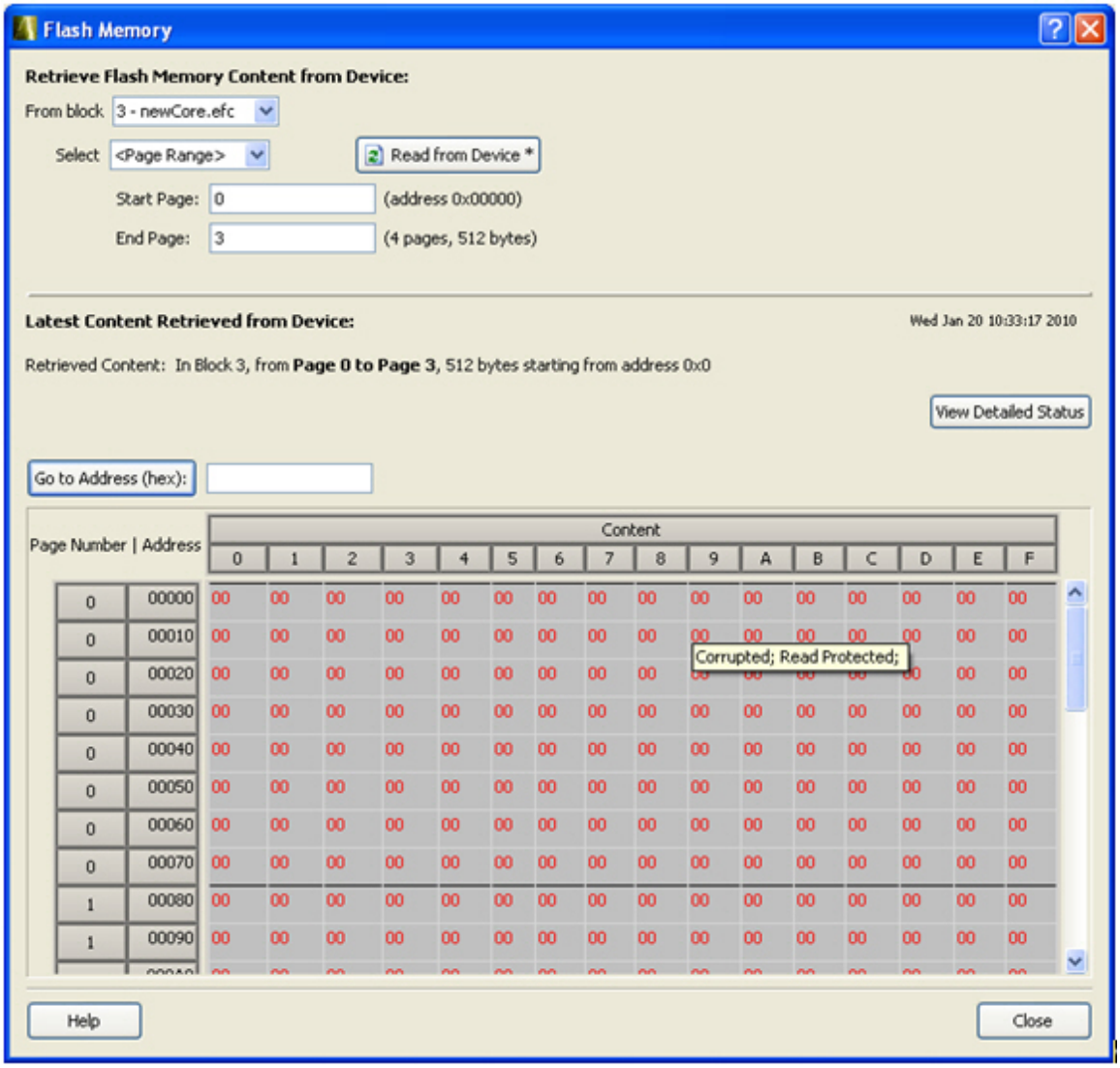

Figure 111 · Flash Memory Browse Retrieved Data

Embedded Flash Memory: Compare Memory Client (SmartFusion and Fusion Only)

After you retrieve the data from the device, the Compare Client Content button lets you compare the content of the selected client from the device with the original programming database (PDB) file. The differences are shown in the Compare Memory Client dialog box (as shown in the figure below).

Note: This option is not available when you select to retrieve the data based on a page range.

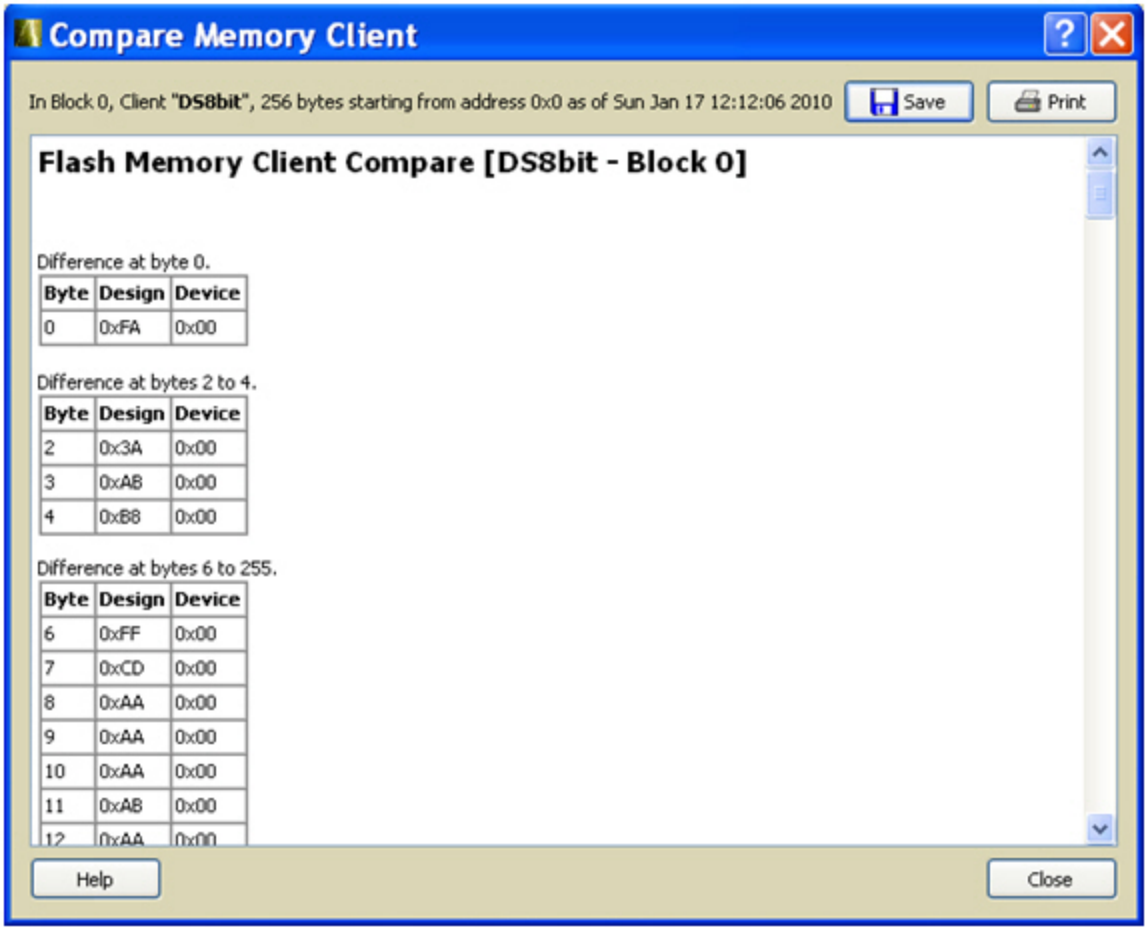

Figure 112 · Compare Memory Client Dialog Box

FlashROM Content Dialog Box (Fusion and SmartFusion Only)

In the FlashROM Content dialog box, you can view the physical blocks in your FlashROM and the client partitions specified in the original design content (requires a PDB that contains your UFC data). If the project's PDB does not contain UFC data, only the physical blocks are displayed.

Scroll through the table to view the Words and Pages for your physical blocks.

The Client Partitions section lists the names and configuration details of the clients set up in the FlashROM Builder. It automatically finds all mismatched client regions. To view the differences between a client and the device content, select a region row in the Client Partitions table. This action highlights the corresponding device content in the Physical Blocks table. The mismatch details are displayed below the Client Partitions table.

To copy the content of the Physical Blocks table to clipboard, select one or more cells in the table and type Ctrl+C.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

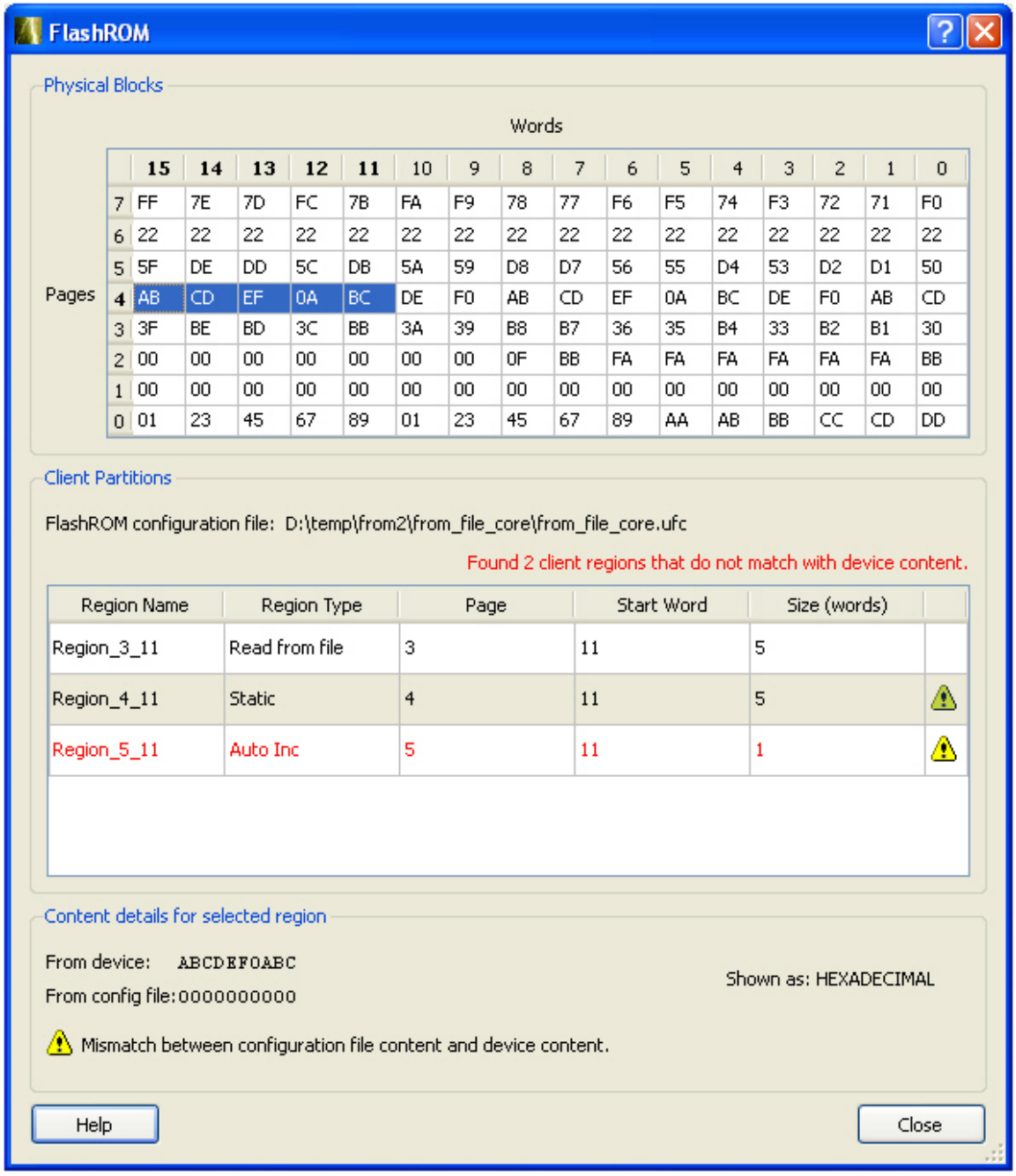

Figure 113 · FlashROM Content Dialog Box

Using SmartDebug with SmartFusion2, IGLOO2, and RTG4

The most common flow for SmartDebug is:

1. Create your design. You must have a FlashPro programmer connected to use SmartDebug.
2. Expand **Debug Design** and double-click **Smart Debug Design** in the Design Flow window. SmartDebug opens for your target device.
3. Click **View Device Status** to view the device status report and check for issues.
4. Examine individual silicon features, such as FPGA debug.

Device Status Report (SmartFusion and Fusion Only)

This dialog box displays the Device Information report. The Device Information report is a complete summary of your device state, analog block test values, user information, factory serial number, and security information. Use this dialog box to save or print your information for future reference.

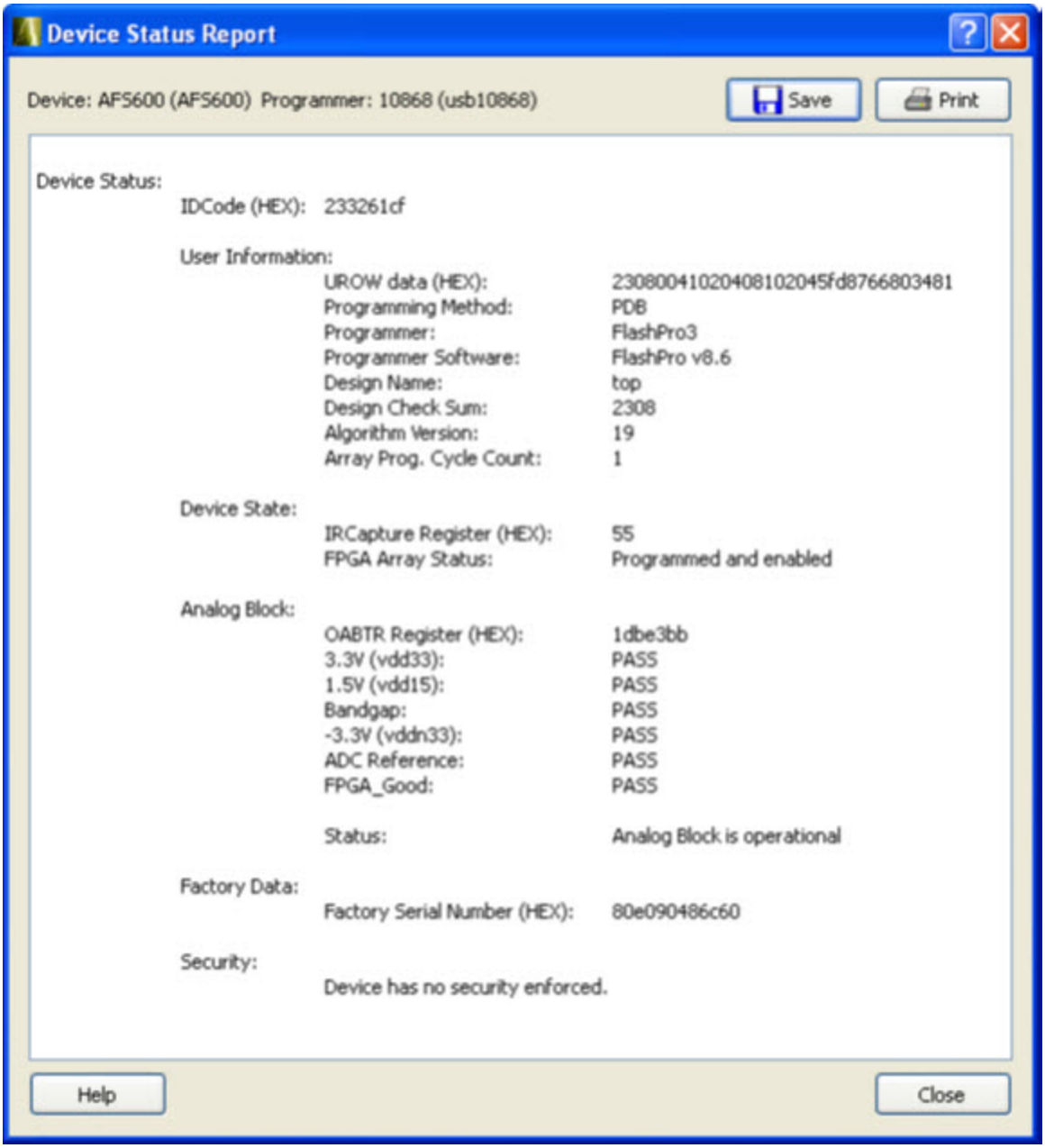

Figure 114 · Device Status Report

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Debug SERDES (SmartFusion2, IGLOO2, and RTG4)

You can examine and debug the SERDES blocks in your design in the Debug SERDES dialog box (shown in the figure below).

To Debug SERDES, expand **SmartDebug** in the Design Flow window and double-click **Debug SERDES**.

Debug SERDES Configuration is explained below. See the PRBS Test and Loopback Test topics for information specific to those procedures.

SERDES Block identifies which SERDES block you are configuring. Use the drop-down menu to select from the list of SERDES blocks in your design.

Debug SERDES - Configuration

Configuration Report

The Configuration Report output depends on the options you select in your PRBS Test and Loopback Tests. The default report lists the following for each Lane in your SERDES block:

Lane mode - Indicates the programmed mode on a SERDES lane as defined by the SERDES system register.

PMA Ready - Indicates whether PMA has completed its internal calibration sequence for the specific lane and whether the PMA is operational. See the SmartFusion2 or IGLOO2 High Speed Serial Interfaces User Guide on the Microsemi website for details.

TxPll status - Indicates the loss-of-lock status for the TXPLL is asserted and remains asserted until the PLL reacquires lock.

RxPLL status - Indicates the CDR PLL frequency is not grossly out of range of with incoming data stream.

Click **Refresh Report** to update the contents of your SERDES Configuration Report. Changes to the specified SERDES register programming can be read back to the report.

SERDES Register Read or Write

Script - Runs Read/Write commands to access the SERDES control/status register map using a script. Enter the full pathname for the script location or click the browse button to navigate to your script file. Click **Execute** to run the script.

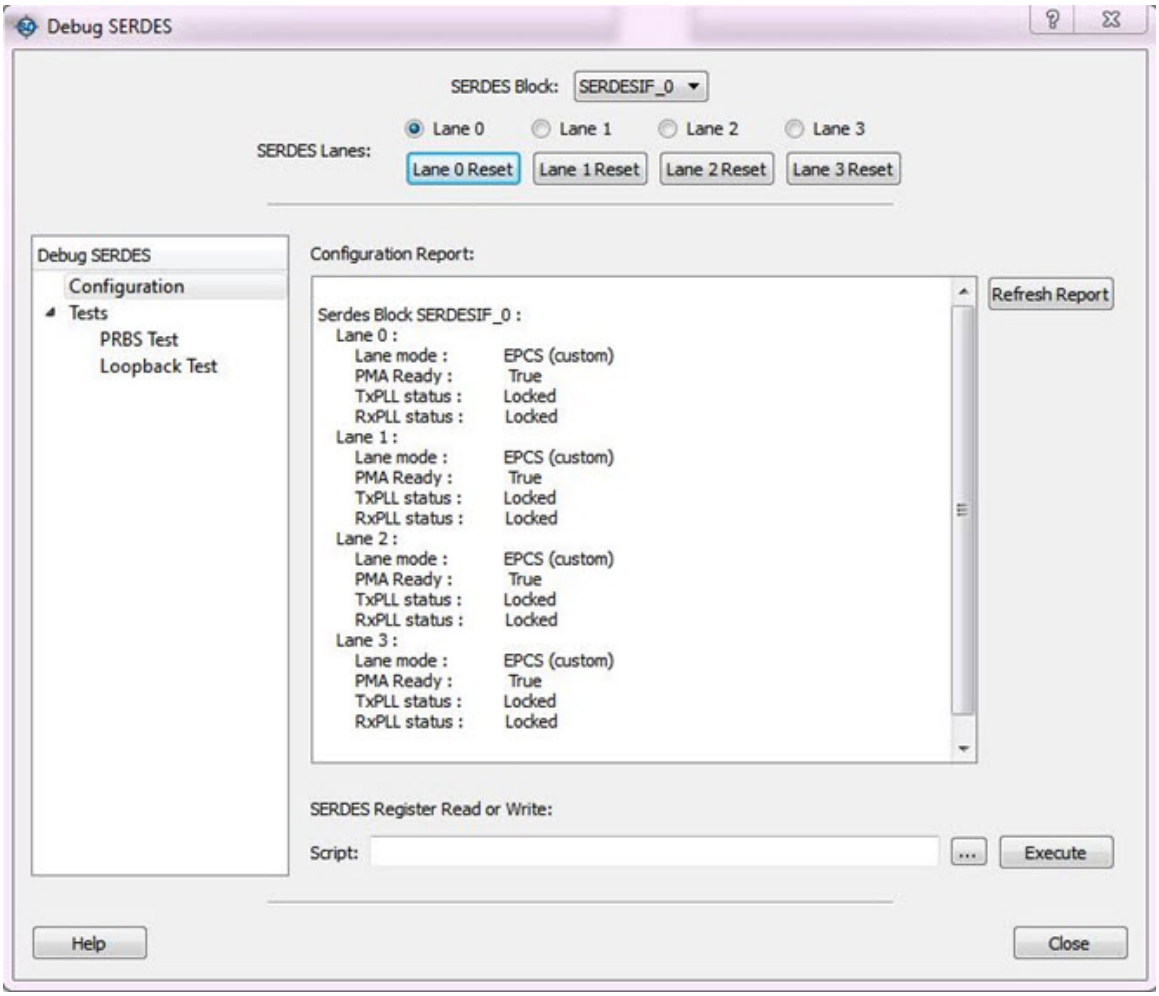

Figure 115 · Debug SERDES - Configuration

Note: The PCIe and XAUI protocols only support PRBS7. The EPCS protocol supports PRBS7/11/23/31.

Debug SERDES – PRBS Test

PRBS data stream patterns are generated and checked by the internal SERDES block. These are used to self-test signal integrity of the device. You can switch the device through several predefined patterns.

View Loopback Test settings in the Debug SERDES - Loopback Test topic.

SERDES Block identifies which SERDES block you are configuring. Use the drop-down menu to select from the list of SERDES blocks in your design.

SERDES Lanes

Select the **Lane** and **Lane Status** on which to run the PRBS test. Lane mode indicates the programmed mode on a SERDES lane as defined by the SERDES system register.

Test Type

Near End Serial Loopback (On-Die) enables a self test of the device. The serial data stream is sent from the SERDES TX output and folded back onto the SERDES RX input.

Serial Data (Off-Die) is the normal system operation where the data stream is sent off chip from the TX output and must be connected to the RX input via a cable or other type of electrical interconnection.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Pattern

The SERDESIF includes an embedded test pattern generator and checker used to perform serial diagnostics on the serial channel, as shown in the table below.

