Interleaver/Deinterleaver MegaCore Function

Solution Brief 42 **June 1999, ver. 1**

Target Applications:
Digital communications systems, digital audio and video broadcast systems, and data storage and retrieval systems

Family:
APEX™ 20K & FLEX® 10K

Ordering Code:
PLSM-INLV

Vendor:

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San Jose, CA 95134
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Features

- High-speed data rates: 120 megasamples per second (MSPS)
- Supports block and convolutional interleaving algorithms
- Parameterized symbol width, depth, and block length
- Compatible with discrete, streaming, and continuous Reed-Solomon encoders/decoders
- Optimized for APEX 20K and FLEX 10K devices
- Uses internal or external memory
- Generates test vectors
- Dynamic burst error distribution analyzer

General Description

Interleavers/deinterleavers are standard digital signal processing (DSP) functions used in many digital communications systems. Applications that store or transmit digital data use interleavers/deinterleavers to enhance the performance of forward error correction (FEC) systems.

Symbol interleavers/deinterleavers can mitigate the effects of burst noise. Typically, these functions are needed for transport channels that require a low bit-error ratio (BER). Therefore, interleaving improves the efficiency of Reed-Solomon encoders/decoders by spreading burst errors across several codewords.

The Altera interleaver/deinterleaver MegaCore™ function uses internal or external single-port or dual-port RAM. You can implement single-port RAM using FLEX 10K embedded array blocks (EABs) or an external RAM device; you can implement dual-port RAM using APEX 20K embedded system blocks (ESBs), FLEX 10KE EABs, or an external RAM device.

The interleaver/deinterleaver MegaCore function operates in the same frequency range used by Reed-Solomon encoders/decoders and supports continuous, streaming, and discrete modes, making the function compatible with any Reed-Solomon code.

The function's MegaWizard™ Plug-In drastically reduces the design creation and simulation cycles from several weeks to several minutes. The wizard generates a highly optimized instance of a custom interleaver/deinterleaver function as well as a MAX+PLUS® II Vector File (**.vec**) that you can use to simulate the function. For example, by choosing a few simple settings, you can build an interleaver function to meet pre-defined specifications, such as DVB 802 or UMTS. In addition, you can implement customized functions by specifying the parameter values for your specific transmission channel requirements.

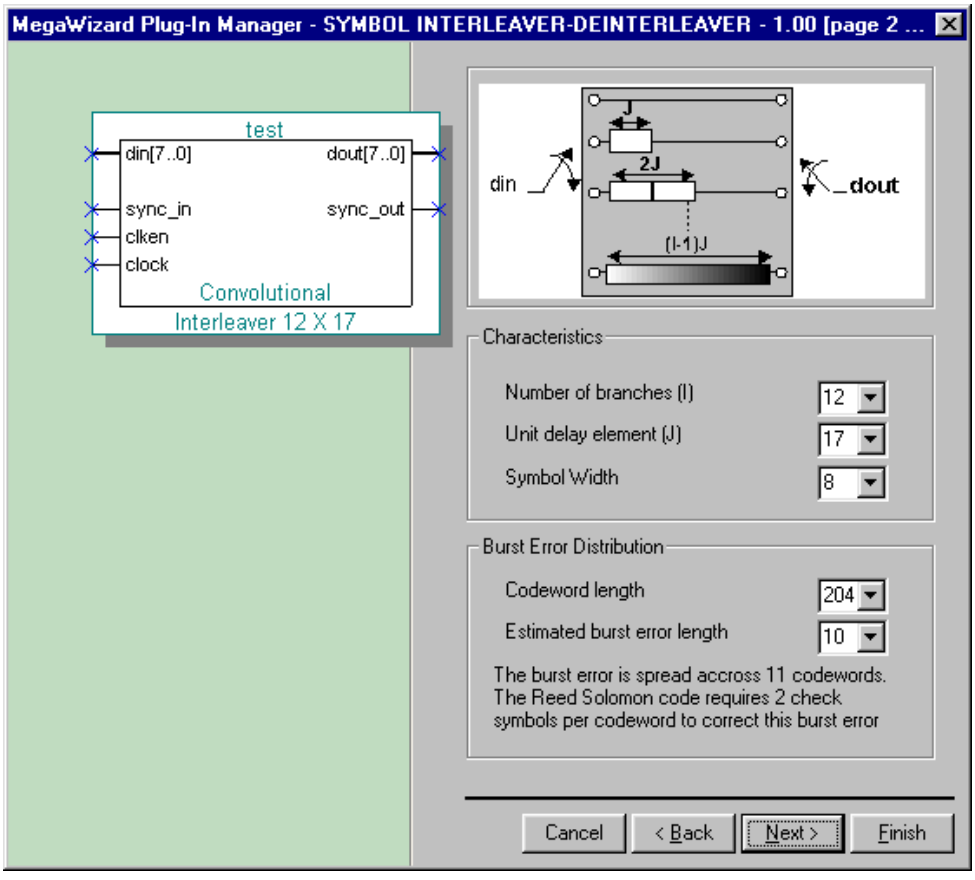
Functional Description

You can run the interleaver/deinterleaver wizard using the Quartus™ or MAX+PLUS II MegaWizard Plug-In Manager. After you set the function's parameters, the wizard generates a customized function that you can instantiate in your design file. Table 1 describes the options for the interleaver/deinterleaver wizard.

Table 1. Interleaver/Deinterleaver Wizard Options		
Option	**Function**	**Description**
Type	Block or convolutional	Specifies a block or convolutional interleaver/deinterleaver.
Number of columns	Block	Specifies the total length of the codeword (i.e., data symbol + checksum symbol).
Number of rows	Block	Specifies the maximum number of codewords in the function's memory.
Number of branches	Convolutional	Specifies the number of branches used by the function.
Unit delay element	Convolutional	Specifies the unit delay for each branch of the function.
Direction	Block or convolutional	Specifies an interleaver (transmitter) or a deinterleaver (receiver).
Memory type	Block or convolutional	Specifies internal or external memory. Convolutional interleaving uses synchronous dual-port RAM; block interleaving uses synchronous single-port RAM. For internal memory, the MegaWizard Plug-In instantiates the most optimum ESB/EAB configuration automatically.
Symbol width	Block or convolutional	Specifies the width of the input symbol.

Figure 1 shows page 2 of the convolutional interleaver/deinterleaver MegaWizard Plug-In.

Figure 1. Interleaver/Deinterleaver MegaWizard Plug-In



Performance

Table 2 shows the interleaver/deinterleaver MegaCore function's performance as calculated using the MAX+PLUS II version 9.2 software.

Table 2. Symbol Interleaver/Deinterleaver Performance

Device	Speed Grade	Function	Parameters	Utilization		Performance (MHz)
				LEs	EABs	
FLEX 10KE	-1	Convolutional interleaver using FLEX 10KE EABs	Number of branches = 12, Unit delay element = 17, Symbol width = 8 bits (digital video broadcast settings)	392	8	110
		Block interleaver using single-port RAM	Number of columns = 36, Number of rows = 24, Symbol width = 8	40	4	120

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