

Introduction

The complexity of today's FPGA designs is compounded by the increasing density and associated pin counts of current FPGAs. It requires you to make a large number of pin assignments that include the pin locations and I/O standards to successfully implement a complex design in the latest generation of FPGAs.

To facilitate the process of entering these assignments, Altera has developed an intuitive, spreadsheet interface called the Assignment Editor (sometimes referred to as the editor in this chapter). The Assignment Editor is designed to make the process of creating, changing, and managing a large number of assignments as easy as possible.

This chapter discusses the following topics:

- "Overview of the Assignment Editor"
- "User Interface" on page 1-3
- "Navigating the Assignment Editor Spreadsheet" on page 1-5
- "Exporting and Importing Assignments" on page 1-7
- "Creating Timing Constraints Using the Assignment Editor" on page 1-9
- "Tcl Interface" on page 1-10
- "Probing to Source Design Files and Other Quartus II Windows" on page 1-10

Overview of the Assignment Editor

You can use the Assignment Editor throughout the design cycle, for making either timing or logic assignments. Altera recommends making assignments using the Assignment Editor to help reduce mistakes while making assignments throughout the design cycle. With the editor's dynamic syntax-checking capability, illegal assignments or incorrect settings can be avoided. You can also use the Assignment Editor to view, filter, and sort assignments based on node name or assignment type.



Even though the Assignment Editor allows you to make pin assignments, Altera recommends using the Pin Planner instead. You can use the Assignment Editor to view and verify the pin assignments that you have made.

The Assignment Editor is a resizable window. This scalability makes it easy to view or edit your assignments right next to your design files. To open the Assignment Editor, click the Assignment Editor icon in the toolbar, or on the Assignments menu, click **Assignment Editor**.



You can also launch the Assignment Editor by pressing **Ctrl+Shift+A** in the Quartus® II software.

The assignments made in the Assignment Editor are saved in the Quartus II Settings File (.qsf), which is located in the project directory. A separate .qsf file exists for each individual revision. Every new assignment is placed on a new line at the end of the .qsf file. Refer to the Quartus II Help for the syntax of the .qsf file. Refer to the “Viewing and Saving Assignments in the Assignment Editor” section for more details about how Assignment Editor handles your assignments.

Every time an assignment is created or updated, the Quartus II software displays the equivalent Tcl command in the **System** tab of the Messages window. You can use the displayed messages as references when making assignments using Tcl commands.

For information about exporting your assignments to a Tcl file, refer to “Tcl Interface” on page 1-10.

Dynamic Syntax Checking

As you enter assignments, the Assignment Editor checks for basic legality and syntax. This checking is not as thorough as the checks performed during compilation, but it rejects incorrect settings.



If there are incomplete assignments when you click **Save** on the File menu, a prompt gives you the choice to either save the file and lose incomplete assignments or cancel the save operation.

The legality status of the assignments is color coded. The color of the text in each row indicates if the assignment is incomplete, disabled, non-editable, or contains errors or warnings (Table 1-1). To customize the colors used in the Assignment Editor, on the Tools menu, click **Options**.

Table 1-1. Description of the Color Codes in the Spreadsheet

Text Color	Description
Green	A new assignment can be created
Dark Yellow	The assignment contains warnings, such as unknown node name
Dark Red	The assignment is incomplete
Red	The assignment has an error, such as an illegal value
Light Gray	The assignment is disabled or turned off
Gray	The assignment is non-editable or read-only


Viewing and Saving Assignments in the Assignment Editor

Although the Assignment Editor is the most common method of entering and modifying assignments, there are other methods you can use to make and edit assignments. For this reason, you can refresh the Assignment Editor after you add, remove, or change an assignment outside the Assignment Editor.


By default, all assignments made in the Quartus II software are first stored in memory, then to the .qsf file on the disk after you start a processing task, or if you save or close your project. Saving assignments to memory avoids reading and writing to your disk drive and improves the performance of the software.

After making assignments in the Assignment Editor, on the File menu, click **Save** to save your assignments and update the .qsf file.

