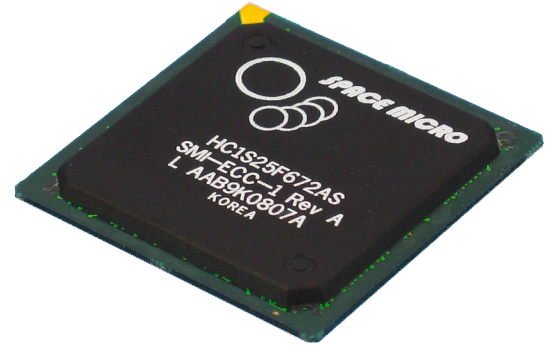


2.5 Gbps Radiation Hardened Forward Error Correction IC

Benefits

Space Micro's Forward Error Correction (FEC) IC provides advanced radiation hardening without sacrificing performance. It is the best performing FEC IC of its kind for space applications. Radiation in space typically greatly restricts the FEC capabilities, and it lags several generations behind its COTS counterpart. Space Micro's FEC IC, however, provides high levels of performance in harsh space radiation environments. Its power requirements make it ideal for small satellite data links in all orbits. Its performance, however, suits any high data rate satellite communication system.



Highlights

With the harsh space radiation environments that satellites are subject to, a reliable, radiation hardened, very high data rate FEC is essential. Space Micro's device is radiation hardened for a total ionizing dose (TID) in excess of 100krad (Si) and is immune to single event latchup (SEL). It automatically recovers from any single event upsets (SEU), and proves an extremely low bit error rate of $1.0E-10$ at $6dB E_b/N_o$, with excellent performance on fading and burst error channels. It utilizes a fully synchronous logic design with global clock enabled and either synchronous or asynchronous global reset for flexible clocking, interfacing, and system integration. All of this is possible due to Space Micro's proprietary concatenated Reed-Solomon/BCH code with 8 different encoding/decoding settings. It is ideal for all space-based communication needs in any orbit.

Applicability

Space Micro's Radiation Hardened FEC IC is ideal for all space-based RF and laser communication links, regardless of LEO, MEO, or GEO.

- Space-space RF or laser communication links
- Space-aircraft RF or laser communication links
- Space-ground RF or laser communication links

Features

- Bit Error Rates below $1.0E-10$ at $6dB E_b/N_o$
- Radiation Hardened
 - $>100krad$ (Si) TID
 - SEL Immunity to $>80LET$
 - Automatic recovery from SEU
- Reports corrected symbol and bit errors
- Detects and reports uncorrectable errors
- Decodes and corrects data and parity errors to support regenerator applications
- Reed-Solomon and BCH concatenated code

SMI ECC-1

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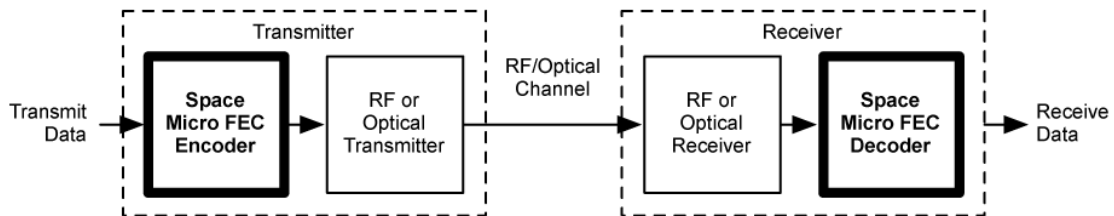
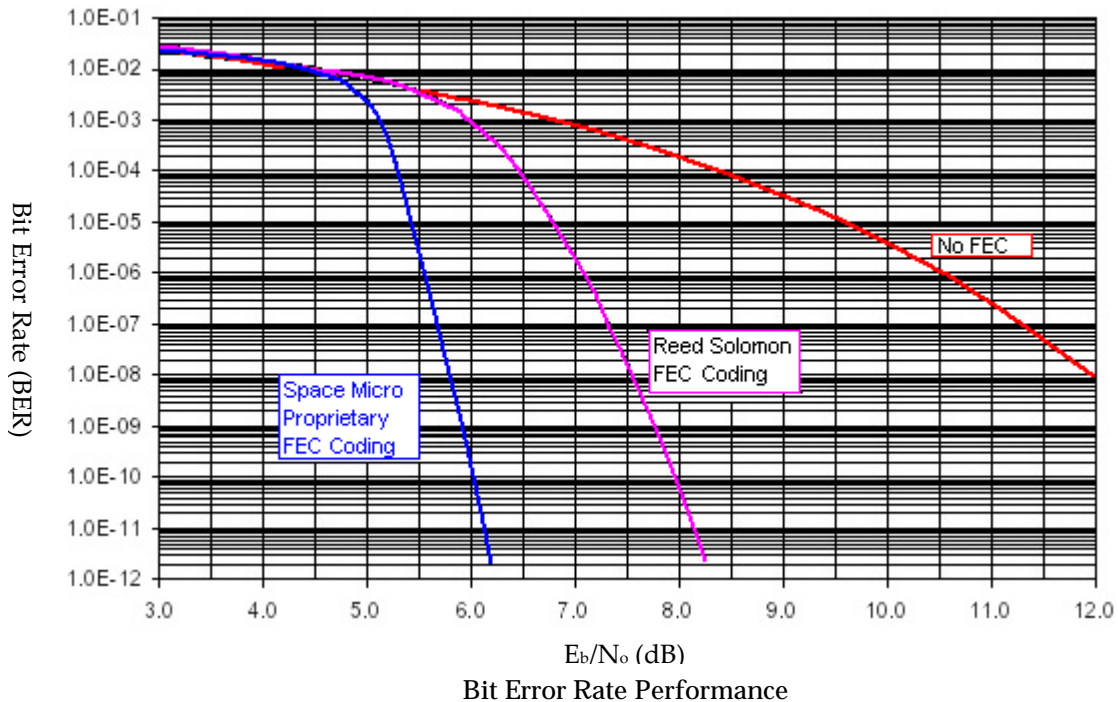
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Performance