Pattern	Type
PRBS7	Pseudo-Random data stream of 2^7 polynomial sequences
PRBS11	Pseudo-Random data stream of 2^11 polynomial sequences
PRBS23	Pseudo-Random data stream of 2^23 polynomial sequences
PRBS31	Pseudo-Random data stream of 2^31 polynomial sequences

Cumulative Error Count

Lists the number of cumulative errors after running your PRBS test. Click **Reset** to reset to zero. 1. By default, Cumulative Error Count = 0, the Data Rate text box is blank, and Bit Error Rate = NA.

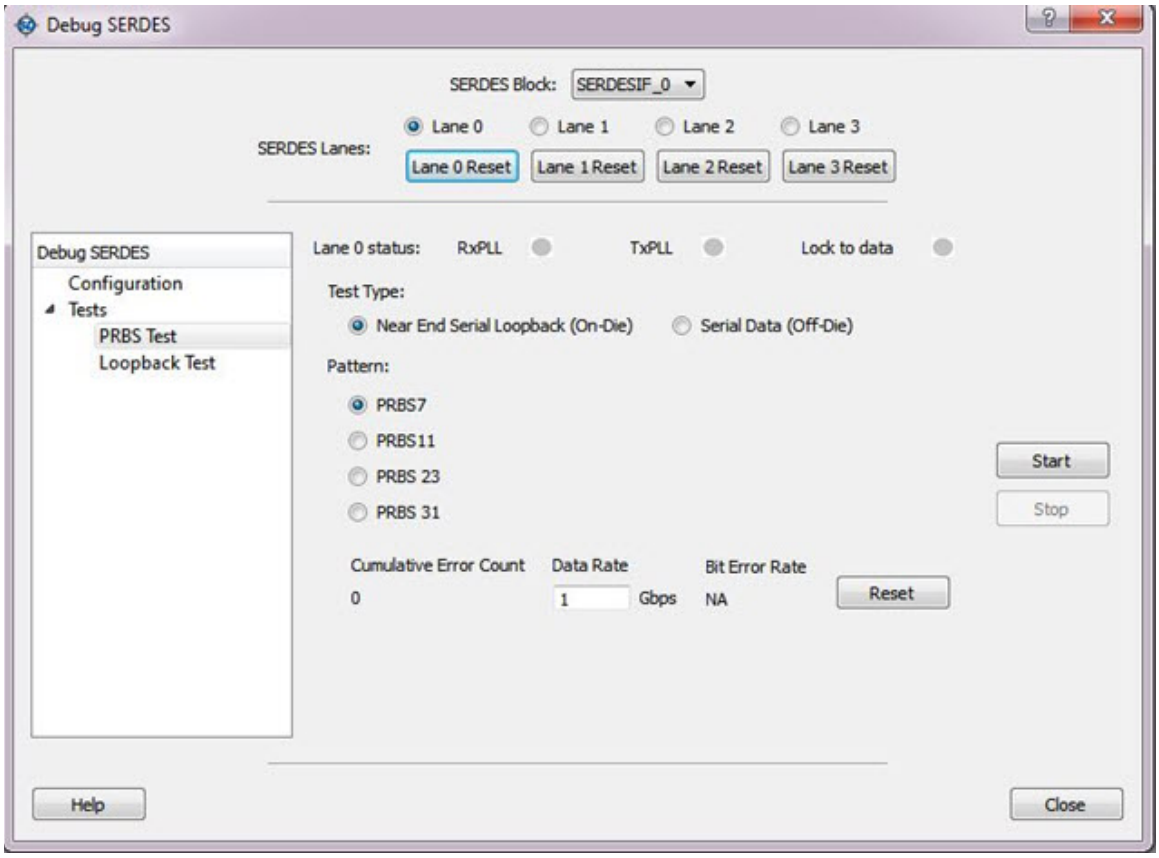

Figure 116 · Debug SERDES - PRBS Test

Note: If the design uses SERDES PCIe, PRBS7 will be the only option shown for PRBS tests..

Bit Error Rate

Displays the Bit Error Rate (BER) for the PRBS test in progress.

The formula for calculating the BER is as follows:

BER = (#bit errors+1)/#bits sent

#bits sent = Elapsed time/bit period

When clicked on Start:

- The BER is updated every second for the entered data rate and errors observed.
- If no data rate is entered by the user, the BER is set to the default.

When clicked on Stop:

- The BER resets to default.

When clicked on Reset:

- The BER is reset to default.
- If no test is in progress, the BER remains in the default value.
- If the PRBS test is in progress, the BER calculation restarts.

Debug SERDES – Loopback Test

Loopback data stream patterns are generated and checked by the internal SERDES block. These are used to self-test signal integrity of the device. You can switch the device through predefined tests.

See the PRBS Test topic for more information about the PRBS test options.

SERDES Block identifies which SERDES block you are configuring. Use the drop-down menu to select from the list of SERDES blocks in your design.

SERDES Lanes

Select the **Lane** and **Lane Status** on which to run the Loopback test. Lane mode indicates the programmed mode on a SERDES lane as defined by the SERDES system register.

Test Type

PCS Far End PMA RX to TX Loopback- This loopback brings data into the device and deserializes and serializes the data before sending it off-chip. This loopback requires 0PPM clock variation between the TX and RX SERDES clocks.

See the SmartFusion2 or IGLOO2 High Speed Serial Interfaces User's Guide on the Microsemi website for details.

Near End Loopback (On Die) - To enable, select the Near End Loopback (On Die) option and click **Start**. Click **Stop** to disable. Using this option allows you to send and receive user data without sending traffic off-chip. You can test design functionality without introducing other issues on the PCB.

See the SmartFusion2 or IGLOO2 High Speed Serial Interfaces User's Guide on the Microsemi website for details.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

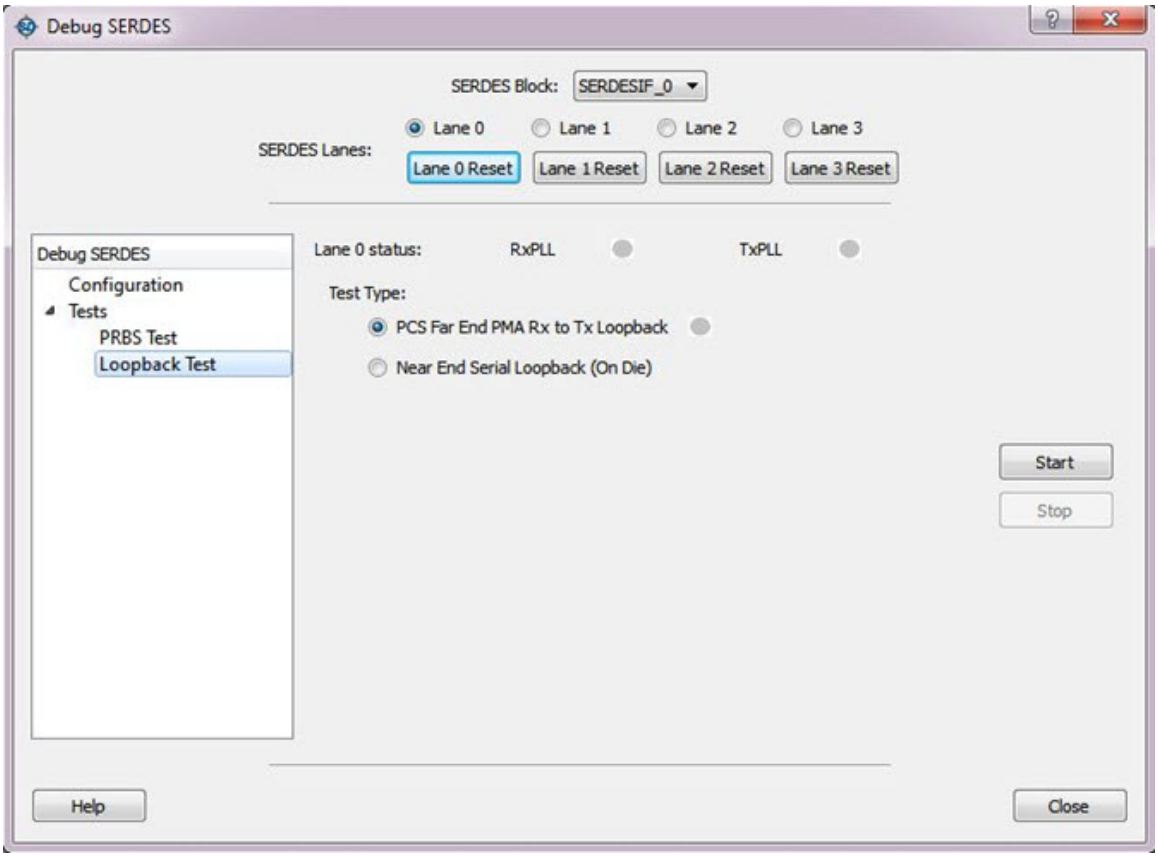

Figure 117 · Debug SERDES - Loopback Test

Debugging

Debug FPGA Array (SmartFusion2, IGLOO2, and RTG4 Only)

In the Debug FPGA Array dialog box, you can view your Live Probes, Active Probes, and Memory Blocks, and Insert Probes (Probe Insertion).

The Debug FPGA Array dialog box includes the following four tabs:

- Live Probes
- Active Probes
- Memory Blocks
- Probe Insertion

Live Probes (SmartFusion2, IGLOO2, and RTG4)

The Live Probes tab displays a table with the probe name and pin type.

Note: SmartFusion2 and IGLOO2 support two probe channels, and RTG4 supports one probe channel.

SmartFusion2 and IGLOO2

Two probe channels (ChannelA and ChannelB) are available. When a probe name is selected, it can be assigned to either ChannelA or ChannelB.

You can assign a probe to a channel by doing either of the following:

- Right-click a probe in the table and choose **Assign to Channel A** or **Assign to Channel B**.
- Click the **Assign to Channel A** or **Assign to Channel B** button to assign the probe selected in the table to the channel. The buttons are located below the table.

When the assignment is complete, the probe name appears to the right of the button for that channel, and SmartDebug configures the ChannelA and ChannelB I/Os to monitor the desired probe points. Because there are only two channels, a maximum of two internal signals can be probed simultaneously.

Click the **Unassign Channels** button to clear the live probe names to the right of the channel buttons and discontinue the live probe function during debug.

Note: At least one channel must be set; if you want to use both probes, they must be set at the same time.

The Active Probes READ/WRITE overwrites the settings of Live Probe channels (if any).

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

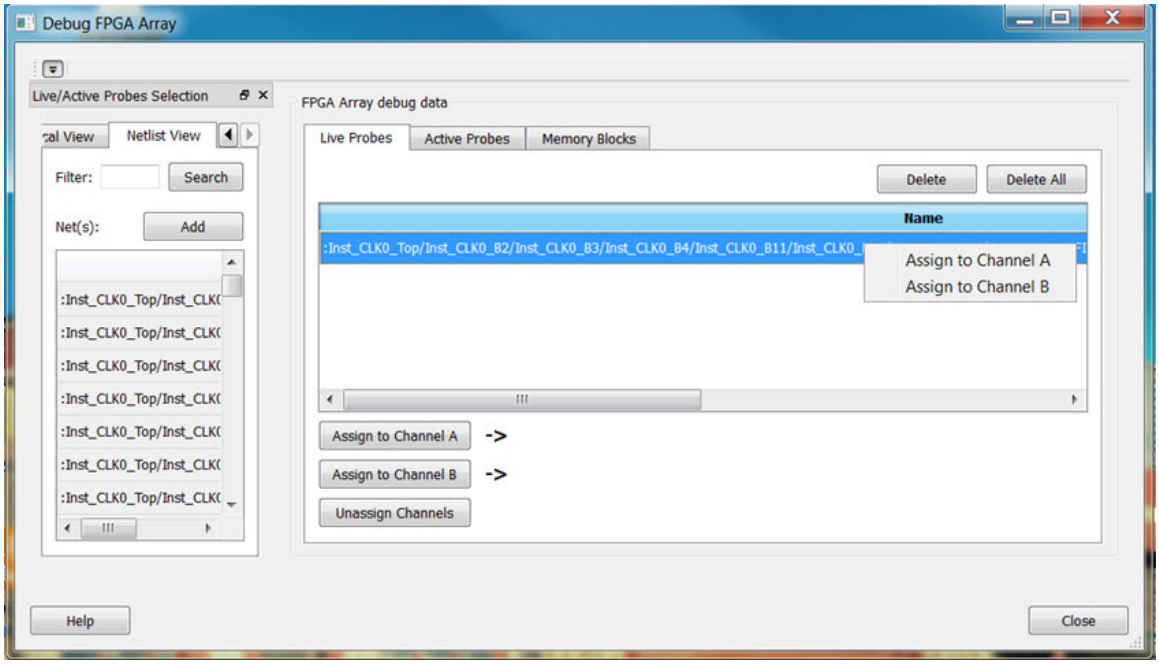

Figure 118 · Live Probes Tab (SmartFusion2 and IGLOO2) in SmartDebug FPGA Array Dialog Box

RTG4

One probe channel (Probe Read Data Pin) is available for RTG4 for debug. When a probe name is selected, it can be assigned to the Probe Channel (Probe Read Data Pin).

You can assign a probe to a channel by doing either of the following:

- Right-click a probe in the table and choose **Assign to Probe Read Data Pin**.
- Click the **Assign to Probe Read Data Pin** button to assign the probe selected in the table to the channel. The button is located below the table.

Click the **Unassign probe read data pin** button to clear the live probe name to the right of the channel button and discontinue the live probe function during debug.

The Active Probes READ/WRITE overwrites the settings of Live Probe channels (if any).

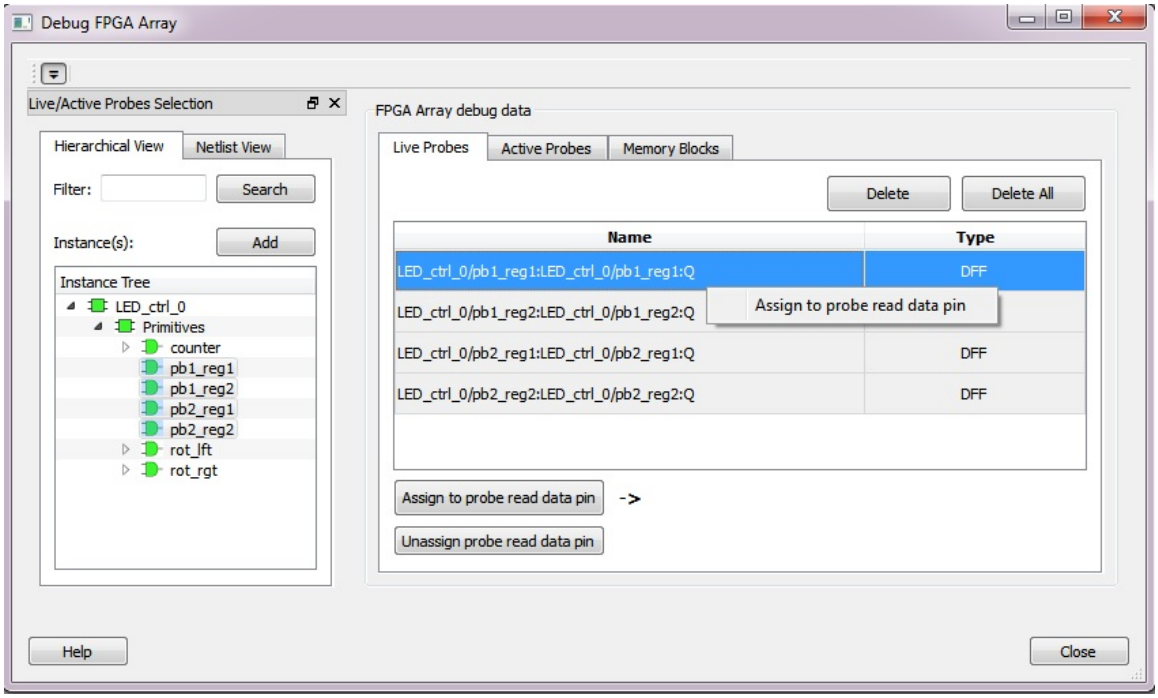

Figure 119 · Live Probes Tab (RTG4) in SmartDebug FPGA Array Dialog Box

Active Probes (SmartFusion2, IGLOO2, and RTG4)

In the left pane of the Active Probes tab, all available Probe Points are listed in instance level hierarchy in the Hierarchical View. All Probe Names are listed with the Name and Type (which is the physical location of the flip-flop) in the Netlist View.

Select probe points from the Hierarchical View or Netlist View, right-click and choose **Add** to add them to the Active Probes UI. You can also add the selected probe points by clicking the **Add** button. The probes list can be filtered by using the Filter box.

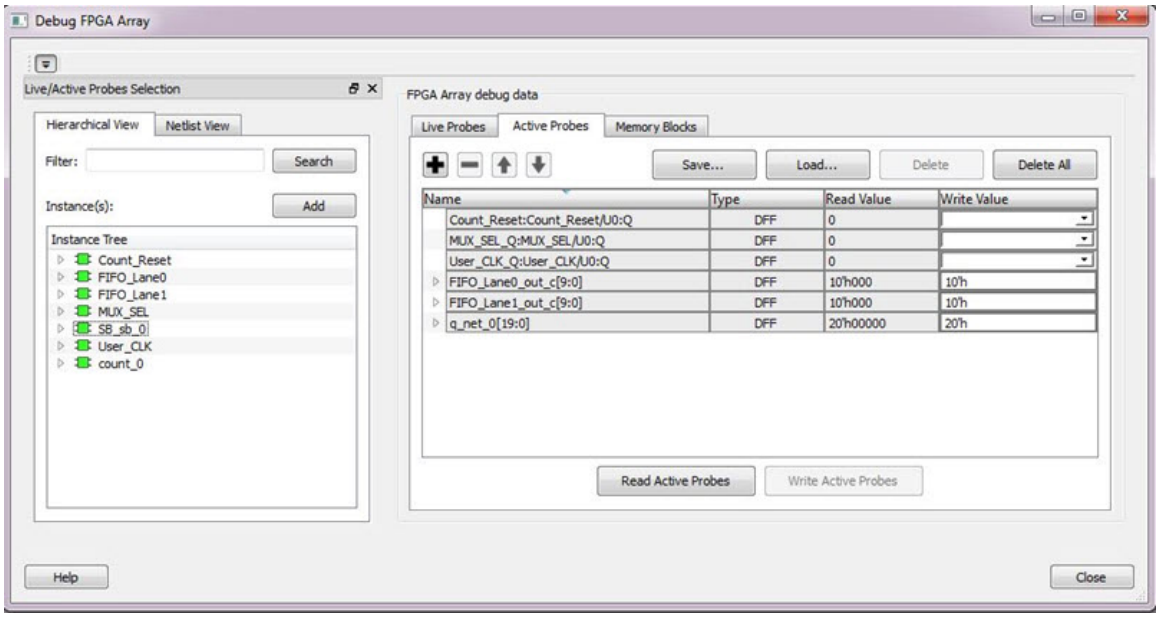

Figure 120 · Active Probes Tab in SmartDebug FPGA Array Dialog Box

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

When you have selected the desired probe, points appear in the Active Probe Data chart and you can read and write multiple probes (as shown in the figure below).

You can use the following options in the Write Value column to modify the probe signal added to the UI:

- Drop-down menu with values ‘0’ and ‘1’ for individual probe signals
- Editable field to enter data in hex or binary for a probe group or a bus

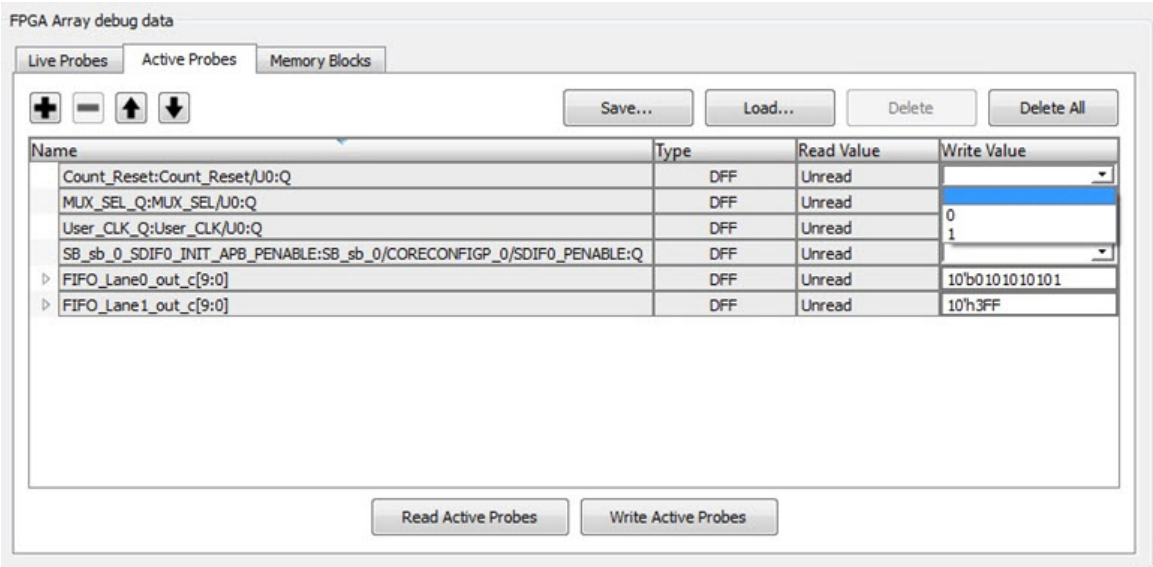

Figure 121 · Active Probes Tab - Write Value Column Options

Memory Blocks (SmartFusion2, IGLOO2, and RTG4)

The left pane in the Memory Blocks tab shows the list of defined memory blocks that are specified in your design. Select a memory block and add it to the UI. After you select a memory block, you can click **Read Block** to show the current content of the memory or write to individual memory locations. Each field is editable, and multiple memory locations can be written at the same time.

Each field is a 9-bit memory word (for SmartFusion2 and IGLOO2 devices) and 9-bit or 12-bit memory word (for RTG4 devices, depending on the memory configuration). Valid inputs are hexadecimal values between 0x0 and 0x1FF (for SmartFusion2, IGLOO2, and RTG4 devices in 9-bit mode) and 0x0 and 0xFFF (for RTG4 devices only in 12-bit mode), as shown in the figure below.

