



Transceiver Signal Integrity Development Kit, Stratix IV GT Edition User Guide



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UG-01077-1.2



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The Transceiver Signal Integrity Development Kit, Stratix® IV GT Edition provides everything you need for the signal integrity evaluation and interoperability of Stratix IV GT transceivers on the Altera® Stratix IV GT EP4S100G2 device. The kit includes a full-featured FPGA development board, hardware and software evaluation tools, documentation, and accessories needed to begin development.

With this signal integrity development kit, you can do the following:

- Evaluate transceiver performance at data rates up to 11.3 Gbps.
- Generate and check pseudo-random binary sequence (PRBS) patterns through an easy-to-use demonstration application.
- Understand the effects of changing differential output voltage (V_{OD}), preemphasis, and equalization settings.
- Perform jitter analysis.
- Verify physical medium attachment (PMA) compliance to 10 gigabit Ethernet, Interlaken, 10G GPON/EPON, IEEE 802.3ba 40G, and other major standards.

Kit Features

This section briefly describes the following Stratix IV GT transceiver signal integrity development kit features:

- **Stratix IV GT EP4S100G2 Signal Integrity Transceiver Development Board**—a development platform that allows you to develop and prototype hardware designs running on the Stratix IV GT FPGA (ordering code: DK-SI-4S100G2N).

 For detailed information about board components and interfaces, refer to the *Transceiver Signal Integrity Development Kit, Stratix IV GT Edition Reference Manual*.

- **Transceiver Signal Integrity Development Kit, Stratix IV GT Edition** includes the following:
 - Schematic and board design files
 - Design examples for the Board Update Portal Embedded Nios® II webserver and the Golden Top Level Project
 - Device data sheets
 - Stratix IV GT Transceiver Signal Integrity Demonstration software
 - Quartus II Stand-Alone Programmer software
 - Stratix IV GT signal integrity development kit application and device driver
 - Complete documentation:
 - *Transceiver Signal Integrity Development Kit, Stratix IV GT Edition User Guide* (this document)—Describes how to use the kit.
 - *Transceiver Signal Integrity Development Kit, Stratix IV GT Edition Reference Manual*—Provides specific information about the board components and interfaces, steps for using the board, and pin-outs and signal specifications.
 - **Readme.txt**—Contains special instructions and refers to the kit documentation.
- **Power Supply and Cable**—The following items are included in the development kit:
 - USB cable
 - Ethernet CAT-5/RJ-45 cable
 - Power supply and AC adapters for North America, Japan, Europe, and the United Kingdom

Software

The software for this kit, described in the following sections, is available on the Altera website for immediate downloading. You can also request to have Altera mail the software to you on DVDs.


Transceiver Signal Integrity Development Kit, Stratix IV GT Edition Installer

The license-free Transceiver Signal Integrity Development Kit, Stratix IV GT Edition installer includes all the documentation and design examples for the kit.

Download the kit installer from the [Transceiver Signal Integrity Development Kit, Stratix IV GT Edition](#) page of the Altera website. Alternatively, you can request a Development Kit DVD from the [Altera Kit Installations DVD Request Form](#) page of the Altera website.

This user guide familiarizes you with the contents of the kit and guides you through the Stratix IV GT transceiver signal integrity board setup. Using this user guide, you can do the following:

- Inspect the contents of the kit
- Install the Transceiver Signal Integrity Development Kit, Stratix IV GT Edition software
- Set up, power up, and verify correct operation of the signal integrity board
- Configure the Stratix IV GT FPGA
- Run the signal integrity software and use the test designs

 For complete information about the signal integrity board, refer to the *Transceiver Signal Integrity Development Kit, Stratix IV GT Edition Reference Manual*.

Before You Begin

Before using the kit or installing the software, check the kit contents and inspect the board to verify that you received all of the items listed in this section. If any of the items are missing, contact Altera before you proceed.

Check the Kit Contents

Refer to “[Kit Features](#)” on page 1–1 for the contents of your kit.

 To ensure that you have the most up-to-date information about this product, refer to the [Transceiver Signal Integrity Development Kit, Stratix IV GT Edition](#) page.

Inspect the Board

To inspect the board, perform the following steps:

1. Place the board on an anti-static surface and inspect it to ensure that it has not been damaged during shipment.



Without proper anti-static handling, the Stratix IV GT transceiver signal integrity board can be damaged.

2. Verify that all components are on the board and appear intact.



In typical applications with the Stratix IV GT transceiver signal integrity board, a heat sink is not necessary. However, under extreme conditions the board may require additional cooling to stay within operating temperature guidelines. You may wish to perform power consumption and thermal modeling to determine whether your application requires additional cooling.



For more information about power consumption and thermal modeling, refer to *AN 358: Thermal Management for FPGAs*.

Hardware Requirements

The kit provides all the hardware you need to use the board.

