Part Number NSW702CD

SINCGARS EDM FEC Decoder Module

Data Sheet **March 1999, v1.0**

Target Applications:

Communications
RT-1523C/D Compatible
SINCGARS SIP Compliant

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Features:

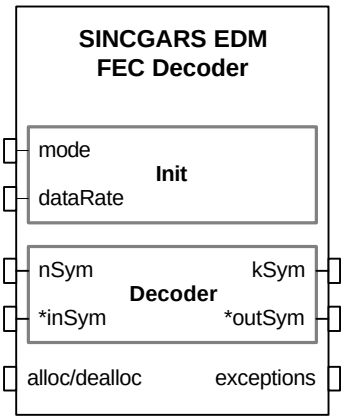
- Provides FEC decoding compliant w/ SINCGARS enhanced data mode (EDM)
- C Source Code
- Supplies concatenated decoding with 1200, 2400, 4800, 9600 bps data and packet mode for both single channel and frequency hopping operation.
- Coding gains approaching theoretical limits.
- Includes Reed-Solomon block codes, GF(2^5), Nadler non-linear block code, parity, and deinterleaving.
- Delivery includes source code and a test bench.
- Refer to Part Number NSW702CE for encode operation.

Preliminary Release

1 General

The SINCGARS waveform provides the primary means of command and control for the United States Army Infantry, Armor, and Artillery Units. This very high frequency (VHF) waveform has the capability to transmit and receive voice, tactical data and record traffic messages. It is also consistent with NATO interoperability requirements. The waveform operates on any one of 2320 channels between 30 – 87.975 MHz.

The original legacy waveform was referred to as SINCGARS Data Mode (SDM) and supported continuous voice and data operation in either single channel (SC) or frequency hopped (FH) modes. The next generation waveform was referred to as the Enhanced Data Mode (EDM) and added extensive forward error correction (FEC) capability to improve communications range.



This specification sheet provides a description of a software object that contains the methods in support of the FEC decoder required for EDM. The decoder includes local methods that include RS decoding (over a Galois Field of 2^5), Nadler decoding, and detection of side information (SI) to establish erasures consistent with EDM. The module also includes a deinterleaver function that supports both EDM SC and FH modes. Interfaces exported from the object include allocate/deallocate, mode/data rate initialization, decode, and an exception indicator.

Table G-1 indicates the concatenated FEC modes applied for EDM. The various information rates are shown in the first column. Data rate adaptation (DRA) is applied to the 1200 and 2400 bps information to realize the required throughput rates. The Reed Solomon (RS) outer block code applied for each rate is listed in column 3; note that the rates shown indicate that the RS codes are modified for some of the modes. The fourth column shows the inner code that is applied in the form of a Nadler (12,5) block code or side information (SI). The fifth column indicates the usage of the inner codes to declare erasures. The sixth column shows the effected rate of the FEC encoder that yields the 16 kbps channel rate. The last column shows the dependency of the interleaver type on the radio mode.

Info. Rate (kbps)	DRA	Outer RS Code GF(2^5)	Inner Code Nadler (12,5) or SI	Erasure Determination	Effective Code Rate	Interleaver Type
1200	216/225	RS(32,6)	Nadler	Nadler Decode Error	0.075	SC (Type I) FH (Type III)
2400	216/225	RS(32,12)	Nadler	Nadler Decode Error	0.15	
4800	1	RS(25,9)	SI (Parity)	Parity Error	0.30	SC (Type II) FH (Type IV)
9600	1	RS(25,18)	SI (Parity)	Parity Error	0.60	
5000 (Burst)	1	RS(32,12)	SI (Parity)	Parity Error	0.3125	

Table G-1: SINCGARS SIP FEC allocations – a combination of RS, Nadler, and SI are applied to achieve the desired channel rate of 16 kbps.

2 Interface Definition

The EDM FEC decoder contains several interfaces that support allocation, deallocation, initialization, and decoding consistent with the EDM data waveforms as described in Table IC-1. The allocate/deallocate functions are used to reserve/release data memory and establish the "initial" condition of the device including any local data tables,

Prototype	Description
unsigned allocateFECDecoder(void);	out: **return code** indicates status of execution. =0 indicates Pass, != 0 indicates failure.
unsigned deallocateFECEncoder(void);	out: **return code** indicates status of execution. =0 indicates Pass, != 0 indicates failure.
unsigned initFECDecoder(unsigned dataRate, unsigned mode);	in: **dataRate** of the codec and is enumerated as either {dr1200, dr2400, dr4800, dr9600, drPacket}. in: **mode** is enumerated as either {SC or FH}. out: **return code** indicates status of execution. =0 indicates Pass, != 0 indicates failure.
unsigned FECDecode(unsigned nSym, unsigned *inSym, unsigned *kSym, unsigned *outSym);	in: **nSym** = number of input symbols to decode (12-bit symbols). in: ***inSym** = pointer to array containing input symbols. out: ***kSym** = number of decoded symbols (5-bit symbols). out: ***outSym** = pointer to array containing output symbols. out: **return code** indicates status of execution. =0 indicates Pass, != 0 indicates failure.

