DSP Development Kit, Stratix & Stratix Professional Edition

Getting Started User Guide

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I.S. EN ISO 9001

About this User Guide

This user guide provides comprehensive information about the Altera® DSP Development Kit, Stratix™ Edition and DSP Development Kit, Stratix Professional Edition.

Table 1 shows the user guide revision history.

Refer to the readme file on the *DSP Development Kit, Stratix Edition CD-ROM* for late-breaking information that is not available in this user guide.

Table 1. User Guide Revision History

Date	Description
April 2003	Updated the document for the DSP Development Kit, Stratix Professional Edition.
February 2003	First publication.

How to Contact Altera

For the most up-to-date information about Altera products, go to the Altera world-wide web site at www.altera.com.

For technical support on this product, go to www.altera.com/mysupport. For additional information about Altera products, consult the sources shown in Table 2.

Table 2. How to Contact Altera

Information Type	USA & Canada	All Other Locations
Technical support	www.altera.com/mysupport/	www.altera.com/mysupport/
	(800) 800-EPLD (3753) (7:00 a.m. to 5:00 p.m. Pacific Time)	(408) 544-7000 *(1)* (7:00 a.m. to 5:00 p.m. Pacific Time)
Product literature	www.altera.com	www.altera.com
Altera literature services	lit_req@altera.com *(1)*	lit_req@altera.com *(1)*
Non-technical customer service	(800) 767-3753	(408) 544-7000 (7:30 a.m. to 5:30 p.m. Pacific Time)
FTP site	ftp.altera.com	ftp.altera.com

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

Typographic Conventions

This document uses the typographic conventions shown in Table 3.

Table 3. Conventions

Visual Cue	Meaning
Bold Type with Initial Capital Letters	Command names, dialog box titles, checkbox options, and dialog box options are shown in bold, initial capital letters. Example: **Save As** dialog box.
bold type	External timing parameters, directory names, project names, disk drive names, filenames, filename extensions, and software utility names are shown in bold type. Examples: $\mathbf{f_{MAX}}$, **\qdesigns** directory, **d:** drive, **chiptrip.gdf** file.
Italic Type with Initial Capital Letters	Document titles are shown in italic type with initial capital letters. Example: *AN 75: High-Speed Board Design.*
Italic type	Internal timing parameters and variables are shown in italic type. Examples: t_{PIA}, $n + 1$. Variable names are enclosed in angle brackets (< >) and shown in italic type. Example: <*file name*>, <*project name*>**.pof** file.
Initial Capital Letters	Keyboard keys and menu names are shown with initial capital letters. Examples: Delete key, the Options menu.
"Subheading Title"	References to sections within a document and titles of on-line help topics are shown in quotation marks. Example: "Typographic Conventions."
`Courier type`	Signal and port names are shown in lowercase Courier type. Examples: `data1`, `tdi`, `input.` Active-low signals are denoted by suffix `n`, e.g., `resetn`. Anything that must be typed exactly as it appears is shown in Courier type. For example: `c:\qdesigns\tutorial\chiptrip.gdf`. Also, sections of an actual file, such as a Report File, references to parts of files (e.g., the AHDL keyword `SUBDESIGN`), as well as logic function names (e.g., `TRI`) are shown in Courier.
1., 2., 3., and a., b., c.,...	Numbered steps are used in a list of items when the sequence of the items is important, such as the steps listed in a procedure.
■	Bullets are used in a list of items when the sequence of the items is not important.
✓	The checkmark indicates a procedure that consists of one step only.
☞	The hand points to information that requires special attention.
↵	The angled arrow indicates you should press the Enter key.
👣	The feet direct you to more information on a particular topic.

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About this Kit

The DSP Development Kit, Stratix Edition and DSP Development Kit, Stratix Professional Edition provides everything you need to develop complete system-on-a-programmable-chip (SOPC) solutions. This document describes how to install the software provided with the kit and how to connect the cables to the Stratix EP1S25 and EP1S80 DSP development boards. Figure 1 shows the kit contents.

Figure 1. DSP Development Kit Contents

The DSP development kit includes:

- *Stratix EP1S25 or EP1S80 DSP Development Board*—The Stratix EP1S25 and EP1S80 DSP development boards are prototyping platforms that provide system designers with a solution for DSP designs. Key features of the boards include a Stratix EP1S25 or EP1S80 device, high-speed analog-to-digital (A/D) and digital-to-analog (D/A) converters, and connectors for Texas Instruments and Analog Devices evaluation boards. Refer to the *Stratix EP1S25 Development Board Data Sheet* or *Stratix EP1S80 Development Board Data Sheet* for more information.

