dvance Product Information

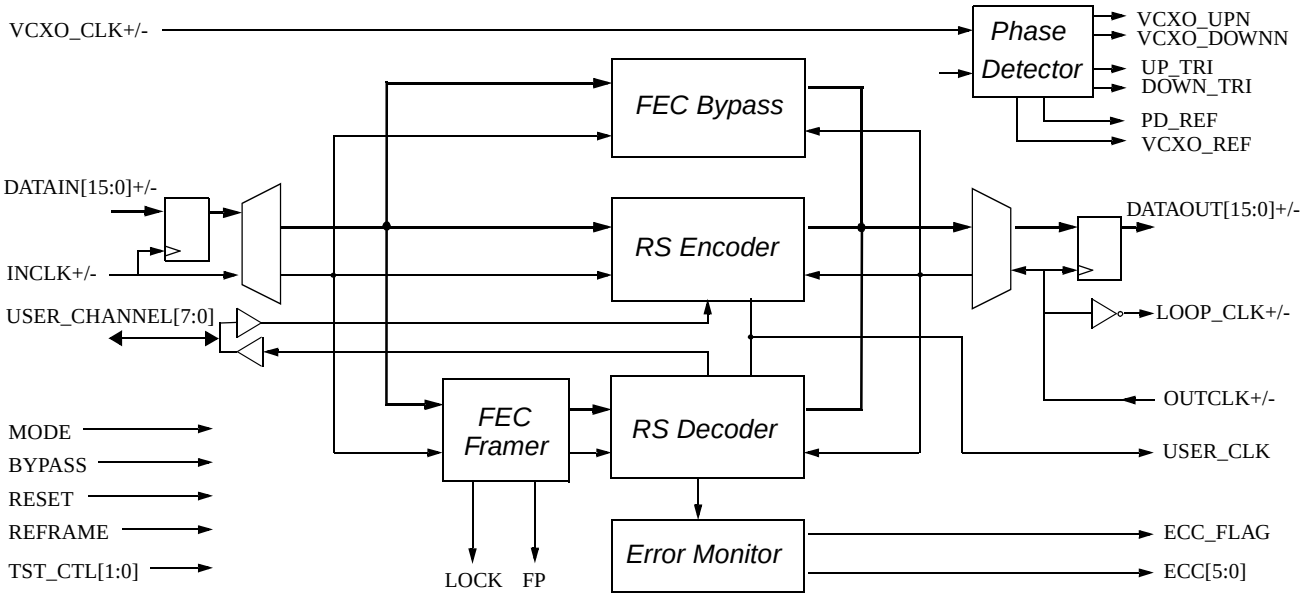
VSC9210

2.488 Gbits/sec SONET/SDH
FEC Encoder and Decoder (CODEC) Chipset

Features

- Reed-Solomon Encoding and Decoding using a (255,241) code
- Realizes a Decoder Output BER of 10^{-20} for Input BER of 10^{-5}
- Processes Data rates up to 2.654 Gbps and Information rates to 2.488 Gbps
- Device pin configured as stand-alone Encoder, Decoder, or Bypass with clocks disabled
- Provides a dedicated user defined data channel at 10.368 Mbps
- Provides count of correctable 0's and 1's that are in error in prior Code Word
- Operable at OC-48, OC-12, OC-3 rates
- Interfaces directly with Vitesse OC-48 rate components
- PECL and TTL I/O
- Telecom Temperature range: 0 - 85C Case
- Maximum power 1.05W (Encoder), 2.82W (Decoder @ 10^{-5} Input BER), 0.74W (Bypass)
- +3.3V Power Supply
- Thermally Enhanced 208 PQFP Package

VSC9210 Block Diagram



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Functional Overview

The device utilizes two 16 bit differential PECL I/O ports to interface with a high speed Multiplexer and a Demultiplexer. For the Encoder, the 1:16 Demultiplexer is used to convert the incoming 2.5 Gbps STS-48 information to a 16 bit parallel data at 155 MHz to interface with the VSC9210. After the encoding process, the 16 bit parallel output data from the VSC9210 is obtained at 165 MHz and is converted to a 2.65 Gbps data stream using the 16:1 Multiplexer. In the case of the Decoder configuration, the Demultiplexer operates on a 2.65 Gbps data stream while the Multiplexer provides the 2.5 Gbps STS-48 information stream. Clock dividers are incorporated within the VSC9210 to provide control of an external PLL circuit for synthesizing the necessary reference clock for the Multiplexer. In the case of the Bypass mode, the input and output rates are identical and both the Multiplexer and Demultiplexer operate at 2.5 Gbps. See Figure 1 for System Diagram detail.

