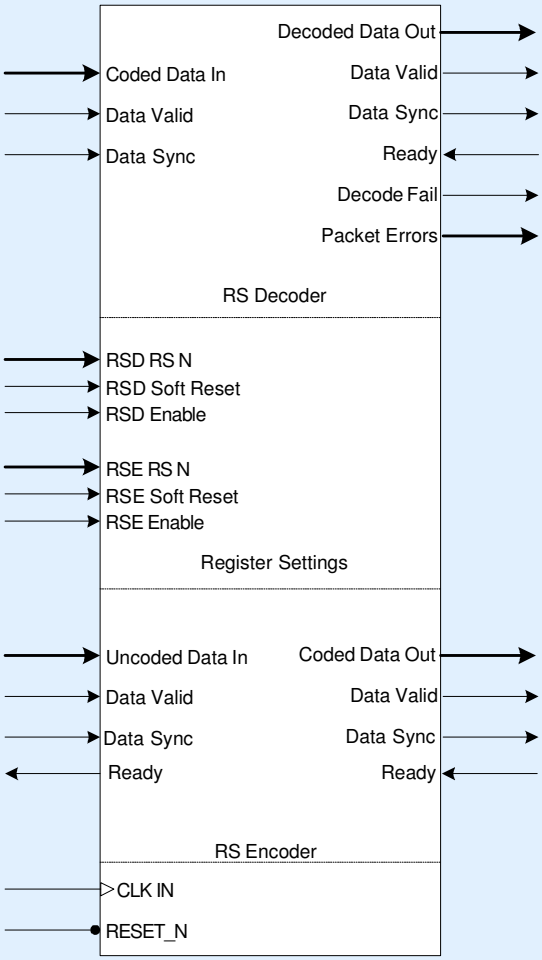
Reed Solomon Codec (Errors-only)

CMS0007

- Errors Only Reed-Solomon CODEC using the Berlekamp Massey algorithm for efficient implementation.
- Register programmable, fixed or synchronous "on-the-fly" loading for different values of N in a Reed-Solomon (N, N-2T) code. T fixed by synthesis.
- Supports shortened codes.
- Can be synthesised for any Galois Field, Reed-Solomon code, and correcting power T, with maximum values for N set by synthesis parameters.
- Requires one single-port memory with storage for two non-shortened Reed Solomon blocks.
- Excellent performance in both FPGA and ASIC implementations.



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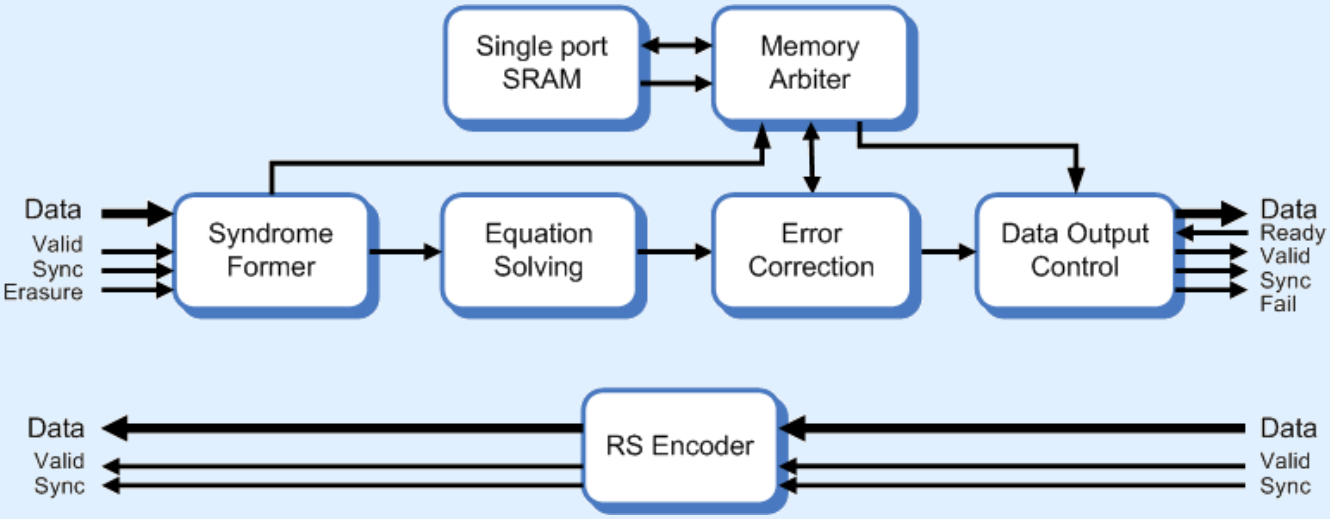
Block Diagram



Detailed Description

The Commsonic CMS0007 Reed Solomon Codec provides ultimate flexibility in its operation and build. The design uses the Berlekamp Massey algorithm in order to maximise speed and efficiency.