Software Requirements

The kit requires the following software:

- Quartus II Subscription Edition software (to run the demonstration GUI)



Certain DLLs that are required for the demonstration application (**stratixIVGT_si_demo.exe**) to function properly are not included with the kit installation software. These needed DLLs are installed with the Quartus II Subscription Edition software, versions 9.1, 9.1sp1, or 9.1sp2. Make sure you successfully display the main Quartus II GUI at least once. If you don't want to purchase a license, you can uninstall the Quartus II software; the demonstration application will continue to function properly. Refer to *"Installing the Quartus II Software"* on page 3-2.

- Quartus II Programmer
- Windows XP operating system or later

References

For other related information, refer to the following websites:

- For additional daughter cards available for purchase:

www.altera.com/products/devkits/kit-daughter_boards.jsp

- For the Stratix IV device documentation:

www.altera.com/literature/lit-stratix-iv.jsp

- For the eStore if you want to purchase devices:

www.altera.com/buy/devices/buy-devices.html

- For Stratix IV GT OrCAD symbols:

www.altera.com/support/software/download/pcb/pcb-pcb_index.html

- For Nios II 32-bit embedded processor solutions:

www.altera.com/technology/embedded/emb-index.html

- For Nios II 32-bit embedded processor solutions:

www.altera.com/technology/embedded/emb-index.html

The instructions in this chapter explain how to install the following software:

- Transceiver Signal Integrity Development Kit, Stratix IV GT Edition software.
- Quartus II software—Certain DLLs that are required for the demonstration application (**stratixIVGT_si_demo.exe**) to function properly are not included with the kit installation software. These needed DLLs are installed with the Quartus II Subscription Edition software, versions 9.1, 9.1sp1, or 9.1sp2. Make sure you can successfully display the main Quartus II GUI at least once. If you don't want to purchase a license, you can uninstall the Quartus II software. The demonstration application will continue to function properly. Refer to [“Installing the Quartus II Software” on page 3-2](#).
- USB-Blaster driver.

Before starting the installation, verify that you have complied with the conditions described in [“Software Requirements” on page 2-2](#).

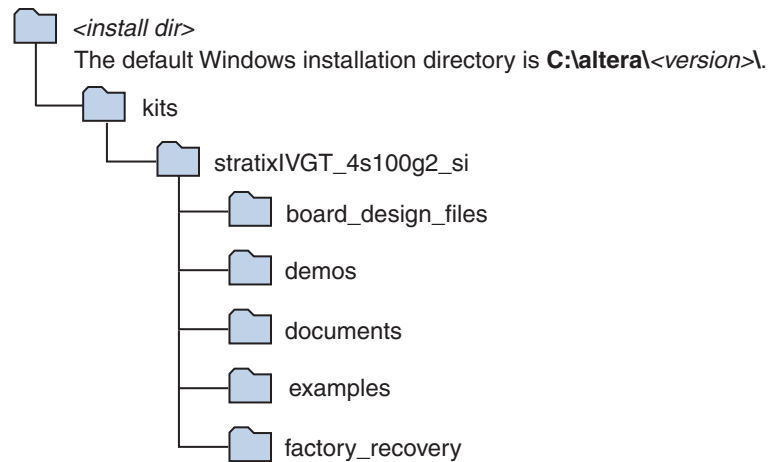
Installing the Transceiver Signal Integrity Development Kit, Stratix IV GT Edition

To install the Transceiver Signal Integrity Development Kit, Stratix IV GT Edition, perform the following steps:

1. Run the kit installer you acquired in [“Software” on page 1-2](#).
2. Follow the on-screen instructions to complete the installation process. Be sure that the installation directory you choose is in the same relative location to the Quartus II software installation.

The installation program creates the Transceiver Signal Integrity Development Kit, Stratix IV GT Edition directory structure shown in [Figure 3-1](#).

Figure 3-1. Stratix IV GT Transceiver Signal Integrity Kit Installed Directory Structure



Note to Figure 3-1:

(1) Early-release (engineering silicon) versions might have slightly different directory names.

[Table 3-1](#) lists the file directory names and a description of their contents.

Table 3-1. Installed Directory Contents

Directory Name	Description of Contents
board_design_files	Contains schematic, layout, assembly, and bill of material board design files. Use these files as a starting point for a new prototype board design.
demos	Contains demonstration applications that may change from release to release.
documents	Contains the development kit documentation.
examples	Contains the sample design files for the Stratix IV GT transceiver signal integrity development kit.
factory_recovery	Contains the original data programmed onto the board before shipment. Use this data to put the board into the original condition.

Installing the Quartus II Software

Certain DLLs that are required for the demonstration application (**stratixIVGT_si_demo.exe**) to function properly are not included with the kit installation software. These needed DLLs are installed with the Quartus II Subscription Edition software, versions 9.1, 9.1sp1, or 9.1sp2. Make sure you successfully display the main Quartus II GUI at least once. If you don't want to purchase a license, you can uninstall the Quartus II software; the demonstration application will continue to function properly.