The User Channel is an 8 bit TTL interface operating at 1.296 MHz resulting in an aggregate data rate of 10.368 Mbps. This data channel is encoded and decoded along with the 16-bit STS data, i.e. errors occurring in this User Channel are also corrected.

The VSC9210 can be operated at or below unencoded and encoded data rates of 155Mbs and 165Mbs respectively. The ratio of the two input clocks (INCLK and OUTCLK) must be 15/16 for Encoder operation, and 16/15 for Decoder operation.

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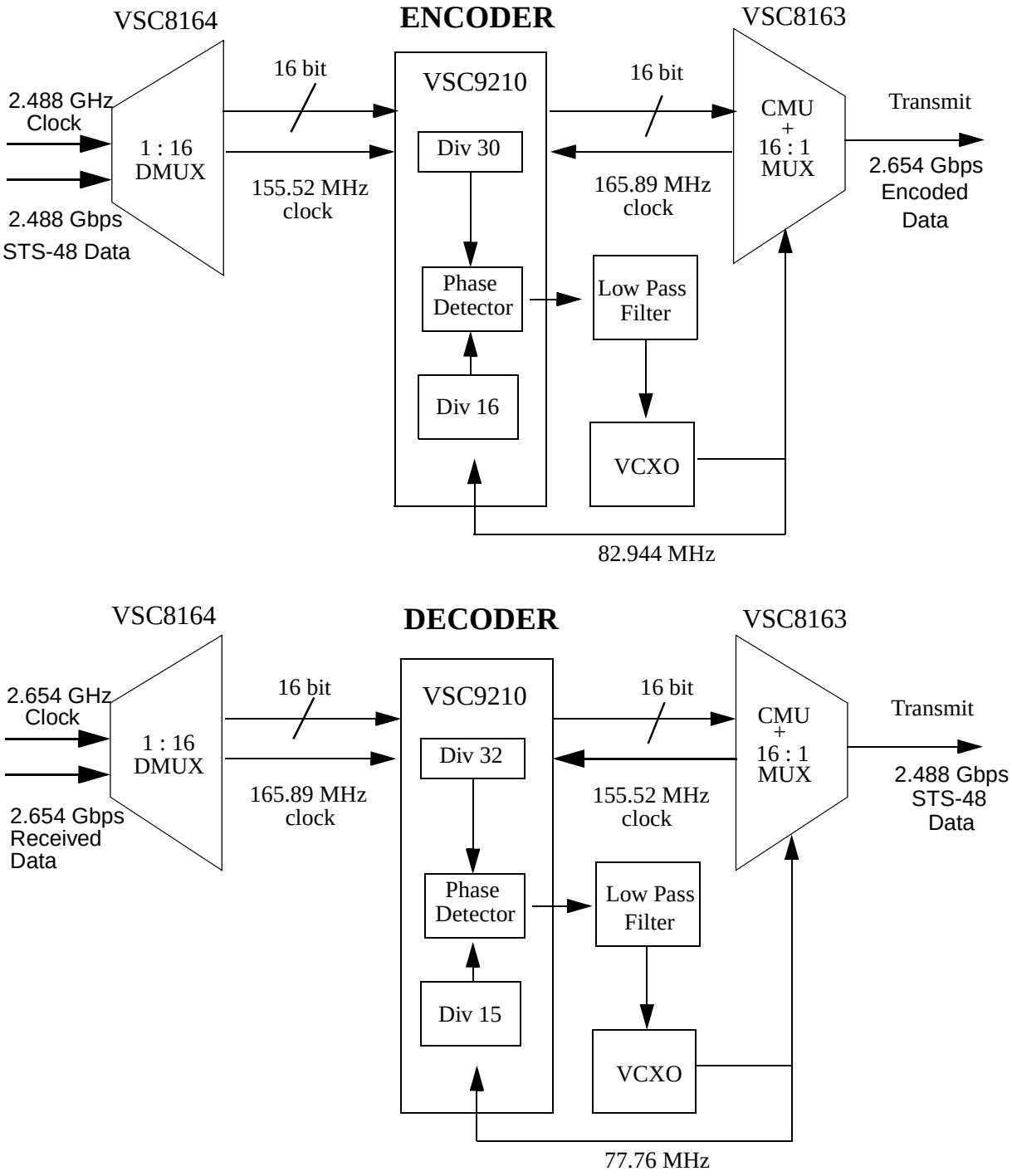
Figure 1: FEC System Diagram



