



### Features

- Constraint length 9
- Code rates 1/2, 1/3, and 1/4
- Simple handshake protocol for reliable interfacing
- Fully synchronous design
- Very high speed operation
- Comprehensive verification plan provided

### General Description

The SALxx320E consists of verilog IP for implementing 256-state convolutional encoder. The basic code is a constraint length 9 transparent code which is well suited to channels with predominantly Gaussian noise. The encoder is of the non-systematic non-recursive type, and supports three encoders with rates 1/2, 1/3, and 1/4. The encoder is selected using the rate signal.

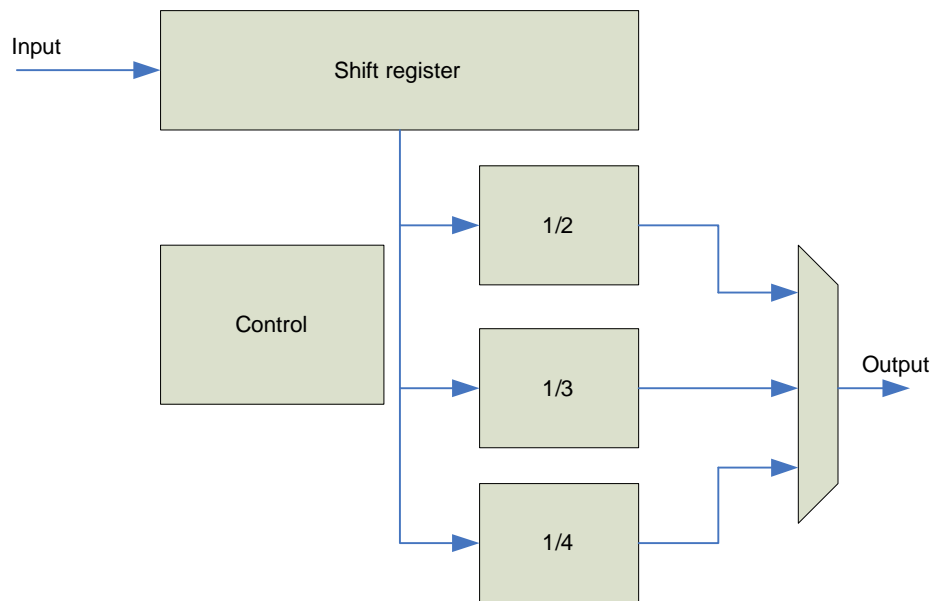
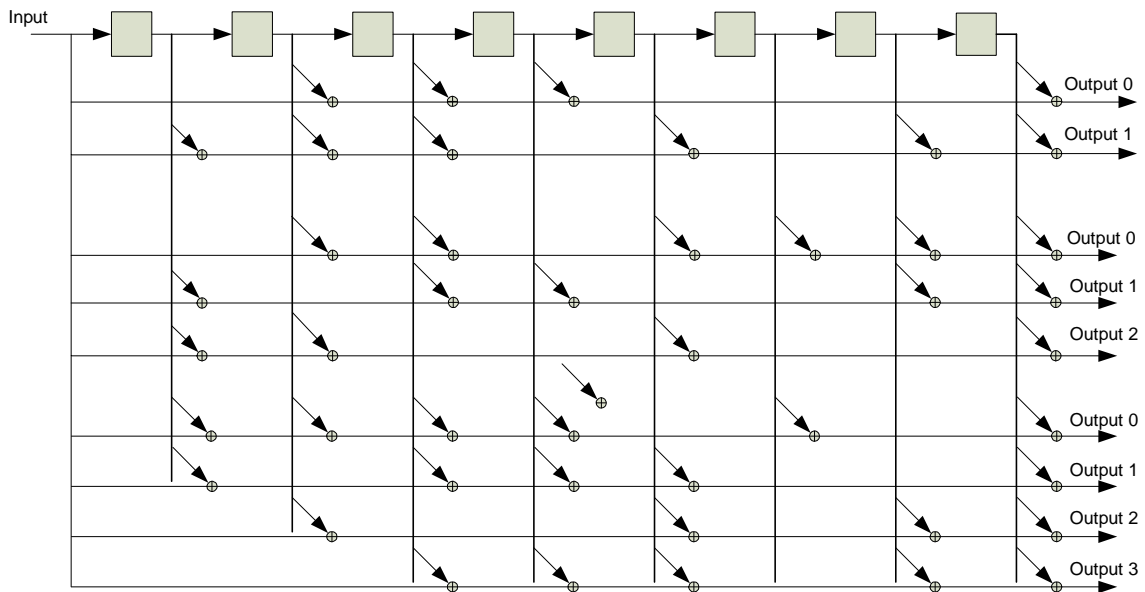


Figure 1: Encoder Block Diagram

## Theory of Operation

The SALxx320E is a generic 256-state convolutional encoder. Its operation is very simple: a serial stream of data is shifted into the device, and an encoded serial data stream is shifted out of the device. Refer to figure 1. The rate signal determines which Convolutional encoder has been selected. The connection polynomials in octal are specified below:



Example application: 3GPP2 Convolutional Encoders

Figure 2: Constituent Encoder Detail

## Signal Descriptions

The module pinout is shown in the figure below, and in table 1. The signals are conveniently organized into functional groups as follows:

### Clock and Reset

The design is fully synchronous with a single clock signal. The reset signal is synchronous and needs to be asserted for at least one full clock cycle to reset internal logic.