To run the demonstration application or to create new designs, perform the following steps:

1. From Altera's [Download Center](#), click the *Request previous versions of Quartus II* link just above the **Download Individual Components** section, which brings up an email form to request a link to the Quartus II software, version 9.1, 9.1sp1, or 9.1sp2.

2. Follow the online instructions to complete the installation process to install the Quartus II software.



If you have difficulty installing the Quartus II software, refer to the *Quartus II Installation & Licensing for Windows and Linux Workstations*.

Installing the USB-Blaster Driver

The Stratix IV GT transceiver signal integrity board includes integrated USB-Blaster circuitry for FPGA programming. However, for the host computer and signal integrity board to communicate, you must install the USB-Blaster driver on the host computer.

To download the USB-Blaster driver, go to the Altera support site at www.altera.com/support/software/drivers/dri-index.html.

To install it, go to www.altera.com/support/software/drivers/usb-blaster/dri-usb-blaster-xp.html.

The instructions in this chapter explain how to power up the signal integrity development board.

Powering Up the Board

To power up the board, perform the following steps:

1. Verify that the MAX/JTAG jumper J26 is OFF, and that the mini-DIP switch SW2 settings located adjacent to jumper J62 match the settings in the following table:

Table 4-1.

Switch Pin	SW2.1	SW2.2	SW2.3	SW2.4
Label	S0	S1	S2	S3
Position	up or 0	down or 1	down or 1	down or 1



Maintain these settings as they control the speed of the board oscillator. For more information, refer to the *Transceiver Signal Integrity Development Kit, Stratix IV GT Edition Reference Manual*.

2. Connect the power cable to the board and plug the other end into a power outlet.
3. Connect the DC adapter (+16 V, 3.75 A) to the DC power jack (J1).



Use only the supplied 16-V power supply. Power regulation circuitry on the board could be damaged by supplies greater than 16 V.

4. Ensure the POWER switch (SW1) is in the ON position. When power is supplied to the board, LED D3 turns on indicating that the board has power.

After the board powers up, the on-board flash memory, which ships preprogrammed with the factory design, automatically configures the Stratix IV GT device. The FACTORY LED illuminates, signaling that the Stratix IV GT device is configured with the preprogrammed factory design.

This chapter describes the Board Update Portal which allows you to upload new designs and provides access to useful and relevant information about the kit.

Board Update Portal

This development kit is shipped with an example design stored in the factory portion of the flash memory on the board. Whenever jumper J62 is set to LOAD FACTORY, the Stratix IV GT FPGA is automatically configured with the Board Update Portal example design. The example design is an embedded web server, which serves the Board Update Portal web page. The web page allows you to upload new FPGA designs to the designated flash memory on your board, and also provides links to useful information, on the Altera website at www.altera.com, including links to kit-specific and design resources.

After the Board Update Portal is used to successfully update a design, jumper J62 can be set to LOAD USER and the design configures upon reset or power up. To do so, set the configuration program select jumper, PGMSEL, (J62) to the position (jump pins 1-2) and power cycle the board. This cycle can be repeated for different designs as long as the factory Board Update Portal is preserved. If the Board Update Portal is corrupted or deleted from the flash memory, refer to “[Restoring the Factory Design to the Flash Device](#)” on page A-4.

The source for the Board Update Portal design resides in the `<install dir\kits\stratixIVGT_4sGT_4s100g2_si\examples`. It consists of a Nios II embedded processor, an Ethernet MAC, and an HTML web server. When the board is connected to the network, the Nios II processor obtains an IP address and allows the browser access to its HTML web page.

This section provides instructions on how to connect to the Board Update Portal web page.



Before you proceed, ensure that you have the following:

- A PC with a connection to a working Ethernet port on a DHCP enabled network.
- A separate working Ethernet port connected to the same network for the board.
- The Ethernet and power cables that are included in the kit.

Connecting to the Board Update Portal Web Page

1. With the board powered down, make sure jumper J62 is in the LOAD FACTORY position (pins 2-3).
2. Attach the Ethernet cable from the board to the LAN.
3. Power up the board. The board connects to the LAN's gateway router, and obtains an IP address. The LCD on the board displays the IP address.

4. Launch a web browser on a PC that is connected to the same network, and enter the IP address from the LCD into the browser address bar. The Board Update Portal web page appears in the browser page.
5. Click **Signal Integrity Development Kit** to view the latest version of the development kit software.



If you download new software, double-click the downloaded **.exe** file to begin the installation process.



Visit the Board Update Portal web page to check for additional new designs and documentation updates.



If the Board Update Portal cannot connect for some reason, then go to the [Transceiver Signal Integrity Development Kit, Stratix IV GT Edition](#) page of the Altera website to ensure that the board has the latest kit software.

Using the Board Update Portal to Update Designs

The Board Update Portal allows remote update of new FPGA configurations to the flash memory. Perform the following steps to update the memory on your board with a design downloaded from the Altera website.