Starting with the Quartus II software version 5.1, you can force all assignments to be written to a disk drive. On the Tools menu, click **Options**. In the **Options** dialog box, open the **Processing** page and turn off **Update assignments to disk during design processing only**.

 For more information about how the Quartus II software writes to the **.qsf** file, refer to the *Managing Quartus II Projects* chapter in volume 2 of the *Quartus II Handbook*.

You can refresh the Assignment Editor window by clicking **Refresh** on the View menu. If you make an assignment using the Tcl console, Pin Planner, or directly modifying the **.qsf** file outside the Assignment Editor, you must click **Refresh** to update the Assignment Editor spreadsheet.

 If the **.qsf** file is edited while the project is open, on the File menu, click **Save Project** to ensure that you are editing the latest **.qsf** file.

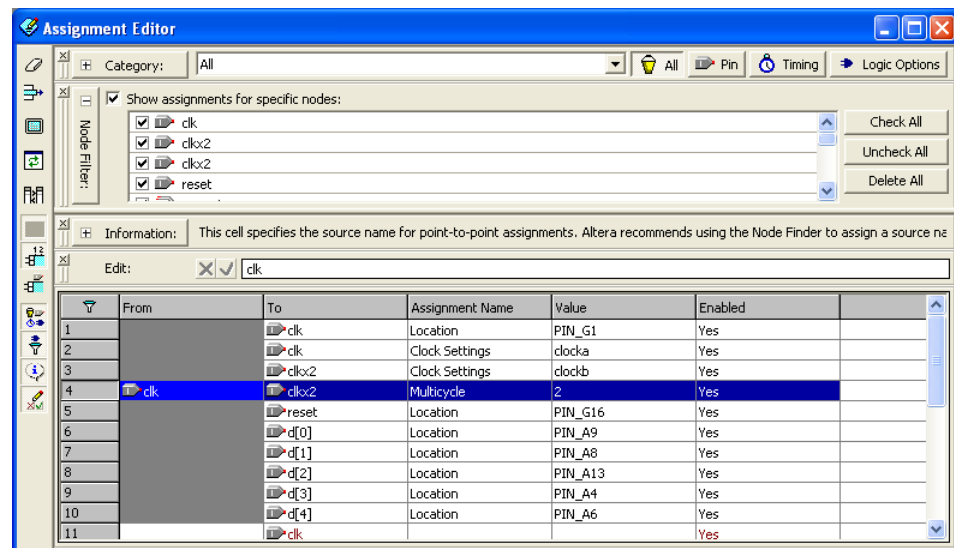
Each time the Assignment Editor is refreshed, the following message is displayed in the **System** tab of the Messages window:

```
Info: Assignments reloaded -- assignments updated outside Assignment Editor
```

User Interface

The Assignment Editor window consists of four bars and a spreadsheet (Figure 1-1). The spreadsheet is where you view and edit the assignments. You can use the bars to filter, edit, or get detailed information about the assignments.

Figure 1-1. The Assignment Editor Window



You can hide all four bars in the View menu if desired, or you can collapse all the bars for a better view of the spreadsheet. Table 1-2 provides a brief description of each bar.

Table 1-2. Assignment Editor Bar Descriptions

Bar Name	Description
Category	Lists the types of available assignments
Node Filter	Lists a selection of design nodes to be viewed or assigned
Information	Displays a description of the selected assignment
Edit	Allows you to edit the text in the selected cell(s)

Category Bar

The **Category** bar lists all assignment categories available for the selected device. You can use the **Category** bar to select a particular type of assignment and filter out all other assignments, making the spreadsheet show only the applicable assignments. For example, to view all t_{su} (setup time) assignments in your project, select **tsu** in the **Category** list. If you select **All** in the **Category** list, the Assignment Editor displays all assignments.

When you collapse the **Category** bar, three buttons are displayed that allow you to select from various preset categories ([Figure 1-2](#)). For example, clicking the **Timing** button changes the spreadsheet to show only the timing-related assignments of your project.