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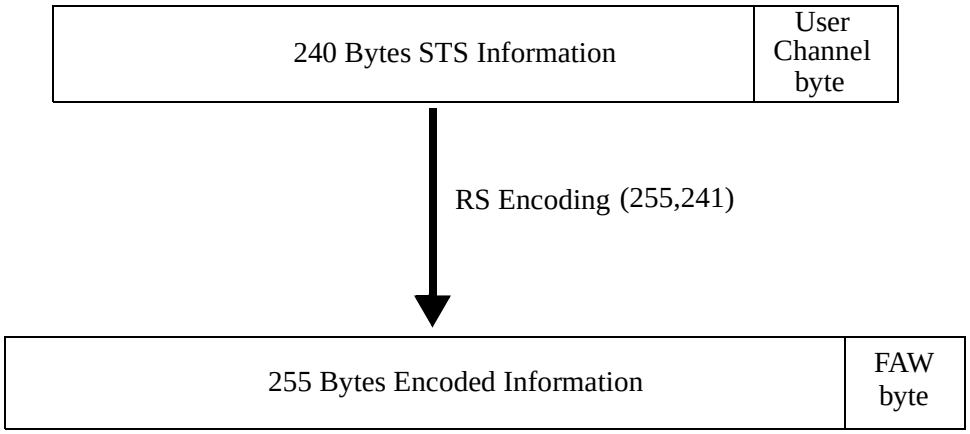
Overview of Reed-Solomon Codes

The VSC9210 CODEC device performs error correction and detection using Reed-Solomon (RS) codes. The codeword comprises *n* symbols each being *m* bits long with $n = 2^m - 1$. An (*n*,*k*) code is guaranteed to correct '*t*' symbol errors occurring anywhere in the codeword, with $2t = n-k$. RS codes can also correct burst errors. An (*n*,*k*) RS code can correct a minimum of $m(t-1) + 1$ bits of burst error within every codeword up to a maximum of *mt* bits depending on the occurrence of the burst error across the symbol boundaries. During encoding for non-systematic RS codes, a *k* symbol information vector is converted to an *n* symbol codeword by multiplying with a generator polynomial. The decoding process involves computing the error locations and the magnitude of the errors, and performing the error correction. Decreasing the ratio *k/n* improves the error correction performance of the code, but requires an increased encoded data output rate.

A symbol length of 8 (*m* = 8) results in a 255 symbol codeword that offers efficient error correction performance. The (255,241) code can correct 7 symbol errors and can handle a maximum burst error of 49 - 56 bits within each codeword as detailed above. For an input BER of 10^{-5} the output BER is 10^{-20}.

The codeword for the VSC9210 is constructed as follows. Of the 241 symbol information vectors (*k*), 240 are the incoming STS-48 data and the 241st symbol is the User Data Channel (USER_CHANNEL[7:0]). After non-systematic encoding of the 241 symbols, the 255 encoded symbols (*n*) are appended with an additional fixed Frame Alignment Word (FAW) used for FEC Frame alignment by the Decoder; the fixed value of the FAW is $F6_H$. These 256 symbols comprise a encoded Codeword as shown below in Figure 2.

Figure 2: Codeword after Reed-Solomon Encoding



The 255th byte of the encoded information is the User Channel Data. Though the User Channel Data byte is encoded and will be correctable, the mathematics involved for this RS code implementation does not transform the last information byte. Thus, the User Channel Data byte can be accessed externally within the encoded channel if desired (if not erred) as well as obtained after the VSC9210 Decoder processing of the Codeword.