Table IC-1: External interfaces to the EDM FEC Decoder.

arrays, or state variables that are locally persistent to the decoder. The initialization function allows the calling routine to establish the data rate of the decoder as enumerated in Table IC-1. A data array is passed to the decoder and the decoded data is returned from the call to FECDecode( ). All methods provide a return code that indicates the success/failure of the process; these can be used externally to establish exception handling.

3 Data Flow

Figure IC-1 depicts a block diagram of the FEC decoder. The Nadler may be used to correct errors and is also used to declare erasures through observation of detected code distance characteristics. The parity is similarly used to detect errors and thereby erase symbols. The detected symbols and erasure indications are passed through the deinterleaver. The deinterleaver is designed to disperse contiguous error events thereby increasing the effectiveness of the RS block code. The deinterleaved stream is processed through the RS decoder, producing an estimate of the

original 5-bit symbol sequence. The data rate adaptation is removed for 1200 and 2400 bps data rates as required in the waveform specification.

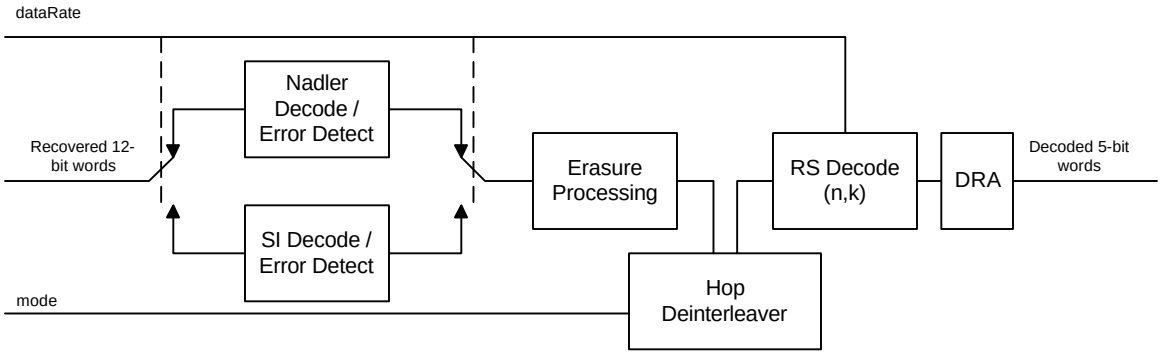


Figure IC-1: SIP FEC Decoder – supplies RS, Nadler, SI application and deinterleaving to support all EDM data rates for SC and FH modes.

4 Context Description

Figure CD-1 depicts a system context for application of the SINCGARS EDM FEC Decoder module within a software-based EDM receive implementation. Data arrives from the demodulator and is parsed into blocks of 12-bit words. The information is then routed to either the SC or FH EDM Receive Overlay Module where the various fields are detected and overlay information is stripped off. The data is then passed through the FEC decoder which detects erasures, performs error corrections, and removes all redundancy. The resultant data stream is packet into 5-bit words with a block size that is dependent on the data rate. Note that the parameters of the modules are specified by the mode (SC/FH) and the data rate. These parameters are established based on user specified changes at the user interface and are therefore static during waveform transmission.

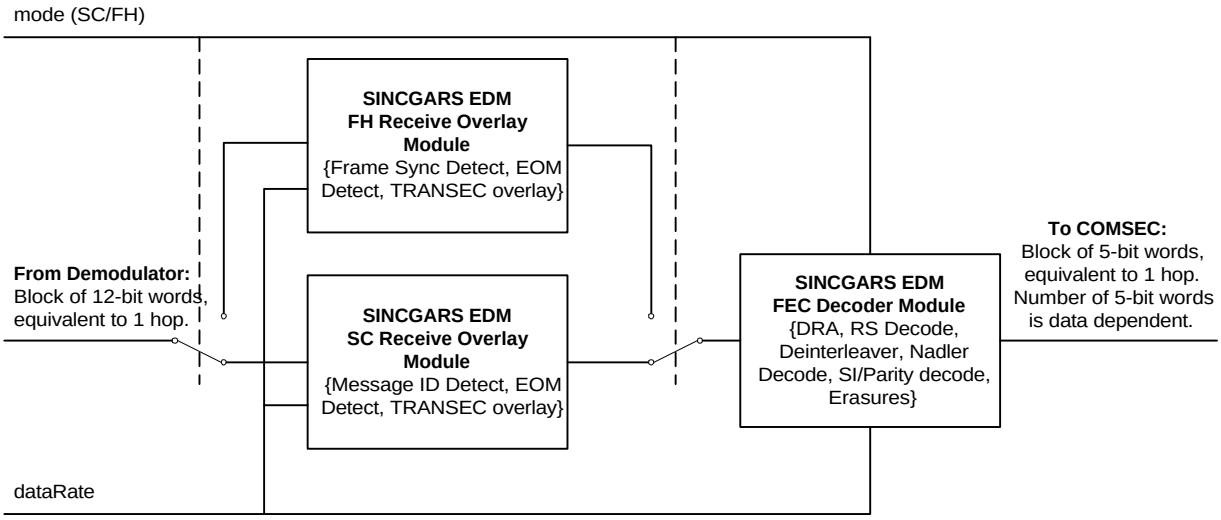


Figure CD-1: System Context for EDM receive operation.