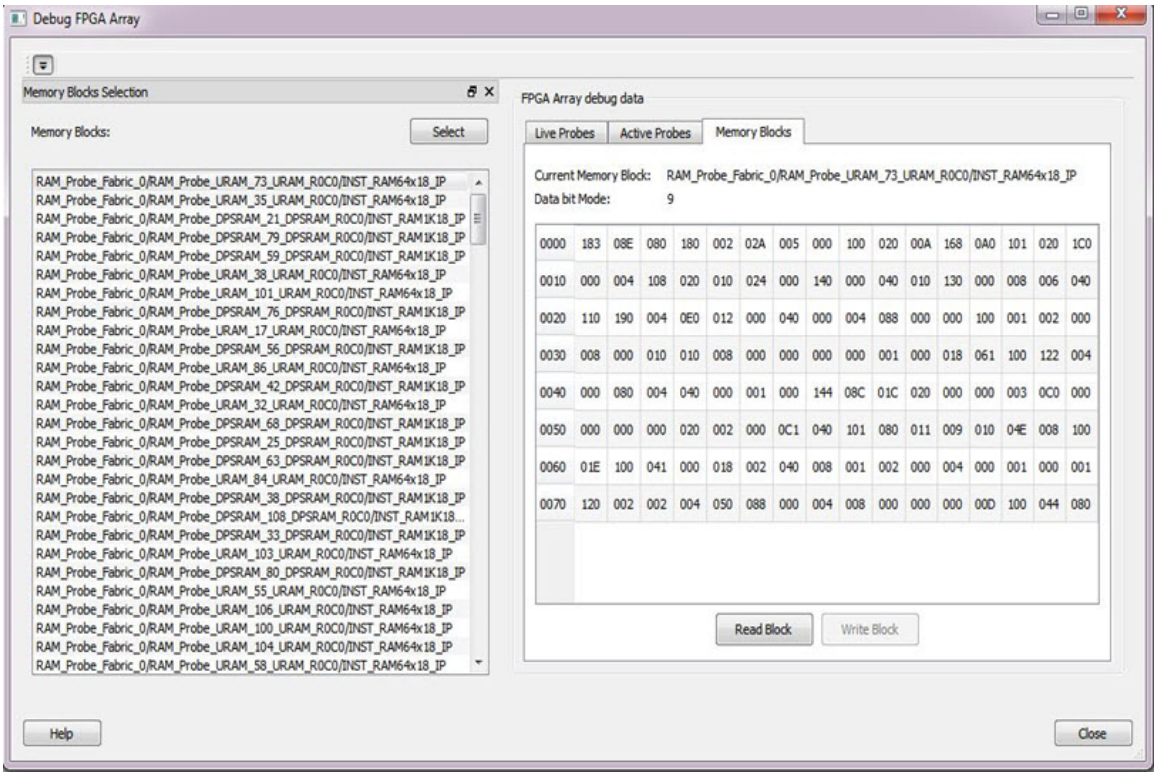

Figure 122 · Debug FPGA Array - Memory Blocks Tab

Fields that have changed but have not yet been written appear in red text until you click **Write Block** to initiate a memory write (as shown in the figure below).

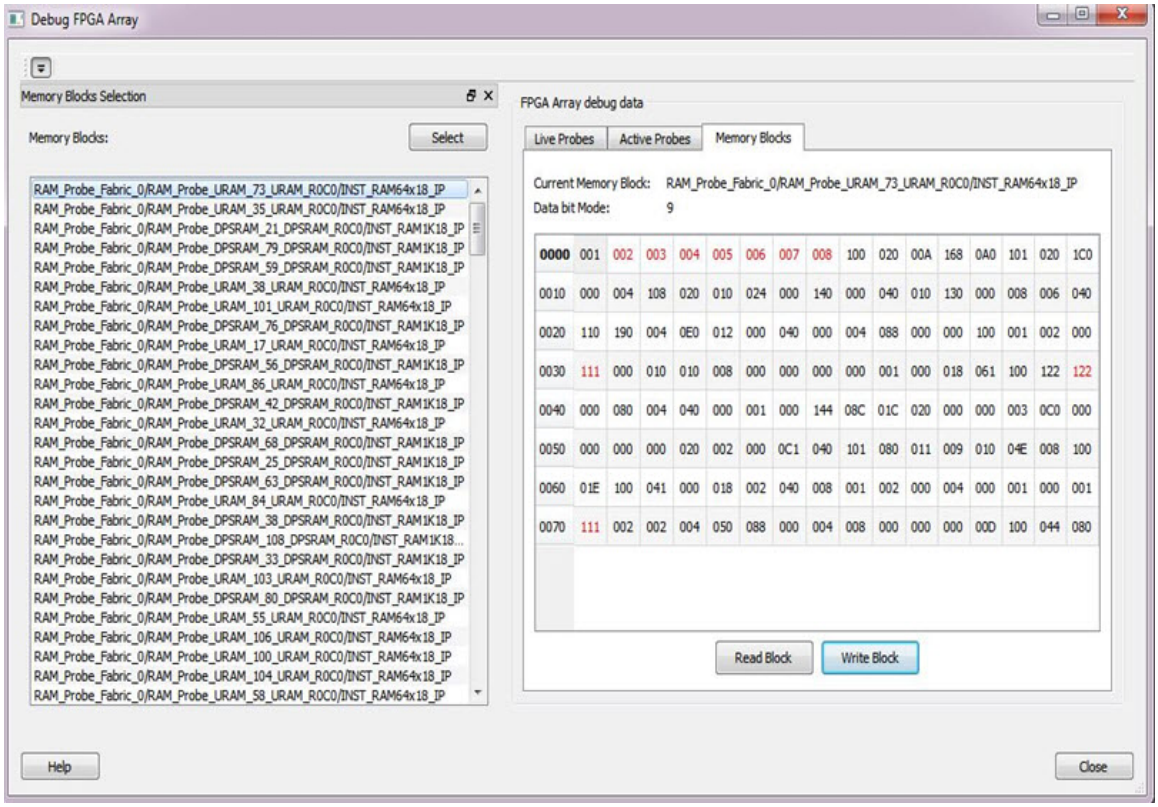

Figure 123 · Memory Blocks with Updated Values

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Probe Insertion (Post-Layout) - SmartFusion2, IGLOO2, and RTG4

Introduction

Probe insertion is a post-layout debug process that enables internal nets in the FPGA design to be routed to unused I/Os. Nets are selected and assigned to probes using the Probe Insertion window in SmartDebug. The rerouted design can then be programmed into the FPGA, where an external logic analyzer or oscilloscope can be used to view the activity of the probed signal.

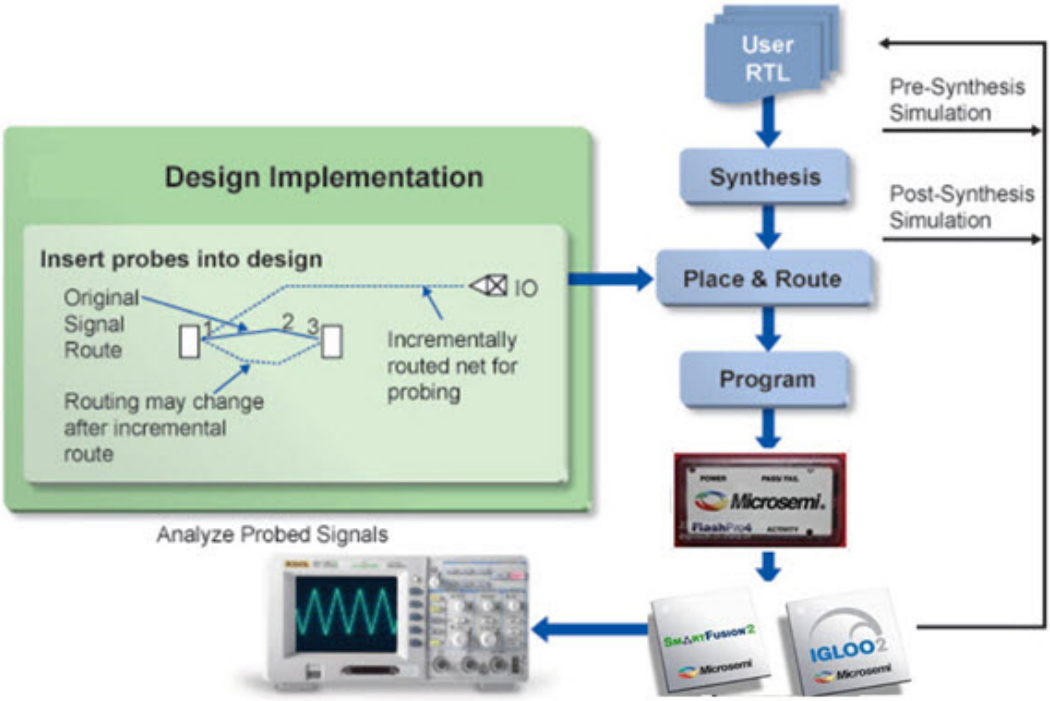

Figure 124 · Probe Insertion in the Design Process

The Probe Insertion debug feature is complementary to Live Probes and Active Probes. Live Probes and Active Probes use a special dedicated probe circuitry.

Probe Insertion

1. Double-click **SmartDebug Design** in the Design Flow window to open the SmartDebug main window.

Note: FlashPro Programmer must be connected for SmartDebug.

2. Select **Debug FPGA Array** and then select the Probe Insertion tab.

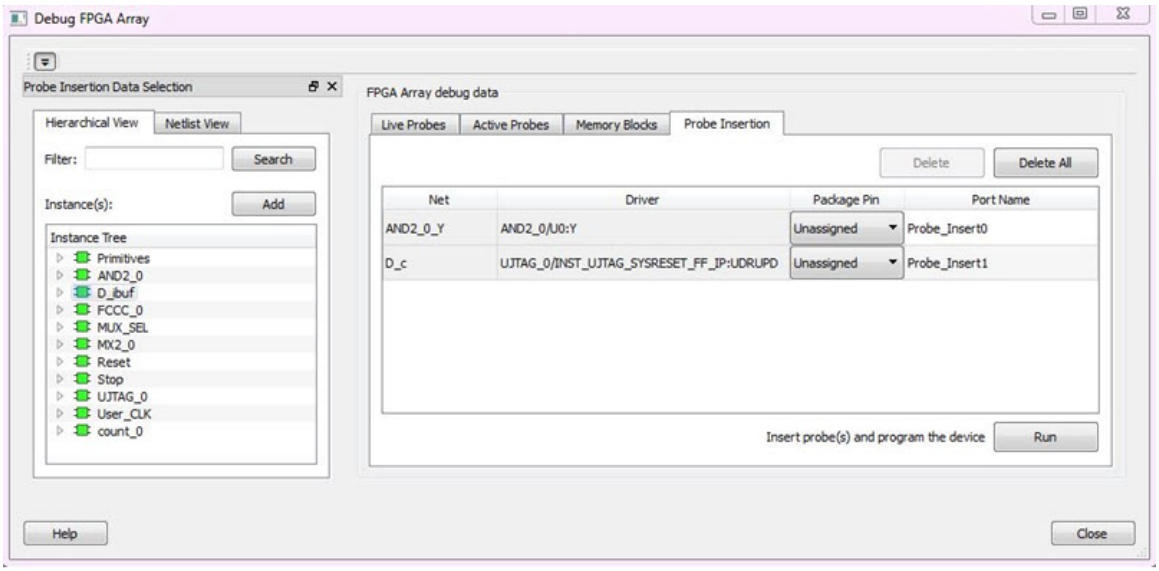

Figure 125 · Probe Insertion Tab

In the left pane of the Probe Insertion tab, all available Probe Points are listed in instance level hierarchy in the Hierarchical View. All Probe Names are shown with the Name and Type in the Netlist View.

3. Select probe points from the Hierarchical View or Netlist View, right-click and choose **Add** to add them to the Active Probes UI. You can also add the selected probe points by clicking the **Add** button. The probes list can be filtered by using the Filter box.

   Each entry has a Net and Driver name which identifies that probe point.
   The selected net(s) appear in the Probes table in the Probe Insertion tab, as shown in the figure below. SmartDebug automatically generates the Port Name for the probe. You can change the Port Name from the default if desired.

4. Assign a package pin to the probe using the drop-down list in the Package Pin column. You can assign the probe to any unused package pin (spare I/O).

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

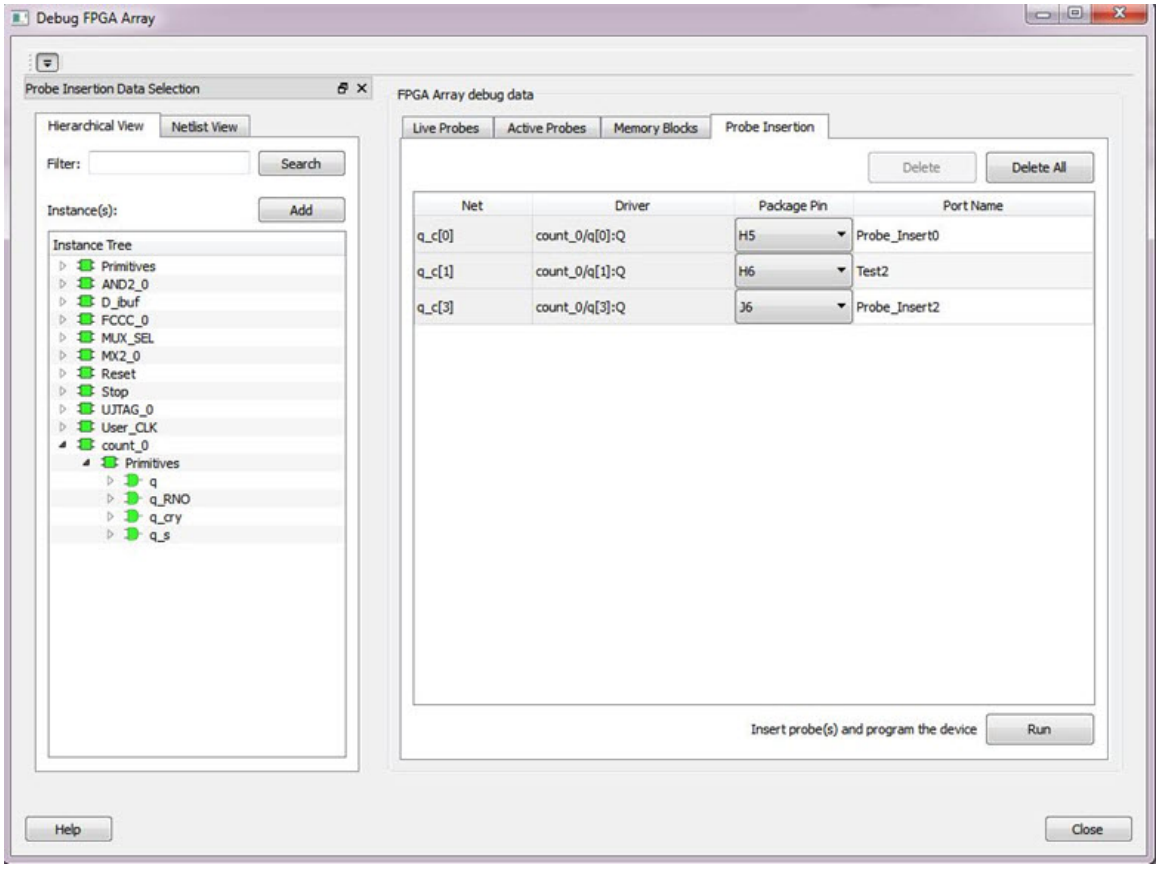

Figure 126 · Debug FPGA Array > Probe Insertion > Add Probe

5. Click **Run**.

   This triggers Place and Route in incremental mode, and the selected probe nets are routed to the selected package pin. After incremental Place and Route, Libero automatically reprograms the device with the added probes.

   The log window shows the status of the Probe Insertion run.

Probe Deletion

To delete a probe, select the probe and click **Delete**. To delete all the probes, click **Delete All**.

Note: Deleting probes from the probes list without clicking **Run** does not automatically remove the probes from the design.

Reverting to the Original Design

To revert to the original design after you have finished debugging:

1. In SmartDebug, click **Delete All** to delete all probes.
2. Click **Run**.
3. Wait until the action has completed by monitoring the activity indicator (spinning blue circle). Action is completed when the activity indicator disappears.
4. Close SmartDebug.

Export Pin Report

Double-click **Export Pin Report** to display the pin report in your Design Datasheet/Report.

The Pin Report lists the pins in your device. Right-click **Export Pin Report** and choose **Configure Options** to select your pin report type. You can generate a report sorted by port name and/or by package pin name, as shown in the figure below. The Pin Report generates two files:

- <design>_pinrpt_name.rpt - Pin report sorted by name.
- <design>_pinrpt_number.rpt - Pin report sorted by pin number.

You must select at least one report.

Export Pin Report also generates a Bank Report by default; the filename is <design>-bankrpt.rpt.

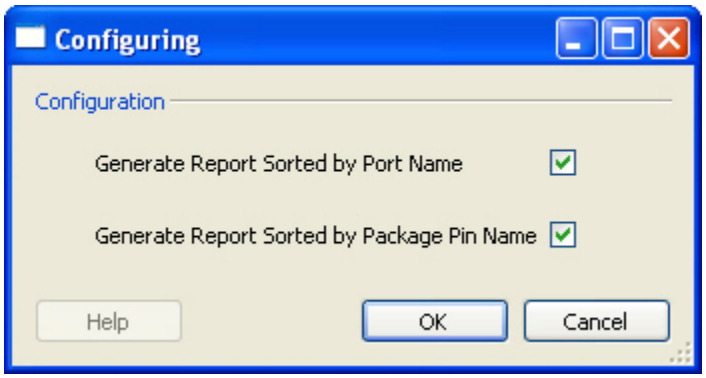

Figure 127 · Export Pin Report Dialog Box

Export BSDL File

Double-click Export BSDL File (in the Libero SoC Design Flow window, **Handoff Design for Production > Export BSDL File**) to generate the BSDL File report to your Design Datasheet/Report.

For SmartFusion, IGLOO, ProASIC3, and Fusion devices, do the following:

1. Open Designer interactively.
2. Click **Compile**.
3. Click **Layout**.
4. Click **Programming File** and click **Finish** when done.
5. In the Generate Programming Files dialog box, under Output formats, select **IEEE 1532 Files (*.bsd, *.isc)**.
6. Click **Generate** to generate the related BSDL file.

The BSDL file provides a standard file format for electronics testing using JTAG. It describes the boundary scan device package, pin description and boundary scan cell of the input and output pins. BSDL models are available as downloads for many Microsemi SoC devices; see the Microsemi website for more information.

Export IBIS Model

Double-click Export IBIS Model (in the Libero SoC Design Flow window, **Handoff Design for Production > Export IBIS Model**) to generate the IBIS Model report to your Design Datasheet/Report.

The IBIS model report provides a standard file format for recording parameters like driver output impedance, rise/fall time, and input loading, which may then be used by any software application.

See the IBIS model application note for more information on IBIS models.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Export Firmware – SmartFusion2

When your design has been completed, you can export the design firmware configuration using the Export Firmware tool. The firmware configuration contains:

- Register configuration files for MSS, FDDR, and SERDES blocks instantiated in your design. This information must be compiled with your application along with the SmartFusion2 CMSIS firmware core to have proper Peripheral Initialization when the Cortex-M3 boots.
- Firmware drivers compatible with the hard and soft peripherals instantiated in your design.

To export your design firmware configuration, double-click **Export Firmware** in the Libero SoC Design Flow window under Handoff Design for Firmware Development. The Export Firmware dialog box opens.

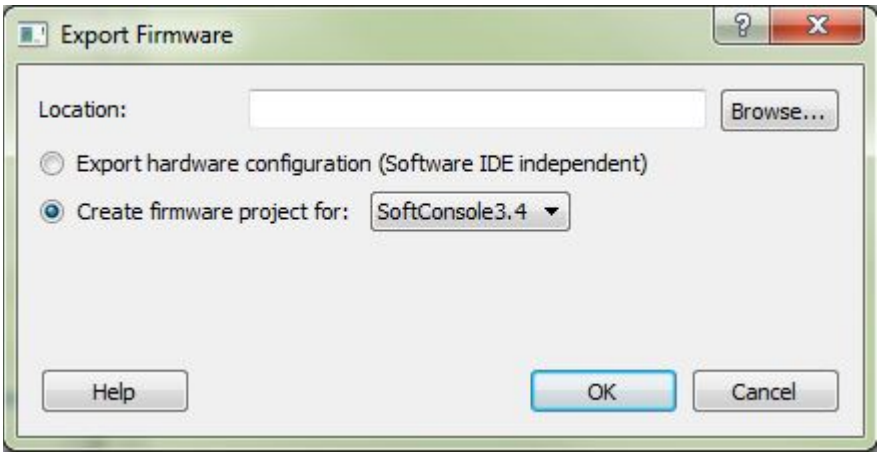

Figure 128 · Export Firmware Dialog Box

Location: Provide the location where you want the firmware configuration files to be exported. When you export the firmware, Libero SoC creates a Firmware folder to store all the drivers and register configuration files.

Export hardware configuration (Software IDE independent):Beginning in Libero SoC v11.7, the Export hardware configuration option exports register configuration files for MSS, FDDR and SERDES blocks instantiated in your design. CMSIS and other firmware drivers must be generated using the standalone Firmware Catalog executable. These options are available to support SoftConsole 4.0 flow.

Create firmware project for: <selected Software Tool Chain>

This option is checked by default. Libero SoC creates the firmware project for the IDE tool of your choice and creates the SoftConsole/IAR/Keil (per your choice) folder to store the projects.

To enable you to manage your firmware project separately from Libero's automatically generated firmware data, the created software workspace contains two software projects:

hardware_platform - This project contains all the firmware and hardware abstraction layers that correspond to your hardware design. This project is configured as a library and is referenced by your application project. The content of this folder is overwritten every time you export your firmware project.

application - This project produces a program and results in the binary file. It links with the hardware_platform project. This folder does not get overwritten when you re-export your firmware. This is where you can write your own main.c and other application code, as well as add other user drivers and files. You can reference header (*.h) files of any hardware peripherals in the hardware_platform project – include paths are automatically set up for you.

To build your workspace, make sure you have both the hardware_platform and _application projects set to the same compile target (Release or Debug) and build both projects.

To open your exported firmware projects you must invoke your third-party development tool (SoftConsole, Keil or IAR) outside Libero SoC and point it to the exported firmware workspace.

Note: You must re-export firmware if you make any changes to your design.

TCL Command

```
export_firmware \
-export_dir {D:\Designs\software_drivers} \
-create_project 1 \
-software_ide {Keil}
```

Version Supported

Libero SoC v11.7 supports the following versions of third-party development tools:

- SoftConsole v3.4
- IAR v7.4
- Keil V5.16

Running Libero SoC from your Software Tool Chain

When launched from your software toolchain, Libero SoC becomes solely an MSS configurator. This can be useful if you are responsible for the embedded code development for the SmartFusion device and are more comfortable in your existing software tool chain.

Any FPGA fabric development needs to be done using the regular Libero® SoC tool flow. Using the Libero SoC in the software toolchain mode only enables you to configure the SmartFusion Microcontroller Subsystem (MSS) and not the FPGA fabric.