1. Type the IP address displayed on the LCD into the web browser on the PC or use the browser's **Back** button to return to the main Board Update Portal web page.
2. Click the **Browse** button next to the **Hardware File Name** field and browse to the new **.flash** file that was downloaded. If there is a software component to the design, then include it in the same manner in the **Software File Name** field, otherwise leave the field empty.
3. Click **Upload**. The progress bar indicates the percent complete.
4. After the upload process is complete, the FPGA can be configured with the new image. To do this, change jumper J62 to LOAD (jump pins 1-2). To enable reconfiguration of the FPGA, power up the board again or press RESET SW8. The design running in flash is the selected **.flash** file.



As long as the factory image is not overwritten, the Board Update Portal can be used to update new images in the same manner. If the factory memory image is overwritten, it can be restored by following the instructions in ["Restoring the Factory Design to the Flash Device"](#) on page A-4.

The kit installs a demonstration application and test designs. The application provides an easy-to-use interface where you can select various transceiver settings and observe the result. Before you run the application and test designs, connect the USB cable to the board and navigate to the Stratix IV GT Transceiver Signal Integrity Demonstration application as explained in [“Installing the Transceiver Signal Integrity Development Kit, Stratix IV GT Edition”](#) on page 3–1.

Test Designs

Altera provides a set of SRAM Object File (.sof) test designs for the evaluation of the Stratix IV GT device transceiver performance and board features. Before you run the application, use the Quartus II Programmer to configure the Stratix IV GT device with one of the .sof files. [Table 6–1](#) shows file name, data rate, transceiver mode, and clock source details for each test design.

Table 6–1. Test Design Details

File Name	Transceiver Block and Channel	Data Rate (Gbps)	Transceiver Mode	Clock Source
signal_integrity_demo1.sof	Block 2 Channel 0	11.3	Basic mode with low latency PCS enabled (1)	Y4 (706.25 MHz)
	Block 2 Channel 1	11.3	Basic mode with low latency PCS enabled (1)	Y4 (706.25 MHz)
	Block 1 Channels 2-5	10.3125	Basic mode with low latency PCS enabled (1)	Y3 (644.53 MHz)
signal_integrity_demo2.sof	Block 2 Channel 0	11.3	Basic mode with low latency PCS enabled (1)	Y4 (706.25 MHz)
	Block 2 Channel 1	11.3	Basic mode with low latency PCS enabled (1)	Y4 (706.25 MHz)
	Block 1 Channels 6-9	10.3125	Basic mode with low latency PCS enabled (1)	Y3 (644.53 MHz)

Note to Table 6–1:

(1) This is the only transceiver mode available for the corresponding data rate.

Early-release kits might not ship with the latest designs and new designs might be added after kit release. Refer to [“Connecting to the Board Update Portal Web Page”](#) on page 5–1 to access the most current designs and revisions.

Configuring the FPGA Using Quartus II Programmer

It is sometimes necessary to use the Quartus II Programmer to configure the FPGA with specific .sof files, such as the designs in [Table 6–1](#). Before configuring the FPGA, ensure that the Quartus II Programmer and the USB-Blaster driver are installed on the host computer and the development board is powered up.

To configure the Stratix IV GT FPGA, perform the following steps:

1. Start the Quartus II Programmer.
2. Click **Auto Detect** to display the devices in the JTAG chain.
3. Click **Add File** and select the path to the desired **.sof**.
4. Turn on the **Program/Configure** option for the added file.
5. Click **Start** to download the selected file to the FPGA. The FPGA is configured when the progress bar reaches 100%.



To determine if the appropriate test design **.sof** is programmed, check the LCD for the test design number. Refer to [“LCD Information”](#) for more information.

LCD Information

The LCD shows the following information:

- The Stratix IV GT device junction temperature in Celsius.
- The power in watts for the different transceivers (VCCA_L/R, VCCT, VCCR, VCCH_GXB, VCCL_GXB) and core (VCC) voltage supply rails. Turn the rotary switch SW16 to observe the different voltage supply values. To learn more about the switch position for displaying the various supply rail values on the LCD, click the **Help** button in the demonstration application.
- The sof/pof number that is programmed is indicated by ‘pof’ followed by the number.

The power values shown for the VCCA_L/R and the VCCH_GXB assume that the jumper settings are set to 3.0 V and 2.5 V, respectively. Click the **Help** button to see the required jumper settings.

Running the Demonstration Application and Test Designs

The demonstration application communicates with the set of test designs provided with the kit. You can change the various transceiver parameters that are described in this section.




To run the application, make sure that the board is powered up properly and there is a USB cable attached, then go to the

`<install dir>\kits\stratixIVGT_4s100g2_si\demos\` directory and double-click on **stratixIVGT_si_demo.exe** file. Ensure that the Stratix IV FPGA is programmed with the **.sof** specified in [Table 6-1 on page 6-1](#).



Certain DLLs are required for the demonstration application (**stratixIVGT_si_demo.exe**) to function properly that are not included with the kit installation software. These needed DLLs are installed with the Quartus II Subscription Edition software, version 9.1. Once installed, you can immediately uninstall the Quartus II software afterwards if you don't want to purchase a license. Refer to [“Installing the Quartus II Software” on page 3-2](#).