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Signal Definitions

Signal	*Name*	*I/O*	*Freq/ Type*	*Description*
DATAIN[15:0] +/-	Parallel Receive Data.	I	155/166 Mbs PECL	This parallel data bus receives the incoming STS-48 at 155MHz (or Encoded data at 166 MHz). DATAIN[15] is the most significant bit and DATAIN[0] is the least significat bit. DATAIN[15] corresponds to the first arriving bit on the serial data stream. DATAIN[15:0] is sampled on the rising edge of INCLK.
INCLK +/-	Parallel Receive Data Clock.	I	155/166 MHz PECL	This clock reference is used to capture the Parallel Receive Data on the rising edge. The clock frequency is 155.52MHz relating to STS-48 for Encoder operation; 165.888MHz for Decoder operation (16/15 ratio).
DATAOUT[15:0] +/-	Parallel Transmit Data	O	166/155 Mbs PECL	This parallel data bus outputs the Encoded Data at 166MHz (or Decoded STS-48 data at 155MHz). DATAOUT[15] is the most significant bit and DATAOUT[0] is the least significat bit. DATAOUT[15] corresponds to the first transmitted bit on the serial data stream.
OUTCLK +/-	Parallel Transmit Data Clock.	I	166/155 MHz PECL	This clock reference is used to output the Parallel Transmit Data on the falling edge after Encode or Decode operation is complete. The clock frequency is 166.888MHz for Encoder operation; 155.52MHz relating to STS-48 for Decoder operation (15/16 ratio).
LOOP_CLK +/-	Parallel Transmit Data Loopback Clock.	O	166/155 MHz PECL	This clock is used by the receiving device to capture DATAOUT[15:0] on the rising edge. It is an inverted version of the received OUTCLK input signal.
MODE	Mode Control	I	STATIC TTL	Static control pin to set device to Encoder or Decoder operation (when not in Bypass mode; BYPASS = 0). MODE = 0 for Encoder, MODE = 1 for Decoder. Signal has internal pulldown.

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Signal	*Name*	*I/O*	*Freq/ Type*	*Description*
BYPASS	FEC Bypass Control	I	STATIC TTL	Active high signal to disable FEC Encode/ Decode operation. INCLK and OUTCLK ***must*** be same rate (155.52 MHz). Signal has internal pulldown.
RESET	Reset	I	TTL	Active high asynchronous reset signal used during manufacturing. Not required for system use. Schmidt trigger input with internal pulldown.
REFRAME	FEC Re-Frame Control	I	TTL	Active high asynchronous control to force a new FEC Frame search. Intended for testing only, not required for system operation. Schmidt trigger input with internal pulldown.
SYNC_INHIBIT	FIFO Self-Synchronize Inhibit	I	STATIC TTL	Active high signal to inhibit FIFO self locking mechanism - used for four 9210's in a 10Gb/s application. Not required for STS-48 system use. Signal has internal pulldown.
TEST_CTL[1:0]	Manufacturing Test Control	I	STATIC TTL	Allows USER_CHANNEL[7:0] to be used as a test port for manufacturing tests. For user operation these ***must*** be set to" 00". Signals have internal pulldown.
USER_CHANNEL[7:0]	User Data Channel	I/O	1.296 MB/s 2 mA TTL	Bidirectional User Data Channel: input for Encoder, output for Decoder. Input is captured relative to rising edge of USER_CLK in Encoder mode. Output should be captured on rising edge of USER_CLK when in Decoder mode; data is valid when ECC_FLAG is low. Signals are open drain outputs and require external pullup resistors of approximately 10K to V_{DD}.
ECC[5:0]	Error Correction Count	O	1.296 MHz 2mA TTL	Provides count of corrected errors in previous FEC Codeword (2048 bits). Data is to be captured with USER_CLK; rising edge for quantity of 1's in error, falling edge for quantity of 0's in error that were corrected. Data is valid only when ECC_FLAG is low, otherwise data output is $3F_H$.

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Signal	*Name*	*I/O*	*Freq/ Type*	*Description*
ECC_FLAG	Error Correction Count Flag	O	2 mA TTL	Active high signal indicating that the previous Codeword had an uncorrectable quantity of errors; greater than 7 symbol errors. When low, ECC[5:0] contains the 1's errors and the subsequent ECC[5:0] contains the 0's errors. When high, ECC[5:0] and USER_CHANNEL[7:0] will be invalid.
FP	FEC Frame Pulse	O	4 mA TTL	Active high frame signal that occurs every Codeword (1.296 MHz) when FEC Framer is in lock. When Framer is in lock but verifying LOCK status is correct, FP signals are not presented. Pulse width is approximately 48ns.
LOCK	FEC Framer Lock Status	O	2 mA TTL	Active high signal indicating FEC Framing is in lock.
USER_CLK	User Data Channel Clock	O	1.296 MHz 4 mA TTL	Clock used for USER_CHANNEL, ECC[5:0], ECC_FLAG, FP, and LOCK access.
VCXO_UPN/_DOWNN	Phase Detector Error	O	8 mA	Active low error signals from the internal Phase Detector to be used by an external summing and integrating loop filter to drive a VCXO in the PLL circuit. Signals are open-drain and require external pullup resistors.
UP_TRI/DOWN_TRI	Tri-state Phase Detector Error	O	4 mA TTL	Error signals from internal Phase Detector that are to be tied together to create a single error signal for an external integrating loop filter to drive a VCXO in the PLL circuit. Signals are Tri-state when no phase error is present.
PD_REF/PD_VCXO	External Phase Detector Scaled clocks	O	5.184 MHz 2 mA TTL	PD_REF is the scaled input clock (INCLK) and PD_VCXO is the scaled vcxo clock (VCXO_CLK) that can be used by an external phase detector circuit if desired.