The MSS Configurator can be integrated in any software development IDE that supports external tools. Configure your IDE to start the Libero SoC executable and use the parameters below to customize your interface. For SoftConsole, Keil and IAR the parameters are:

```
"PROJECT_LOCATION:<path>" //Project directory location, and the location of your
generated MSS files.
"DESIGN_NAME:<name>" //Name of your design.
"STARTED_BY:<tool>" //Identifies which tool invoked the MSS Configurator; can be
SoftConsole, Keil, or IAR EWARM
```

See Also

Exporting Firmware and the Software IDE Workspace

Libero SoC Frequently Asked Questions

Software IDE Integration

View/Configure Firmware Cores

Application Notes

Application notes are available for all Microsemi SoC devices. A full list of application notes is available at the Microsemi SoC website.

Application notes are organized by product or type. For example, you can view a full list of application notes for SmartFusion, or you can view a list of application notes on Design Entry that includes documents for all available families.

The following is a short list of popular application notes covering a range of applications and devices.

- AC333: Connecting User Logic to the SmartFusion Microcontroller Subsystem App Note (design files required - 23 MB) - Describes how to create AHB Lite or APB3 wrapper on custom logic and how to connect it to the MSS System via the Fabric Interface Controller.
- AC225 Programming Antifuse Devices App Note - Provides an overview of the programming options available for the antifuse families.
- AC362: SmartFusion cSoC: Programming FPGA Fabric and eNVM Using In-Application Programming Interface App Note (design files required - 50 MB)

- AC335: Building an APB3 Core for SmartFusion cSoC FPGAs App Note (design files required - 13 MB) - Describes how to create an APB3 wrapper interface for your logic or IP and connect it to the MSS via the Fabric Interface Controller.
- AC265: Clock Generation and Distribution Design Example App Note (design files required - 1 MB) - Demonstrates the use of the IGLOO and ProASIC3 clock conditioning circuits and phase-locked loops (PLLs) to generate multiple clock signals with different phases and frequencies.

Tutorials and Training Modules

Software tutorials, webcasts and online training modules are available on the Microsemi website. See the website for a full list.

The following list is an example of the tutorials available. Training modules may require you to register to enter the Microsemi Training Portal. Registration is free.

Example Tutorials

ARM Cortex M1-Embedded Processor Tutorial (design files required - 105 MB) - Describes how to create a Cortex-M1 processor system that runs on the Fusion development kit board available from Microsemi SoC.

SmartFusion cSoC Webserver Demo Using uIP and FreeRTOS - Demonstrates the SmartFusion device capabilities using the SmartFusion Development Kit Board. Requires the following design files and the SmartFusion Development Kit Board.

- Design files using Softconsole (RAR, 15.2 MB, 5/12)
- Design files using IAR (RAR, 11.9 MB, 5/12)
- Design files using Keil (RAR, 13.5 MB, 5/12)
- Programming File (RAR, 226 KB, 5/12)

Using Keil µVision and Microsemi SmartFusion (programming files required - 91 KB)- Describes the process of operating an ARM Keil MDL Toolkit featuring µVision and Microsemi's SmartFusion family.

Catalog

In the Libero SoC, from the **View** menu choose **Windows > Catalog**.

The Catalog displays a list of available cores, busses and macros (see image below).

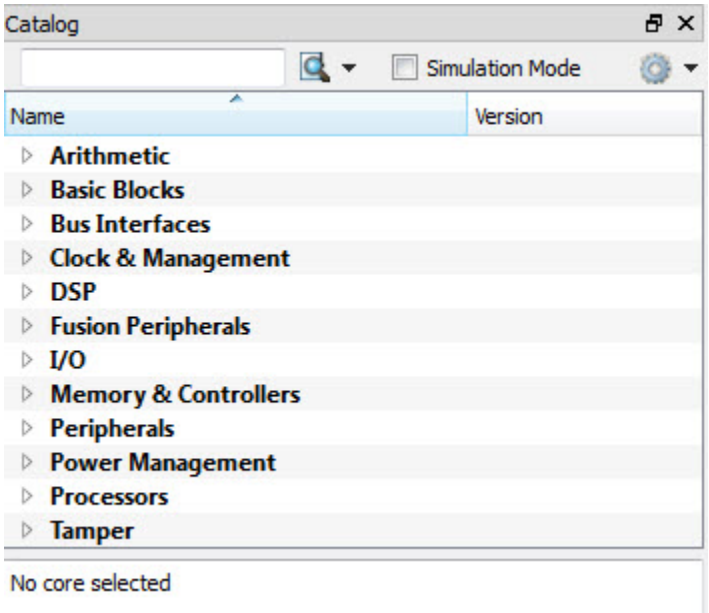

Figure 129 · Libero SoC Catalog

From the Catalog, you can create a component from the list of available cores, add a processor or peripheral, add a bus interface to your SmartDesign component, instantiate simulation cores or add a macro (Arithmetic, Basic Block, etc.) to your SmartDesign component.

Double-click a core to configure it and add it to your design. Configured cores are added to your list of Components/Modules in the Design Explorer.

Click the Simulation Mode checkbox to instantiate simulation cores in your SmartDesign Testbench. Simulation cores are basic cores that are useful for stimulus, such as driving clocks, resets, and pulses.

Viewing Cores in the Catalog

The font indicates the status of the core:

- Plain text - In vault and available for use
- Asterisk after name (*) - Newer version of the core (VLN) available for download
- *Italics* - Core is available for download but not in your vault
- ~~Strikethrough~~ - core is not valid for this version of Libero SoC

The colored icons indicate the license status. Blank means that the core is not license protected in any way. Colored icons mean that the core is license protected, with the following meanings:

Green Key - Fully licensed; supports the entire design flow.

Yellow Key - Has a limited or evaluation license only. Precompiled simulation libraries are provided, enabling the core to be instantiated and simulated within Libero SoC. Using the Evaluation version of the core it is possible to create and simulate the complete design in which the core is being included. The design is not synthesizable (RTL code is not provided). No license feature in the license.dat file is needed to run the core in evaluation mode.You can purchase a license to generate an obfuscated or RTL netlist.

Yellow Key with Red Circle - License is protected; you are not licensed to use this core.

Right-click any item in the Catalog and choose Show Details for a short summary of the core specifications. Choose Open Documentation for more information on the Core. Right-click and choose Configure Core to open the core generator.

Click the **Name** column heading to sort the cores alphabetically.

You can filter the cores according to the data in the Name and Description fields. Type the data into the filter field to view the cores that match the filter. You may find it helpful to set the Catalog Display Options to **List cores alphabetically** when using the filters to search for cores. By default the filter contains a beginning and ending '*', so if you type 'controller' you get all cores with controller in the core name (case insensitive search) or in the core description. For example, to list all the Accumulator cores, in the filter field type:

```
accu
```

Catalog Options

Click the Options button to customize the Catalog Display Options. Click the Catalog Options drop-down arrow to import a core, reload the Catalog, or enter advanced download mode.

You may want to import a core from a file when:

- You do not have access to the internet and cannot download the core, or
- A core is not complete and has not been posted to the web (you have an evaluation core)

See Also

Project Manager - Cores Dialog Box (Advanced Download Mode)

Catalog Options Dialog Box

The Catalog Options dialog box (as shown below) enables you to customize your Catalog display. You can add a repository, set the location of your vault, and change the View Settings for the Catalog. To display this dialog box, click the Catalog Options button .

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

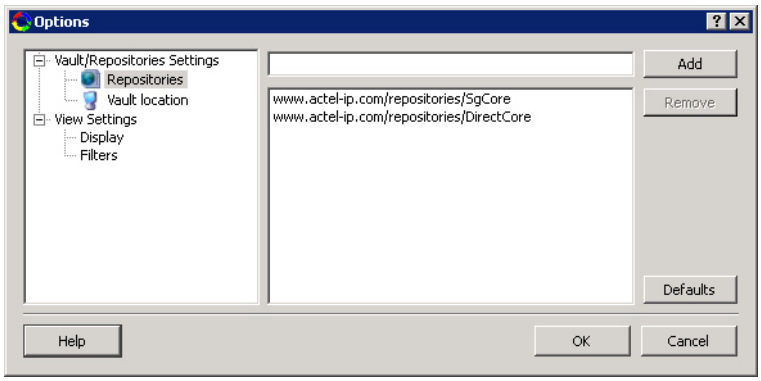

Figure 130 · Catalog Display Options Dialog Box

Vault/Repositories Settings

Repositories

A repository is a location on the web that contains cores that can be included in your design.

The Catalog Options dialog box enables you to specify which repositories you want to display in your Vault. The Vault displays a list of cores from all your repositories, and the Catalog displays all the cores in your Vault.

The default repository cannot be permanently deleted; it is restored each time you open the Manage Repositories dialog box.

Any cores stored in the repository are listed by name in your Vault and Catalog; repository cores displayed in your Catalog can be filtered like any other core.

Type in the address and click the **Add** button to add new repositories. Click the **Remove** button to remove a repository (and its contents) from your Vault and Catalog. Removing a repository from the list removes the repository contents from your Vault.

Vault location

Use this option to choose a new vault location on your local network. Enter the full domain pathname in the Select new vault location field. Use the format:

```
\\server\share
```

and the cores in your Vault will be listed in the Catalog.

View Settings

Display

Group cores by function - Displays a list of cores, sorted by function. Click any function to expand the list and view specific cores.

List cores alphabetically - Displays an expanded list of all cores, sorted alphabetically. Double click a core to configure it. This view is often the best option if you are using the filters to customize your display.

Show core version - Shows/hides the core version.

Filters

Filter field - Type text in the Filter Field to display only cores that match the text in your filter. For example, to view cores that include 'sub' in the name, set the Filter Field to **Name** and type **sub**.

Display only latest version of a core - Shows/hides older versions of cores; this feature is useful if you are designing with an older family and wish to use an older core.

Show all local and remote cores - Displays all cores in your Catalog.

Show local cores only - Displays only the cores in your local vault in your Catalog; omits any remote cores.

Show remote cores that are not in my vault - Displays remote cores that have not been added to your vault in your Catalog.

Changing Device Information

Device and package information, device variations, and operating conditions are set when you import a netlist and compile a new design. However, you can change this information for existing designs.

To change device information for existing designs:

1. In the **Project** menu, choose **Project Settings**. The Project Settings dialog box opens.
2. Select your updated options, such as Die, Package, and Speed.
3. Click **Close**.

Refer to the Microsemi FPGA Data Book or call your local Microsemi Sales Representative for information about device, package, speed grade, variations, and operating conditions.

Compatible Die Change

When you change the device, some design information can be preserved depending on the type of change.

Changing Die Revisions

If you change the die from one technology to another, all information except timing is preserved. An example is changing an A1020A (1.2μm) to an A1020B (1.0μm) while keeping the package the same.

Device Change Only

Constraint and pin information is preserved, when possible. An example is changing an A1240A in a PL84 package to an A1280A in a PL84 package.

Repackager Function

When the package is changed (for the same device), the Repackager automatically attempts to preserve the existing pin and Layout information by mapping external pin names based on the physical bonding diagrams. This always works when changing from a smaller package to a larger package (or one of the same size). When changing to a smaller package, the Repackager determines if any of the currently assigned I/Os are mapped differently on the smaller package. If any of the I/Os are mapped differently, then the layout is invalidated and the unassigned pins identified.

Core Manager

The Core Manager only lists cores that are in your current project. If any of the cores in your current project are not in your vault, you can use the Core Manager to download them all at once.

For example, if you download a sample project and open it, you may not have all the cores in your local vault. In this instance you can use the Core Manager to view and download them with one click. Click **Download All** to add any missing cores to your vault. To add any individual core, click the green download button.

To view the Core Manager, from the **View** menu choose **Windows > Cores**.

The column headings in the Core Manager are:

- **Name** - Core name.
- **Vendor** - Source of the core.
- **Core Type** - Core type.
- **Version** - Version of the core used in your project; it may be a later version than you have in your vault. If so, click **Download All** to download the latest version.

Deleting Files

Files can be deleted from the current project or from the disk.

To delete a file from the project:

1. Select the **Files** tab in the Design Explorer window.
2. **Right-click** the file and choose **Delete from Project**. The file remains on your disk.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

To delete a file from your project and the disk:

1. Select the **Files** tab in the Design Explorer window.
2. **Right-click** the file and choose **Delete from Disk and Project**. The file is deleted from your disk and is no longer part of any project.

Design Hierarchy in the Design Explorer

The Design Hierarchy tab displays a hierarchical representation of the design based on the source files in the project. The software continuously analyzes and updates source files and updates the content. The Design Hierarchy tab (see figure below) displays the structure of the modules and components as they relate to each other.

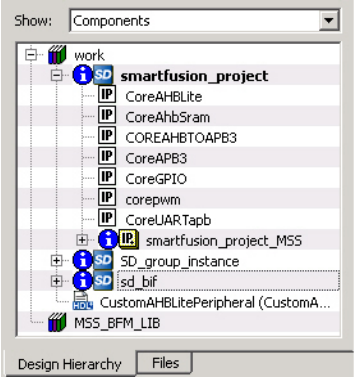

Figure 131 · Design Hierarchy

You can change the display mode of the Design Hierarchy by selecting **Components** or **Modules** from the **Show** drop-down list. The components view displays the entire design hierarchy; the modules view displays only schematic and HDL modules.

The file name (the file that defines the block) appears next to the block name in parentheses.

To view the location of a component, right-click and choose **Properties**. The Properties dialog box displays the pathname, created date, and last modified date.

All integrated source editors are linked with the SoC software. If a source is modified and the modification changes the hierarchy of the design, the Design Hierarchy automatically updates to reflect the change.

If you want to update the Design Hierarchy, from the **View** menu, choose **Refresh Design Hierarchy.**

To open a component:

Double-click a component in the Design Hierarchy to open it. Depending on the block type and design state, several possible options are available from the right-click menu. You can instantiate a component from the Design Hierarchy to the Canvas in SmartDesign.

Icons in the Hierarchy indicate the type of component and the state, as shown in the table below.

Table 15 · Design Hierarchy Icons

Icon	Description
	SmartDesign component
	SmartDesign component with HDL netlist not generated
	IP core was instantiated into SmartDesign but the HDL netlist has not been generated
	Core
	Error during core validation

Icon	Description
	Updated core available for download
	HDL netlist

Design Menu - Libero SoC

Command	Icon	Function
Configure Firmware		Opens the firmware view
Generate Bitstream		Runs the push-button flow from synthesis through layout, compile, and place and route.
Generate Datasheet		Generates a datasheet for your design.
Reports		Creates and/or opens the Datasheet Reports for your project

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Designer in Libero SoC

Microsemi's Designer software is integrated with the Libero SoC Project Manager. The Designer interface opens only when you choose not to use the default settings in the push-button design flow.

To implement your design, click the Build button in the Libero SoC Design Flow window. If you wish to change the default settings for any element in the design flow, right-click the function and choose **Open Interactively**.

The following tools are available to run interactively:

SmartTime

SmartPower

NetlistViewer

PinEditor

ChipPlanner

I/O Attribute Editor

Edit Core Definition - Ports and Parameters Dialog Box

This dialog box appears when you add a core you created with HDL+.

Click to select any Extracted Parameter and click the Delete button to remove it from the list. Extracted Parameters may be configured if you add the HDL+ core to the Canvas.

If you delete an Extracted Parameter and want to re-add it to the list click the **Re-extract ports and parameters from HDL button**.

Click **Add/Edit bus interfaces** to open the Edit Core Definition - Bus Interfaces dialog box.

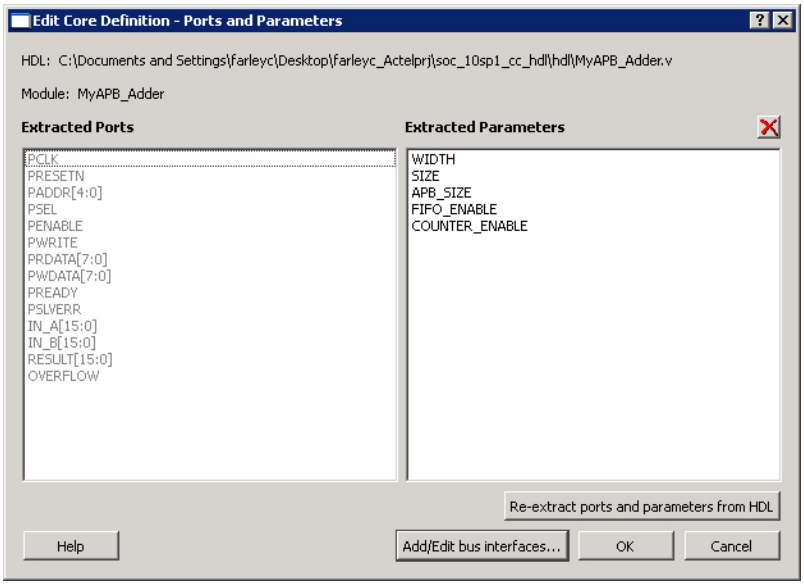

Figure 132 · Edit Core Definition - Ports and Parameters Dialog Box

Edit Menu - Libero SoC

Command	Icon	Shortcut	Function
Undo		CTRL + Z	Reverses your last action
Redo		CTRL + Y	Reverses the action of your last Undo command
Find		CTRL + F	Displays the Find dialog box, which you use to locate instances, nets, ports, and regions
Find Next		F3	Finds the next occurrence of the text in the Find field
Replace		CTRL + H	Displays the Replace dialog box; enables you to search and replace content in your files (files must be open and selected to use this feature)

Execute Script Dialog box

You can use the Execute Script dialog box to run Tcl scripts from within Libero SoC. You do not need to have a design open in order to run a script.

Specify a script file, enter Arguments (if necessary), and click Run to execute.

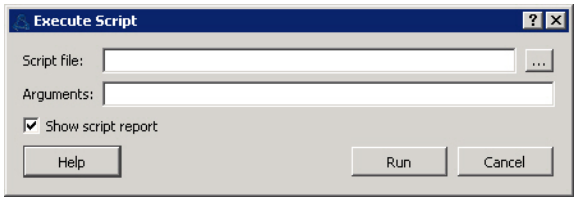

Figure 133 · Execute Script Dialog Box

Script file

Specify a script file. Browse to Select a script file with a valid extension (*.tcl or *.dsf).

Arguments

Input your arguments for your script file (if necessary).

Export Script Dialog Box

The Export Script Files dialog box enables you to export Tcl script file, useful if you want to run Libero SoC in batch mode or run operations from the command line.

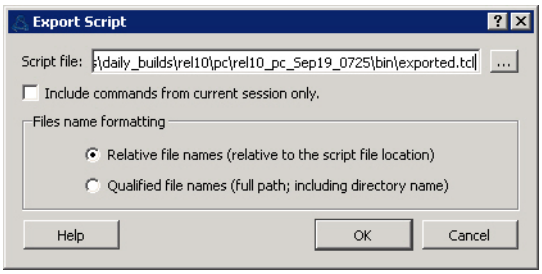

Figure 134 · Export Script Dialog Box

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Script file

Specifies the location of the file you are about to save.

Include commands from current session only limits your commands to the current session. De-select if you wish to include commands from other sessions.

File name formatting

Relative file names (relative to the script file location) truncates all the directories in the script with relative filenames. Select this option if you do not plan to move the script file.

Qualified file names (full path; including directory name) includes the full pathname for all the files and directories. Select this option if you want to move the file to a different directory.

File Menu - Libero SoC

Command	Icon	Shortcut	Sub-menu	Function
New			SmartDesign	Opens the appropriate New file dialog box and prompts you to enter a name and specify additional options (if necessary)
			HDL	
			SmartDesign Testbench	
			HDL Testbench	
			SDC (sdc)	
			Physical Design Constraint (PDC)	
			Simulation Script (do)	
Open				Opens the Open dialog box; enables you to select a file to open
Close <filename>				Closes the current file; the Project Manager remains open
Save <filename>		Ctrl + S		Saves the current file
Save <filename> As				Saves the current file as a different type (such as a TXT file)
Import Files				Opens the Import Files dialog box; enables you to import project files into the Project Manager. Types include HDL Source Files, HDL Stimulus Files, Blocks, I/O Constraint (PDC) Files, Timing Constraint files, and more.

Command	Icon	Shortcut	Sub-menu	Function
Link Files			Create Link	Opens the Create Link dialog box; browse to select the file you wish to link. Linked files are added to the Design Explorer in the Modules defined in multiple files list.
			Change All Links	Opens the Change All Links dialog box; enables you to update/change all the links for the files in your project at once.
			Unlink All: Copy Files Locally	Copies all linked files to your local project.
VHDL Library >			Add Library	Adds VHDL library to your Design Hieararchy
			Rename Library	Renames an existing VHDL library
			Remove Library	Removes an existing VHDL library from your project
Print				Displays the Print dialog box (if available); allows you to print whatever element of the project you are working on

Files Tab and File Types

The Files tab displays all the files associated with your project, listed in the directories in which they appear.

Right-clicking a file in the Files tab provides a menu of available options specific to the file type. You can also delete files from the project by selecting **Delete from Project** from the right-click menu. You can delete files from the project and the disk by selecting **Delete from Disk and Project** from the right-click menu.

You can instantiate a component by dragging the component to a SmartDesign Canvas or by selecting **Instantiate in SmartDesign** from the right-click menu.

You can configure a component by double-clicking the component or by selecting **Open Component** from the right-click menu.

File Types

When you create a new project in the Libero SoC it automatically creates new directories and project files. Your project directory contains all of your 'local' project files. If you import files from outside your current project, the files must be copied into your local project folder. (The Project Manager enables you to manage your files as you import them.)

Depending on your project preferences and the version of Libero SoC you installed, the software creates directories for your project.

The top level directory (<project_name>) contains your PRJ file; only one PRJ file is enabled for each Libero SoC project.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

component directory - Stores your SmartDesign components (SDB and CXF files) for your Libero SoC project.

constraint directory **-** All your constraint files (SDC, PDC)

designer directory **-** ADB files (Microsemi Designer project files), -_ba.SDF, _ba.v(hd), STP, PRB (for Silicon Explorer), TCL (used to run designer), impl.prj_des (local project file relative to revision), designer.log (logfile)

Note: The Microsemi ADB file memory requirement is equivalent to 2x the size of the ADB file. If your computer does not have 2x the size of your ADB file's memory available, please make memory available on your hard drive.

hdl directory **-** all hdl sources. *.vhd if VHDL, *.v and *.h if Verilog

simulation directory - meminit.dat, modelsim.ini files

smartgen directory - GEN files and LOG files from generated cores

stimulus directory - BTIM and VHD stimulus files

synthesis directory - *.edn, *_syn.prj (Synplify log file), *.psp (Precision project file), *.srr (Synplify logfile), precision.log (Precision logfile), *.tcl (used to run synthesis) and many other files generated by the tools (not managed by Libero SoC)

viewdraw directory - viewdraw.ini files

HDL Templates in the Libero SoC

Use the templates in the Libero SoC Project Manager to create HDL.