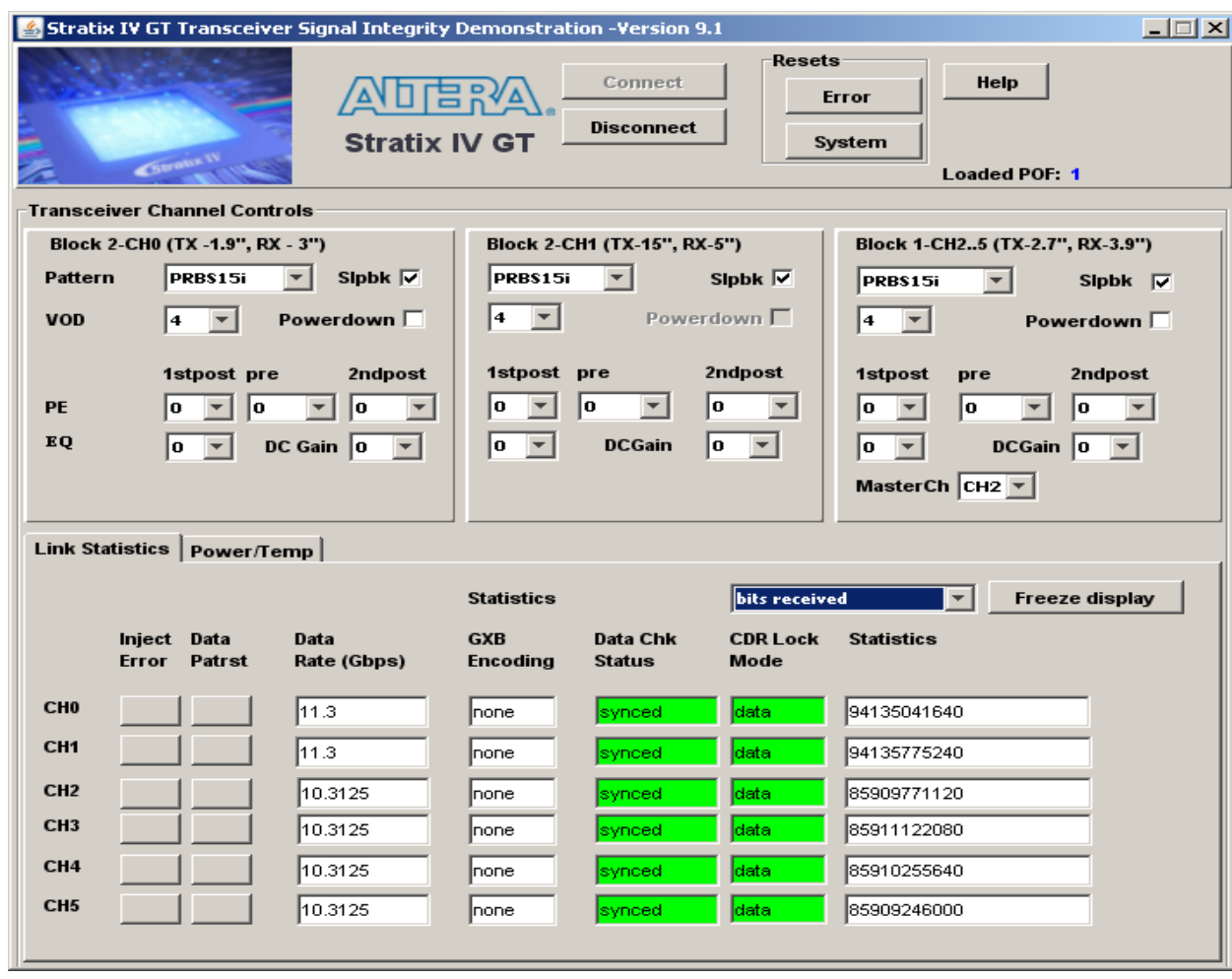
To enable the application to communicate with the board, click the **Connect** button. To close the application, click the **Disconnect** button ([Figure 6-1](#)).

-  Because the demonstration application communicates with the board using the same interface as the Quartus II Programmer or SignalTap® II Embedded Logic Analyzer, you can run only one of these applications at a time.
-  The application will not run unless the USB cable is attached, power is applied, and the correct .sof is programmed to the Stratix IV GT FPGA as specified in Table 6-1 on page 6-1.
-  For operating system stability, keep the USB cable connected and the board powered ON when running the demonstration application.

Demonstration Application Description

The demonstration application provides an easy-to-use interface (Figure 6-1) to change transceiver parameters and observe the performance. You can customize your board design by choosing transceiver settings from the categories described in this section.

Figure 6-1. Demonstration Application Control Panel Window



Analog Settings

You can use the application to dynamically control transceiver PMA settings for the different transceiver blocks. The following list defines the analog setting parameters in the control panel window:

Parameter	Description
VOD	differential output driver voltage.
EQ	equalization.
Gain	DC gain.
PE	preemphasis/deemphasis. pre , 1stpost , and 2ndpost settings represent different taps.

