



Clock Control Block (ALTCLKCTRL) IP Core

User Guide



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1. About this IP Core

The Altera clock control block (ALTCLKCTRL) megafunction IP core that you can easily configure with the IP Catalog and parameter editor.

The common applications of using this IP core are as follows:

- Dynamic clock source selection—When using the clock control block, you can select the dynamic clock source that drives the global clock network. However, only certain combinations of signal sources are supported, as described in “[Global Clock Control Block](#)” on page 3–2. You cannot select clock sources dynamically to drive the regional clock networks and the dedicated external clock-out path.
- Dynamic power-down of a clock network—The dynamic clock enable or disable feature allows internal logic to power-down the clock network. When a clock network is powered-down, all the logic fed by that clock network is not toggling, thus the overall power consumption of the device is reduced.

Features

The ALTCLKCTRL IP core provides the following additional features:

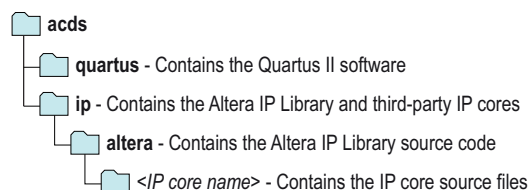
- Supports specification of operation mode of the clock control block
- Supports specification of the number of input clock sources
- Provides an active high clock enable control input

Installing and Licensing IP Cores

The Altera IP Library provides many useful IP core functions for production use without purchasing an additional license. You can evaluate any Altera IP core in simulation and compilation in the Quartus II software using the OpenCore evaluation feature.

Some Altera IP cores, such as MegaCore® functions, require that you purchase a separate license for production use. You can use the OpenCore Plus feature to evaluate IP that requires purchase of an additional license until you are satisfied with the functionality and performance. After you purchase a license, visit the [Self Service Licensing Center](#) to obtain a license number for any Altera product. For additional information, refer to [Altera Software Installation and Licensing](#).

Figure 1–1. IP core Installation Path



The default installation directory on Windows is `<drive>:\altera\<version number>`; on Linux it is `<home directory>/altera/<version number>`.

IP Catalog and Parameter Editor

The Quartus II IP Catalog (**Tools > IP Catalog**) and parameter editor help you easily customize and integrate IP cores into your project. You can use the IP Catalog and parameter editor to select, customize, and generate files representing your custom IP variation.



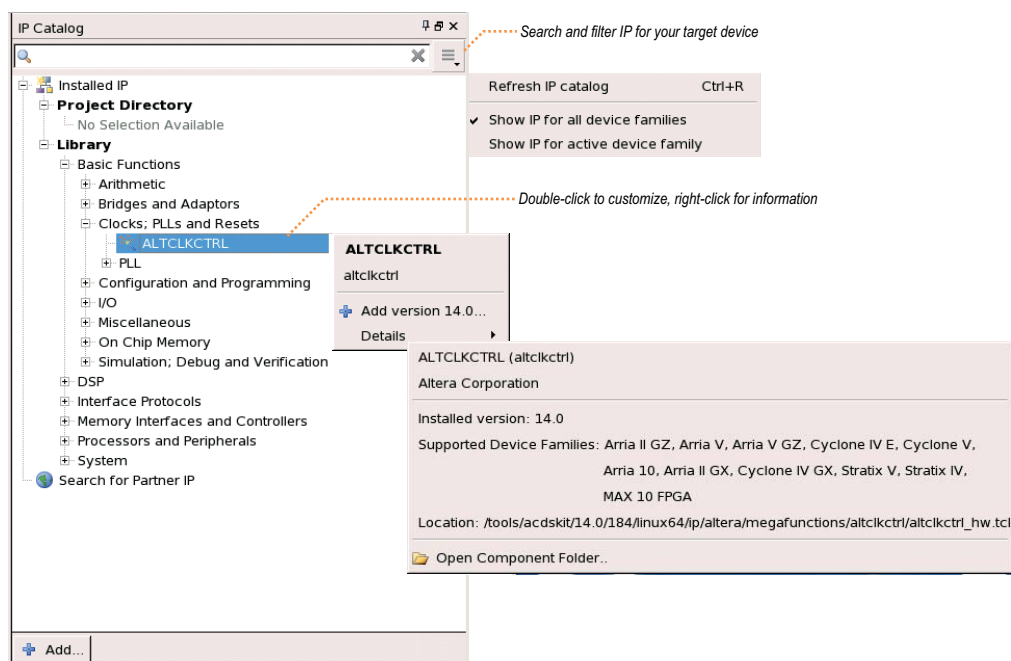
The IP Catalog (**Tools > IP Catalog**) and parameter editor replace the MegaWizard™ Plug-In Manager for IP selection and parameterization, beginning in Quartus II software version 14.0. Use the IP Catalog and parameter editor to locate and parameterize Altera IP cores.


The IP Catalog lists IP cores available for your design. Double-click any IP core to launch the parameter editor and generate files representing your IP variation. The parameter editor prompts you to specify an IP variation name, optional ports, and output file generation options. The parameter editor generates a top level Qsys system file (.qsys) or Quartus II IP file (.qip) representing the IP core in your project. You can also parameterize an IP variation without an open project.

Use the following features to help you quickly locate and select an IP core:

- Filter IP Catalog to **Show IP for active device family** or **Show IP for all device families**.
- Search to locate any full or partial IP core name in IP Catalog. Click **Search for Partner IP**, to access partner IP information on the Altera website.
- Right-click an IP core name in IP Catalog to display details about supported devices, installation location, and links to documentation.

Figure 1–2. Quartus II IP Catalog



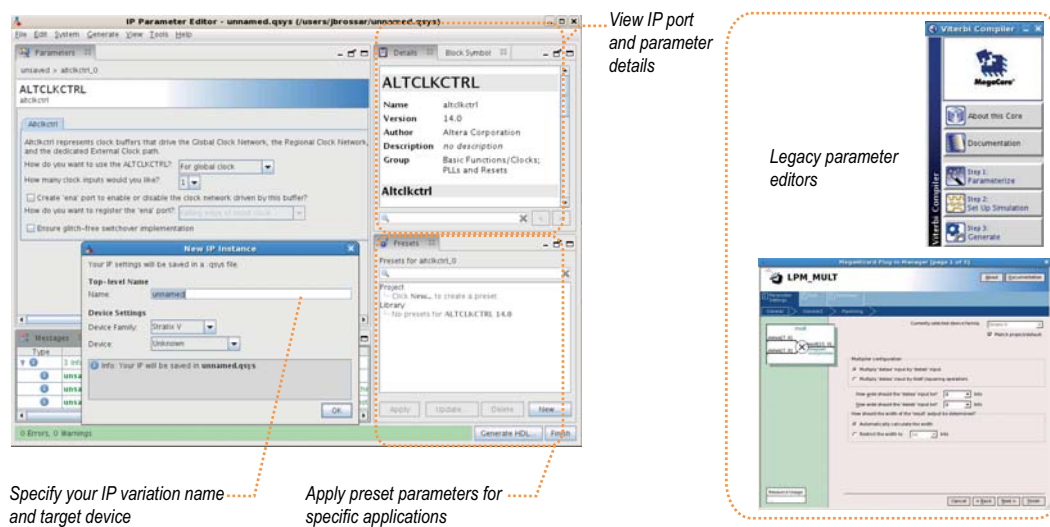
 The IP Catalog is also available in Qsys (**View > IP Catalog**). The Qsys IP Catalog includes exclusive system interconnect, video and image processing, and other system-level IP that are not available in the Quartus II IP Catalog.