To use the templates included with the Project Manager, from the View menu, choose Windows > HDL Templates. Find the template you want to use and double-click to add it to your HDL file.

Place the cursor where you want to add the template, browse the list of VHDL and Verilog templates, and double-click the template to add it to your design.

The VHDL and Verilog templates are useful if you want to modify your netlist but are unfamiliar with the language. The templates facilitate the writing of HDL files by inserting predefined language constructs. You can also save your own template files to reuse in other designs (for example, if you wanted to add the same header in all your files).

To create a user template:

- Import an HDL file as a template, or
- Save an open HDL file from the text editor as a template. To do so, right-click in the text editor and choose Export as Template.

Help Menu - Libero SoC

The Help menu enables you to access the Libero SoC online help, reference manuals, check for updates, and view your license and version information.

Command	Function
Help Topics	Opens the Libero Project Manager online help
Release Notes	
Microsemi Technical Support	Displays the Microsemi customer support web page in your default browser
Microsemi SoC Web Site	Displays the Microsemi SoC page in your default browser
Check for Software Updates	Checks for updates to the Libero Project Manager software

Command	Function
License Details	Displays detailed license information for your version of Libero SoC
About Libero	Displays version and release numbers for Libero SoC

Import Files Dialog Box (Project Manager)

Use the Import Files dialog box to add new files to your project in the Libero SoC Project Manager.

You can import schematics, VHDL or Verilog source files, stimulus files, SDC, PDC, VCD, and SAIF files, cores, and even tool profiles (from other Libero SoC projects).

Browse to and select the file you wish to add and click **Import**, or click **Cancel** to return to the Project Manager.

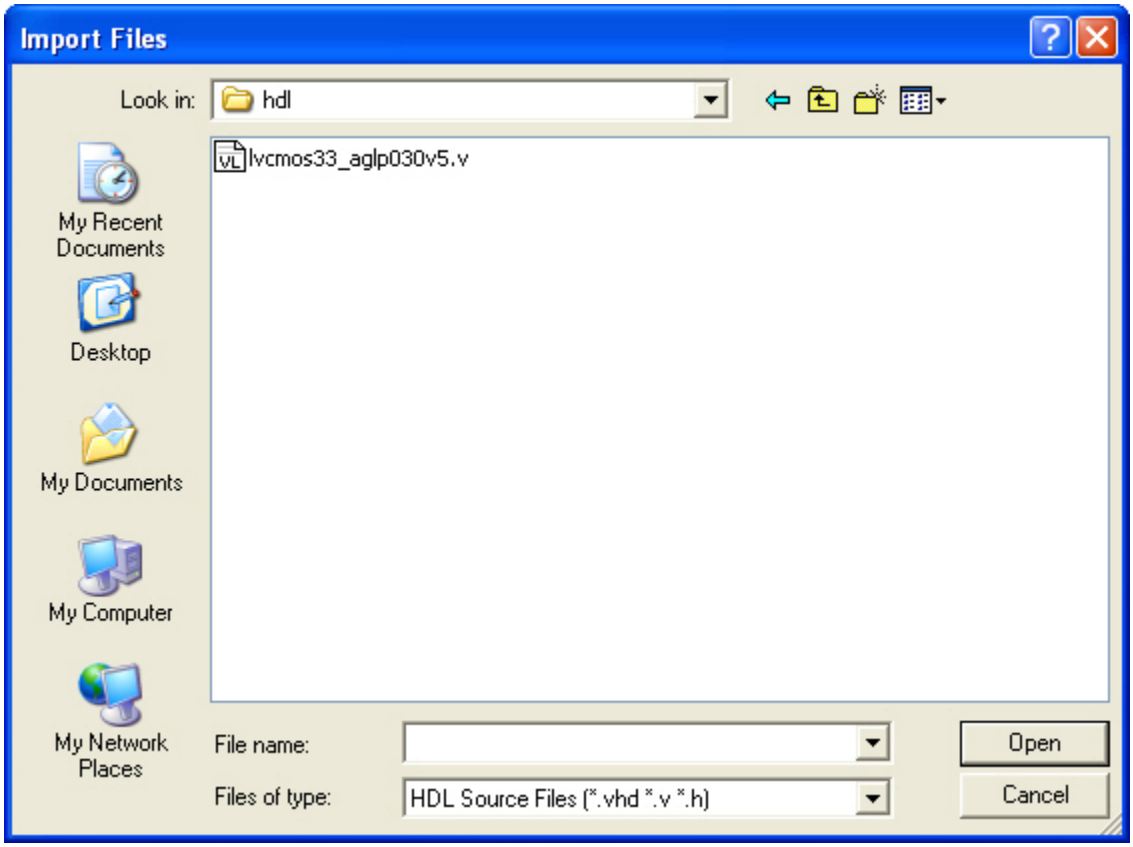

Figure 135 · Import Files Dialog Box

Look in

Specifies your current directory. Browse to find your file if it is not listed here. If you are in the correct directory and your file is not listed here, select the **File of type** extension to match it.

File name

Type the file name, or browse to its location and select it.

File of type

Specify the file type displayed in the dialog box.

To access this dialog: from the **File** menu, choose **Import Files**.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Importing Schematics

You can import any schematic created with ViewDraw AE.

To import a schematic file:

1. From the **File** menu, choose **Import Files**.
2. In **Files of type**, choose **Schematics**.
3. In **Look in**, navigate to the drive/folder where the file is located.
4. Select the file to import and click **Open**. The schematic is imported into your project and appears in the Files tab, under Schematic files.

To open the schematic, click ViewDraw AE in the Design Flow window, or right-click the file in the File Manager and select **Open Schematic**.

License Details

To display information about your license:

From the **Help** menu, choose **License Details**. The software displays your complete license configuration, all Microsemi-installed software and versions, as well as your HostID and disk volume serial number.

Link Files

You can add or change links for individual files in your project, or change all the links in your files at once.

To add a link to an individual file, right-click the file in the Files list and choose **Create Link From File**. Navigate to the file you wish to link to your project and click **Create Link**. The Project Manager adds the file to your Files list; a small link icon indicates that the source file is not stored with the project.

If you have a single project file with a broken link , right-click the file and choose **Change Link**. This opens the Change Link dialog box and enables you to specify a new file location.

You can update all the links in your project at once. This is useful when you are linking to shared network folders that may have been renamed or moved. To change links for your entire project, from the **File** menu, choose **Change All Links**. This opens the Change All Links dialog box. Enter (or browse) your old and new paths to update the links for your project.

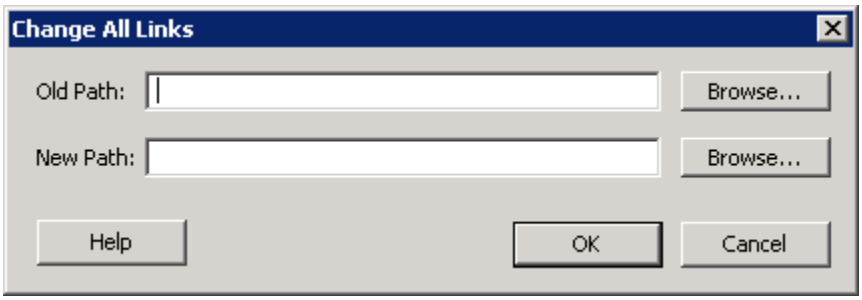

Figure 136 · Change All Links Dialog Box

To unlink a file, right-click the file in the Files tab and choose **Unlink: copy file locally**. This copies the file to the directory in your project folder that corresponds to the file type.

To unlink all files and copy them to your local project, from the **File** menu choose **Unlink All: Copy files locally**.

You can also change/remove links from the Design Explorer; to do so, right-click the file in the **Design Explorer > Modules defined in multiple files** and choose **Change Link**.

Log Window

Colors and Symbols

The log window displays Messages, Errors, Warnings, and Information. Messages are represented by symbols and color-coded. The default colors are:

Type	Color
Error	Red
Warning	Blue
Information	Black

The colors can be changed by using the Preferences dialog box.

Linked Messages

Error and warning messages that are dark blue and underlined are linked to online help to provide you with more details or helpful workarounds. Click them to open online help.

New Project Creation Wizard – Project Details

You can create a Libero SoC project using the New Project Creation Wizard. You can use the pages in the wizard to:

- Specify the project name and location
- Select the device family and parts
- Set the I/O standards
- Use System Builder or MSS in your design project
- Import HDL source files and/or design constraint files into your project

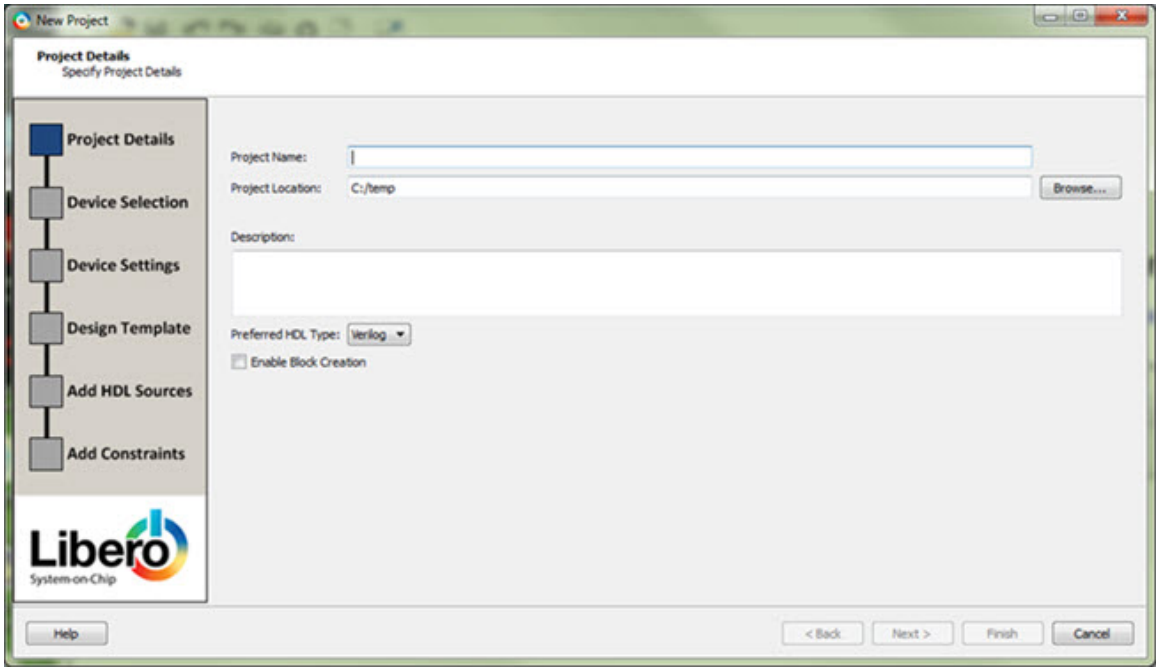

Figure 137 · Libero SoC New Project Creation Wizard

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Project

Project Name - Identifies your project name; do not use spaces or reserved Verilog or VHDL keywords.

Project Location – Identifies your project location on disk.

Description – General information about your design and project. The information entered appears in your Datasheet Report View.

Preferred HDL type - Sets your HDL type: Verilog or VHDL. Libero-generated files (SmartDesigns, SmartGen cores, etc.) are created in your specified HDL type. Libero SoC supports mixed-HDL designs.

Enable Block Creation - Enables you to build blocks for your design. These blocks can be assembled in other designs, and may have already completed Layout and been optimized for timing and power performance for a specific Microsemi device. Once optimized, the same block or blocks can be used in multiple designs.

When you are finished, click **Next** to proceed to the next page.

See Also

New Project Creation Wizard - Device Selection

New Project Creation Wizard – Device Settings

New Project Creation Wizard – Design Template

New Project Creation Wizard - Add Constraints

New Project Creation Wizard – Add HDL Source Files

New Project Creation Wizard – Device Selection

The Device Selection page is where you specify the Microsemi device for your project. Use the filters and drop-down lists to refine your search for the right part to use for your design.

This page contains a table of all parts with associated FPGA resource details generated as a result of a value entered in a filter.

When a value is selected for a filter:

- The parts table is updated to reflect the result of the new filtered value.
- All other filters are updated, and only relevant items are available in the filter drop-down lists.

For example, when SmartFusion2 is selected in the Family filter:

- The parts table includes only SmartFusion2 parts.
- The Die filter includes only SmartFusion2 dies in the drop-down list for Die.

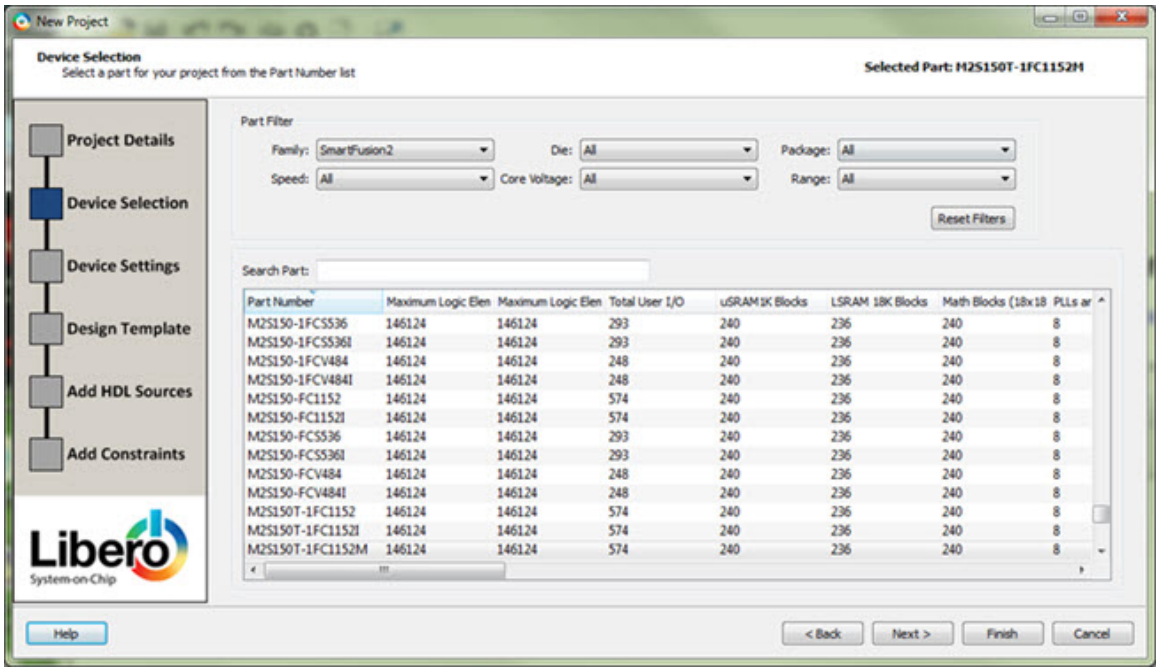

Figure 138 · New Project Creation Wizard - Device Selection Page

Family – Specify the Microsemi device family. Only devices belonging to the family are listed in the parts table.

Die / Package / Speed - Set your device die, package, and speed grade, respectively. Only parts matching the filtering option are listed in the parts table.

Core Voltage - Set the core voltage for your device. Wide range voltage for die voltage (VCCA) and VCCI is available for ProASIC3L and 1.2V IGLOO devices. Two numbers separated by a "~" are shown if a wide range voltage is supported. For example, 1.2~1.5 means that the device core voltage can vary between 1.2 and 1.5 volts.

Range - Define the voltage and temperature ranges a device may encounter in your application. Tools such as SmartTime, SmartPower, timing-driven layout, power-driven layout, the timing report, and back-annotated simulation are affected by operating conditions.

Supported ranges include:

- Commercial (COM) - Junction temperature is a function of ambient temperature, air flow, and power consumption.
- Industrial (IND) - Junction temperature is a function of ambient temperature, air flow, and power consumption.
- Military (MIL) - Junction temperature is a function of the case temperature, air flow, and power consumption.

Note: Supported operating condition ranges vary according to your device and package.

Refer to your device datasheet to find your recommended temperature range.

Set your I/O operating voltages in Project Settings > Device I/O Settings.

Reset Filters – Reset all filters to the default ALL option except **Family**.

Search Parts – Enter a character-by-character search for parts. Search results appear in the parts table.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

New Project Creation Wizard – Device Settings

The Device Settings page is where you set the Device I/O Technology, PLL Supply Voltage, Reserve pins for Probes and activate the System Controller Suspended Mode.

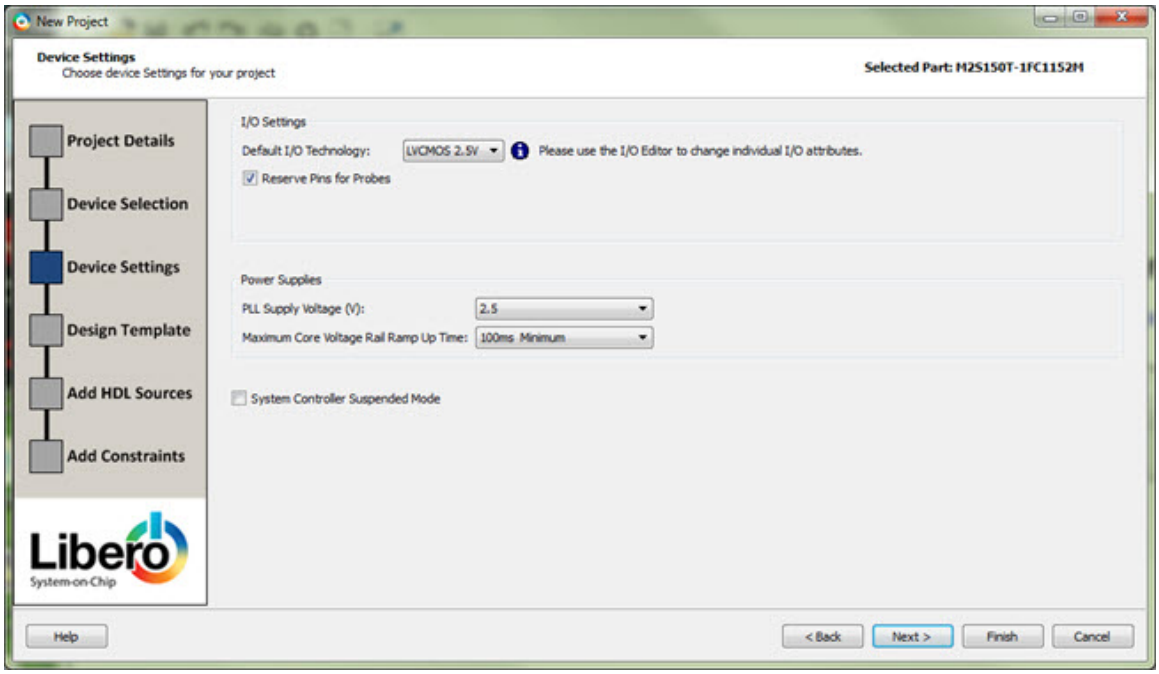

Figure 139 · New Project Creation Wizard – Device Settings Page

Default I/O Technology - Set all your I/Os to a default value. You can change the values for individual I/Os in the I/O Attribute Editor. The I/O Technology available is family-dependent.

Reserve Pins for Probes (SmartFusion2, IGLOO2 and RTG4) - Reserve your pins for probing if you intend to debug using SmartDebug.

Reserve Pins for SPI (RTG4 only) – Check this box to reserve pins for SPI functionality in Programming. This option is displayed in the Compile Report when the compile process completes.

PLL Supply Voltage (V) (SmartFusion2, IGLOO2 only) - Set the voltage for the power supply that you plan to connect to all the PLLs in your design, such as MDDR, FDDR, SERDES, and FCCC.

Maximum Core Voltage Rail Ramp Up Time (SmartFusion2, IGLOO2 only) - Power-up management circuitry is designed into every SmartFusion2 and IGLOO2 SoC FPGA. These circuits ensure easy transition from the powered-off state to the powered-up state of the device. The SmartFusion2, IGLOO2, and RTG4 system controller is responsible for systematic power-on reset whenever the device is powered on or reset. All I/Os are held in a high-impedance state by the system controller until all power supplies are at their required levels and the system controller has completed the reset sequence.

The power-on reset circuitry in SmartFusion2 and IGLOO2 devices requires the VDD and VPP supplies to ramp monotonically from 0 V to the minimum recommended operating voltage within a predefined time. There is no sequencing requirement on VDD and VPP. Four ramp rate options are available during design generation: 50 µs, 1 ms, 10 ms, and 100 ms. Each selection represents the maximum ramp rate to apply to VDD and VPP.

Device information (such as Die, Package and Speed) can be modified later in the Project Settings dialog box.

System Controller Suspended Mode (SmartFusion2, IGLOO2 only) - Enables designers to suspend operation of the System Controller. Enabling this bit instructs the System Controller to place itself in a reset state when the device is powered up. This effectively suspends all system services from being performed. For a list of system services, refer to the SmartFusion2 or IGLOO2 System Controller User's Guide for your device on the Microsemi website.

Device information (such as Die, Package and Speed) can be modified later in the Project Settings dialog box.

New Project Creation Wizard – Design Template

The Design Template page is where you can use Libero SoC's built-in template to automate your design process. The template uses the System Builder tool for system-level design or the Microcontroller Subsystem (MSS) in your design. Both will speed up your design process.

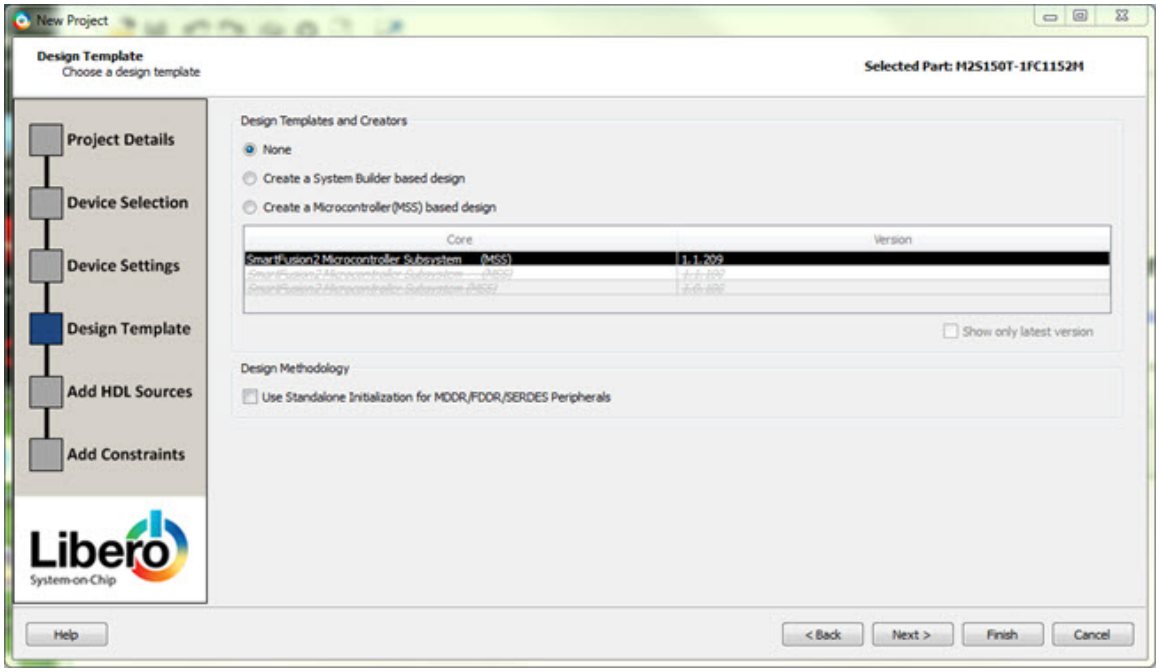

Figure 140 · New Project Creation Wizard – Design Template Page

None- Select if you do not want to use a design template.