Resets

The following list describes the available resets:

Reset	Description
System	Reset for the transceiver.
Error	Reset for all the error counters to zero.



After the **System Reset** is asserted, the **DataChk Status** may show **unsynced** for some channels due to the asynchronous nature of the reset. Asserting the **Data Patrst** synchronizes the error checker to the transmitted data.

Help

The **Help** button displays the image of the Stratix IV signal integrity board and also highlights the channel locations and their data rates based on the **.sof** loaded.

Power Down

Turn on **Powerdown** to power down the transceiver block.

Serial Loopback

Serial loopback is available for all the channels and can be controlled during run time. After the serial loopback status in the interface changes, the **DataChk Status** field may show **unsynced** for some channels due to the asynchronous nature of the serial loopback signal. The **Data Patrst** should be asserted in this case to synchronize the error checker with the transmitted data.

Data Patterns

The application supports high- and low-frequency patterns for PRBS15i, PRBS7, PRBS23 and PRBS31. No synchronization patterns are sent prior to sending the PRBS pattern. Therefore, you can use a third party receiver to recognize the PRBS data.

Data verifiers are not available for the high frequency (1010..) and low frequency (5'1s and 5'0s) patterns.

Link Statistics Tab

The **Link Statistics** settings include the following options:

Parameter	Description
Statistics	Displays the BER, number of bits received, number of errors received, and the error slope based on the selection from the list. The error slope shows the error trend (increase or decrease). You can use this statistic to determine whether the PMA control settings must be increased or decreased to get an error free link.
Inject Error	Injects errors in the channels. Every time this button is asserted, one-bit error is introduced.
Data Patrst	Reset for the data pattern generators and checkers.
Data Rate	Based on the test design selected, the application displays the serial data rate of the transceiver channels.
GXB Encoding	Displays whether the data sent by the test design is 8B/10B encoded.
DataChk Status	The DataChk Status field displays the following: <ul style="list-style-type: none"> n synced status displayed in green indicates that the error checker has received the predefined header byte and no errors are detected. n unsynced status displayed in gray indicates that the error checker has not received the selected pattern. n If the DataChk Status field shows unsynced, check whether the transmitter of the channel showing unsynced is connected to the receiver channel by external cable or by internal serial loopback. However, when sending the high frequency data pattern, the DataChk Status shows unsynced. This is because the error checker is not provided for high frequency pattern. n error status indicates that the error checker is detecting errors in the received pattern.
CDRLock Mode	Shows whether the transceiver Clock Recovery Unit (CRU) is locked to the reference clock or to the data. When the transceiver locks to the incoming data, this field displays data indicating that the receive PLL has recovered the clock from the incoming data.
Freeze Display	When you click the Freeze display button, the display field does not change and the counting continues. When you click the Unfreeze display , the current running values are shown.

Power and Temperature Tab

The application displays the Stratix IV device junction temperature. It also shows the power or current values for the six supply rails.

You can also observe the power and temperature values on the LCD. For more information, refer to [“LCD Information” on page 6-2.S](#)

There is a common flash interface (CFI) type flash memory device on the Stratix IV GT transceiver signal integrity board. When you first receive the kit, the CFI flash device arrives programmed with a default factory FPGA configuration for running the Board Update Portal example design and a default user configuration for running the primary transceiver signal integrity demonstration. There are several other factory software files written to the CFI flash device to support the running of the Board Update Portal. These software files were created using the Nios II EDS just as the hardware design was created using the Quartus II Design application.

Board Update Portal CFI Flash Memory Map

Table A-1 shows the default memory contents of the 512-Mb (64-MB) single-die CFI flash device. For the Board Update Portal to run correctly and update designs in the user memory, this memory map must not be altered.

Table A-1. Byte Address Flash Memory Map

Block Description	Size	Address Range
Unused	32 KB	0x03FF8000 - 0x03FFFFFF
Unused	32 KB	0x03FF0000 - 0x03FF7FFF
Unused	32 KB	0x03FE8000 - 0x03FEFFFF
Unused	32 KB	0x03FE0000 - 0x03FE7FFF
User software	24,320 KB	0x02820000 - 0x03FDFFFF
Factory software	8,192 KB	0x02020000 - 0x0281FFFF
zipfs (html, web content)	8,192 KB	0x01820000 - 0x0201FFFF
User hardware	12,288 KB	0x00C20000 - 0x0181FFFF
Factory hardware	12,288 KB	0x00020000 - 0x00C1FFFF
PFL option bits	32 KB	0x00018000 - 0x0001FFFF
Reserved	32 KB	0x00010000 - 0x00017FFF
Ethernet option bits	32 KB	0x00008000 - 0x0000FFFF
User design reset vector	32 KB	0x00000000 - 0x00007FFF


Using the Board Update Portal or Nios II EDS tools, you can update the user flash configuration with designs provided on Altera’s website for demonstration and evaluation. For more information, refer to [“Board Update Portal”](#) on page 5-1.