Illustrated below is the Bit Error Rate (BER) performance for the Space Micro FEC code, on an Additive White Gaussian Noise (AWGN) channel with hard decision decoding. The coding gain is increased on burst error channels and when used with soft decision decoding.



Typical System Configuration

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Technical Specifications

Data Rate	2.5Gbps (for FEC code rate $\geq .937$)
Total Ionizing Dose	>100krad (Si)
Single Event Latchup	Immune to >80 LET (MeV-cm ² /mg)
Single Event Upset	1.0E-4 upsets/device-day (GEO)
Decoder Latency	30-50ns
Bit Error Rate	1.0E-10 at 6dB
Package	672-pin BGA/CGA
Core Voltage	1.5V (130nm technology die)
Channel SNR (E_b/N_o)	5-6dB
FEC Code	RS(outer)/BCH(inner) concatenated with 8 encoding/decoding settings

AC Characteristics

Clock Frequency	167 MHz
Clock Low Time	2.4 ns
Clock High Time	2.4 ns
Input Setup Time	2 ns
Input Hold Time	0
Output Delay	2.5 ns

DC Characteristics

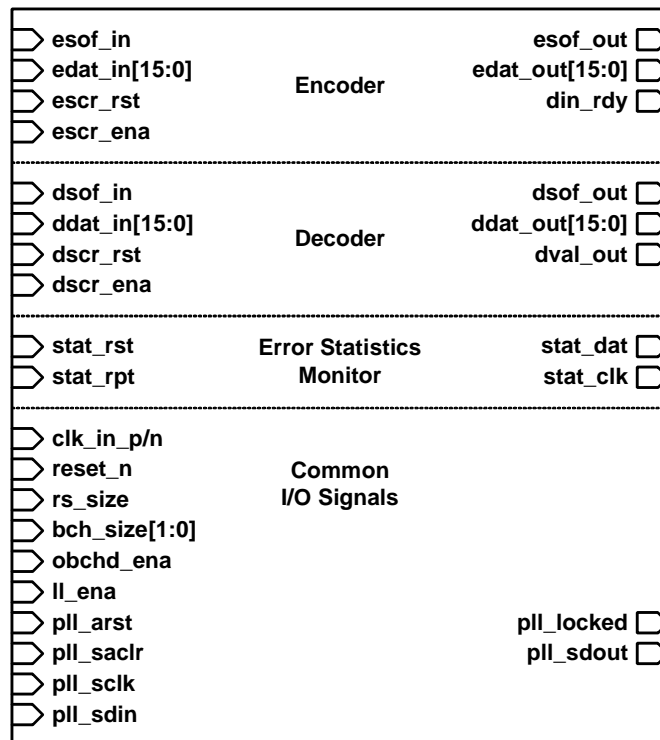
Storage Temperature (absolute)	-40 to +150 C
Operating Temperature (absolute)	0 to +70 C
Supply Voltage (operating)	2.5 V
Supply Current (static)	1 mA
Supply Current (dynamic)	240 mA
Capacitance (Input)	10 pF maximum