### Control signals

Two signals control flow of data into the device, *din\_rdyin\_n* and *din\_rdyout\_n*. The *din\_rdyin\_n* signal indicates that data into the device is valid. The *din\_rdyout\_n* signal indicates that the device is ready to receive data.

Two signals control flow of data out of the device, *dout\_rdyout\_n* and *dout\_rdyin\_n*. The *dout\_rdyout\_n* signal indicates that data out of the device is valid. The *dout\_rdyin\_n* signal indicates to the device that it's OK to shift data out of the device.

### Data signals

The data are clocked in on *din* and clocked out on *dout*.

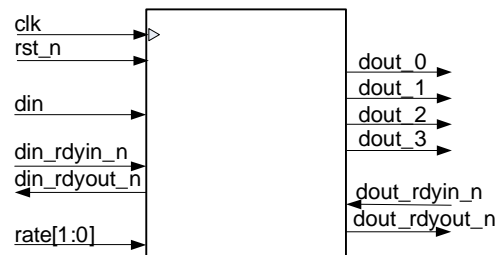


Figure 3: Component pinout

Pin	Sense	Width	Description
clk	in	1	Clock
rst_n	in	1	Synchronous reset
init	in	1	Soft reset
rate	in	2	Code rate: 00 = 1/2, 01 = 1/3, 10 = 1/4, 11 = 1/4
din	in	1	Serial data (message) in
din_rdyin_n	in	1	Indicates serial data in is valid
din_rdyout_n	out	1	Indicates the device is ready to receive data
dout_0	out	1	Data out
dout_1	out	1	Data out
dout_2	out	1	Data out
dout_3	out	1	Data out
dout_rdyin_n	in	1	Indicates to the device that data can be shifted out
dout_rdyout_n	out	1	Indicates that data is available to be shifted out

## Waveforms

### Input

The input functional timing is shown below. *Din\_rdyin\_n* is used as an input data enable, *din\_rdyout\_n* is used to indicate when the device is ready to receive data.

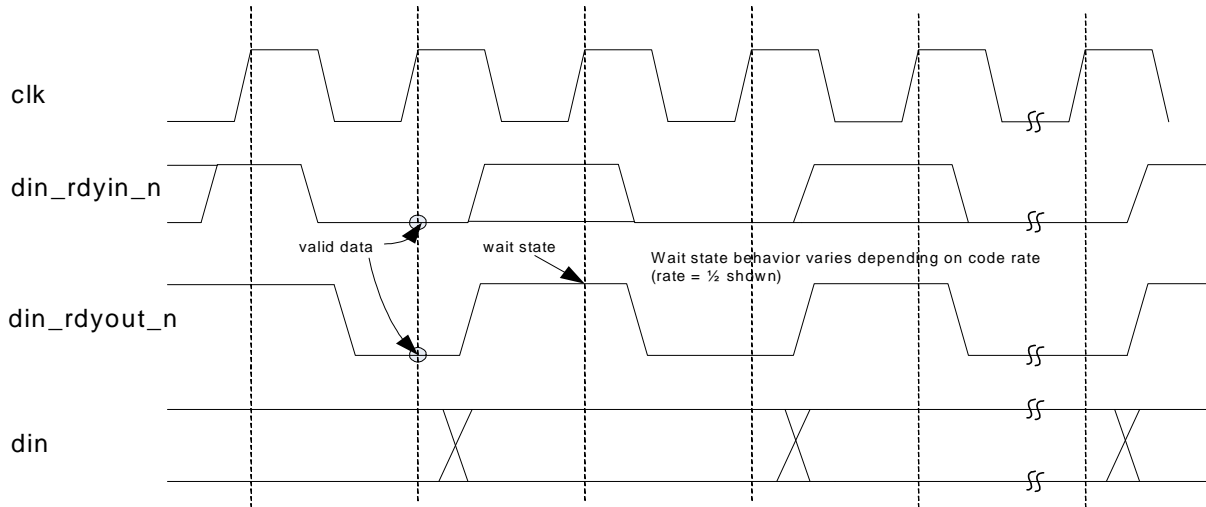


Figure 4: Input timing

### Output

The output functional timing is shown below. *Dout\_rdyout\_n* is used as an output data ready indication, *dout\_rdyin\_n* is used to indicate to the device that it's OK to shift data out.