Altera advises against overwriting the FACTORY HW or SW images unless you are expert with the Altera tools or overwriting the factory design is deliberate. If you unintentionally overwrite the FACTORY HW or SW images, refer to [“Restoring the Factory Design to the Flash Device”](#) on page A-4.

Parallel Flash Loader

The development kit features a MAX II configuration design in the `<install dir>\kits\stratixIVGT_4s100g2_si\examples\maxII_epm1270_si` directory that includes a PFL megafunction. The Parallel Flash Loader (PFL) on the MAX II device is used to configure from CFI flash when the RESET SW8 is pressed or the board is powered up.

 For more information about the PFL megafunction, refer to *AN 386: Using the Parallel Flash Loader with the Quartus II Software*.

Custom User Design

As you develop your own project using the Altera tools, you may wish to program the flash device so that, upon power up, it loads the FPGA with your own user design. With the Nios II EDS tool `sof2flash`, your Quartus II compiled `.sof` can be converted to a `.flash` file. The `.flash` file can then be written to the user hardware location of the flash memory using either the Board Update Portal or the Nios II EDS `nios2-flash-programmer` from a Nios II command-line shell.

If you used the Nios II EDS to derive your software design, you can use the Nios II EDS tools to convert your compiled and linked software Executable and Linkable Format File (`.elf`) design to `.flash` files. After your design files are in the `.flash` format, then both hardware and software files can be written using the Board Update Portal or using the Nios II EDS `nios2-flash-programmer`.

 For more information about Nios II EDS software tools and practices, refer to www.altera.com/products/ip/processors/nios2/tools/ni2-development_tools.html

The following sections describe how to program the flash device using first the Board Update Portal, then using only the Nios II EDS command-line tools.

Creating Flash Files Using the Nios II EDS

If you have hardware developed using the Quartus II application, and software developed using the Nios II EDS, follow these instructions:


1. On the Windows Start Menu, go to **All Programs** > **altera** > **Nios II EDS** > **Nios II Command Shell**.
2. In the Nios II Command Shell, navigate to the directory where your design files are located and type the following Nios II EDS commands:

- For `.sof` Quartus II hardware files:


```
sof2flash --input=yourfile_hw.sof --output=yourfile_hw.flash --offset=0xC20000 ←
```

- For `.elf` Nios II software files:

```
elf2flash --base=0x08000000 --end=0x0BFFFFFF --reset=0x08820000 --input=yourfile_sw.elf
--output=yourfile_sw.flash
--boot=$SOPC_KIT_NIOS2/components/altera_nios2/boot_loader_cfi.srec ←
```


 For boards with dual-die CFI flash devices, use `--base=0x0A000000` and `--offset=0x00020000`. For more information, refer to the *Board Revision History* appendix of the *Transceiver Signal Integrity Development Kit, Stratix IV GT Edition Reference Manual*.

These steps result in a set of **.flash** files suitable for Board Update Portal writing to the user flash memory. For more information, refer to “[Board Update Portal](#)” on page 5–1.

 If your own design uses additional software files such as files used by the runtime program or image data, you must first convert the files to **.flash** format and concatenate them into one **your_sw.flash** file before using the Board Update Portal to upload them.

 The Board Update Portal standard **.flash** format conventionally uses either `<filename>_hw.flash` for hardware design files or `<filename>_sw.flash` for software design files.

If you have a hardware **.sof** developed using the Quartus II application that operates without a software design file, you should still use the Nios II EDS tool **sof2flash** to convert the **.sof** to **.flash** file, as described earlier for the hardware files. When the Board Update Portal is implemented in this case, only the **yourfile_hw.flash** file is selected without the **yourfile_sw.flash** file.

You can program the **.flash** files using the Nios II EDS **nios2-flash-programmer** instead of the Board Update Portal as described in the next section.

Nios II EDS Flash Programming Instructions

To program the **.flash** files or any compatible S-Record File (**.srec**) to the board using **nios2-flash-programmer**, perform the following steps:

Firstly, configure the FPGA with a compatible **.sof** for flash-programming:

1. Move jumper J62 from LOAD FACTORY to LOAD USER (jump pins 1-2).
2. With the board powered up and the USB cable attached, as described in “[Configuring the FPGA Using Quartus II Programmer](#)” on page 6–1, start the Quartus II Programmer.
3. Click **Add File** and select the following path:
`<install dir>\kits\stratixIVGT_4s100g2_si\factory_recovery\s4gt100_si_bup.sof`
4. Turn on the **Program/Configure** option for the added file.
5. Click **Start** to download the selected configuration file to FPGA. The FPGA is configured when the progress bar reaches 100%, after which the user LEDs flash repeatedly on and off indicating that the flash device is ready for programming.