Figure 1-2. Collapsed Category Bar

Node Filter Bar

The **Node Filter** bar is used when you want the spreadsheet to show only assignments for specific nodes based on the list of selected node filters. The bar provides flexibility in how you view and make your settings.

For example, when **Show assignments for specific nodes** is turned on, the spreadsheet shows only assignments for nodes that match the selected node filter. You can create a new node filter by using the Node Finder to select a node name or by typing the node name. The node name filter can be a node name or assignment group, and can include wildcard symbols (* and ?). The wildcards symbols are used to filter for a selection of nodes with only one entry in the Node Filter. For more information about wildcard symbols and assignment groups, refer to [“Navigating the Assignment Editor Spreadsheet”](#) on page 1-5.

Information Bar

The **Information** bar provides a brief description of the currently selected cell and what information you should enter into the cell. For example, the **Information** bar describes whether a cell should contain a node name or a number value.

Edit Bar

The **Edit** bar is an efficient way to enter a value into one or more spreadsheet cells. To change the contents of multiple cells at the same time, select the cells in the spreadsheet, then type or choose the new value in the **Edit** field in the **Edit** bar.

Assignment Spreadsheet

The spreadsheet displays the assignments of your project. You can sort columns, use pull-down list boxes to view available options, and copy and paste multiple cells into the Assignment Editor. Refer to “[Entering Values into the Spreadsheet](#)” for details about ways to make assignments in the spreadsheet.

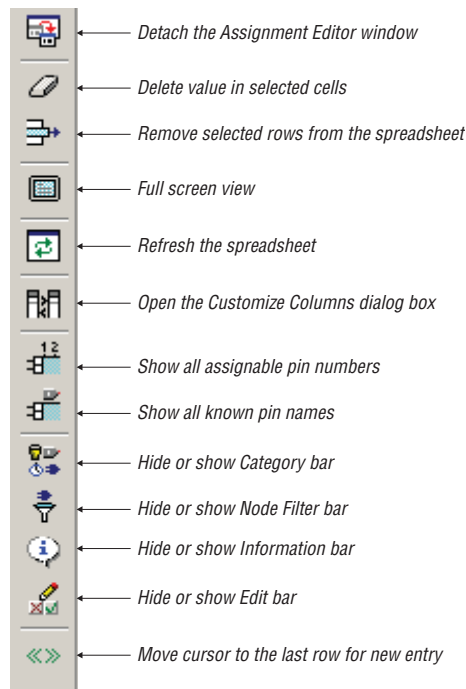
When you enter an assignment, the font color of the row changes to indicate the status of the assignment. For more information, refer to “[Dynamic Syntax Checking](#)” on page 1-2.

The spreadsheet also supports customizable columns that allow you to show, hide, and arrange columns. For more information, refer to “[Customizing the Spreadsheet Columns](#)” on page 1-7.

Toolbar

The Assignment Editor’s toolbar contains shortcut buttons for easy access to the editor’s features. [Figure 1-3](#) describes the buttons in the toolbar.

Figure 1-3. Description of Icons in the Toolbar




Navigating the Assignment Editor Spreadsheet

This section describes methods for navigating through the spreadsheet.

Entering Values into the Spreadsheet















There are many ways to select or enter nodes into the spreadsheet, including the Node Finder, the Node Filter bar, the Edit bar, or by directly typing the node name into a cell in the spreadsheet.

 To open the Node Finder, click **Node Finder** in the Edit menu, or right-click any cell in the spreadsheet or the Node Filter bar and click **Node Finder**. Alternatively, you can click **Node Finder** in the pull-down menu of the **To** and **From** columns in the spreadsheet.

A node type icon is shown beside each node name and filter to identify its type.

Table 1-3 lists the different icons and describes its type.