Using the Parameter Editor

The parameter editor helps you to configure your IP variation ports, parameters, architecture features, and output file generation options:

- Use preset settings in the parameter editor (where provided) to instantly apply preset parameter values for specific applications.
- View port and parameter descriptions and links to detailed documentation.
- Generate testbench systems or example designs (where provided).

Figure 1-3. IP Parameter Editors



Specifying IP Core Parameters and Options

The parameter editor GUI allows you to quickly configure your custom IP variation. Use the following steps to specify IP core options and parameters in the Quartus II software. Refer to Specifying IP Core Parameters and Options (Legacy Parameter Editors) for configuration of IP cores using the legacy parameter editor.

1. In the IP Catalog (**Tools > IP Catalog**), locate and double-click the name of the IP core to customize. The parameter editor appears.
2. Specify a top-level name for your custom IP variation. The parameter editor saves the IP variation settings in a file named `.<your_ip>qsys`. Click **OK**.

3. Specify the parameters and options for your IP variation in the parameter editor, including one or more of the following. Refer to your IP core user guide for information about specific IP core parameters.
 - Optionally select preset parameter values if provided for your IP core. Presets specify initial parameter values for specific applications.
 - Specify parameters defining the IP core functionality, port configurations, and device-specific features.
 - Specify options for processing the IP core files in other EDA tools.
4. Click **Generate HDL**, the **Generation** dialog box appears.
5. Specify output file generation options, and then click **Generate**. The IP variation files generate according to your specifications.
6. To generate a simulation testbench, click **Generate > Generate Testbench System**.
7. To generate an HDL instantiation template that you can copy and paste into your text editor, click **Generate > HDL Example**.
8. Click **Finish**. The parameter editor adds the top-level **.qsys** file to the current project automatically. If you are prompted to manually add the **.qsys** file to the project, click **Project > Add/Remove Files in Project** to add the file.
9. After generating and instantiating your IP variation, make appropriate pin assignments to connect ports.



For information about using a legacy parameter editor, refer to “Specifying IP Core Parameters and Options (Legacy Parameter Editors)” in the *Introduction to Altera IP Cores*.

Files Generated for Altera IP Cores

The Quartus II software v14.0 Arria 10 Edition and later generates the following output file structure for Altera IP cores.

Figure 1–4. IP Core Generated Files

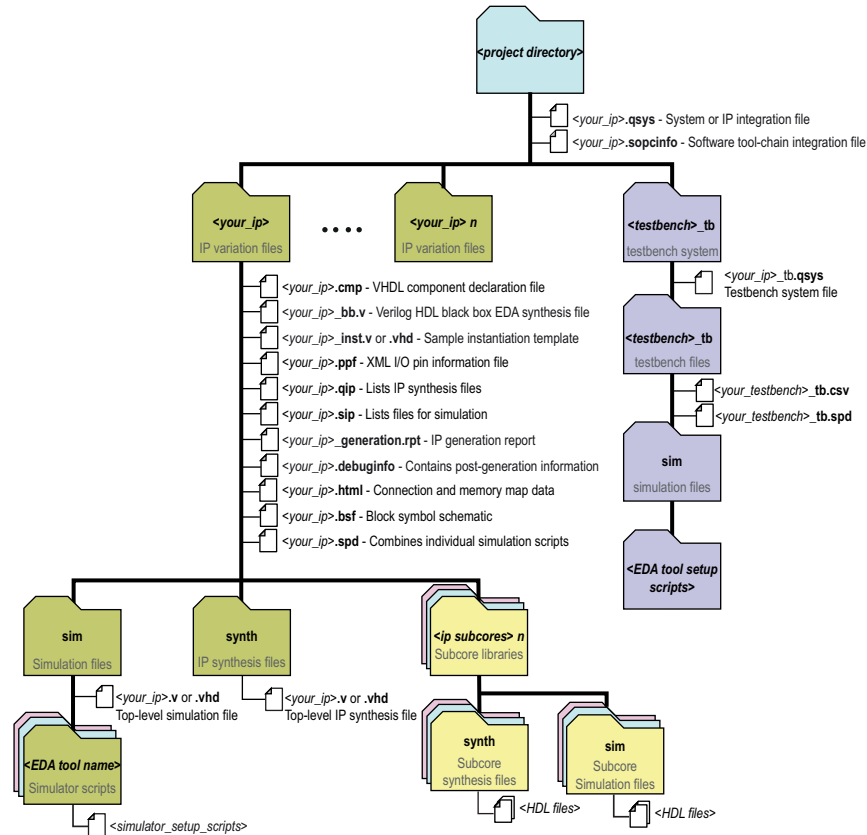


Table 1–1. IP Core Generated Files

File Type	Description
<my_ip>.qsys	The Qsys system or top-level IP variation file. <i><my_ip></i> is the name that you give your IP variation.
<system>.sopcinfo	Describes the connections and IP component parameterizations in your Qsys system. You can parse its contents to get requirements when you develop software drivers for IP components. Downstream tools such as the Nios II tool chain use this file. The .sopcinfo file and the system.h file generated for the Nios II tool chain include address map information for each slave relative to each master that accesses the slave. Different masters may have a different address map to access a particular slave component.
<my_ip>.cmp	The VHDL Component Declaration (.cmp) file is a text file that contains local generic and port definitions that you can use in VHDL design files.
<my_ip>.html	A report that contains connection information, a memory map showing the address of each slave with respect to each master to which it is connected, and parameter assignments.

