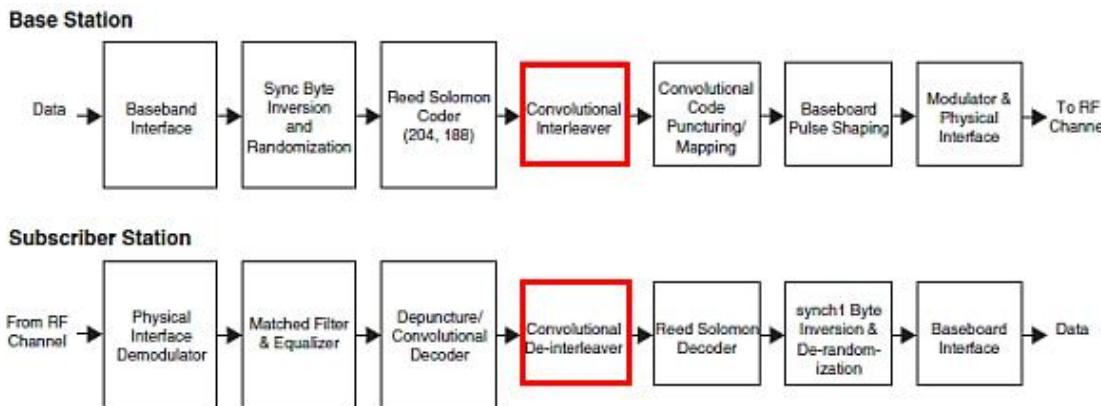# Interleaver/De-Interleaver

Overview

Interleaving is a technique commonly used in communication systems to overcome correlated channel noise such as burst error or fading. The interleaver rearranges input data such that consecutive data are spaced apart. At the receiver end, the interleaved data is arranged back into the original sequence by the **de-interleaver**. As a result of interleaving, correlated noise introduced in the transmission channel appears to be statistically independent at the receiver and thus allows better error correction.

The **Lattice Interleaver/de-interleaver IP core** supports rectangular block type and convolutional architectures. Rectangular interleaving arranges the input data row-wise in a matrix. The interleaved data is obtained by reading the columns of the matrix. Convolutional interleaving feeds the input data to a number of branches, each of which has a shift register with pre-defined length. The output data is taken from the branch outputs. Lattice's Convolutional Interleaver/de-interleaver IP Cores are compliant with ATSC and DVB standards, while the Rectangular Interleaver/de-interleaver is compliant with IEEE 802.16a standard.

Features

- High performance and area efficient symbol interleaver/de-interleaver
- Supports multiple standards, such as DVB, ATSC and IEEE 802.16
- Convolutional and rectangular block type architectures available
- Fully synchronous design using a single clock
- Symbol size from 1 to 256 bits
- Full handshake capability for input and output interfaces

- Rectangular block type features
  - Variable block size
  - Variable number of rows
  - Variable number of columns
  - Row permutations
  - Column permutations

- Convolutional type features
  - User-configurable number of branches
  - User-configurable branch length

Performance and Resource Utilization

Results for LatticeECP3[1]						
Mode	**SLICEs**	**LUTs**	**Registers**	**I/Os**	**sysMEM EBRs**	**f_{MAX} (MHz)**
Convolutional Interleaver DVB	86	122	159	23	1	336

Mode	SLICEs	LUTs	Registers	I/Os	sysMEM EBRs	f_{MAX} (MHz)
Convolutional De-Interleaver DVB	89	133	164	23	1	340
Rectangular Interleaver 802.16	54	64	101	24	2	340
Rectangular De-Interleaver 802.16	72	82	132	24	2	338

1. Performance and utilization data are generated using an LFE3-95E-8FN672CES device with Lattice's Diamond 1.0 software. Performance may vary when using a different software version or targeting a different device density or speed grade within the LatticeECP3 family.

Results for LatticeECP2M[1]

Mode	SLICEs	LUTs	Registers	I/Os	sysMEM EBRs	f_{MAX} (MHz)
Convolutional Interleaver DVB	86	121	759	23	1	329
Convolutional De-Interleaver DVB	88	132	164	23	1	370
Rectangular Interleaver 802.16	52	75	101	24	2	353
Rectangular De-Interleaver 802.16	70	103	132	24	2	370

1. Performance and utilization data are generated using an LFE2M35E-7F484C device with Lattice's. Diamond 1.0 software. Performance may vary when using a different software version or targeting a different device density or speed grade within the LatticeECP2M family.