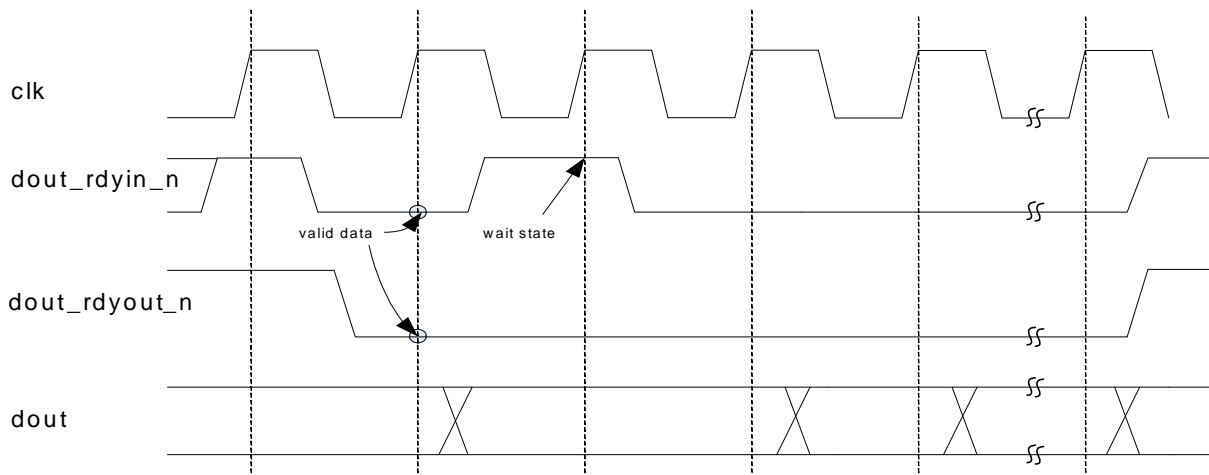


Figure 5. Output timing

## Module Verification

The SALxx320E has been subjected to extensive verification to ensure the highest quality product possible. A comprehensive test plan was implemented which included the following:

- High-quality random data source
- High-quality random noise source
- Extensive flow-control simulations
- Verification of operation against known data sequences