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FEC IC I/O Layout

Outer (RS) Block Size (n_o, k_o)	Inner (BCH) Block Size (n_i, k_i)	FEC Code Rate	FEC Overhead	System Clock (MHz)
(255, 255)	(1, 1)	1.000	0.0%	155.52
(255, 239)	(1, 1)	0.937	6.7%	165.93
(255, 255)	(127, 120)	0.945	5.8%	164.59
(255, 239)	(127, 120)	0.886	12.9%	175.61
(255, 255)	(63, 57)	0.905	10.5%	171.89
(255, 239)	(63, 57)	0.848	17.9%	183.40
(255, 255)	(31, 26)	0.839	19.2%	185.43
(255, 239)	(31, 26)	0.786	27.2%	197.84

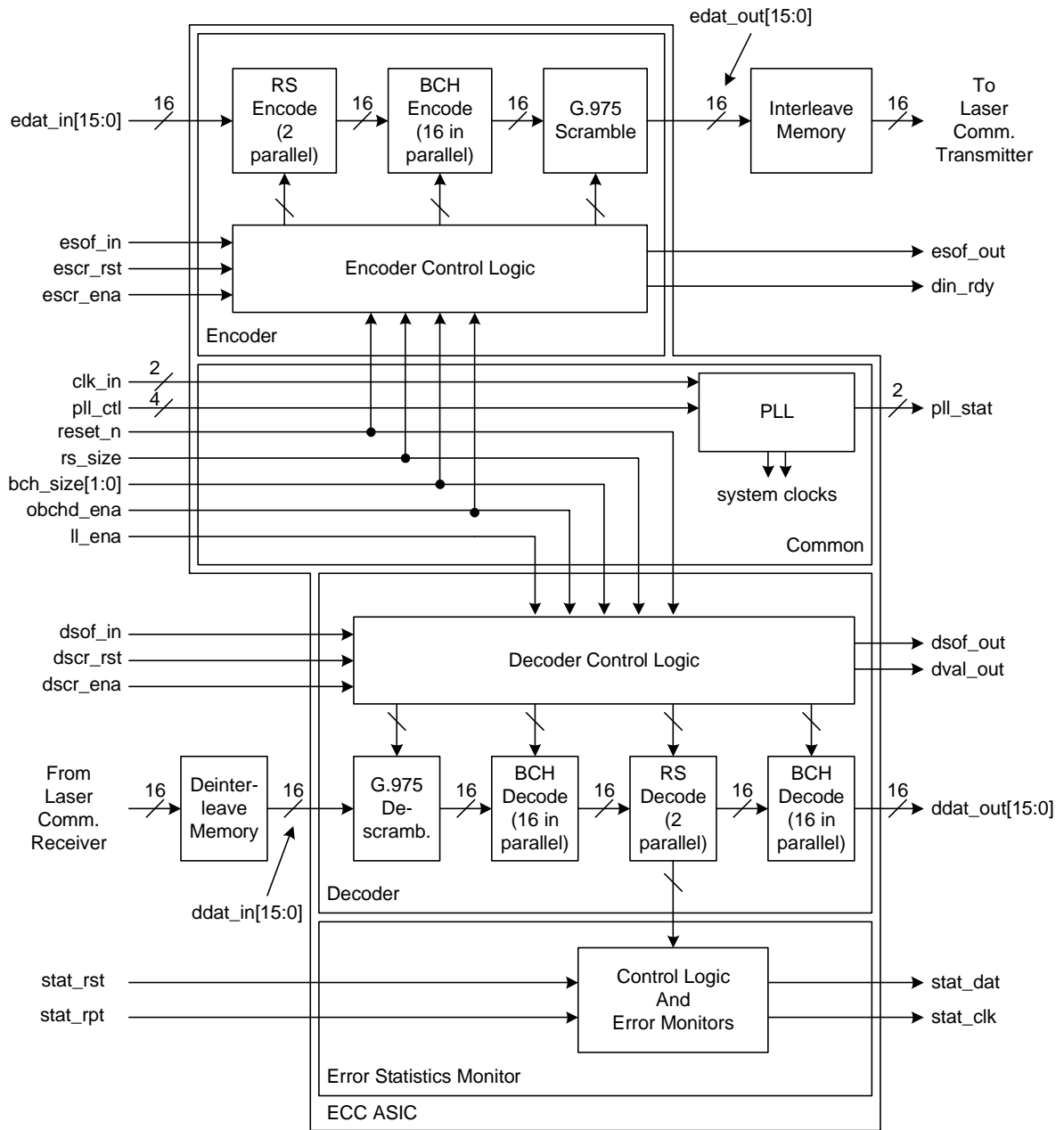
FEC Programming Options and Code Rates

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2.5 Gbps Radiation Hardened Forward Error Correction IC



FEC IC Top Level Block Diagram

Contact Space Micro for application specific configurations or additional details

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