Table 1–1. IP Core Generated Files

File Type	Description
<code><my_ip>_generation.rpt</code>	IP or Qsys generation log file. A summary of the messages during IP generation.
<code><my_ip>.debuginfo</code>	Contains post-generation information. Used to pass System Console and Bus Analyzer Toolkit information about the Qsys interconnect. The Bus Analysis Toolkit uses this file to identify debug components in the Qsys interconnect.
<code><my_ip>.qip</code>	Contains all the required information about the IP component to integrate and compile the IP component in the Quartus II software.
<code><my_ip>.csv</code>	Contains information about the upgrade status of the IP component.
<code><my_ip>.bsf</code>	A Block Symbol File (.bsf) representation of the IP variation for use in Quartus II Block Diagram Files (.bdf).
<code><my_ip>.spd</code>	Required input file for <code>ip-make-simscript</code> to generate simulation scripts for supported simulators. The .spd file contains a list of files generated for simulation, along with information about memories that you can initialize.
<code><my_ip>.ppf</code>	The Pin Planner File (.ppf) stores the port and node assignments for IP components created for use with the Pin Planner.
<code><my_ip>_bb.v</code>	You can use the Verilog black-box (_bb.v) file as an empty module declaration for use as a black box.
<code><my_ip>.sip</code>	Contains information required for NativeLink simulation of IP components. You must add the .sip file to your Quartus II project.
<code><my_ip>_inst.v</code> or <code>_inst.vhd</code>	HDL example instantiation template. You can copy and paste the contents of this file into your HDL file to instantiate the IP variation.
<code><my_ip>.regmap</code>	If IP contains register information, .regmap file generates. The .regmap file describes the register map information of master and slave interfaces. This file complements the .sopcinfo file by providing more detailed register information about the system. This enables register display views and user customizable statistics in the System Console.
<code><my_ip>.svd</code>	Allows HPS System Debug tools to view the register maps of peripherals connected to HPS within a Qsys system. During synthesis, the .svd files for slave interfaces visible to System Console masters are stored in the .sof file in the debug section. System Console reads this section, which Qsys can query for register map information. For system slaves, Qsys can access the registers by name.
<code><my_ip>.v</code> or <code><my_ip>.vhd</code>	HDL files that instantiate each submodule or child IP core for synthesis or simulation.
mentor/	Contains a ModelSim® script msim_setup.tcl to set up and run a simulation.
aldec/	Contains a Riviera-PRO script rivierapro_setup.tcl to setup and run a simulation.
/synopsys/vcs /synopsys/vcsmx	Contains a shell script vcs_setup.sh to set up and run a VCS® simulation. Contains a shell script vcsmx_setup.sh and synopsys_sim.setup file to set up and run a VCS MX® simulation.
/cadence	Contains a shell script ncsim_setup.sh and other setup files to set up and run an NCSIM simulation.
/submodules	Contains submodule HDL files and /sim and /synth directories.

Specifying IP Core Parameters and Options (Legacy Parameter Editors)

Some IP cores use a legacy version of the parameter editor for configuration and generation. Use the following steps to configure and generate an IP variation using a legacy parameter editor.



 The legacy parameter editor generates a different output file structure than the latest parameter editor. Refer to *Specifying IP Core Parameters and Options* for configuration of IP cores using the latest parameter editor.

Figure 1–5. Legacy Parameter Editors



1. In the IP Catalog (**Tools > IP Catalog**), locate and double-click the name of the IP core to customize. The parameter editor appears.
2. Specify a top-level name and output HDL file type for your IP variation. This name identifies the IP core variation files in your project. Click **OK**.
3. Specify the parameters and options for your IP variation in the parameter editor. Refer to your IP core user guide for information about specific IP core parameters.
4. Click **Finish** or **Generate** (depending on the parameter editor version). The parameter editor generates the files for your IP variation according to your specifications. Click **Exit** if prompted when generation is complete. The parameter editor adds the top-level **.qip** file to the current project automatically.

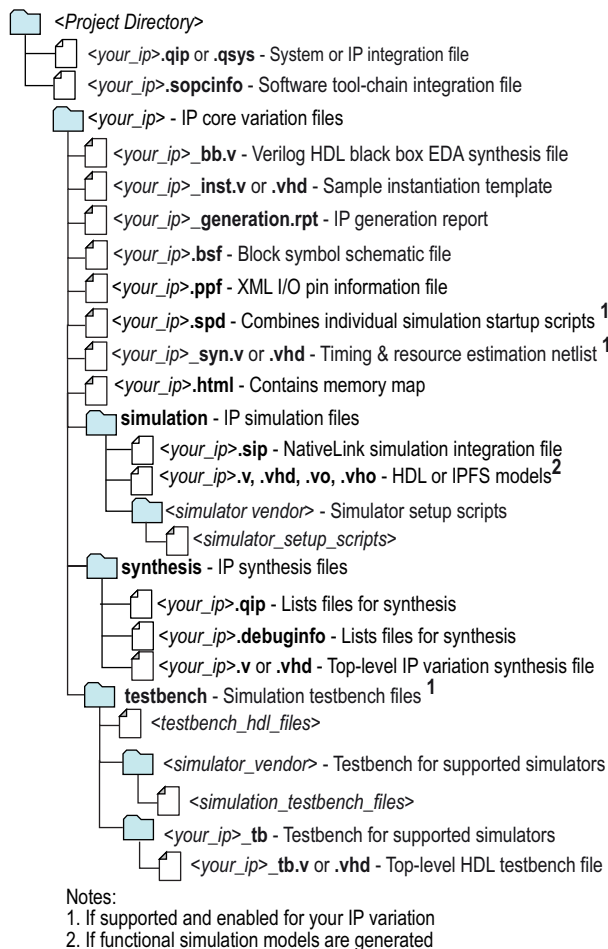
 To manually add an IP variation generated with legacy parameter editor to a project, click **Project > Add/Remove Files in Project** and add the IP variation **.qip** file.

 For information about using the latest parameter editor, refer to “Specifying IP Core Parameters and Options” in the *Introduction to Altera IP Cores*.

Files Generated for Altera IP Cores (Legacy Parameter Editor)

The Quartus II software generates the following output file structure for Altera IP cores that use a legacy parameter editor:

Figure 1–6. IP Core Generated Files (Legacy Parameter Editor)



Modifying an IP Variation

You can easily modify the parameters of any Altera IP core variation in the parameter editor to match your design requirements. Use any of the following methods to modify an IP variation in the parameter editor.

Table 1–2. Modifying an IP Variation

Menu Command	Action
File > Open	Select the top-levelHDL(.v, or .vhd) IP variation file to launch the parameter editor and modify the IP variation. Regenerate the IP variation to implement your changes.

Table 1-2. Modifying an IP Variation

Menu Command	Action
View > Utility Windows > Project Navigator > IP Components	Double-click the IP variation to launch the parameter editor and modify the IP variation. Regenerate the IP variation to implement your changes.
Project > Upgrade IP Components	Select the IP variation and click Upgrade in Editor to launch the parameter editor and modify the IP variation. Regenerate the IP variation to implement your changes.

Upgrading IP Cores

IP core variants generated with a previous version of the Quartus II software may require upgrading before use in the current version of the Quartus II software. Click **Project > Upgrade IP Components** to identify and upgrade IP core variants.

The **Upgrade IP Components** dialog box provides instructions when IP upgrade is required, optional, or unsupported for specific IP cores in your design. You must upgrade IP cores that require it before you can compile the IP variation in the current version of the Quartus II software. Many Altera IP cores support automatic upgrade.

The upgrade process renames and preserves the existing variation file (.v, .sv, or .vhd) as *<my_ip>_BAK.v, .sv, .vhd* in the project directory.