- *DSP Builder (DSP System-Level Design Tool that Interfaces the Quartus II and MATLAB/Simulink Software)*—DSP system design in Altera® devices requires both high-level algorithms and hardware description language (HDL) development tools. Altera's DSP Builder integrates these tools by combining the algorithm development, simulation, and verification capabilities of The MathWorks MATLAB/Simulink system-level design tools with HDL synthesis, simulation, and Altera development tools. DSP Builder shortens DSP design cycles by helping you create the hardware representation of a DSP design in an algorithm-friendly development environment. DSP Builder allows system, algorithm, and hardware designers to share a common development platform. Refer to the *DSP Builder User Guide* for more information.

- *Quartus® II Development Software*—The Quartus II development software provides a comprehensive environment for SOPC design. The Quartus II software integrates into nearly any design environment, with interfaces to industry-standard EDA tools. You can obtain a 12-month license for the software from the Altera web site.

  The Quartus II license only allows you to use the product for 12 months. After 12 months, you must purchase a renewal subscription to continue using the software.

- *Evaluation MegaCore® IP Functions*—The kit contains evaluation versions of Altera DSP MegaCore functions. You can evaluate the functions using the OpenCore® feature, which lets you quickly and easily verify the functionality of an IP function, and evaluate its size and speed before making a purchase decision. Additionally, these functions have the OpenCore Plus hardware evaluation feature, which allows you to generate time-limited programming files for prototyping and board-level simulation. You can obtain a license to enable the OpenCore Plus feature from the Altera web site.

  The OpenCore Plus hardware evaluation feature is an evaluation tool for prototyping only. You must purchase a license to use an Altera IP function in production designs.

- *Reference Designs/Labs*—Altera provides several labs and reference designs with the DSP Development Kit, Stratix Edition and DSP Development Kit, Stratix Professional Edition to help you get started building applications. See "Using the Reference Designs/Labs" on page 21 for more information on the labs provided.

Before You Begin

Before using the kit or installing the software, be sure to check the contents of the kit and inspect the board to verify that you received all of the items. If any of these items are missing, contact Altera before you proceed. You should also verify that your PC meets the software and system requirements of the kit.

DSP Development Kit, Stratix Edition Contents

The DSP Development Kit, Stratix Edition contains the following items:

- Stratix DSP development board with an EP1S25 device
- SLP-50 anti-aliasing filter from Mini-Circuits
- ByteBlaster™ II cable
- Power cable and adapters for North America, Europe, United Kingdom, and Japan
- SMA cable
- RS-232 cable
- *DSP Development Kit, Stratix Edition CD-ROM* (version 1.1.0)
- *DSP Builder: Quartus II & MATLAB/Simulink Interface CD-ROM* (version 2.1.1)
- *The MathWorks Product & Documentation CDs* (Release 13)
- *Quartus II Development Software CD-ROM* (version 2.2)

DSP Development Kit, Stratix Professional Edition Contents

The DSP Development Kit, Stratix Professional Edition contains the following items:

- Stratix DSP development board with an EP1S80 device
- SLP-50 anti-aliasing filter from Mini-Circuits
- ByteBlaster II cable
- Power cable and adapters for North America, Europe, United Kingdom, and Japan
- SMA cable
- RS-232 cable
- *DSP Development Kit, Stratix Edition CD-ROM* (version 1.1.0)
- *DSP Builder: Quartus II & MATLAB/Simulink Interface CD-ROM* (version 2.1.2)

- *The MathWorks Product & Documentation CDs* (Release 13)
- *Quartus II Development Software CD-ROM* (version 2.2)

Inspect the Board

Place the board on an anti-static surface and inspect it to ensure that it has not been damaged during shipment. Verify that all components are on the board and appear intact.

The board can be damaged without proper anti-static handling. Therefore, you should take anti-static precautions before handling the board.

Refer to the *Stratix EP1S25 DSP Development Board Data Sheet or Stratix EP1S80 DSP Development Board Data Sheet*—which is available on the *DSP Development Kit, Stratix Edition CD-ROM*—for information on the board components and their locations.

Software Requirements

You should install the following software before you begin developing designs for the kit.