Create a System Builder based design (SmartFusion2 and IGLOO2 only) – Use System Builder to generate your top-level design.

Create a Microcontroller (MSS) based design (SmartFusion2 and IGLOO2 only) – Instantiate a Microcontroller (MSS) in your design. The version of the MSS cores available in your vault is displayed. Select the version you desire.

Use Standalone Initialization for MDDR/FDDR/SERDES Peripherals (SmartFusion2 and IGLOO2 only) – Check this box if you want to create your own peripheral initialization logic in SmartDesign for each of your design peripherals (MDDR/FDDR/SERDES). When checked, System Builder does not build the peripherals initialization logic for you. Standalone initialization is useful if you want to make the initialization logic of each peripheral separate from and independent of each other.

New Project Creation Wizard – Add HDL Source Files

The Add HDL Source Files page is where you add HDL design source files to your Libero SoC project. The HDL source files can be imported or linked to the Libero SoC Project.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

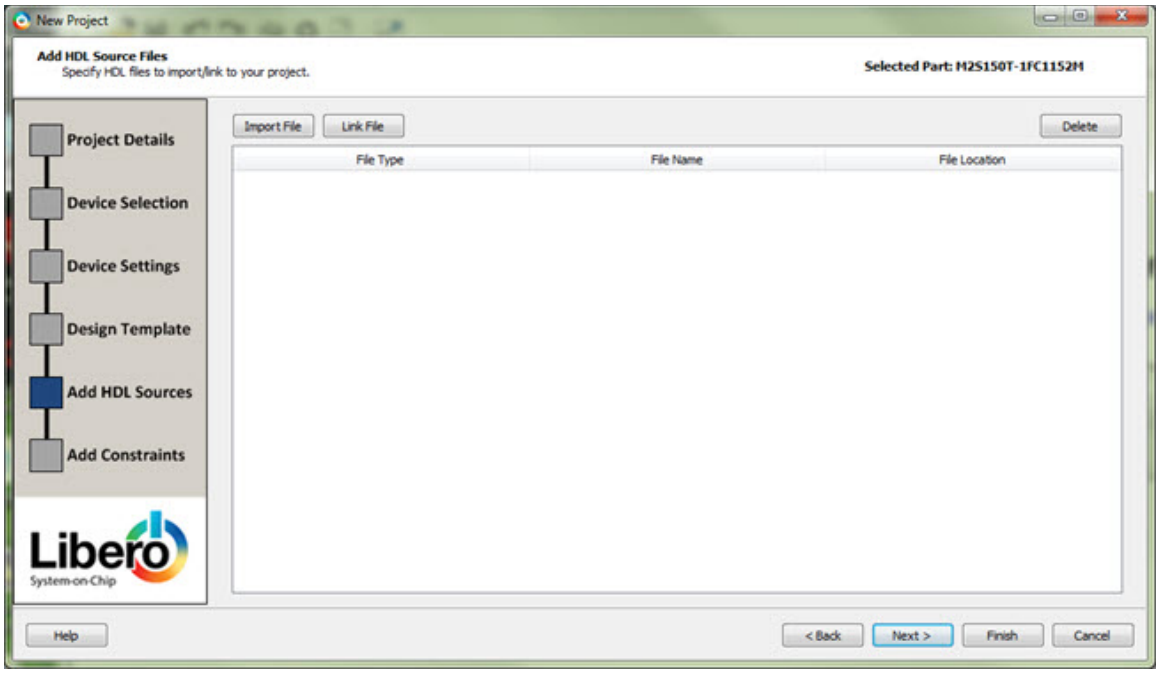

Figure 141 · New Project Creation Wizard - Add HDL Source Files Page

Import File – Navigate to the disk location of the HDL source. Select the HDL file and click **Open**. The HDL file is copied to the Libero Project in the <prj_folder>/hdl folder.

Link File – Navigate to the disk location of the HDL source. Select the HDL file and click **Open**. The HDL file is linked to the Libero Project. Use this option if the HDL source file is located and maintained outside of the Libero project.

Delete - Delete the selected HDL source file from your project. If the HDL source file is linked to the Libero project, the link will be removed.

New Project Creation Wizard - Add Constraints

The Add Constraints page is where you add Timing constraints and Physical Constraints files to your Libero SoC project. The constraints file can be imported or linked to the Libero SoC Project.

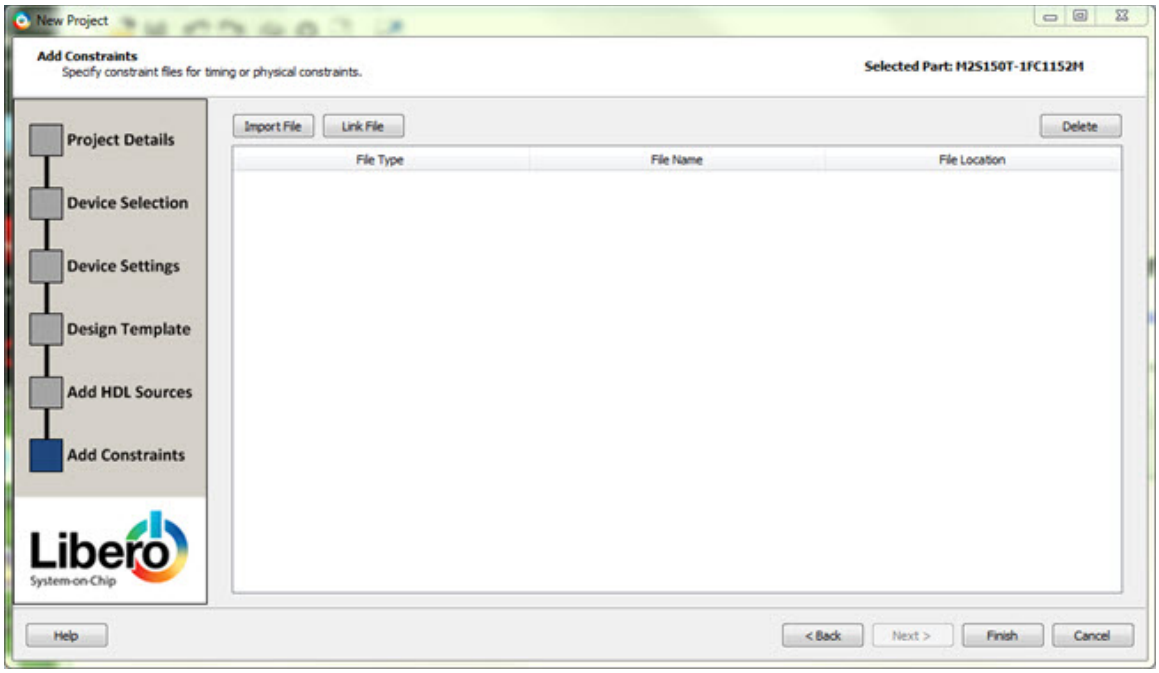

Figure 142 · New Project Creation Wizard – Add Constraints Page

Import File – Navigate to the disk location of the constraints file. Select the constraints file and click **Open**. The constraints file is copied to the Libero Project in the <prj_folder>/constraint folder.

Link File – Navigate to the disk location of the constraints file. Select the constraints file and click **Open**. The constraints file is linked to the Libero Project. Use this option if the constraint file is located and maintained outside of the Libero project.

Delete - Remove the selected constraints file from your project. If the constraints file is linked to the Libero project, the link will be removed.

Click **Finish** to complete New Project Creation.

The **Reports** tab displays the result of the New Project creation.

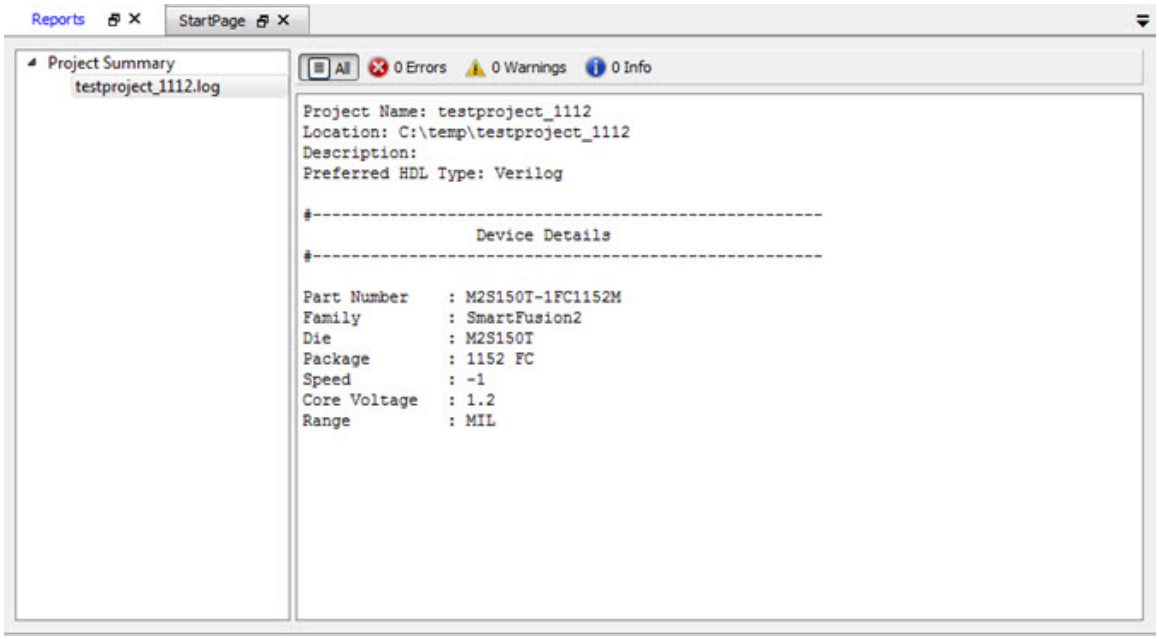

Figure 143 · Reports Tab

New File Dialog Box

The New File dialog box opens when you choose to create any of the following new files:

- SmartDesign
- SmartDesign Testbench - Use a SmartDesign to instantiate and connect stimulus cores or modules to drive your Root design.
- HDL
- HDL Testbench - Creates a new HDL testbench in your project. You can use a testbench to apply stimulus, analyze results or to compare the results of two different simulations.

To create a new file:

1. From the **File** menu, choose **New > <file type>**.
2. Set any additional options (if necessary) and enter a name.
3. Click **OK**. The saved file is added to your Libero SoC project.

Open Project Dialog Box

Use the Open Project dialog box to navigate to and open existing projects in the Project Manager. Browse to your project and click **Open**, or click **Cancel** to return to the Project Manager.

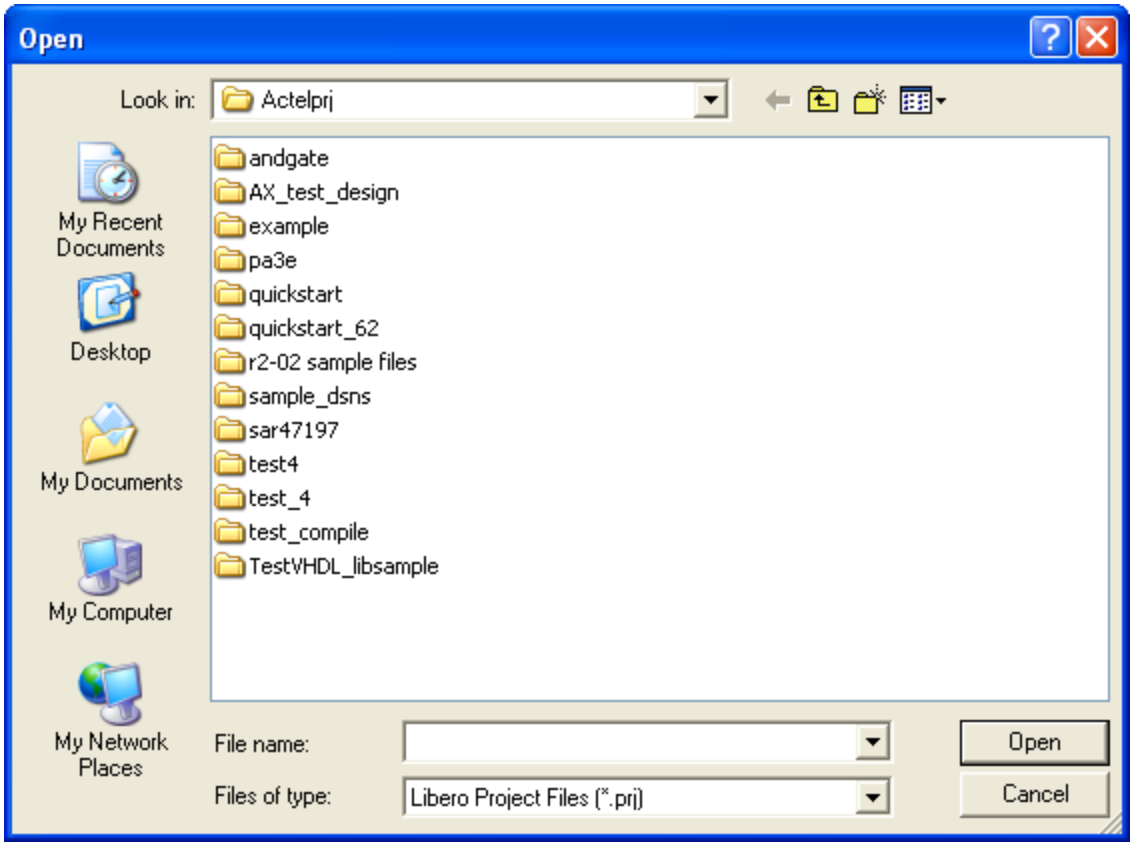

Figure 144 · Open Project Dialog Box

Look in

Specifies the directory that contains your project.

File name

Type the file name, or browse to its location and select it.

File of type

Specify the file type displayed in the dialog box.

To access this dialog: from the **Project** menu, select **Open Project**.

Opening your Libero SoC project

Libero SoC does not open your most recent project automatically. You can change your default startup preferences in the Startup tab.

To open a project in Libero SoC:

From the **File** menu, choose **Open Project** or **New Project**. If you create a new project the Project Manager opens the New Project Creation Wizard.

Tip: Recent saved projects are available from the Project menu. From the **Project** menu, choose **Recent Projects**, and then select the project to open.

You can open an existing project by double-clicking the *.prj file or dragging the *.prj file over the Libero SoC desktop icon.

See Also

`open_project`

Organize Constraint Files

The Organize Constraint Files dialog box enables you to set the constraint file and order in the Libero SoC.

Click the **Use list of files organized by User** radio button to add or remove Associated Constraint files.

To specify the constraint file order:

1. In the Design Flow window under Implement Design, right-click **Compile** and choose **Organize Input Files > Organize Constraint Files**. The Organize Constraint Files dialog box appears.
2. Click the **Use list of files organized by User** radio button to Add/Remove source files for the selected tool.
3. Select a file and click the Add or Remove buttons as necessary. Use the Up and Down arrows to change the order.
4. Click **OK**.The files appear in the Design Flow window under **Implement Design > Compile > Constraints** with a green check mark to indicate that they are being used in the project.

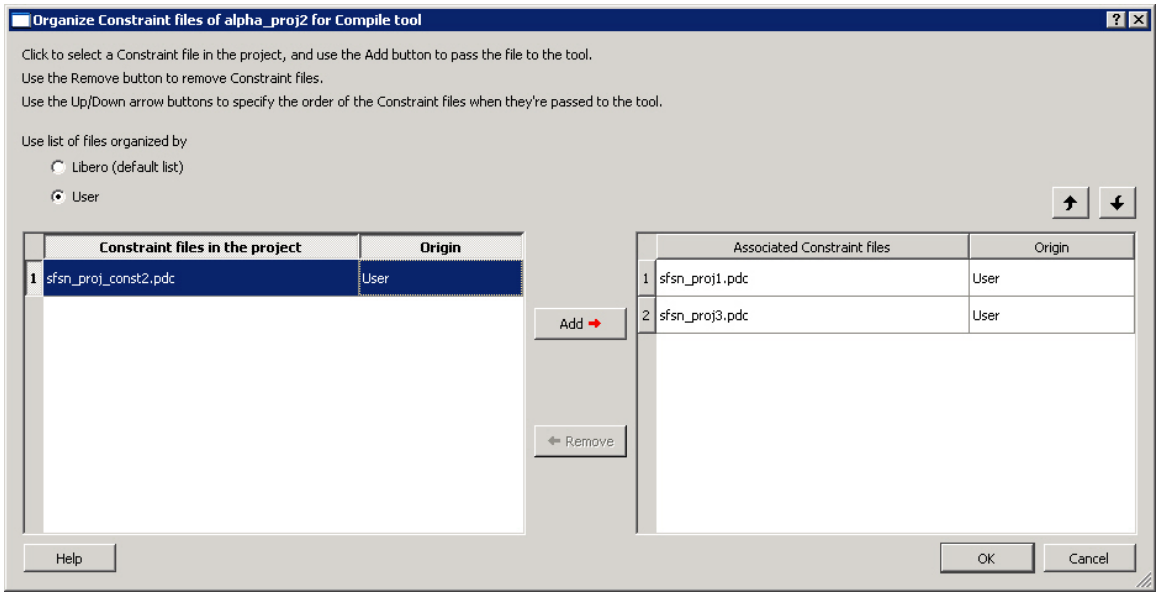

Figure 145 · Organize Constraint Files Dialog Box

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Organize Simulation Files

The Organize Simulation files dialog box enables you to set the constraint file order in the Libero SoC.

Click the **Use list of files organized by User** radio button to add or remove Associated Simulation files.

To specify the simulation file order:

1. In the Design Flow window under Implement Design > Verify Post Layout Implementation, right-click **Simulate** and choose **Organize Input Files > Organize Simulation Files**. The Organize Simulation Files dialog box appears.
2. Click the **Use list of files organized by User** radio button to Add/Remove source files for the selected tool.
3. Select a file and click the Add or Remove buttons as necessary. Use the Up and Down arrows to change the order.
4. Click **OK**.

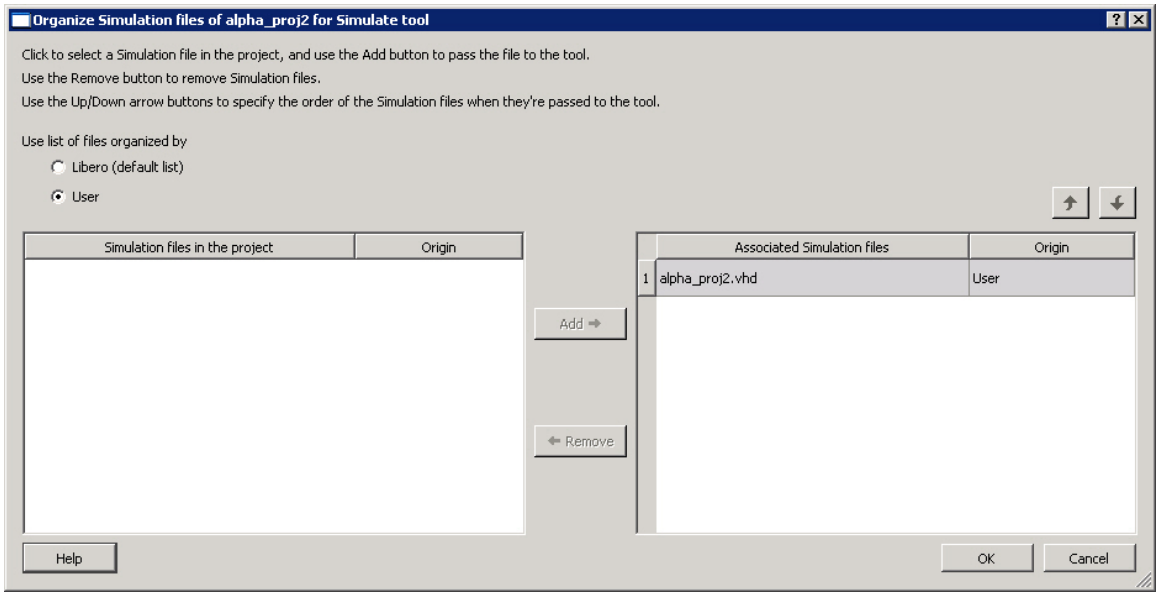

Figure 146 · Organize Simulation Files Dialog Box

Organize Source Files

The Organize Source Files dialog box enables you to set the source file order in the Libero SoC.

Click the **Use list of files organized by User** radio button to Add/Remove source files for the selected tool.

To specify the file order:

1. In the Design Flow window under Implement Design, right-click **Synthesize** and choose **Organize Input Files > Organize Source Files**. The Organize Source Files dialog box appears.
2. Click the **Use list of files organized by User** radio button to Add/Remove source files for the selected tool.
3. Select a file and click the Add or Remove buttons as necessary. Use the Up and Down arrows to change the order of the Associated Source files.
4. Click **OK**.