Table 1-3. IP Core Upgrade Status

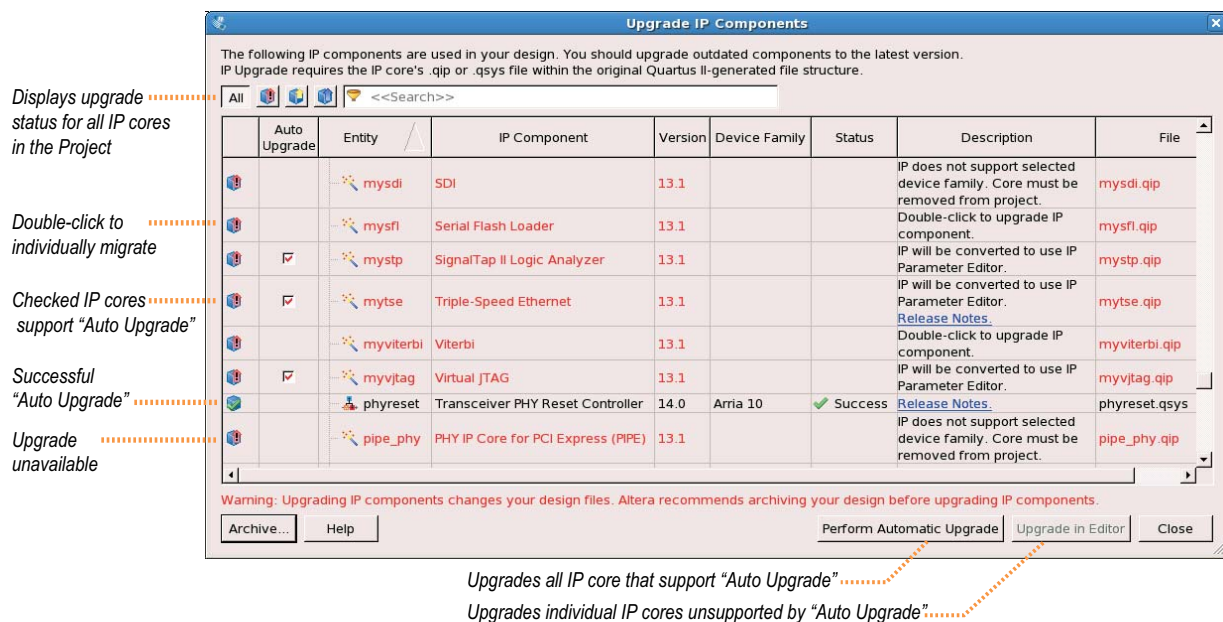
IP Core Status	Corrective Action
Required Upgrade IP Components	You must upgrade the IP variation before compiling in the current version of the Quartus II software.
Optional Upgrade IP Components	Upgrade is optional for this IP variation in the current version of the Quartus II software. You can upgrade this IP variation to take advantage of the latest development of this IP core. Alternatively you can retain previous IP core characteristics by declining to upgrade.
Upgrade Unsupported	Upgrade of the IP variation is not supported in the current version of the Quartus II software due to IP core end of life or incompatibility with the current version of the Quartus II software. You are prompted to replace the obsolete IP core with a current equivalent IP core from the IP Catalog.

Before you begin

- Archive the Quartus II project containing outdated IP cores in the original version of the Quartus II software: Click **Project > Archive Project** to save the project in your previous version of the Quartus II software. This archive preserves your original design source and project files.
- Restore the archived project in the latest version of the Quartus II software: Click **Project > Restore Archived Project**. Click **OK** if prompted to change to a supported device or overwrite the project database. File paths in the archive must be relative to the project directory. File paths in the archive must reference the IP variation .v or .vhd file or .qsys file (not the .qip file).

1. In the latest version of the Quartus II software, open the Quartus II project containing an outdated IP core variation. The **Upgrade IP Components** dialog automatically displays the status of IP cores in your project, along with instructions for upgrading each core. Click **Project > Upgrade IP Components** to access this dialog box manually.
2. To simultaneously upgrade all IP cores that support automatic upgrade, click **Perform Automatic Upgrade**. The **Status** and **Version** columns update when upgrade is complete. Example designs provided with any Altera IP core regenerate automatically whenever you upgrade the IP core.

Figure 1-7. Upgrading IP Cores



Upgrading IP Cores at the Command Line

You can upgrade IP cores that support auto upgrade at the command line. IP cores that do not support automatic upgrade do not support command line upgrade.

- To upgrade a single IP core that supports auto-upgrade, type the following command:

```
quartus_sh -ip_upgrade -variation_files <my_ip_filepath/my_ip>.<hdl> <qii_project>
```

Example: `quartus_sh -ip_upgrade -variation_files mega/pll25.v hps_testx`
- To simultaneously upgrade multiple IP cores that support auto-upgrade, type the following command:

```
quartus_sh -ip_upgrade -variation_files "<my_ip_filepath/my_ip1>.<hdl>; <my_ip_filepath/my_ip2>.<hdl>" <qii_project>
```

Example: `quartus_sh -ip_upgrade -variation_files "mega/pll_tx2.v;mega/pll3.v" hps_testx`



IP cores older than Quartus II software version 12.0 do not support upgrade. Altera verifies that the current version of the Quartus II software compiles the previous version of each IP core. The *MegaCore IP Library Release Notes* reports any verification exceptions for MegaCore IP. The *Quartus II Software and Device Support Release Notes* reports any verification exceptions for other IP cores. Altera does not verify compilation for IP cores older than the previous two releases.

Migrating IP Cores to a Different Device



IP migration allows you to target the latest device families with IP originally generated for a different device. Some Altera IP cores require individual migration to upgrade. The **Upgrade IP Components** dialog box prompts you to double-click IP cores that require individual migration.

1. To display IP cores requiring migration, click **Project > Upgrade IP Components**. The **Description** field prompts you to double-click IP cores that require individual migration.
2. Double-click the IP core name, and then click **OK** after reading the information panel. The parameter editor appears showing the original IP core parameters.
3. For the **Currently selected device family**, turn off **Match project/default**, and then select the new target device family.
4. Click **Finish**, and then click **Finish** again to migrate the IP variation using best-effort mapping to new parameters and settings. Click **OK** if you are prompted that the IP core is unsupported for the current device. A new parameter editor opens displaying best-effort mapped parameters.
5. Click **Generate HDL**, and then confirm the Synthesis and Simulation file options. Verilog is the parameter editor default HDL for synthesis files. If your original IP core was generated for VHDL, select **VHDL** to retain the original output HDL format.
6. To regenerate the new IP variation for the new target device, click **Generate**. When generation is complete, click **Close**.
7. Click **Finish** to complete migration of the IP core. Click **OK** if you are prompted to overwrite IP core files. The **Device Family** column displays the migrated device support. The migration process replaces `<my_ip>.qip` with the `<my_ip>.qsys` top-level IP file in your project.




If migration does not replace `<my_ip>.qip` with `<my_ip>.qsys`, click **Project > Add/Remove Files in Project** to replace the file in your project.