Results for LatticeECP2[1]

Mode	SLICEs	LUTs	Registers	I/Os	sysMEM EBRs	f_{MAX} (MHz)
Convolutional Interleaver DVB	86	121	759	23	1	357
Convolutional De-Interleaver DVB	88	132	164	23	1	370
Rectangular Interleaver 802.16	52	75	101	24	2	370
Rectangular De-Interleaver 802.16	70	103	132	24	2	370

1. Performance and utilization data are generated using an LFE2-50E-7F672C device with Lattice's Diamond 1.0 software. Performance may vary when using a different software version or targeting a different device density or speed grade within the LatticeECP2 family.

Results for LatticeEC/P[1]

Mode	SLICEs	LUTs	Registers	I/Os	sysMEM EBRs	f_{MAX} (MHz)
Convolutional Interleaver DVB	92	128	159	23	1	267
Convolutional De-Interleaver DVB	95	140	164	23	1	235
Rectangular Interleaver 802.16	61	81	101	24	2	258
Rectangular De-Interleaver 802.16	81	94	132	24	2	230

1. Performance and utilization data are generated using an LFECP20E-5F672C device with Lattice's Diamond 1.0 software. Performance may vary when using a different software version or targeting a different device density or speed grade within the LatticeECP/EC family.

Results for LatticeSC/M[1]

Mode	SLICEs	LUTs	Registers	I/Os	sysMEM EBRs	f_{MAX} (MHz)
Convolutional Interleaver DVB	107	139	159	23	1	375
Convolutional De-Interleaver DVB	110	154	164	23	1	375
Rectangular Interleaver 802.16	56	84	101	24	2	375

Mode	SLICEs	LUTs	Registers	I/Os	sysMEM EBRs	f_{MAX} (MHz)
Rectangular De-Interleaver 802.16	77	117	132	24	2	375

1. Performance and utilization data are generated using an LFSC3GA25E-7F900C device with Lattice's Diamond 1.0 software. Performance may vary when using a different software version or targeting a different device density or speed grade within the LatticeSC/M families.

Results for LatticeXP2[1]

Mode	SLICEs	LUTs	Registers	I/Os	sysMEM EBRs	f_{MAX} (MHz)
Convolutional Interleaver DVB	86	121	159	23	1	314
Convolutional De-Interleaver DVB	88	132	164	23	1	299
Rectangular Interleaver 802.16	52	75	101	24	2	314
Rectangular De-Interleaver 802.16	70	103	132	24	2	314

1. Performance and utilization data are generated using an LFXP2-30E-7F484C device with Lattice's Diamond 1.0 software. Performance may vary when using a different software version or targeting a different device density or speed grade within the LatticeXP2 family.

Results for LatticeXP[1]

Mode	SLICEs	LUTs	Registers	I/Os	sysMEM EBRs	f_{MAX} (MHz)
Convolutional Interleaver DVB	92	128	159	23	1	211
Convolutional De-Interleaver DVB	95	140	164	23	1	194
Rectangular Interleaver 802.16	61	81	101	24	2	191
Rectangular De-Interleaver 802.16	81	94	132	24	2	233

1. Performance and utilization data are generated using an LFXP20E-5F484C device with Lattice's Diamond 1.0 software. Performance may
vary when using a different software version or targeting a different device density or speed grade within the LatticeXP family.

Ordering Information

Family	OPN
LatticeECP3	INTV-DINT-E3-U3
LatticeECP2M	INTV-DINT-PM-U3
LatticeECP2	INTV-DINT-P2-U3
LatticeEC/P	INTV-DINT-E2-U3
LatticeSC	INTV-DINT-SC-U3
LatticeXP2	INTV-DINT-X2-U3
LatticeXP	INTV-DINT-XM-U3

IP Version: 3.4
Evaluate: To download a full evaluation version of this IP, go to the IPexpress tool and click the IP Server button in the toolbar. All LatticeCORE IP cores and modules available for download will be visible. For more information on viewing/downloading IP please read the **IP Express Quick Start Guide**.
Purchase: To find out how to purchase the IP Core, please contact your **local Lattice Sales Office**.