Synthesis Parameters

Setting up the Reed-Solomon codec is very simple. Firstly, it is necessary to set up the Galois field over which the code will operate using three parameters:

gal_bps. Bits per symbol (typically 7 or 8 for communications applications).

gal_alpha. Primitive root of the field (usually 2).

gal_field_gen_poly. Field Generator Polynomial (e.g. $x^8+x^4+x^3+x^2+1$ is usually used for GF{2^8}.

Once the field is set up, the next task is to select the Reed-Solomon code parameters. This involves configuring the parameters:

RS_T. The number of symbols that can be corrected per codeword.

J0. The first power of alpha used in the code generator polynomial.

The code polynomial G(x) is then determined by:

$$G(x) = (1-\alpha^{J0})\,(1-\alpha^{J0+1})\ldots\,(1-\alpha^{J0+2*RS\_T-1})$$

These parameters are set once in a VHDL package and are applicable to the full design. The field and code parameters are set by constants and fixed for a particular implementation of the block.

Register Configuration

Once the code has been selected, it is possible to adapt the correcting power for a particular application by adjusting the values of N that is selectable using the register RS_N.

For example, if the code instantiation selected is an RS(255, 239) code then the decoder is capable of correcting eight errors in every 255 symbols - since N=255 and T=8 are the maximum values permitted by this instantiation. Setting RS_N less than 255 will allow the same number of errors to be fixed in a shorter block size thereby increasing the correcting power of the code.

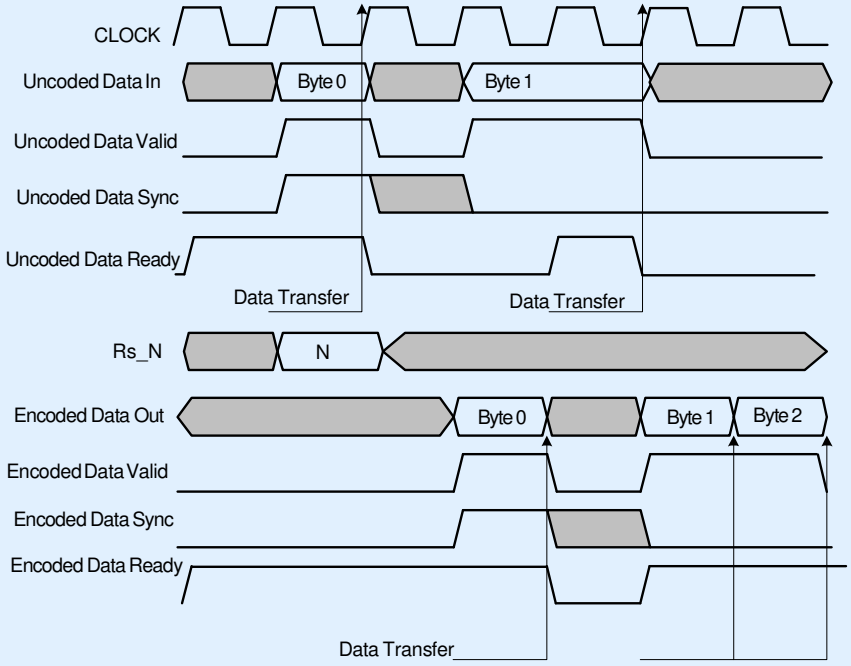
An additional feature is the ability to accept new value on N on a packet-by-packet basis. The value of N is loaded with sync and valid to allow *on-the-fly* changes. Alternatively the value of N may be tied to a constant to minimise gate count.