8. Review the latest parameters in the parameter editor or generated HDL for correctness. IP migration may change ports, parameters, or functionality of the IP core. During migration, the IP core's HDL generates into a library that is different from the original output location of the IP core. Update any assignments that reference outdated locations. If your upgraded IP core is represented by a symbol in a supporting Block Design File schematic, replace the symbol with the newly generated `<my_ip>.bsf` after migration.

-  The migration process may change the IP variation interface, parameters, and functionality. This may require you to change your design or to re-parameterize your variant after the **Upgrade IP Components** dialog box indicates that migration is complete. The **Description** field identifies IP cores that require design or parameter changes.
-  For more information about specific IP cores, refer to [IP user guide documentation](#) and the *Altera IP Release Notes*.

2. Parameter Settings

This section describes the parameter settings for the ALTCLKCTRL IP core. You can parameterize the IP core in the parameter editor GUI, or the command-line interface (CLI).

 This user guide assumes that you are familiar with IP cores and how to create them. If you are unfamiliar with Altera® IP cores, refer to the [Introduction to Altera IP Cores](#).

Parameter Settings

Table 2-1. ALTCLKCTRL Parameters (Part 1 of 3)

Configuration Setting	Description
How do you want to use the ALTCLKCTRL?	<p>Specify the ALTCLKCTRL buffering mode. You can select from the following modes:</p> <p>Auto—Allows the Compiler to pick the best clock buffer to use.</p> <p>For global clock—Allows a clock signal to reach all parts of the chip with the same amount of skew; you can select input port <code>clkselect</code> to switch between the four clock inputs.</p> <p>For dual regional clock—half chip ⁽⁵⁾—Allows a clock signal to reach half of the chip by using two regional clocks to drive two quadrants; only one clock input is accepted.</p> <p>For regional clock —quarter chip ⁽⁵⁾—Allows a clock signal to reach a quadrant of the chip; only one clock input is accepted.</p> <p>For regional clock—This mode is available for Arria 10 and Cyclone 10 GX devices only. Allows a clock to reach a region covering six interface tiles vertically (two at the edge of the device), and the entire chip horizontally.</p> <p>For external path ⁽⁵⁾—Represents the clock path from the outputs of the PLL to the dedicated clock output pins; only one clock output is accepted.</p> <p>For periphery clock—Allows a clock signal to reach a quadrant or an octant of the chip depending on the device; only one clock input is accepted. For tile-based architectures like Arria 10 and Cyclone 10 GX devices, a periphery clock will reach a region aligned with the source interface tile, and half the chip horizontally.</p>
How many clock inputs would you like? ⁽¹⁾	Specify the number of input clock sources for the clock control block. You can specify up to four clock inputs.
Create 'ena' port to enable or disable the clock network driven by this buffer ⁽²⁾	Turn on this option if you want to create an active high clock enable signal to enable or disable the clock network.

Table 2–1. ALTCLKCTRL Parameters (Part 2 of 3)

Configuration Setting	Description
How do you want to register the 'ena' port?	<p>Turn on this option to choose the register mode for the <code>ena</code> port. The available register modes are:</p> <p>Falling edge of input clock—the <code>clkout</code> pin is the output of the first falling edge driven register.</p> <p>Double register with input clock—the <code>clkout</code> pin is the output of the second falling edge driven register.</p> <p>Not registered—the <code>clkout</code> pin is set to one of the <code>clk_in</code> input (after the multiplexer).</p> <p>This option is available after you turn on the Create 'ena' port to enable or disable the clock network driven by this buffer option.</p> <p>This option is available in Stratix III, Stratix IV, and Stratix V devices only.</p>
Ensure glitch-free switchover implementation	<p>Turn on this option to implement a glitch-free switchover when you use multiple clock inputs.</p> <p>You must ensure the clock that is currently selected is running before switching to another source. If the selected clock is not running, the glitch-free switchover implementation will not be able to switch to the new clock source.</p> <p>By default, the <code>clkselect</code> port is set to 00. A clock must be applied to <code>inclk0x</code> for the values on the <code>clkselect</code> ports to be read.</p>
Generate netlist	<p>Turn on this option if you want to generate a netlist for your third-party EDA synthesis tool to estimate the timing and resource usage of the IP core. If you turn on this option, a netlist file (<code>_syn.v</code>) is generated. This file is a representation of the customized logic used in the Quartus II software and provides connectivity of the architectural elements in the IP core but may not represent true functionality.</p>

Table 2–1. ALTCLKCTRL Parameters (Part 3 of 3)

Configuration Setting	Description
Summary Page	<p>Specify the types of files to be generated. Only the files marked with red check marks are optional.</p> <p>Choose from the following types of files:</p> <ul style="list-style-type: none"> ■ Variation file ⁽¹⁾ ■ AHDL Include file (<function name>.inc) ■ VHDL component declaration file (<function name>.cmp) ■ Quartus II symbol file (<function name>.bsf) ■ Instantiation template file (<function name>_inst.v) ■ Verilog HDL black box file (<function name>_bb.v) ■ Synthesis area and timing estimation netlist (_syn.v) ⁽⁴⁾ <p>For more information about the wizard-generated files, refer to Quartus II Help or to the <i>Recommended HDL Coding Styles</i> chapter in volume 1 of the <i>Quartus II Handbook</i>.</p>

Notes to Table 2–1:

- (1) You can change the number of clock inputs only if you choose the **Auto** or **For global clock** options.
- (2) Not supported if you chose the **For periphery clock** option.
- (3) The Variation file contains wrapper code in the language you specified on page 2a and is automatically generated.
- (4) The synthesis area and timing estimation netlist file (_syn.v) is automatically generated if the **Generate netlist** option on page 4 is turned on.
- (5) This mode is not supported in Arria 10 and Cyclone 10 GX devices.

Command Line Interface Parameters

Expert users can choose to instantiate and parameterize the IP core through the command-line interface using the clear box generator command. This method requires you to have command-line scripting knowledge.



For more information about using the clear box generator, refer to the [Introduction to Altera IP Cores](#).

Table 2–2 lists the parameters for the ALTCLKCTRL IP core.