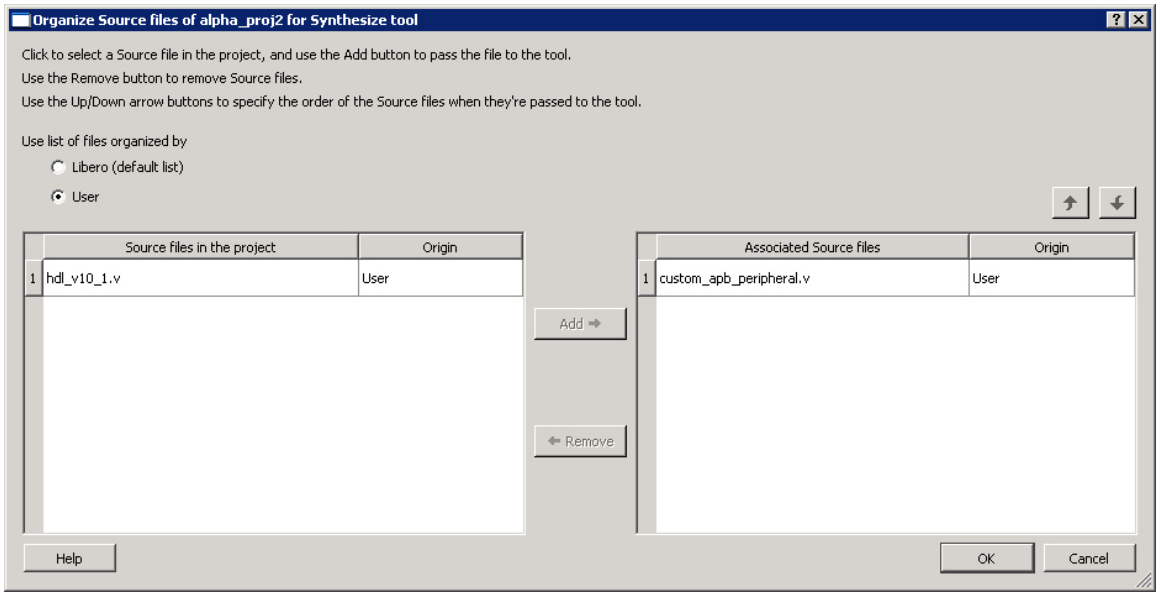

Figure 147 · Organize Source Files Dialog Box

Organize Stimulus Files Dialog Box

The Organize Stimulus files dialog box enables you to set the stimulus file order in the Libero SoC.

Click the **Use list of files organized by User** radio button to add or remove Associated Stimulus files.

To specify the stimulus file order:

1. In the Design Flow window under Create Design > Verify Pre-Synthesized Design, right-click **Simulate** and choose **Organize Input Files > Organize Stimulus Files**. The Organize Stimulus Files dialog box appears.
2. Click the **Use list of files organized by User** radio button to Add/Remove source files for the selected tool.
3. Select a file and click the Add or Remove buttons as necessary. Use the Up and Down arrows to change the order.
4. Click **OK**.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

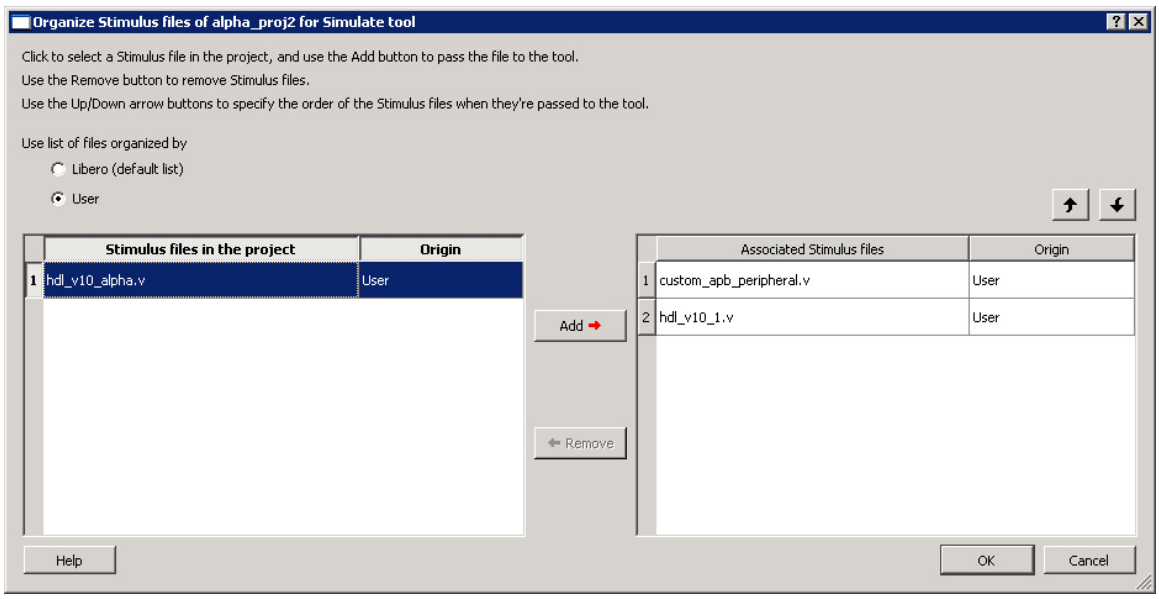

Figure 148 · Organize Stimulus Files Dialog Box

Physical Synthesis and the Libero SoC

If you want to run physical synthesis on your design (such as with PALACE) you must run it manually. Automatic physical synthesis is not supported from within the Libero SoC.

Preferences

User Preferences Dialog Box

Use the Preferences dialog to customize the Libero SoC Project Manager.

To set your preferences:

1. From the **Project** menu, choose **Preferences**.
2. Specify your preferences.

   Software update
   Log window
   Vault update
   Startup (File association)
   Text Editor
   IP Cores
   Design Flow
   Proxy
   PDF reader (Linux only)
   Web browser (Linux only)
3. Click **OK**.

Note: These preferences are stored on a per-user basis; they are not project specific.

Project Menu - Libero SoC

Command	Sub-menu	Icon	Function
New Project			Starts the New Project Wizard
Open Project			Opens the Open Project dialog box
Close <project name>			Closes the current active project; the Project Manager remains open
Save <project name>			Saves the current project
Save <project name>			Saves the current project in a new directory; prompts you to enter a new project name
Project Settings			Opens the Project Settings dialog box, enables you to set your Device, HDL Type, Design Flow, Simulation and Simulation Library options.
Tool Profiles			Opens the Project Profile dialog box; enables you to specify locations for your third-party synthesis, stimulus, and simulation tools. Libero SoC includes tools for synthesis, stimulus, and

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Command	Sub-menu	Icon	Function
			simulation.
Vault/Repositories Settings			Opens the Vault/Repositories Settings dialog box; enables you to view/change the location of your vault and repositories.
Preferences			Opens the Preferences dialog box
Execute Script			Opens Execute Script dialog box; enables you to run Tcl script from the Project Manager
Export Script			Opens the Export Script dialog box; enables you to export a Tcl script
Recent Projects			Opens list of recent projects.
Exit			Closes Libero SoC

Project Settings Dialog Box

The Project Settings dialog box enables you to modify your Device, HDL, and Design Flow settings and your Simulation Options.

Device Selection

Sets the device Family, Die, and Package for your project. See the New Project Creation Wizard - Device Settings page for a detailed description of the options.

Device Settings

Reserve Pins for Probes(SmartFusion2, IGLOO2, and RTG4 only) - Reserve your pins for probing if you intend to debug using SmartDebug.

Reserve Pins for SPI (RTG4 only) – Check this box to reserve pins for SPI functionality in Programming. This reserved SPI pin option is displayed in the Compile Report when the compile process completes.

Default I/O Technology - Sets all your I/Os to a default value. You can change the values for individual I/Os in the I/O Attributes Editor.

Design Flow

Preferred Language

Sets your HDL to VHDL or Verilog. You can import both Verilog and VHDL files into your project. However, the HDL files generated in the flow (such as the post-layout netlist for simulation) are created in the HDL (Verilog or VHDL) you set as the Preferred Language here.

Block Flow (Available only in Classic Constraint Flow)

Enable Designer Block creation - Enables you to create and publish design blocks (*.cxz files) in Libero SoC. Design blocks are low-level components that may have completed the place-and-route step and met the timing and power requirements. These low-level design blocks can then be imported into a Libero SoC project and re-used as components in a higher level design. See Designing with Designer Block Components in Online Help for more information.

Enable Synthesis - Option to enable or disable synthesis for your root file; useful if you wish to skip synthesis on your root file by default.

Root <Design>

Enable Synthesis - Set this option to run synthesis on your root (top-level) design. Uncheck this box if you wish to skip synthesis on your root (top-level) design.

Synthesis Gate Level Netlist Format

Sets your gate level netlist format to Verilog or EDIF. For Secure IP design flow, you must set the format to Verilog. See the Microsemi website for more information about the Secure IP flow.

Design Methodology (for SmartFusion2 and IGLOO2 only)

Use Standalone Initialization for MDDR/FDDR/SERDES Peripherals – Enables you to create your own peripheral initialization logic in SmartDesign for each of your design peripherals (MDDR/FDDR/SERDES). When checked, System Builder does not build the peripherals initialization logic for you. Standalone initialization is useful if you want to make the initialization logic of each peripheral separate from and independent of each other.

For more information, refer to the Standalone Peripheral Initialization User Guide.

Reports (Available only in Enhanced Constraint Flow)

Maximum number of high fanout nets to be displayed - Enter the number of high fanout nets to be displayed. The default value is 10. This means the top 10 nets with the highest fanout will appear in the <root>_compile_netlist_resource.xml> Report.

Abort Flow if Errors are found in Physical Design Constraints (PDC) – (Enhanced Constraint Flow only) Check this checkbox to abort Place and Route if the I/O or Floorplanning PDC constraint file contains errors.

Abort Flow if Errors are found in Timing Constraints (SDC) – (Enhanced Constraint Flow only) Check this checkbox to abort Place and Route if the Timing Constraint SDC file contains errors.

Analysis Operating Conditions (For SmartFusion2, IGLOO2, and RTG4)

Sets the Operating Temperature Range (COM/IND/MIL/Custom), the Core Voltage Range (COM/IND/MIL/Custom) and Default I/O Voltage Range (COM/IND/MIL/Custom).

Radiation (krad) - For RTG4 only, enter the radiation value (in krads) for your device. Valid range is from 0 to 300.

Enable Single Event Transient mitigation (RTG4 only) - Controls the mitigation of Single Event Transient (SET) in the FPGA fabric. When this box is checked, SET filters are turned on globally to help mitigate radiation-induced transients. By default, this box is unchecked.

These settings are propagated to Verify Timing, Verify Power, and Backannotated Netlist for you to perform Timing/Power Analysis.

Note: For SmartFusion, IGLOO, ProAsic3, and Fusion projects, The Temperature and Voltage Range tables are disabled. To perform Timing/Power analysis with different operating conditions, invoke Designer and make the operating condition settings in the Project Settings page.

Simulation Options and Simulation Libraries

Sets your simulation options. See the Project Settings: Simulation Options topic for more information.

Project Settings: Simulation

To access this dialog box, from the **Project** menu choose **Project Settings** and click **Simulation Options > DO File**.

Use the Simulation tab to set your simulation values in your project. You can set change how Libero SoC handles Do files in simulation, import your own Do files, set simulation run time, and change the DUT name used in your simulation. You can also change your library mapping in this dialog box.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

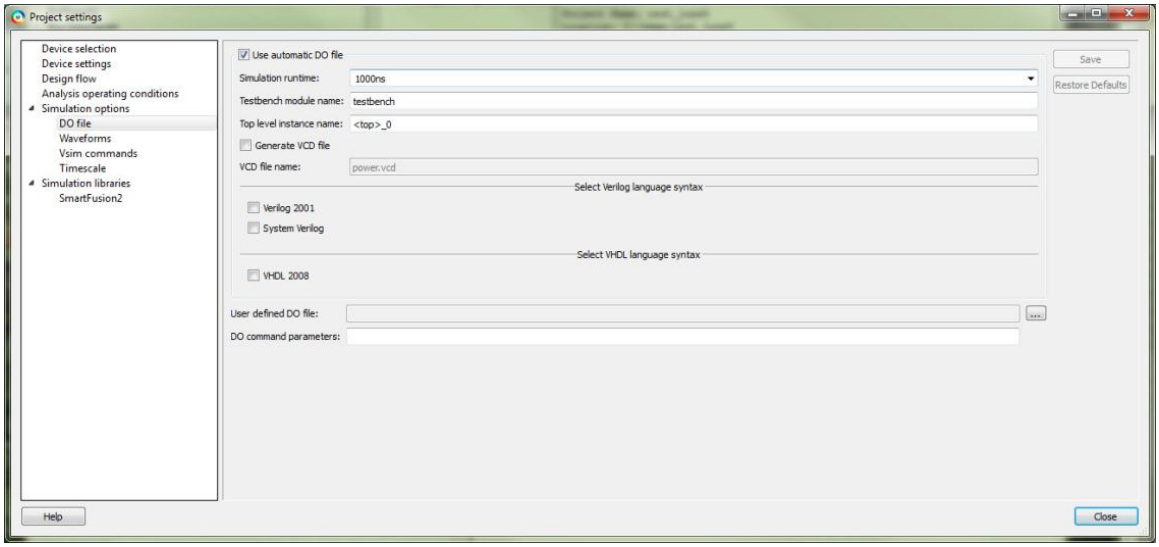

Figure 149 · Project Settings: - DO File

DO file

Use automatic DO file

Select if you want the Project Manager to automatically create a DO file that will enable you to simulate your design.

Simulation Run Time - Specify how long the simulation should run. If the value is 0, or if the field is empty, there will not be a run command included in the run.do file.

Testbench module name - Specify the name of your testbench entity name. Default is “testbench,” the value used by WaveFormer Pro.

Top Level instance name - Default is <top_0>, the value used by WaveFormer Pro. The Project Manager replaces <top> with the actual top level macro when you run simulation (presynth/postsynth/postlayout).

Generate VCD file - Click the checkbox to generate a VCD file.

VCD file name - Specifies the name of your generated VCD file. The default is power.vcd; click power.vcd and type to change the name.

Select Verilog Language Syntax

Sets your DO file Verilog language syntax.

Select VHDL Language Syntax

VHDL 2008 - Select if you wish to use VHDL 2008 for your DO file.

User defined DO file - Enter the DO file name or click the browse button to navigate to it.

DO command parameters - Text in this field is added to the DO command.

Waveforms

Include DO file - Including a DO file enables you to customize the set of signal waveforms that will be displayed in Model*Sim*.

Display waveforms for - You can display signal waveforms for either the top-level testbench or for the design under test. If you select **top-level testbench** then Project Manager outputs the line 'add wave /testbench/*' in the DO file run.do. If you select **DUT** then Project Manager outputs the line 'add wave /testbench/DUT/*' in the run.do file.

Log all signals in the design - Saves and logs all signals during simulation.

Vsim Commands

SDF timing delays - Select Minimum (Min), Typical (Typ), or Maximum (Max) timing delays in the back-annotated SDF file.

Disable Pulse Filtering during SDF-based Simulations - When the check box is enabled the **+pulse_int_e/1 +pulse_int_r/1 +transport_int_delays** switch is included with the vsim command for post-layout simulations; the checkbox is disabled by default.

Resolution

The default is family specific (review the dialog box for your default setting), but you can customize it to fit your needs.

Additional options - Text entered in this field is added to the vsim command.

Timescale

TimeUnit - Enter a value and select s, ms, us, ns, ps, or fs from the pull-down list, which is the time base for each unit. The default setting is ns.

Precision - Enter a value and select s, ms, us, ns, ps, or fs from the pull-down list. The default setting is ps.

Simulation Libraries

Use default library path - Sets the library path to default from your Libero SoC installation.

Library path - Enables you to change the mapping for your simulation library (both Verilog and VHDL). Type the pathname or click the Browse button to navigate to your library directory.

Project Sources

Project sources are any design files that make up your design. These can include schematics, HDL files, simulation files, testbenches, etc. Anything that describes your design or is needed to program the device is a project source.

Source files appear in the Project Flow window. The Design Hierarchy tab displays the structure of the design modules as they relate to each other, while the Files tab displays all the files that make up the project.

The design description for a project is contained within the following types of sources:

- Schematics
- HDL Files (VHDL or Verilog)
- SmartDesign components

One source file in the project is the top-level source for the design. The top-level source defines the inputs and outputs that will be mapped into the devices, and references the logic descriptions contained in lower-level sources. The referencing of another source is called an *instantiation*. Lower-level sources can also instantiate sources to build as many levels of logic as necessary to describe your design.

File Linking

The Project Manager enables you to link to files not managed in your Libero project. Linked files are useful if you want to preserve a file in an archive, or if more than one person is using a file and it is impractical to store it on your local machine. If you link to external files and rename your project, the Project Manager asks if you want to copy the external files into your project or continue using the link. Note that some files (such as schematics) cannot be linked.

Some project sources can be imported.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Sources for your project can include:

Source	File Extension
Schematic	*.1-9
Verilog Module	*.v
VHDL Entity	*.vhd
SmartDesign Component	*.vhd
Testbench	*.vhd
Stimulus	*.tim
Programming Files	*.afm; *.prb

See Also

Creating HDL Sources
Generating a Bitstream file
Generating Programming files

Reserved Microsemi Keywords

See the online help for a complete list of reserved Microsemi keywords.

Right-Click (Shortcut) Menu Options in Libero SoC Design Hierarchy

Right-click menu options vary depending on your design state.

The option in bold the right-click menu is the action performed when you double-click the tool. For example, if you expand Implement Design and right-click **Synthesize**, Run is bold, indicating that it is the default action when you double-click the tool in the Design Hierarchy.

- **Run** - Runs the current tool. If any predecessor tools are required to be in the PASSED state, then they will be run as well.
- **Clean and Run All**- Clean all predecessor tools (deletes Report and output files) and run up to this tool.
- **Clean** - Delete report and output files of this tool. Subsequent tools become OUT OF DATE.
- **Open Interactively** - Open the tool to set/change the tool options.
- **Update and Run** -- Available if a tool is in the OUT OF DATE state; it cleans all predecessor tools that are in the OUT OF DATE state and runs up to this tool.
- **Run Synthesize > Compile > Place and Route > Verify Timing > Generate Programming Data > Program Device** - Enables you to bypass the Fabric portion of the design flow.

  For example, in SmartFusion you can go directly from MSS configuration to Program Device by just using the .EFC file. For users who are not using any of the FPGA fabric, this is useful because you can skip the entire FPGA flow. In that instance you can select Run MSS Configurator > Program Device.
- **Organize Input Files** - Enables you to customize which project files are used by the tool.
- **Import Files** - Shortcut to import files that are relevant to that tool. For example, the relevant files for the Compile tool are PDC and SDC files, so the dialog is pre-filtered to only allow importing of those types
- **Edit Profile** - Shortcut to open the Tool Profiles dialog box.

- **View Report** - Opens the report of that tool in the Reports view.
- **Configure Options**- - Opens the Libero SoC tool options specific to that tool.

Save Project As Dialog Box

The Save Project As dialog box enables you to save your entire project with a new name and location.

Enter the name and location for your modified project and click OK to continue.

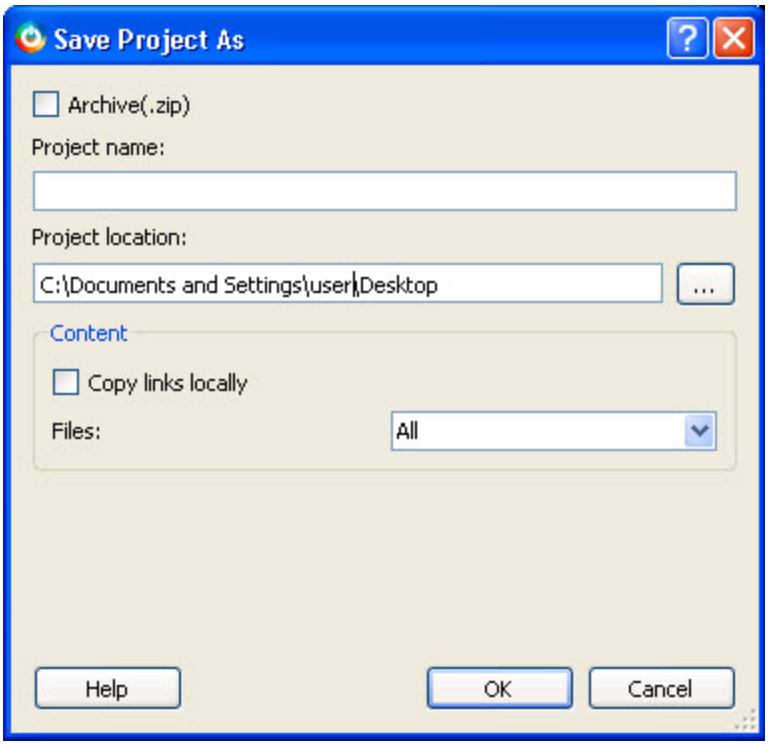

Figure 150 · Save Project As Dialog Box

Archive (*.zip) - Creates a ZIP file of your project and saves it at the specified location. This is useful if you want to create a quick zip of your project.

Project Name

Type the project name for your modified project.

Project Location

Accept the default location or **Browse** to the new location where you can save and store your project. All files for your project are saved in this directory.

Content

Copy Links locally - Select this checkbox to copy the links from your current project into your new project. If you do not select this checkbox, the links will not be copied and you must add them manually.

Files

- **All** - Includes all your project and source files; the state of the project is retained.
- **Project files only** - Copies only the project-related information required to retain the state of the project.
- **Source files only** - Copies all the source files into the specified location. This means the configuration of all the tools in the tool chain is retained but the states are not. Source files means constraint information and component information available in the component, hdl and smartgen directories.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

Files are saved as shown in the table below.

Folder Name	Files		
	All	**Project**	**Source**
component	All Files	All Files	All Files
constraint	All Files	All Files	All Files
hdl	All Files	All Files	All Files
stimulus	All Files	All Files	All Files
viewdraw	All Files	All Files	All Files
smartgen	All Files	All Files	All Files
firmware	All Files	All Files	All Files
CoreConsole	All Files	All Files	All Files
SoftConsole/Keil/IAR	All Files	All Files	All Files
Phy_Synthesis	All Files	All Files	Not Copied
simulation	All Files	*.ini, *.bfm, *.do., *.vec	*.ini, *.bfm, *.do., *.vec
synthesis	All Files	*.edn, *.sdc, *.so, *.prj, *.srr, *.v, run_options.txt, synplify.log	*.prj files
Designer/impl1	All Files	All Files	*.ide_des files
Designer/<root>	All Files	All Files	Not Copied
tooldata	All Files	All Files	All Files

To access this dialog, from the **Project** menu, choose **Save Project As.**

Saving Files

Files and projects are saved when you close them.

To save an active file:

- From the **Project** menu, choose **Save** or **Save As**.
- Click the **Save** button in the toolbar.

Script Export Options Dialog Box

If you export a Tcl script in the Project Manager, the Script Export Options dialog box appears.

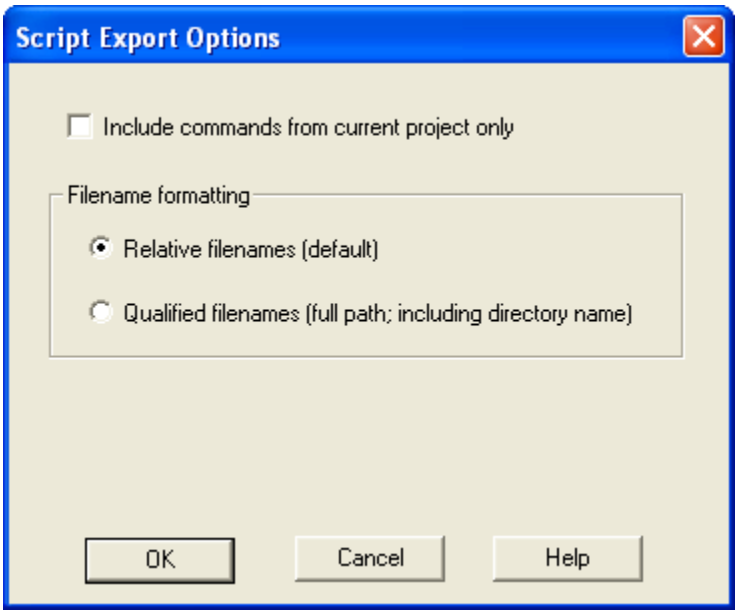

Figure 151 · Script Export Options Dialog Box

Include commands from current project only - Select this option if you want to include all the commands from your current project.