Table 1-3. Node Type Icons


Node Type Icon	Description
 a[0]  a	Input pin
 result[0]  result	Output pin
 taps_bidir  taps_bidir	Bidirectional pin
 taps:inst xn[0]  taps:inst xn	Register
 taps:inst xn[1]  taps:inst xn	Combinational logic
 Asg_1	Assignment group
 d*	Node name or filter that contains wildcard symbols
 taps:inst	Instance
 ae	Missing information—probably caused by incorrect node name, or Analysis and Synthesis has not been performed

Wildcards

To simplify the tasks of making many node assignments, the Quartus II software accepts the * and ? wildcard characters. Use these wildcard characters to reduce the number of individual assignments you need to make for your design.

The * wildcard character matches any string. For example, given an assignment made to a node specified as reg*, the Assignment Editor applies the assignment to all design nodes that match the prefix reg with none, one, or several characters following the prefix, such as reg, reg1, reg[2], regbank, and reg12bank.


The ? wildcard character matches any single character. For example, given an assignment made to a node specified as reg?, the Assignment Editor applies the assignment to all design nodes that match the prefix reg and any single character following, such as reg1, rega, and reg4.

 All assignments that support wildcards are shown in the pull-down list under the **Assignment Name** column of the Assignment Editor with “(Accepts wildcards/groups)” displayed beside it.

Assignment Groups

An assignment group, also known as a time group, is a collection of design nodes grouped together and represented as a single unit for the purpose of making assignments to the collection. Using assignment groups with the Assignment Editor provides the flexibility required for making complex assignments to a large number of nodes. You can also exclude specific nodes, wildcards, and assignments from an assignment group.

To create an assignment group, on the Assignments menu, click **Assignment (Time) Groups**. The **Assignment Groups** dialog box appears. You can add or delete members of each assignment group using wildcards in the Node Finder.

 For more information about using Assignment Groups for timing analysis, refer to the *Quartus II Classic Timing Analyzer* chapter in volume 3 of the *Quartus II Handbook*.

Customizing the Spreadsheet Columns

To provide more control over the display of information in the spreadsheet, the Assignment Editor supports customizable columns.

You can move columns, sort them in ascending or descending order, show or hide individual columns, and align the content of the column left, center, or right for improved readability.

When the Quartus II software starts for the first time, you see a pre-selected set of columns. For example, when the Quartus II software is first started, the Comment column is hidden. To show or hide any of the available columns, on the View menu, click **Customize Columns**. When you restart the Quartus II software, your column settings are maintained.

You can use the **Comments** column to document the purpose of an assignment, or to explain why you applied a timing or logic constraint. You can use the **Enabled** column to disable any assignment without deleting it. This feature is useful when performing multiple compilations with different timing constraints or logic optimizations.

Exporting and Importing Assignments

Designs that use the LogicLock™ hierarchical design methodology use the **Import Assignments** command to import assignments into the current project. You can also use the **Export Assignments** command to save all the assignments in your project to a file to be used for archiving or to transfer assignments from one project to another.

On the Assignments menu, click **Export Assignments** or **Import Assignments** to do the following:

- Export your Quartus II assignments to a .qsf file.

- Import assignments from a Quartus II Entity Settings File (.esf), a MAX+PLUS® II Assignment and Configuration File (.acf), a Synopsys Design Constraint (.sdc) file, a text file (.txt), or a Comma Separated Value (.csv) file.

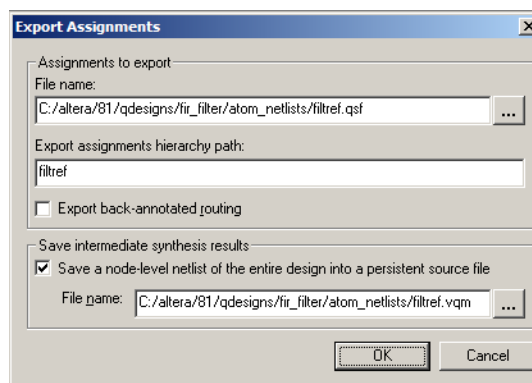
In addition to the **Export Assignments** and **Import Assignments** dialog boxes, the **Export** command on the File menu allows you to export your assignments to a .tcl file or a .csv file.