- Quartus II software version 2.2 or later. See "Installing the Quartus II Software" on page 14.
- Internet Explorer 4.01 with Service Pack 2 or later to use Quartus II Help. You need a web browser to register the Quartus II software and request license files.
- Altera recommends that you install the software on the *DSP Development Kit, Stratix Edition CD-ROM*. See "Installing the MegaCore Functions & Reference Designs/Labs" on page 14.
- The following software is required to create HDL designs that use blocks from DSP Builder:
  - MATLAB version 6.5
  - Simulink version 4.5 or 5.0
  - Quartus II version 2.2 or higher

  If you want to use the QPSK reference design, you must use Simulink version 5.0.

DSP Builder provides automated flows using Tcl scripts as well as a manual flow (refer to the *DSP Builder User Guide* for a description of these flows). In addition to Quartus II integrated synthesis, the automated flow also supports:

– Synplify® version 7.2 or higher
or LeonardoSpectrum™ version 2002c or higher
– ModelSim® version 5.5 or higher

Important Considerations

- You need your network identification card (NIC) ID for licensing the Quartus II software and to enable the OpenCore Plus feature for the IP functions.

  Your NIC ID is a 12-digit hexadecimal number that identifies the Windows NT workstation that serves Quartus II licenses. Networked (or floating node) licensing requires a NIC ID or server host ID. When obtaining a license file for network licensing, you should use the NIC ID from the PC that will issue the Quartus II licenses to distributed users over a network. You can find the NIC ID for your card by typing `ipconfig /all` at a command prompt. Your NIC ID is the number on the physical address line, minus the dashes.

- You need administrative privileges to install parts of the Quartus II software on Windows NT or Windows 2000.

Quartus II System Requirements

To use the DSP Development Kit, Stratix Edition or DSP Development Kit, Stratix Professional Edition with the Quartus II software provided with the kit, your system must meet the Quartus II software minimum requirements. Refer to "System Requirements" in the *Quartus II Installation & Licensing Manual for PCs*, which is included with the kit, for the system requirements.

Software Installation

The DSP Development Kit, Stratix Edition or DSP Development Kit, Stratix Professional Edition contains the Quartus II software, DSP Builder for use with the MATLAB and Simulink software, evaluation MegaCore functions that support the OpenCore Plus feature, and reference designs/labs.

Installing the Quartus II Software

Refer to "Installing the Quartus II Software" in the *Quartus II Installation & Licensing Manual for PCs*, which is included with the kit, for the software installation instructions. After the software finishes installing, you must request and install a license to enable it. See "Set Up Licensing" on page 17 for more information.

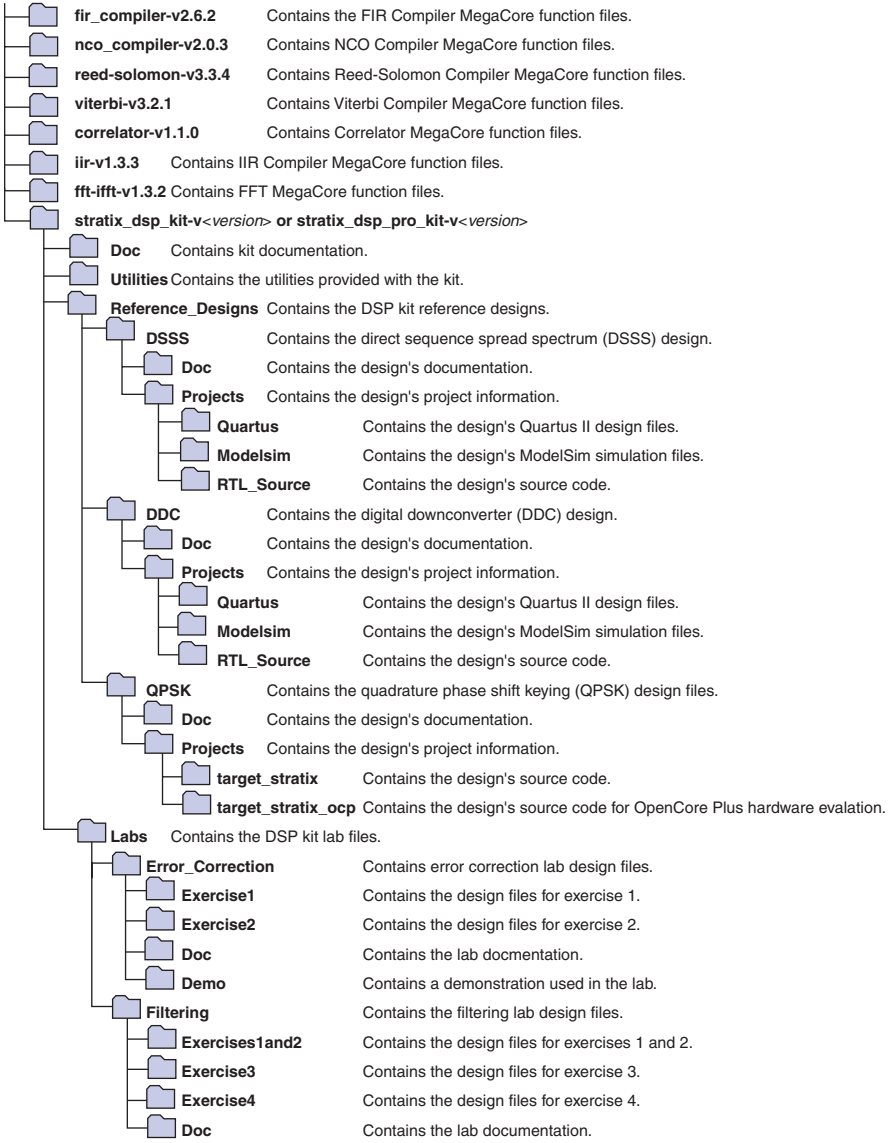
Installing the MegaCore Functions & Reference Designs/Labs