Secondly, run the Nios II EDS **nios2-flash-programmer**:

1. On the Windows Start Menu, go to **All Programs > altera > Nios II EDS > Nios II Command Shell**.
2. In the Nios II Command Shell, navigate to the `<install dir>\kits\stratixIVGT_4s100g2_si\factory_recovery` directory and type the following Nios II EDS command:

```
nios2-flash-programmer --base=0x08000000 yourfile_hw.flash ↵
```


and after programming completes and if there is a software component, type the following Nios II EDS command:

```
nios2-flash-programmer --base=0x08000000 yourfile_sw.flash ↵
```

 For boards with dual-die CFI flash devices, use `--base=0x0A000000` just when programming the `yourfile_sw.flash`. Continue to use `--base=0x08000000` for `yourfile_hw.flash`. For more information, refer to the *Board Revision History* appendix of the *Transceiver Signal Integrity Development Kit, Stratix IV GT Edition Reference Manual*.


This step results in writing the `.flash` file or files to their appropriate user locations.

3. Click the Quartus II Programmer **Start** button to download the configuration file to the FPGA. The FPGA is configured when the progress bar reaches 100%, after which the user LEDs flash repeatedly on and off indicating that the flash is written.
4. Repower the board so that the new user design runs on the board.

 For more information about the `nios2-flash-programmer` utility, refer to the *Nios II Flash Programmer User Guide*.

Restoring the Factory Design to the Flash Device

To restore the development board to factory condition, the contents of the flash device must be rewritten and the board repowered. Make sure you have the Nios II EDS installed, and perform the instructions in this section.

 For boards with dual-die CFI flash devices, use `<install dir>\kits\stratixIVGT_4s100g2_si\factory_recovery\dual_die_flash` directory. For more information, refer to the *Board Revision History* appendix of the *Transceiver Signal Integrity Development Kit, Stratix IV GT Edition Reference Manual*.

Nios II EDS Recovery Instructions

1. Set the board switches to the factory default settings described in “Powering Up the Board” on page 4-1.
2. Start the Quartus II Programmer.
3. Click **Add File** and select the following path:
`<install dir>\kits\stratixIVGT_4s100g2_si\factory_recovery\s4gt100_si_bup.sof`
4. Turn on the **Program/Configure** option for the added file.
5. Click **Start** to download the selected configuration file to FPGA. The FPGA is configured when the progress bar reaches 100%, after which the user LEDs flash repeatedly on and off indicating that the flash device is ready for programming.
6. On the Windows Start Menu, go to **All Programs> altera> Nios II EDS> Nios II Command Shell**.

7. In the Nios II Command Shell, navigate to the `<install dir>\kits\stratixIVGT_4s100g2_si\factory_recovery` directory and type the following Nios II EDS commands:

```
nios2-flash-programmer --base=0x08000000 restore_0_s4gt100_si_bup.flash ↵
```



For boards with dual-die CFI flash devices, use `--base=0x0A000000`. For more information, refer to the *Board Revision History* appendix of the *Transceiver Signal Integrity Development Kit, Stratix IV GT Edition Reference Manual*.

8. After all flash programming completes, cycle POWER switch SW1 OFF then ON again.
9. Using the Quartus II Programmer, click **Add File** and select `<install dir>\kits\stratixIVGT_4s100g2_si\factory_recovery\s4gt100_si_bup.sof`.
10. Turn on the **Program/Configure** option for the added file.
11. Click **Start** to download the selected configuration file to FPGA. The FPGA is configured when the progress bar reaches 100%, after which the user LEDs flash repeatedly on and off indicating that the flash device is now restored to factory condition.
12. Cycle POWER switch SW1 OFF then ON to load and run the restored factory design.
13. The restore script cannot restore the board's MAC address automatically. In the Nios II command shell, type the following Nios II EDS command:

```
nios2-terminal ↵
```

and follow the instructions in the terminal window to generate a unique MAC address.



To ensure that you have the most up-to-date factory restore files and information about this product, go to the Altera website at www.altera.com/products/devkits/kit-dev_platforms.jsp.

This chapter provides additional information about the document and Altera.

Revision History

The following table displays the revision history for this user guide.

Date	Version	Changes Made
December 2014	1.2	Removed support for SONET OC-19.
January 2012	1.1	<ul style="list-style-type: none"> ■ Removed content about the kit CD ROM. CD ROM is no longer included in the kit. ■ Add notes about installing Quartus II to make sure needed files are present to run the demonstration application. ■ Made changes because of the dual-die flash to single-die flash replacement. ■ Add further content explaining how to use configuration jumper J62.
December 2009	1.0	Initial release.

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
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, <code>\qdesigns</code> directory, D: drive, and <code>chiptrip.gdf</code> file.
<i>Italic Type with Initial Capital Letters</i>	Indicate document titles. For example, <i>Stratix IV Design Guidelines</i> .

Visual Cue	Meaning
<i>italic type</i>	Indicates variables. For example, $n + 1$. Variable names are enclosed in angle brackets (< >). For example, <file name> and <project name>.pdf 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.
	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.