Table 2–2. ALTCLKCTRL Parameters

Parameter Name	Type	Required	Comments												
clock_type	String	Yes	<div>This parameter specifies the operation mode. The values are:<table><tr><th>Value</th><th>Signal Selection</th></tr><tr><td>AUTO</td><td>Auto-selected clock (default value)</td></tr><tr><td>GCLK</td><td>Global clock</td></tr><tr><td>LCLK</td><td>Regional clock</td></tr><tr><td>EXTCLK</td><td>External clock</td></tr><tr><td>SIDE_CLK</td><td>Dual-regional clock</td></tr></table></div> <div>The clkselect and ena ports are unavailable if the clock_type parameter is set to EXTCLK.</div>	Value	Signal Selection	AUTO	Auto-selected clock (default value)	GCLK	Global clock	LCLK	Regional clock	EXTCLK	External clock	SIDE_CLK	Dual-regional clock
Value	Signal Selection														
AUTO	Auto-selected clock (default value)														
GCLK	Global clock														
LCLK	Regional clock														
EXTCLK	External clock														
SIDE_CLK	Dual-regional clock														
ena_register_mode	String	No	Register mode for the ena port. Values are NONE , FALLING_EDGE , and DOUBLE_REGISTER . Only available in Arria II GX, Arria II GZ, Arria V, Arria V GZ, Arria 10, Cyclone V, Cyclone 10 GX, Stratix III, Stratix IV, and Stratix V devices.												
lpm_hint	String	No	Allows you to specify Altera-specific parameters in VHDL Design Files (.vhd). The default value is UNUSED .												
lpm_type	String	No	Identifies the library of parameterized modules (LPM) entity name in VHDL Design Files (.vhd).												
intended_device_family	String	No	Used for modeling and behavioral simulation purposes. Create the ALTCLKCTRL IP core with the parameter editor to get the value for this parameter.												
implement_in_les	String	No	Specifies if you want the clock control unit to be implemented using logic elements (LEs). Values are “ ON ” or “ OFF ”. The default setting is “ OFF ”.												
number_of_clocks	Integer	Yes	Specifies the number of global-type clock inputs. Values are numeric type (1 to 4). For other clock types, only one clock input is accepted.												
use_glitch_free_switch_over_implementation	String	No	Specifies if you want to implement a glitch-free switchover when you use multiple clock inputs. Values are “ ON ” and “ OFF ”. If omitted, the default setting is “ OFF ”.												
width_select	Integer	Yes	Specifies the width of the clock select when you use multiple clock inputs. The clock select inputs dynamically selects the clock source that drives the clock network. The values are 1 or 2 . If omitted, the default value is 1 , which means 1-bit width.												

3. Functional Description

This chapter describes the functional description and the design examples of the ALTCLKCTRL IP core. This section also includes the prototype, component declarations, and the ports descriptions of the ALTCLKCTRL IP core. You can use the ports to customize the ALTCLKCTRL IP core according to your application.

Clock Control Block

A clock control block is a dynamic clock buffer that allows you to enable and disable the clock network and dynamically switch between multiple sources to drive the clock network. [Table 3–1](#) shows the clock control block and the devices that support it.

Table 3–1. Clock Buffers that Drive the Clock Control Block

Clock Control Block	Arria 10	Arria V	Arria II GX	Stratix V	Stratix IV	Stratix III	Cyclone 10 GX	Cyclone 10 LP	Cyclone V	Cyclone IV	Cyclone I II
Global Clock Network	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dual Regional Clock Network	—	✓	✓	✓	✓	✓	—	—	✓	—	—
Regional Clock Network	✓	✓	✓	✓	✓	✓	✓	—	✓	—	—
Dedicated External Clock Out Path	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
For Periphery Clock	✓	✓	✓	✓	✓	✓	✓	—	✓	—	—

The following table describes the clock control block.

Table 3–2. Clock Control Block

Clock Control Block	Description
Global Clock Network	Allows a clock signal (or other global signals) to reach all parts of the chip with a similar amount of skew.
Regional Clock Network	Allows a signal to reach one quadrant of the chip (though half of the chip can be reached by driving two quadrants). For Arria 10 and Cyclone 10 GX devices, the regional clock network drives a “sliding window” of SCLK regions corresponding to six interface tiles high.
External Clock-Out Path	Represents the clock path from the outputs of the phase-locked loop (PLL) to the dedicated PLL_OUT pins. The ALTCLKCTRL IP core also provides glitch-free implementation for multiple clock input signals.



You must ensure the clock that is currently selected is running before switching to another source. If the selected clock is not running, the glitch-free switchover implementation will not be able to switch to the new clock source.

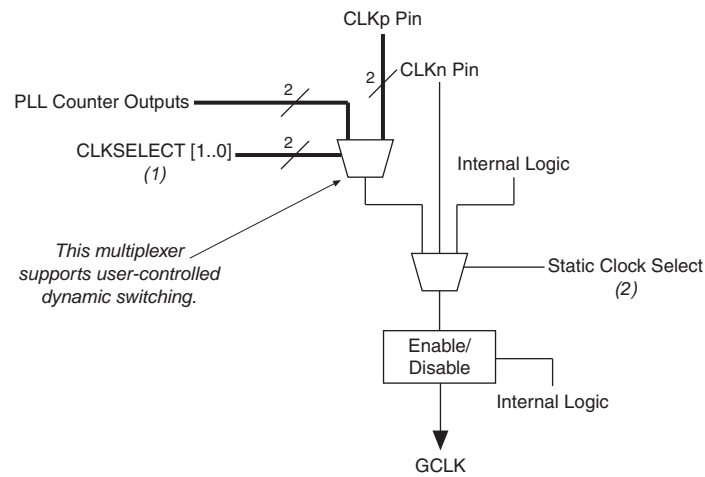
Global Clock Control Block

When a clock control block is configured to drive a global clock network, you can select the clock source statically or you can control the selection dynamically by using internal logic to drive multiplexer selector inputs. When selecting the clock source statically, you can set the clock source to any of the inputs. For example, you can use the dedicated CLK pin, internal logic, and PLL outputs.

When selecting the clock source dynamically, you can select two PLL outputs (such as c0 or c1), a combination of clock pins, or PLL outputs.

Figure 3-1 shows a clock control block and the possible sources that can drive the global clock network.

Figure 3-1. Global Clock Control Block



Notes to Figure 3-1:

- (1) You can dynamically control these clock select signals through internal logic only when the device is operating in user mode.
- (2) You can only set these clock select signals through a configuration file and cannot be dynamically controlled during user-mode operation.



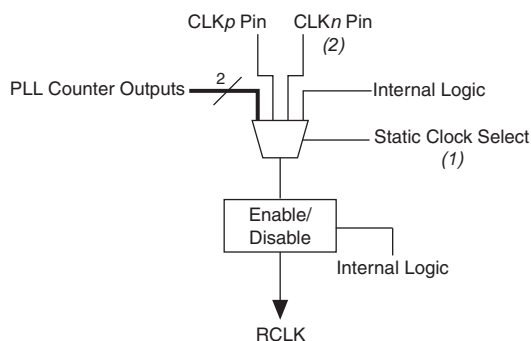
For more information about global clock control block or network in a specific device, refer to the respective device handbook.

Regional Clock Control Block

When the clock control block is configured to drive a regional clock network, you can only control the clock source selection statically. You can set any inputs to the clock select multiplexer as the clock source.

Figure 3-2 shows a clock control block configured to drive a regional clock network.

Figure 3-2. Regional Clock Control Block



Notes to Figure 3-2:

- (1) You can only control these clock select signals through a configuration file and cannot be dynamically controlled during user-mode operation.
- (2) Only the `CLKn` pins on the top and bottom of the device feed to the regional clock control blocks.