To install the MegaCore functions and reference designs:

✓ Insert the *Stratix DSP Development Kit CD-ROM* into your CD-ROM drive. The installation program runs automatically.

The MegaCore functions with the OpenCore Plus feature and the reference designs/labs are installed. Figure 1 shows the directory structure.

Figure 1. DSP Development Kit Directory Structure



Install DSP Builder

To install DSP Builder on a PC running Windows 98/NT/2000/XP, perform the following steps.

Before you install DSP Builder, Altera recommends that you install the MATLAB and Simulink software and the Quartus II software.

1. Close the following software applications if they are open:
   - Quartus II
   - MAX+PLUS II
   - LeonardoSpectrum
   - Synplify
   - MATLAB and Simulink
   - ModelSim
2. Choose **Run** (Windows Start menu).
3. Type <*drive letter*>**:**`\DSPBuilder.exe`, where <*drive letter*> is your CD-ROM drive.
4. Click **OK**. The **DSPBuilder v**<*version*> **- InstallShield Wizard** dialog box appears. Follow the on-line instructions to finish installation.

DSP Builder launches the LeonardoSpectrum, Synplify, or Quartus II software by retrieving the software's path information from your PC's registry file. If you have installed multiple versions of these software products, the registry may not point to the version you want to use with DSP Builder. In DSP Builder version 2.0.0 or higher you can specify a path to use other than the registry setting for each of the tools.

Refer to "Specifying LeonardoSpectrum, Synplify & Quartus II Path Information for SignalCompiler" in the *DSP Builder User Guide* for information on specifying the paths.

When you have finished installing DSP Builder, view DSP Builder libraries in the MATLAB software by performing the following steps.

1. Start the MATLAB software.
2. Expand the Simulink icon in the **Launch Pad** window.
3. Double-click the **Library Browser** icon. The **Altera DSP Builder** folder appears in the **Simulink Library Browser** window.

Refer to the *DSP Builder User Guide* for information on the DSP Builder directory structure. The *DSP Builder User Guide* also includes a tutorial that describes how to create a design in Simulink and then convert it to VHDL for synthesis, Quartus II compilation, and RTL simulation.

Set Up Licensing

Before using the Quartus II software, DSP Builder, or the OpenCore Plus feature of the evaluation MegaCore functions, you must request a license file from the Altera web site at www.altera.com/licensing and install it on your PC. When you request a license file, Altera e-mails you a **license.dat** file that enables the software.

To obtain a license, perform the following steps:

1. Point your web browser to the Altera web site at www.altera.com/licensing.
2. Click the **DSP Development Kit, Stratix™ Edition** or **DSP Development Kit, Stratix Professional Edition** link.
3. Follow the on-line instructions to request your license. A license file is e-mailed to you.
4. To install your license, refer to "Specifying the License File" in the *Quartus II Installation & Licensing Manual for PCs*, which is included with the kit.