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Signal	*Name*	*I/O*	*Freq/ Type*	*Description*
VCXO_CLK +/-	VCXO Input Clock	I	78/83 MHz PECL	Input clock from external VCXO in PLL circuit. Signal is scaled to 5.184 MHz to drive internal phase detectors and PD_VCXO.

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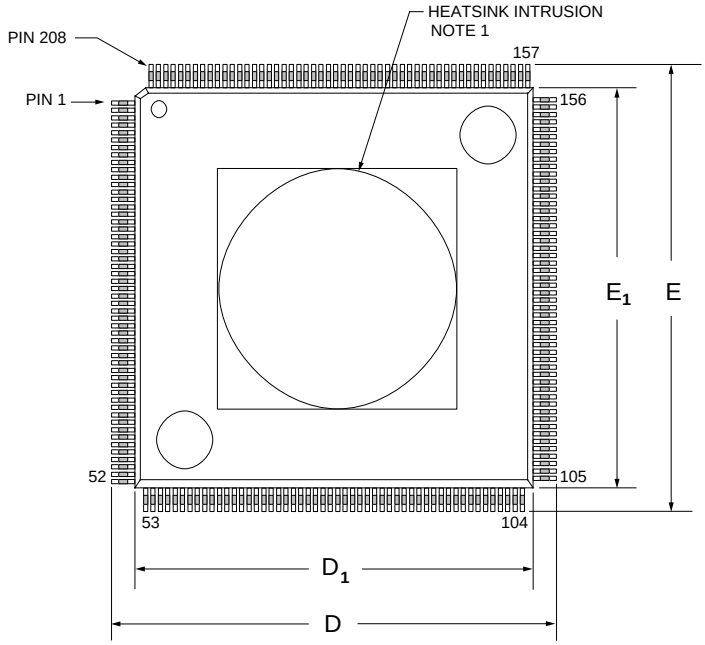
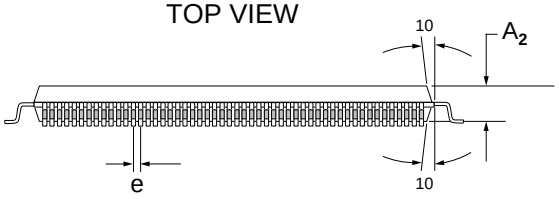
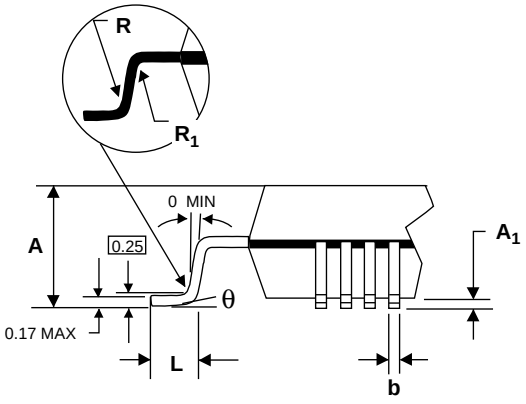
Package Information



TOP VIEW





Key	*mm*	*Tolerance*
A	4.10	MAX
A1	0.50	MAX
A2	3.49	±. .10
D	30.60	±. .20
D1	28.00	±. .10
E	30.60	±. .20
E1	28.00	±. .10
L	.88	+.15/-.10
e	.50	BASIC
b	.22	±. .05
θ	0° - 7°	
R	.15	TYP
R1	.25	MAX

NOTES:
1) 0.0127 Maximum
20.32 +/- 0.50 DIA.
Package #: 101-228-6
Issue #:

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Ordering Information

The order number for this product is formed by a combination of the device number, and package type.

VSC9210 **QG**

Device Type
VSC9210:
2.488Gb/s SONET/SDH
FEC Encoder/Decoder

Package
QG: 208PQFP

Notice

This document contains information on products that are in the preproduction phase of development. The information contained in this document is based on simulation results and initial product characterization. Characteristic data and other specifications are subject to change without notice. Therefore, the reader is cautioned to confirm that this datasheet is current prior to placing orders.

Warning

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