You can use these file formats for many different aspects of your project. For example, you can use a .csv file for documentation purposes or to transfer pin-related information to board layout tools. The .tcl file makes it easy to apply assignments in a scripted design flow. The LogicLock design flow uses the .qsf file to transfer your LogicLock region settings.

Exporting Assignments

You can use the **Export Assignments** dialog box to export your Quartus II software assignments into a .qsf file, generate a node-level netlist file, and export back-annotated routing information as a Routing Constraints File (.rcf). See [Figure 1-4](#).

Figure 1-4. Export Assignments Dialog Box



On the Assignments menu, click **Export Assignments** to open the **Export Assignments** dialog box. The LogicLock design flow also uses this dialog box to export LogicLock regions.

- For more information about using the **Export Assignments** dialog box to export LogicLock regions, refer to the *Analyzing and Optimizing the Design Floorplan* chapter in volume 2 of the *Quartus II Handbook*.

On the File menu, click **Export** to export all assignments to a .tcl file or export a set of assignments to a .csv file. When you export assignments to a .tcl file, only user-created assignments are written to the Tcl script file; default assignments are not exported.

When assignments are exported to a .csv file, only the assignments displayed in the current view of the Assignment Editor are exported.

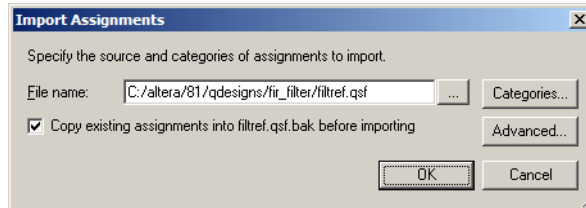
Importing Assignments

The **Import Assignments** dialog box allows you to import Quartus II assignments from a **.qsf** file, an **.esf** file, an **.acf** file, or a **.csv** file (Figure 1-5).

To import assignments from any of the supported assignment files, perform the following steps:

1. On the Assignments menu, click **Import Assignments**. The **Import Assignments** dialog box appears (Figure 1-5).

Figure 1-5. Import Assignments Dialog Box



2. In the **File name** text-entry box, type the file name or browse to the assignment file. The **Select File** dialog box appears.
3. In the **Select File** dialog box, select the file and click **Open**.
4. Click **OK**.



When you import a **.csv** file, the first uncommented row of the file must be in the exact format as it was when exported.

You can create a backup copy of your assignments before importing new assignments by turning on the **Copy existing assignments into <revision name>.qsf.bak before importing** option.

When importing assignments from a file, you can choose which assignment categories to import by following these steps:

1. Click **Categories** in the **Import Assignments** dialog box.
2. Turn on the categories you want to import from the **Assignment categories** list.

To select specific types of assignments to import, click **Advanced** in the **Import Assignments** dialog box. The **Advanced Import Settings** dialog box appears. You can choose to import instance, entity, or global assignments and select various assignment types to import.




For more information about these options, refer to the Quartus II Help.


Creating Timing Constraints Using the Assignment Editor

Accurate timing constraints guide the place-and-route engine in the Quartus II software to help optimize your design into the FPGA. After completing a place-and-route, perform a static timing analysis using the Quartus II Classic Timing Analyzer or the Quartus II TimeQuest Timing Analyzer to analyze slack and critical paths in your design.

If you are using the Quartus II Classic Timing Analyzer, create timing constraints using the Assignment Editor. In the Assignment Editor, select **Timing** in the **Category** list to show all timing-related settings and make the desired timing assignments in the editor's spreadsheet.

 For more information about the Quartus II Classic Timing Analyzer, refer to the *Quartus II Classic Timing Analyzer* chapter in volume 3 of the *Quartus II Handbook*.

If you are using the Quartus II TimeQuest Timing Analyzer, the TimeQuest Timing Analyzer uses timing assignments from a Synopsys Design Constraint (.sdc) file. Therefore, you must convert assignments from the .qsf format to the .sdc format before you can proceed with the timing analysis.


 For information about converting the timing assignments in your .qsf file to an .sdc file, refer to the *Switching to the Quartus II TimeQuest Timing Analyzer* chapter in volume 3 of the *Quartus II Handbook*.