Before installing your license, close the following software if it is running on your PC:

- Quartus II
- MAX+PLUS II
- MATLAB and Simulink
- LeonardoSpectrum
- Synplify
- ModelSim

Connect the Cables to the Board & PC

The instructions in this section explain how to set up the following hardware:

- ByteBlaster II cable
- RS-232 cable
- Power supply cable
- SMA cable
- SLP-50 anti-aliasing filter

Before connecting the cables, shut down and power off your PC. Turn on your PC when you are finished connecting the cables (ByteBlaster II and/or RS-232) to it.

ByteBlaster II Cable

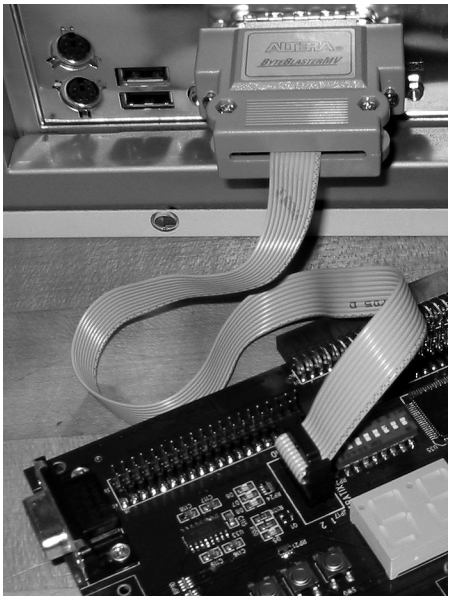
The board supplies power to the ByteBlaster II download cable.

- ✓ Connect the ByteBlaster II cable's 10-pin female plug to the Stratix device JTAG header on the board (JP30) and connect the other end to your PC to configure the Stratix device directly using an SRAM Object File (**.sof**). See Figure 2. The labs provided in this kit include SOFs for configuring the Stratix device directly.

  Align the ByteBlaster II connector so that the red stripe is oriented towards the Altera logo on the board.

Refer to the *Stratix EP1S25 DSP Development Board Data Sheet* or *Stratix EP1S80 DSP Development Board Data Sheet* for more information on how to configure the Stratix device on the board. Refer to *AN 208: Configuring Stratix & Stratix GX Devices* for more information on configuring Stratix devices.

Figure 2. Connect the ByteBlaster II Cable to the Board

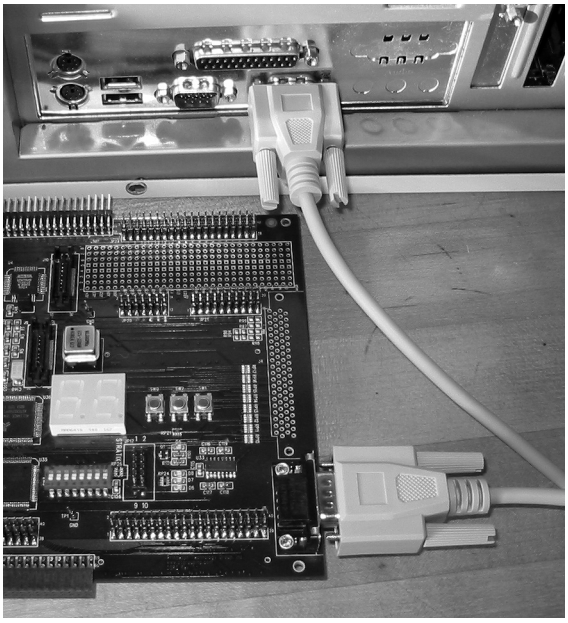


RS-232 Cable

Attach the serial cable to one of the serial ports on your PC and to the RS-232 male connector at J8 on the board. See Figure 3.

For the Stratix DSP board to communicate with the PC via the RS-232 cable, RS-232 interface logic must be implemented in the Altera device on the board.