Filename Formatting - Choose **Relative filenames** if you do not intend to move the Tcl script from the saved location, or **Qualified filenames** if you plan to move the Tcl script on your machine.

Search in Libero SoC

Search options vary depending on your search type.

To find a file:

1. Use CTRL + F to open the Search window.
2. Enter the name or part of name of the object you wish to find in the Find field. '*' indicates a wildcard, and [*-*] indicates a range, such as if you search for a1, a2, ... a5 with the string a[1-5].
3. Set the Options for your search (see below for list); options vary depending on your search type.
4. Click **Find All** (or **Next** if searching Text).

   Searching an open text file, Log window or Reports highlights search results in the file itself.
   All other results appear in the Search Results window (as shown in the figure below).

Match case: Select to search for case-sensitive occurrences of a word or phrase. This limits the search so it only locates text that matches the upper- and lowercase characters you enter.

Match whole word: Select to match the whole word only.

NOTE: Links and cross-references in this PDF file may point to external files and generate an error when clicked. **View the online help included with software to enable all linked content.**

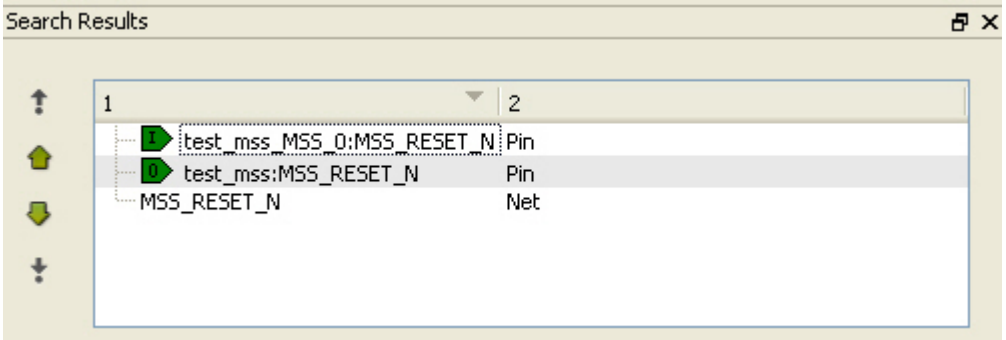

Figure 152 · Search Results

Current Open SmartDesign

Searches your open SmartDesign, returns results in the Search window.

Type: Choose Instance, Net or Pin to narrow your search.

Query: Query options vary according to Type.

Type	Query Option	Function
Instance	Get Pins	Search restricted to all pins
	Get Nets	Search restricted to all nets
	Get Unconnected Pins	Search restricted to all unconnected pins
Net	Get Instances	Searches all instances
	Get Pins	Search restricted to all pins
Pin	Get Connected Pins	Search restricted to all connected pins
	Get Associated Net	Search restricted to associated nets
	Get All Unconnected Pins	Search restricted to all unconnected pins

Current Open Text Editor

Searches the open text file. If you have more than one text file open you must place the cursor in it and click CTRL + F to search it.

Find All: Highlights all finds in the text file.

Next: Proceed to next instance of found text.

Previous: Proceed to previous instance of found text.

Replace with: Replaces the text you searched with the contents of the field.

Replace: Replaces a single instance.

Replace All: Replaces all instances of the found text with the contents of the field.

Design Hierarchy

Searches your Design Hierarchy; results appear in the Search window.

Find All: Displays all finds in the Search window.

Stimulus Hierarchy

Searches your Stimulus Hierarchy; results appear in the Search window.

Find All: Displays all finds in the Search window.

Log Window

Searches your Log window; results are highlighted in the Log window - they do not appear in the Search Results window.

Find All: Highlights all finds in the Log window.

Next: Proceed to next instance of found text.

Previous: Proceed to previous instance of found text.

Reports

Searches your Reports; returns results in the Reports window.

Find All: Highlights all finds in the Reports window.

Next: Proceed to next instance of found text.

Previous: Proceed to previous instance of found text.

Files

Searches your local project file names for the text in the Search field; returns results in the Search window.

Find All: Lists all search results in the Search window.

Files on disk

Searches the files' content in the specified directory and subdirectories for the text in the Search field; returns results in the Search window.

Find All: Lists all finds in the Search window.

File type: Select a file type to limit your search to specific file extensions, or choose *.* to search all file types.

Select a Workspace Dialog Box

This dialog box enables you to choose which processor you want to open when you have two or more processors in your design.

It is only available if you have two or more processors and double-click Develop Firmware > Write Application Code.

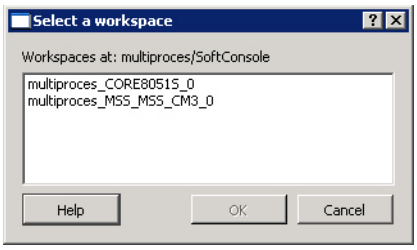

Figure 153 · Select a Workspace Dialog Box

Organize Source Files

The Organize Source Files dialog box enables you to set the source file order in the Libero SoC.

Click the **Use list of files organized by User** radio button to Add/Remove source files for the selected tool.

To specify the file order:

1. In the Design Flow window under Implement Design, right-click **Synthesize** and choose **Organize Input Files > Organize Source Files**. The Organize Source Files dialog box appears.
2. Click the **Use list of files organized by User** radio button to Add/Remove source files for the selected tool.
3. Select a file and click the Add or Remove buttons as necessary. Use the Up and Down arrows to change the order of the Associated Source files.
4. Click **OK**.

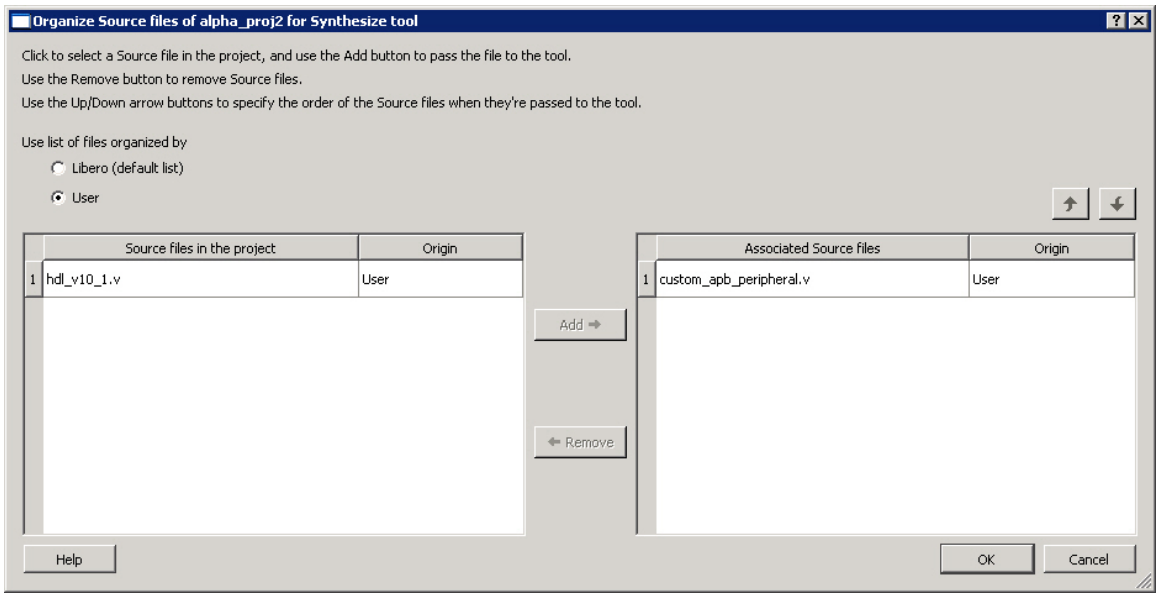

Figure 154 · Organize Source Files Dialog Box

Stimulus Hierarchy

To view the Stimulus Hierarchy, from the **View** menu choose **Windows > Stimulus Hierarchy**.

The Stimulus Hierarchy tab displays a hierarchical representation of the stimulus and simulation files in the project. The software continuously analyzes and updates files and content. The tab (see figure below) displays the structure of the modules and component stimulus files as they relate to each other.

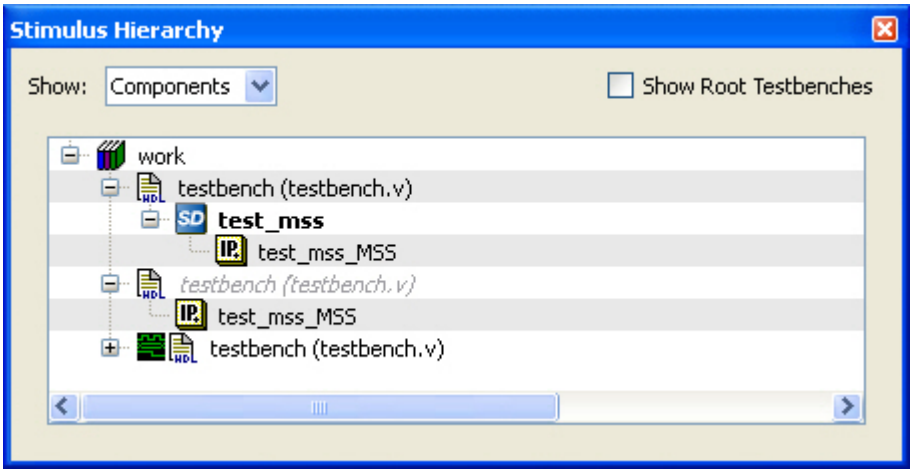

Figure 155 · Stimulus Hierarchy Dialog Box

Expand the hierarchy to view stimulus and simulation files. Right-click an individual component and choose **Show Module** to view the module for only that component.

Seelct **Components** or **Modules** from the **Show** drop-down list to change the display mode. The Components view displays the stimulus hierarchy; the modules view displays HDL modules and stimulus files.

The file name (the file that defines the module or component) appears in parentheses.

Click **Show Root Testbenches** to view only the root-level testbenches in your design.

Right-click and choose **Properties**; the Properties dialog box displays the pathname, created date, and last modified date.

All integrated source editors are linked with the SoC software; if you modify a stimulus file the Stimulus Hierarchy automatically updates to reflect the change.

To open a stimulus file:

Double-click a stimulus file to open it in the HDL text editor.

Right-click and choose **Delete from Project** to delete the file from the project. Right-click and choose **Delete from Disk and Project** to remove the file from your disk.

Icons in the Hierarchy indicate the type of component and the state, as shown in the table below.

Table 16 · Design Hierarchy Icons

Icon	Description
	SmartDesign component
	SmartDesign component with HDL netlist not generated
	SmartDesign testbench
	SmartDesign testbench with HDL netlist not generated
	IP core was instantiated into SmartDesign but the HDL netlist has not been generated
	HDL netlist

Text Editor

You can use the Libero IDE HDL text editor or another text editor.

To set your text editor preferences:

1. From the **Project** menu, choose **Preferences**.
2. Click **Text editor**.
2. Set your options and click **OK**.

Libero SoC text editor options:

- **Use Libero text editor**: Select to use the Libero HDL text editor.
- **Enable block folding**: This option lets you fold (hide) portions of your text.
- **Enable line numbers**: This option enables you to see line numbers in the text editor.
- **Open programming/debugging files as read-only:**Select to specify read-only permission to .stp and .prb files.

User defined text editor

- **User defined text editor**: Deselect Use Libero text editor to activate this area. Enter the location of the the EXE for your alternative text editor.
- **Additional parameters:** Use to specify other settings to pass to the text editor. Typically, it is not necessary to modify this field.

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User Template Location - Sets the path where your user templates are exported.

Tool Profiles Dialog Box

The Tool Profiles dialog box enables you to add, edit, or delete your project tool profiles.

Each Libero SoC project can have a different profile, enabling you to integrate different tools with different projects.

To set or change your tool profile:

1. From the **Project** menu, choose **Tool Profiles**. Select the type of tool you wish to add.

- **To add a tool**: Select the tool type and click the **Add** button . Fill out the tool profile and click **OK**.
- **To change a tool profile**: After selecting the tool, click the **Edit** button to select another tool, change the tool name, or change the tool location.
- **To remove a tool from the project**:After selecting a tool, click the **Remove** button.

2. When you are done, click **OK**.

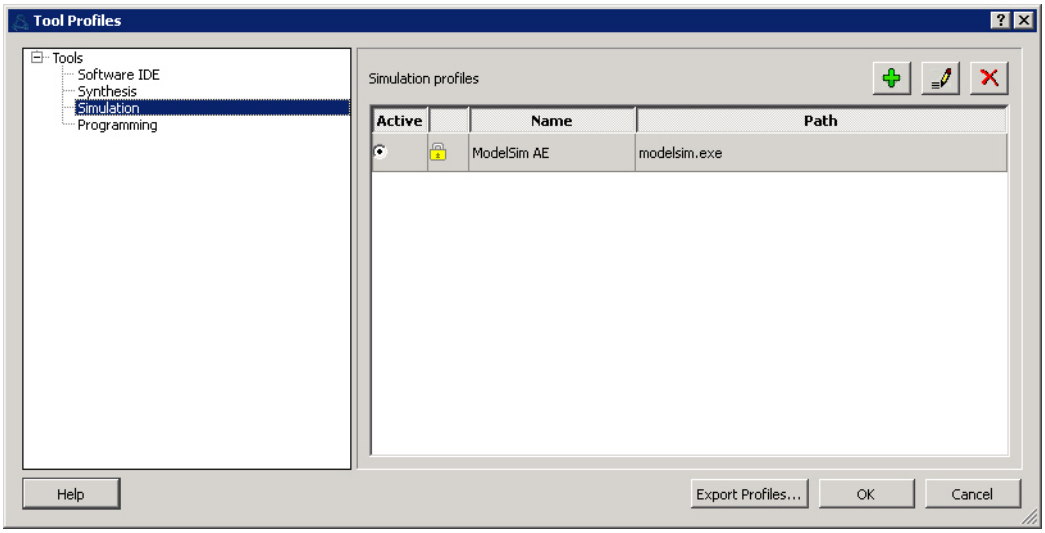

Figure 156 · Libero SoC Tool Profiles Dialog Box

Tools Menu - Libero SoC

Command	Function
SmartDesign	Opens the Create New SmartDesign dialog box. Enter a filename and click OK to open SmartDesign.
HDL	Opens the Create a new HDL file dialog box. Enter a filename and click OK to open the editor.
ViewDraw	Opens the New file dialog box and defaults to Schematic. Enter a filename and click OK to open ViewDraw.
Synthesis	Starts synthesis
Simulation	Starts the simulation software and opens any existing simulation files in your project

Command	Function
FlashPro	Starts the FlashPro programming tool
Identify Debugger	Opens the Identify Debugger (from Synplify)
Write Application Code	Enables you to use a third-party IDE tool, such as Keil or IAR.

Vault/Repositories Settings Dialog Box

The Vault/Repositories Settings dialog box enables you to add, remove, or reset your repositories to default settings.

Use Vault location to specify a new location for your local vault.

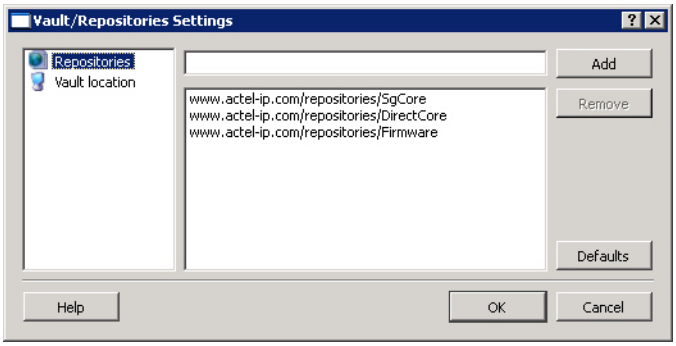

Figure 157 · Vault/Repositories Settings Dialog Box

Videos - Libero SoC

There are short videos available that explain a variety of elements in Libero SoC. The maximum video length is 60 seconds, unless otherwise noted. See the SoC website for a complete list of the latest video content, as well as tutorials and online training.

Video Links

SoC Work Area Description - The SoC Work Window displays the HDL Editor, Report view, and SmartDesign Canvas.

Design Hierarchy Tab and Files Tab - Introduces the Design Hierarchy and Files tabs in the SoC GUI.

Design Flow Tab and Catalog - Introduces the Design Flow tab and the Catalog.

AutoConnect in SmartDesign - Demonstrates the Autoconnect feature in SmartDesign.

Connection Mode in SmartDesign - Demonstrates the manual Connection mode feature in SmartDesign.

View Design Datasheet/Report

The Design Datasheet/Report lists all the reports available for your design.

Reports are added automatically when you move through design development. For example, Timing reports are added when you run timing analysis on your design. The reports are updated each time you run timing analysis.

If a report is not listed you may have to open it manually. For example, you must double-click **Export IBIS Model** to display the IBIS Model report in the Design Datasheet.

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You can view the following reports from here:

- Analyze Timing - Lists the following delay reports:
    - Timing violations report - Flat Slack report provides information about constraint violations.
    - Timing Report - Displays the timing information organized by clock domain.
- Compile - Summarizes your compile parameters and lists any related warnings, errors, PDC commands, device utilization and net information.
- Synthesize - Lists the following synthesis reports:
    - synplify.log - Outputs the Synplify log file output; identical to log file content in Synplify Pro AE if you run synthesis manually.
    - datasheet.srr - Lists the Pin Description, DC Electrical Characteristics, and AC electrical characteristics.
    - run_options.txt - Lists all the run options organized by category: project files; implementation; device options; compile/mapping options; mapper options.
- Export Pin Report - Lists the pins in your device sorted by I/O signal name and by package number.
- Place-and-Route - Lists the following reports:
    - Place-and-Route - Lists Compile and netlist information.
    - Global Net and Global Usage- Contains information about the net(s) that are assigned or routed using Global or LocalClock resources
    - I/O bank reports - Provides information on the I/O functionality, I/O technologies, I/O banks and I/O voltages.
- Export IBIS Model - Exports the IBIS model report, which provides a standard file format for recording parameters like driver output impedance, rise/fall time, and input loading, which may then be used by any software application.
- Programming - Lists the programming information for your design.

View Menu - Libero SoC

Command	Sub-menu	Shortcut	Function
Windows >	Catalog		Shows/hides the Catalog
	Cores		Shows/hides the list of cores used in your design
	Design Flow		Shows/hides the Design Flow window
	Design Hierarchy		Shows/hides the Design Hierarchy
	Files		Shows/hides the Files window
	HDL Templates		Shows/hides the HDL Templates window

Command	Sub-menu	Shortcut	Function
	Log		Shows/hides the Log window
	Search Results		Shows/hides Search results
	Stimulus Hierarchy		Shows/hides the Stimulus Hierarchy
Start Page			Displays the Welcome to Libero SoC page; the page includes links to help and other pages that may be helpful for new users.
Refresh Design Hierarchy		F5	Updates the Hierarchy tab. Useful if you add files to the project and the software does not show them in the Hierarchy.
Maximize Work Area		CTRL+W	Hides the Catalog, Log Window, and Design Explorer windows (if open) and expands the selected tab in the Project Flow or SmartDesign work area.
Reset Layout			Returns the Libero SoC window layout to default.

VHDL Library - Add, Remove, or Rename

Libero SoC enables you to manage your VHDL libraries from within the Project Manager.

From the File menu, select **VHDL Library** and **Add**, **Rename**, or **Remove** to update your library.

When you add a library it appears in your Hierarchy.

	Log		Shows/hides the Log window
	Search Results		Shows/hides Search results
	Stimulus Hierarchy		Shows/hides the Stimulus Hierarchy
Start Page			Displays the Welcome to Libero SoC page; the page includes links to help and other pages that may be helpful for new users.
Refresh Design Hierarchy		F5	Updates the Hierarchy tab. Useful if you add files to the project and the software does not show them in the Hierarchy.
Maximize Work Area		CTRL+W	Hides the Catalog, Log Window, and Design Explorer windows (if open) and expands the selected tab in the Project Flow or SmartDesign work area.
Reset Layout			Returns the Libero SoC window layout to default.

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Product Support

Microsemi SoC Products Group backs its products with various support services, including Customer Service, Customer Technical Support Center, a website, electronic mail, and worldwide sales offices. This appendix contains information about contacting Microsemi SoC Products Group and using these support services.

Customer Service

Contact Customer Service for non-technical product support, such as product pricing, product upgrades, update information, order status, and authorization.

From North America, call **800.262.1060**
From the rest of the world, call **650.318.4460**
Fax, from anywhere in the world **650. 318.8044**

Customer Technical Support Center

Microsemi SoC Products Group staffs its Customer Technical Support Center with highly skilled engineers who can help answer your hardware, software, and design questions about Microsemi SoC Products. The Customer Technical Support Center spends a great deal of time creating application notes, answers to common design cycle questions, documentation of known issues and various FAQs. So, before you contact us, please visit our online resources. It is very likely we have already answered your questions.

Technical Support

For Microsemi SoC Products Support, visit http://www.microsemi.com/products/fpga-soc/design-support/fpga-soc-support.

Website

You can browse a variety of technical and non-technical information on the Microsemi SoC Products Group home page, at http://www.microsemi.com/soc/.

Contacting the Customer Technical Support Center

Highly skilled engineers staff the Technical Support Center. The Technical Support Center can be contacted by email or through the Microsemi SoC Products Group website.

Email

You can communicate your technical questions to our email address and receive answers back by email, fax, or phone. Also, if you have design problems, you can email your design files to receive assistance. We constantly monitor the email account throughout the day. When sending your request to us, please be sure to include your full name, company name, and your contact information for efficient processing of your request.

The technical support email address is soc_tech@microsemi.com.

My Cases

Microsemi SoC Products Group customers may submit and track technical cases online by going to My Cases.

Outside the U.S.

Customers needing assistance outside the US time zones can either contact technical support via email (soc_tech@microsemi.com) or contact a local sales office. Visit About Us for sales office listings and corporate contacts.

ITAR Technical Support

For technical support on RH and RT FPGAs that are regulated by International Traffic in Arms Regulations (ITAR), contact us via soc_tech@microsemi.com. Alternatively, within My Cases, select **Yes** in the ITAR drop-down list. For a complete list of ITAR-regulated Microsemi FPGAs, visit the ITAR web page.

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