Tcl Interface

Whether you use the Assignment Editor or another feature to create your design assignments, you can export them to a Tcl (.tcl) file. You can then use the .tcl file to reapply the settings or to archive your assignments. On the File menu, click **Export** to export your saved assignments to a .tcl file.

You can also generate a .tcl file that sets up your project and applies all the assignments to it. On the Project menu, click **Generate Tcl File for Project** to generate the file.

In addition, as you use the Assignment Editor to enter assignments, the equivalent Tcl commands are shown in the **System** tab of the Messages window. You can reference these Tcl commands to create a customized .tcl file. To copy a Tcl command from the **System** tab of the Messages window, right-click the message and click **Copy**.

 For more information about Tcl scripting with the Quartus II software, refer to the *Tcl Scripting* chapter in volume 2 of the *Quartus II Handbook*.

Probing to Source Design Files and Other Quartus II Windows

The Assignment Editor lets you cross-probe from the viewer to the source design file and to other windows within the Quartus II software. You can select a cell in the Assignment Editor spreadsheet and locate the corresponding item in another applicable Quartus II software window. To locate an item from the editor in another window, right-click the items of interest in the spreadsheet, point to **Locate**, and click the appropriate command. The following commands are available:

- Assignment Editor
- Pin Planner
- Timing Closure Floorplan
- Chip Planner (Floorplan & Chip Editor)
- Resource Property Editor

- Technology Map Viewer
- RTL Viewer
- Design File

Probing to the Assignment Editor from Other Quartus II Windows

You can cross-probe to the Assignment Editor from other windows within the Quartus II software. You can select one or more nodes or nets in another window and locate them in the Assignment Editor spreadsheet. This is useful when you want to see all assignments related to specific nodes.

You can locate nodes in the Assignment Editor from all windows within the Quartus II software. To locate assignments related to an element in the editor from other Quartus II windows, select the node or nodes in the appropriate window. For example, select an entity in the **Entity** list on the **Hierarchy** tab in the Project Navigator, or select nodes in the Timing Closure Floorplan. Next, right-click the selected object, point to **Locate**, and click **Locate in Assignment Editor**. The Assignment Editor opens, or it is brought to the foreground if it is already open.

Conclusion

As FPGAs continue to increase in density and pin count, it is essential to be able to quickly create and view design assignments. The Assignment Editor provides an intuitive and effective way of making assignments. With the spreadsheet interface and the **Category**, **Node Filter**, **Information**, and **Edit** bars, the Assignment Editor provides an efficient assignment entry solution for FPGA designers.

Referenced Documents

This chapter references the following documents:


- *Analyzing and Optimizing the Design Floorplan* chapter in volume 2 of the *Quartus II Handbook*
- *Managing Quartus II Projects* chapter in volume 2 of the *Quartus II Handbook*
- *Quartus II Classic Timing Analyzer* chapter in volume 3 of the *Quartus II Handbook*
- *Switching to the Quartus II TimeQuest Timing Analyzer* chapter in volume 3 of the *Quartus II Handbook*
- *Tcl Scripting* chapter in volume 2 of the *Quartus II Handbook*

Document Revision History

Table 1-4 shows the revision history for this chapter.

Table 1-4. Document Revision History

Date and Document Version	Changes Made	Summary of Changes
March 2009 v9.0	<ul style="list-style-type: none"> ■ Revised and reorganized the entire chapter. ■ Added section “Probing to Source Design Files and Other Quartus II Windows” on page 1-10. ■ Added description of node type icons (Table 1-3). ■ Added explanation of wildcard characters. 	Updated for the Quartus II software version 9.0 release.
November 2008 v8.1	Changed to 8½” × 11” page size. No change to content.	Updated for the Quartus II software version 8.1.
May 2008 v8.0	Updated Quartus II software 8.0 revision and date.	Updated references.

 For previous versions of the *Quartus II Handbook*, refer to the [Quartus II Handbook Archive](#).