Principle I/O Description

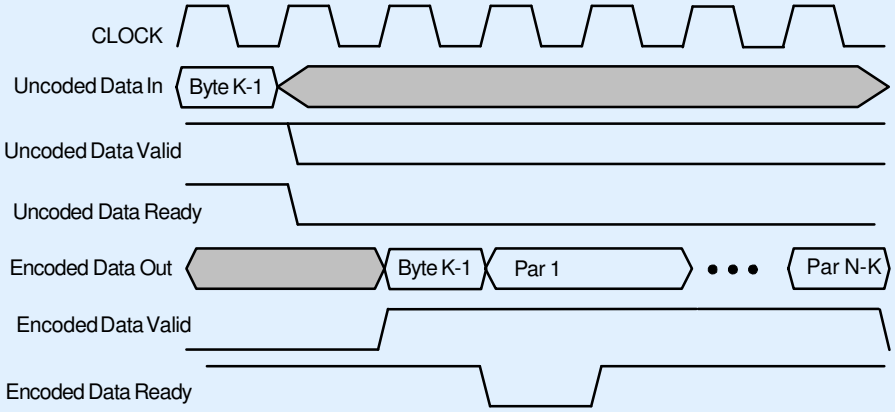
Decoder I/O	
Coded Data In	Reed-Solomon encoded symbols
Coded Data Sync	RS block start flag
Coded Data Valid	Strobe signal for data and sync inputs
Decoded Data Out	The decoded and corrected data output symbols
Decoded Data Sync	Block start indicator for output blocks
Decoded Data Valid	Strobe signal for output data and sync
Decoded Data Ready	Device receiving data is ready. Data transfers when ready/valid are asserted
Decode Fail	Indicates that the block output decode failed due to too many errors.
Packet Errors	Number of errors fixed in the packet. Used in to construct a BER monitor.
Encoder I/O	
Uncoded Data In	Non-coded data input symbols
Uncoded Data Sync	Block start flag
Uncoded Data Valid	Strobe signal for data and sync inputs
Uncoded Data Ready	Encoder ready for new data byte. Data transfers when ready/valid are asserted
Coded Data Out	The encoded data output symbols
Coded Data Sync	Block start indicator for output blocks
Coded Data Valid	Strobe signal for output data and sync
Coded Data Ready	Interface ready for new data byte. Data transfers when ready/valid are asserted
Registers	
RSD N	The number of symbols in the encoded block. Stored at start of packet.
RSD Soft Reset_N	Soft reset for the RS Decoder.
RSD Enable	Enable decoder. When clear data will be passed through without correction.
RSE N	The number of symbols in the encoded block. Stored at start of packet.
RSE Enable	Enable encoder. When clear data will be passed through without parity bytes.
RSE Soft Reset_N	Soft reset for the RS Encoder.
Others	
clock	Clock input.
reset_n	Asynchronous active-low reset input.

Timing Diagrams

RS Encoder packet start:

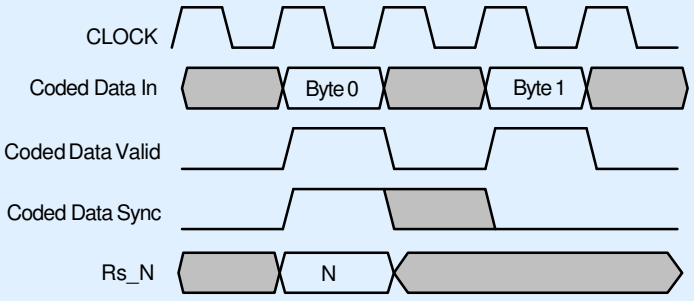


RS Encoder packet end:

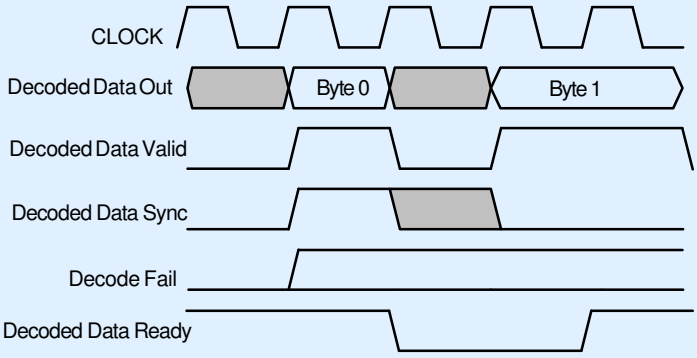


Timing Diagrams (Cont'd)

RS Decoder Data Input:



RS Decoder Data Output:



EXAMPLE APPLICATION

DVB Decoder:

A typical application for the RS Decoder is in a DVB decoder application. The field used is GF{2^8} generated with the polynomial $x^8+x^4+x^3+x^2+1$. The standard calls for an RS(204, 188) code which can be implemented by setting the value of RS_N = 204 as a constant. The value of RS_T is set as a synthesis parameter to 8.

About Commsonic:

Commsonic is an IP and design services company that specialises in the development of ASIC, FPGA, DSP and board-level sub-systems for applications in wireless and wireline communications.

Our expertise is primarily in the gate- and power-efficient implementation of physical-layer (PHY) functions such as modulation, demodulation and channel coding, but we have extensive experience with all of the major elements of a modern baseband 'core' including medium access control (MAC), voiceband DSP, mixed-signal interfaces and embedded CPU and software.

Our services are available on a turn-key basis but they are usually provided as part of a support package attached to members of our expanding family of licensable IP cores.

Commsonic's IP spans the major Standards for cable, satellite and terrestrial digital TV transmission and includes high-performance, adaptable, single-carrier (QAM) and multi-carrier (COFDM) modulator and demodulator solutions for DVB-S2, DVB-C/J.83/A/B/C and DVB-T/H.

Commsonic's customers are typically semiconductor vendors and manufacturers of broadband transceiver equipment that demand leading-edge Standards-based or proprietary PHY solutions but don't have the internal resources necessary to get their products to market soon enough.

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