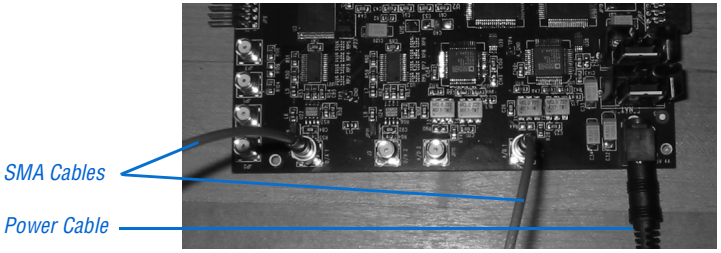
Figure 3. Connect the RS-232 Cable



SMA Cable

Connect both ends of the SMA cable to the Stratix DSP development board. This cable connects the digital-to-analog (D/A 1 and D/A 2) and analog-to-digital (A/D 1 and A/D 2) connectors on the board. See Figure 4.

Figure 4. Connect the SMA Cable



SLP-50 Anti-Aliasing Filter

The SLP-50 anti-aliasing filter from Mini-Circuits provides a 55-MHz cut-off frequency. To use the anti-aliasing filter, connect one end of the filter to one of the digital-to analog connectors on the board (D/A1 or D/A2). Connect the other end of the filter to the SMA cable. You can perform an external loopback from the D/A converter to one of the A/D converters by connecting the other end of the SMA cable to one of the A/D connectors on the board (A/D1 or A/D2).

Power Supply Cable

Connect the power cable to the board as shown in Figure 4 on page 20 and plug the other end into a power outlet.

After the board powers-up, the on-board flash, which ships pre-programmed with a filtering design, automatically configures the Stratix device. The CONF_DONE LED turns on signifying that the Stratix device is configured.

Using the Reference Designs/Labs

Altera provides several labs and reference designs with the DSP Development Kit, Stratix Edition and DSP Development Kit, Stratix Professional Edition to help you get started building applications. Refer to the documentation for each design, which is installed in each design's **doc** directory when you install the software on the *DSP Development Kit, Stratix Edition CD-ROM*, for background information and lab exercises.

- *DSP Filtering Reference Design*—The DSP Development Kit, Stratix Professional Edition filtering reference design lab shows you how to use the Altera DSP Builder for system design, simulation, and board-level verification. DSP Builder is a digital signal processing development tool that interfaces The MathWorks industry-leading system-level DSP tool Simulink with the Altera Quartus II development software. DSP Builder provides a seamless design flow in which you can perform algorithmic design and system integration in the MATLAB and Simulink software and then port the design to hardware description language (HDL) files for use in the Quartus II software.

- *Digital Downconverter (DDC) Reference Design*—The multi-channel DDC reference design targets 3G wireless UMTS specifications and implements 8 independent channels. A DDC demodulates a signal and then decimates it down to baseband. The signal coming to the receiver often contains extra noise, which is removed by filtering and pulse shaping. The DDC reference design consists of numerical controlled oscillators (NCOs), FIR filters, and custom logic.

- *Direct Sequence Spread Spectrum (DSSS) Design*—The DSSS reference design implements a DSSS digital modem that modulates direct sequence spread data onto an IF carrier. The modulated data is input to a channel model and passed to a digital receiver, which demodulates and recovers the data from the received IF signal. The DSSS reference design is implemented using a combination of Altera intellectual property DSP megafunctions, the Altera library of parameterizable modules (LPMs), and custom logic.

- *Quadrature Phase Shift Keying (QPSK) Modem Reference Design*—The QPSK reference design shows how to use DSP Builder for system modeling, simulation, and hardware verification of a modulator/demodulator design. The modem includes forward error correction consisting of Reed-Solomon and Viterbi. The design runs on the Stratix EP1S80 DSP development board and can be used as an example design for modulator/demodulator applications.

- *Error Correction Design (Reed-Solomon)*—This design consists of a Windows application in which you specify a picture to transmit over a channel using the Reed-Solomon MegaCore function. You can use the application to alter the type and intensity of errors inserted into the data as it passes through the channel. The DSP development board implements the hardware portion of the design, which includes the encoder, decoder, and channel.

Documentation

The *DSP Development Kit, Stratix Edition CD-ROM* contains the following documentation:

- *Stratix EP1S25 DSP Development Board Data Sheet*
- *Stratix EP1S80 DSP Development Board Data Sheet*
- *AN 245: Filtering Reference Design Lab*
- *AN 279: Digital Downconverter (DDC) Reference Design*
- *AN 281: QPSK Modem Reference Design*
- *AN 289: Direct Sequence Spread Spectrum (DSSS) Modem Reference Design*
- *AN 176: OpenCore Plus Hardware Evaluation*
- Data sheets and application notes for Altera products

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