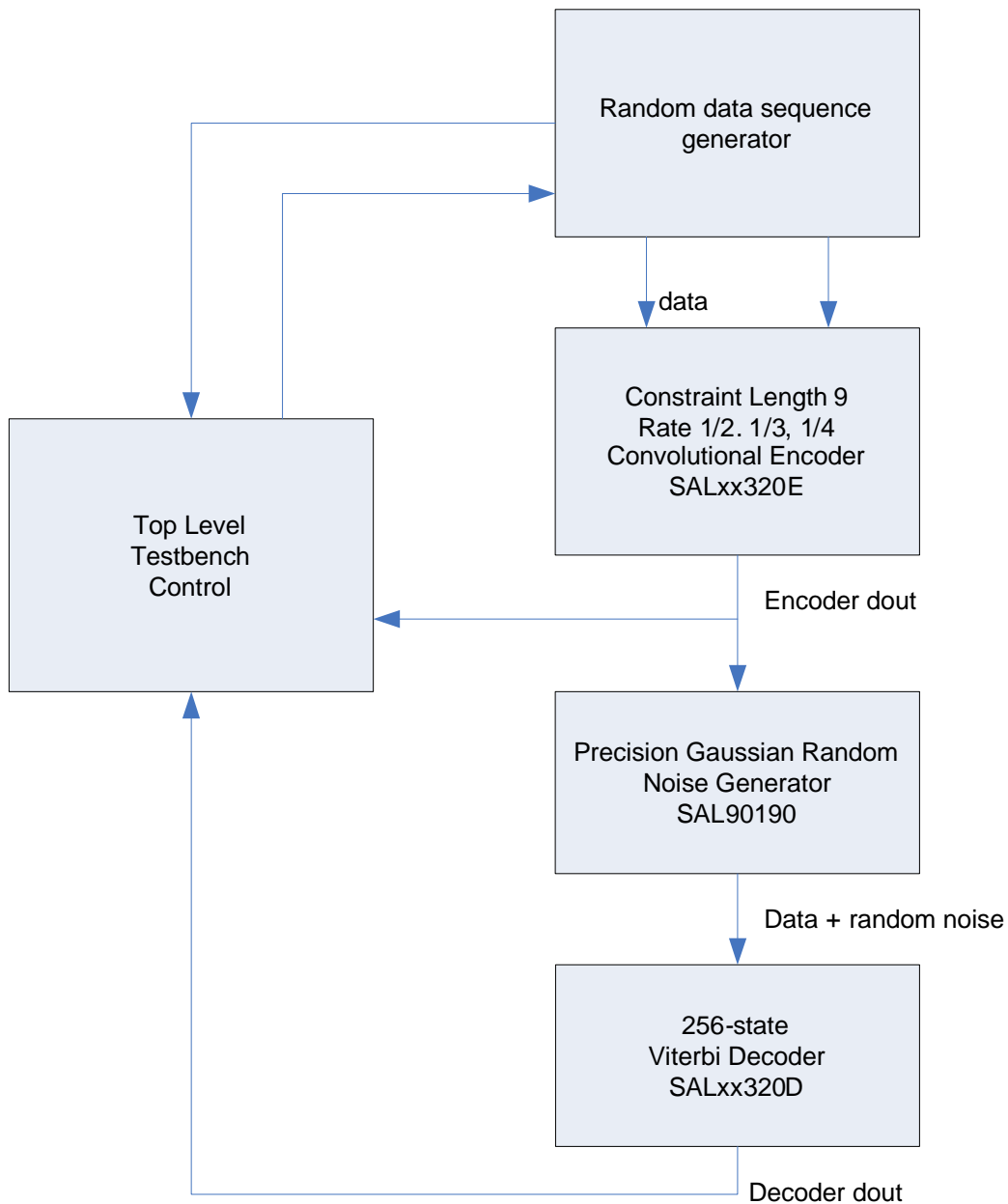
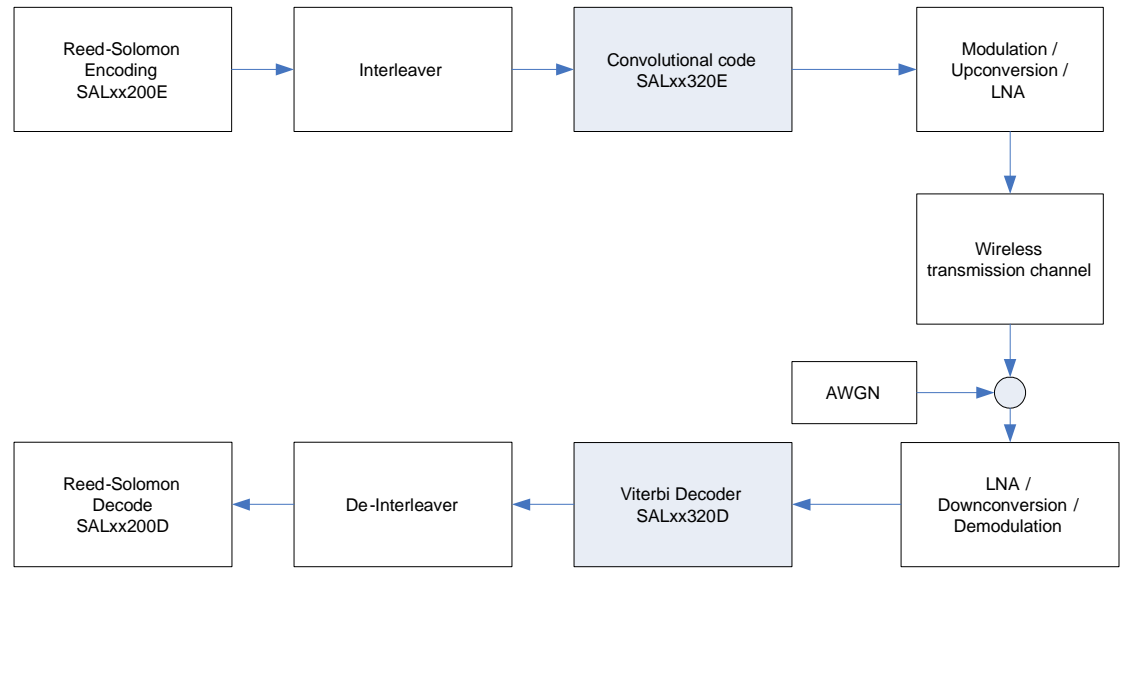


Figure 6: Testbench Block Diagram

## Application: Wireless Internet System

The 256-state convolutional code forms an integral part of a wireless Internet telemetry system.



## Ordering Information

Salamander Error Correction currently has 1 generic 256-state convolutional encoder IP module available:

**SALxx320E** generic 256-state convolutional encoder

## About Salamander:

**Salamander Error Correction** develops and sells error correction modules of the highest quality worldwide.

Salamander Error Correction is a division of Komodo Industries, Inc.

Salamander Error Correction:  
5330 Carroll Canyon Rd  
San Diego, CA 92121  
(858) 373-2112  
fax: (858) 373-1224  
[sales@salamander-ecc.com](mailto:sales@salamander-ecc.com)  
[www.salamander-ecc.com](http://www.salamander-ecc.com)