The unused global and regional clock networks are powered down automatically in the configuration file generated by the Quartus II software. The dynamic clock enable feature allows the internal logic to control the power for the GCLK and RCLK networks. You can enable or disable the clock network with the ALTCLKCTRL IP core.



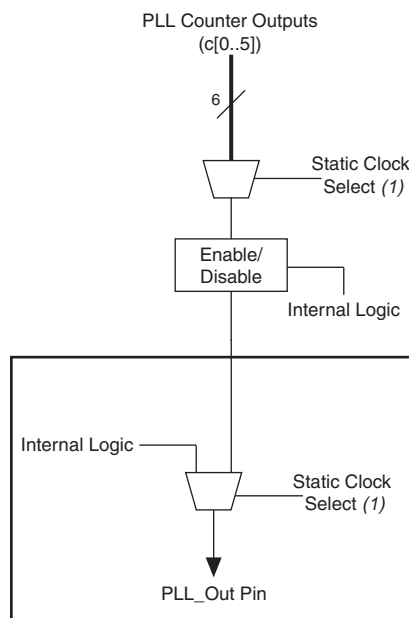
For more information about regional clock control block or network in a specific device, refer to the respective device handbook.

External PLL Output Clock Control Block

When the clock control block is configured to drive the dedicated external clock out, you can only control the clock source selection statically. You can only set the PLL outputs as the clock source.

Figure 3-3 shows a clock control block configured to drive a dedicated external clock out.

Figure 3-3. External PLL Output Clock Control Block ⁽¹⁾



Notes to Figure 3-3:

- (1) The clock control block feeds to a multiplexer within the PLL_OUT pin's I/O element (IOE). The PLL_OUT pin is a dual-purpose pin. Therefore, this multiplexer selects either an internal signal or the output of the clock control block.
- (2) You can only set these clock select signals through the configuration file and cannot be dynamically controlled during user-mode operation.



For more information about external PLL output clock control block or network in a specific device, refer to the respective device handbook.

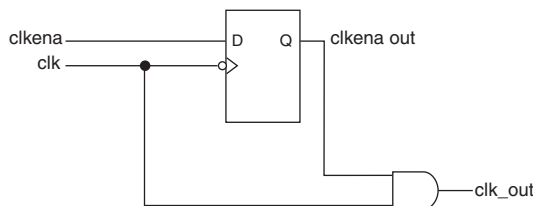
Clock Enable Signals



Single Register Clock Enable Circuit

In Cyclone III, Cyclone IV, and Cyclone 10 LP devices, the clock enable signals are supported at the clock network level. This allows you to enable or disable the GCLK and RCLK networks, or the PLL_OUT pins, which is useful for applications that require low power or sleep mode.

Figure 3-4 shows how the ena clock enable signal is implemented.

Figure 3-4. Clock Enable Implementation in Cyclone III, Cyclone IV, and Cyclone 10 LP Devices



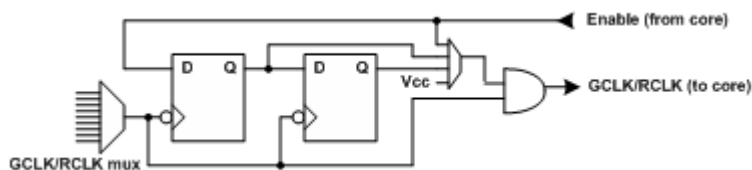
-  Single register is applicable for Cyclone III, Cyclone IV, and Cyclone 10 LP devices only.
-  For more information about clock enable signals in a specific device, refer to the respective device handbook.


Double Register Clock Enable Circuit

The double register clock enable circuit in Arria V, Arria 10, Cyclone V, Cyclone 10 GX, Stratix III, and Stratix IV devices helps with asynchronous enable/disable of the clock network, and avoid metastability issues. If the enable signal can toggle at any time, it's possible that if the enable toggles at the same instant as the falling clock edge, the register can get “stuck” in a state between 0 and 1 for some time, before resolving. Having two registers on the path acts as a synchronization chain and reduces the probability of getting stuck in this state.

Figure 3–5 shows the double register clock enable circuit.

Figure 3–5. Double Register Clock Enable Circuit

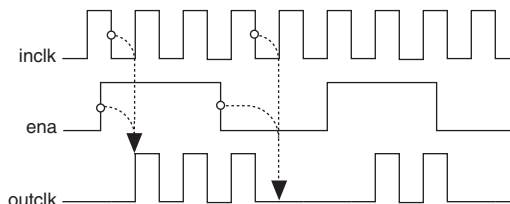


-  For more information about metastability issues, refer to *Managing Metastability with the Quartus II Software* chapter of the Quartus II Handbook.

Clock Enable Timing

Figure 3–6 shows a functional timing waveform example for clock-output enable. Clock enable is synchronous with the falling edge of the input clock.


Figure 3–6. Clock Enable Timing



Connectivity Restrictions

The following section describes the restrictions associated with the signal sources that can drive the `inclk[]` input.

General Restrictions

- The `inclk[]` ports that you use must be consistent with the `clkselect[]` ports that you use.
- When you are using multiple input sources, the `inclk[]` ports can only be driven by the dedicated clock input pins and the PLL clock outputs. Dedicated clock input pins must feed only `inclk[0]` and `inclk[1]`, while the PLL clock outputs must feed only `inclk[2]` and `inclk[3]`.
-  For mapping between the clock input pins, PLL counter outputs, and clock control block inputs in Arria 10 devices, refer to [Pin Mapping in Arria 10 Devices](#).
- The clock control block can multiplex up to four different clock inputs. You cannot cascade clock control blocks to construct a wider multiplexer.
- When you are using the glitch free switchover feature, the clock you are switching from must be active. If it is not active, the switchover circuit will not be able to transition from the clock you originally selected.

ALTCLKCTRL Ports

Input Ports

Table 3–3. ALTCLKCTRL Input Ports

Port Name	Required	Description	Comments										
clkselect[]	No	Input that dynamically selects the clock source to drive the clock network that is driven by the clock buffer.	<p>Input port [1 DOWNTO 0] wide.</p> <p>If omitted, the default is GND.</p> <p>If this signal is connected, only the global clock network can be driven by this clock control block.</p> <table><tr><th>Binary Value</th><th>Signal Selection</th></tr><tr><td>00</td><td>inclk[0]</td></tr><tr><td>01</td><td>inclk[1]</td></tr><tr><td>10</td><td>inclk[2]</td></tr><tr><td>11</td><td>inclk[3]</td></tr></table>	Binary Value	Signal Selection	00	inclk[0]	01	inclk[1]	10	inclk[2]	11	inclk[3]
Binary Value	Signal Selection												
00	inclk[0]												
01	inclk[1]												
10	inclk[2]												
11	inclk[3]												
ena	No	Clock enable of the clock buffer	<p>If omitted, the default value is V_{CC}.</p> <p>This option cannot be used for periphery clock network path in Stratix® III and Stratix IV devices.</p>										
inclk[]	Yes	Clock input of the clock buffer	<p>Input port [3 DOWNTO 0] wide.</p> <p>You can specify up to four clock inputs, inclk[3:0].</p> <p>Clock pins, clock outputs from the PLL, and core signals can drive the inclk[] port.</p> <p>Multiple clock inputs are only supported for the global and auto-selected clock networks.</p>										

Output Ports

Table 3–4. ALTCLKCTRL Output Ports

Port Name	Required	Description	Comments
outclk	Yes	Output of the clock buffer.	—

Additional Information

Document Revision History

Date	Version	Changes
April 2018	2018.04.04	Removed “Prototypes and Component Declarations” section.
June 2017	2017.06.16	Added support for Cyclone 10 GX and Cyclone 10 LP devices.
December 2016	2016.12.05	Updated “General Restrictions” on page 3–7.
August 2014	2014.08.18	<ul style="list-style-type: none"> ■ Added information about specifying parameters for IP cores targeting Arria 10 devices. ■ Added information about the latest IP output for Quartus II version 14.0a10 targeting Arria 10 devices. ■ Added information about individual migration of IP cores to the latest devices. ■ Added information about editing existing IP variations.
June 2014	2014.06.30	<ul style="list-style-type: none"> ■ Replaced MegaWizard Plug-In Manager information with IP Catalog. ■ Added standard information about upgrading IP cores. ■ Added standard installation and licensing information. ■ Removed outdated device support level information. IP core device support is now available in IP Catalog and parameter editor. ■ Removed all references to obsolete SOPC Builder tool.
February 2014	3.1	<ul style="list-style-type: none"> ■ Updated the “ALTCLKCTRL Parameters” on page 2–4 to add the information for the How do you want to register the 'ena' port? and How do you want to use the ALTCLKCTRL? parameter settings. ■ Updated Table 3–1 on page 3–1 to include Arria 10 and Stratix V devices information. Also added a row for Large Periphery Clocks. ■ Added “Double Register Clock Enable Circuit” on page 3–6. ■ Removed “Stratix II Devices Restrictions”, “Design Example: Global Clock Buffer”, and “Functional Simulation in the ModelSim-Altera Software” because beginning from Quartus II software version 13.1, Stratix II devices are no longer supported.
February 2012	3.0	<ul style="list-style-type: none"> ■ Updated information for switchover usage. ■ Added a note about assigning clock type through assignment editor.
September 2010	2.5	Updated ports and parameters.

Date	Version	Changes
December 2008	2.4	<ul style="list-style-type: none"> ■ Updated the following sections: <ul style="list-style-type: none"> ■ “Device Family Support” section ■ “Introduction” section ■ “General Description” section ■ “Design Example: Global Clock Buffer” section ■ “Functional Simulation in the ModelSim-Altera Software” section ■ “This chapter describes the prototype, component declaration, ports, and parameters of the ALTCLKCTRL megafunction. These ports and parameters are available to customize the ALTCLKCTRL megafunction according to your application.” section ■ “How to Contact Altera” section ■ Removed the following sections: <ul style="list-style-type: none"> ■ “Resource Utilization & Performance” section ■ “Software and System Requirements” section ■ “Inferring Megafunctions from HDL Code” section ■ “Instantiating Megafunctions in HDL Code or Schematic Designs” section ■ “Identifying a Megafunction after Compilation” section ■ “SignalTap II Embedded Logic Analyzer” section ■ Removed all screenshots in the “MegaWizard Plug-In Manager Page Descriptions” section ■ Reorganized the “MegaWizard Plug-In Manager Page Descriptions” section into table format. ■ Renamed “About this User Guide” section to “Additional Information” and moved the section to the end of the user guide.
May 2007	2.3	<p>Updated for Quartus II software version 7.1, including:</p> <ul style="list-style-type: none"> ■ Added information on Cyclone® III and Arria® GX device support ■ Added Referenced Documents section
March 2007	2.2	Added Cyclone III device to list of supported devices.
December 2006	2.1	Updated device family support to include Stratix® III devices.
October 2006	2.0	<p>Updated for Quartus II version 6.0, including</p> <ul style="list-style-type: none"> ■ Screen shots ■ ModelSim section in Chapter 2
September 2004	1.0	Initial release

How to Contact Altera

To locate the most up-to-date information about Altera products, refer to the following table.

Contact ⁽¹⁾	Contact Method	Address
Technical support	Website	www.altera.com/support







Contact ⁽¹⁾	Contact Method	Address
Technical training	Website	www.altera.com/training
	Email	custrain@altera.com
Product literature	Website	www.altera.com/literature
Nontechnical support (general) (software licensing)	Email	nacomp@altera.com
	Email	authorization@altera.com



Note to Table:

(1) You can also contact your local Altera sales office or sales representative.

Typographic Conventions

The following table shows the typographic conventions this document uses.

Visual Cue	Meaning
Bold Type with Initial Capital Letters	Indicate command names, dialog box titles, dialog box options, and other GUI labels. For example, Save As dialog box. For GUI elements, capitalization matches the GUI.
bold type	Indicates directory names, project names, disk drive names, file names, file name extensions, software utility names, and GUI labels. For example, \qdesigns directory, D: drive, and chiptrip.gdf file.
<i>Italic Type with Initial Capital Letters</i>	Indicate document titles. For example, <i>Stratix IV Design Guidelines</i> .
<i>italic type</i>	Indicates variables. For example, $n + 1$. Variable names are enclosed in angle brackets (< >). For example, <file name> and <project name>.pof file.
Initial Capital Letters	Indicate keyboard keys and menu names. For example, the Delete key and the Options menu.
“Subheading Title”	Quotation marks indicate references to sections in a document and titles of Quartus II Help topics. For example, “Typographic Conventions.”
Courier type	Indicates signal, port, register, bit, block, and primitive names. For example, data1, tdi, and input. The suffix n denotes an active-low signal. For example, resetn. Indicates command line commands and anything that must be typed exactly as it appears. For example, c:\qdesigns\tutorial\chiptrip.gdf. Also indicates sections of an actual file, such as a Report File, references to parts of files (for example, the AHDL keyword SUBDESIGN), and logic function names (for example, TRI).
	An angled arrow instructs you to press the Enter key.
1., 2., 3., and a., b., c., and so on	Numbered steps indicate a list of items when the sequence of the items is important, such as the steps listed in a procedure.
■ ■ ■	Bullets indicate a list of items when the sequence of the items is not important.
	The hand points to information that requires special attention.
	The question mark directs you to a software help system with related information.
	The feet direct you to another document or website with related information.
	The multimedia icon directs you to a related multimedia presentation.
	A caution calls attention to a condition or possible situation that can damage or destroy the product or your work.

Visual Cue	Meaning
	A warning calls attention to a condition or possible situation that can cause you injury.
	The envelope links to the Email Subscription Management Center page of the Altera website, where you can sign up to receive update notifications for Altera documents.