Part Number NSW702CE

SINCGARS EDM FEC Encoder Module

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

Target Applications:

Communications
RT-1523C/D Compatible
SINCGARS SIP Compliant

Nova Engineering, Inc.
5 Circle Freeway Drive
Cincinnati, OH 45246
Tel.: (513) 860-3456
Fax: (513) 860-3535
E-mail sales@nova-eng.com
WWW http://www.nova-eng.com

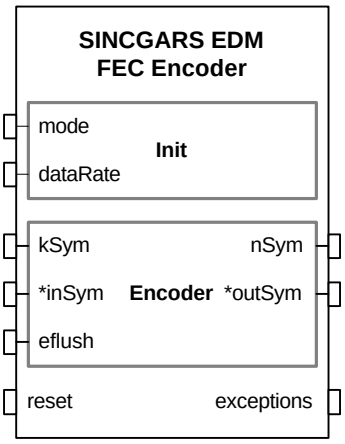
Features:

- Provides FEC encoding compliant w/ SINCGARS enhanced data mode (EDM)
- C Source Code
- Supplies concatenated coding 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 interleaving.
- Delivery includes source code and a test bench.
- Refer to Part Number NSW702CD for decode 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 encoder required for EDM. The encoder includes local methods that include RS encoding (over a Galois Field of 2^5), Nadler encoding, and addition of side information (SI) consistent with EDM. The module also includes an interleaver function that supports both EDM SC and FH modes. Interfaces exported from the object included allocate/deallocate, mode/data rate initialization, encode, flush, 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 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	Effective Code Rate	Interleaver Type
1200	216/225	RS(32,6)	Nadler	0.075	SC (Type I) FH (Type III)
2400	216/225	RS(32,12)	Nadler	0.15	
4800	1	RS(25,9)	SI (Parity)	0.30	SC (Type II) FH (Type IV)
9600	1	RS(25,18)	SI (Parity)	0.60	
5000 (Burst)	1	RS(32,12)	SI (Parity)	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 encoder contains several interfaces that support allocation, deallocation, initialization, encoding, and flush operations 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

Prototype	Description
unsigned allocateFECEncoder(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 initFECEncoder(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 FECEncode(unsigned kSym, unsigned *inSym, boolean eflush, unsigned *nSym, unsigned *outSym);	in: **kSym** = number of input information symbols (5-bit symbols). in: ***inSym** = pointer to array containing input symbols. in: **eflush** = command to flush the decoder. out: ***nSym** = number of encoded symbols (12-bit symbols). out: ***outSym** = array containing output symbols. out: out: **return code** indicates status of execution. =0 indicates Pass, != 0 indicates failure.

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

local data tables, arrays, or state variables that are locally persistent to the encoder. The initialization function allows the calling routine to establish the data rate of the encoder as enumerated in Table IC-1. A data array is passed to the encoder and the encoded data is returned from the call to FECEncode( ). When incoming data is terminated, the encoder flush (eflush) is used to complete the transmission. All routines 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 shows a block diagram of the FEC encoder. The RS encoder and Nadler/SI selection is moded using the initFECEncoder( ) routine. Data rate adaptation is optionally applied as specified by the selected data rate. Blocks of 5-bit information symbols are fed to the RS encoder and the results are passed to the Hop Interleaver. When data is

released from the Hop Interleaver, either the Nadler or the SI is applied and 12-bit words are formed for transmission. Note that two words are concatenated in the SI application to form the desired 12-bit words. An amount of data equivalent to a hop is released from the EDM FEC encode object. When data is no longer available for transmission, the last incomplete buffer is submitted and the transmission is gracefully terminated by exercising the eflush control.

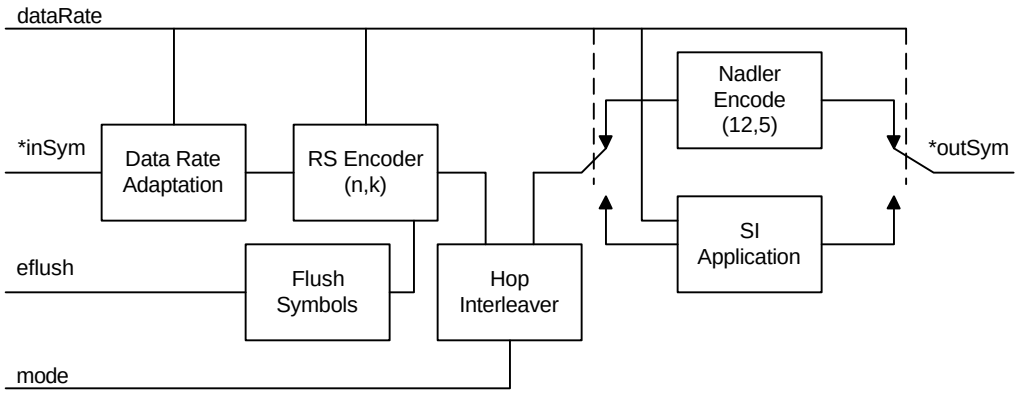


Figure IC-1: SIP FEC Encoder – supplies RS, Nadler, SI application and interleaving to support all EDM data rates for SC and FH modes.

4 Context Description

Figure CD-1 depicts a system context for application of the SINCGARS EDM FEC Encoder module within a software-based EDM transmit implementation. Data arrives from a COMSEC applique and is parsed into a block of 5-bit words. The number of 5-bit words is sufficient to build a single hop; note that this variable is dependent on the data rate. The information is passed through the encoder, then is passed into the appropriate EDM Transmit Overlay module. This module concatenates the appropriate header/trailers, inserts EOMs, frame synchronization information, message IDs, and applies a TRANSEC overlay. The resultant stream is forwarded to the modulator in a block of 12-bit words. The number of words is sufficient to form a single hop. 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.

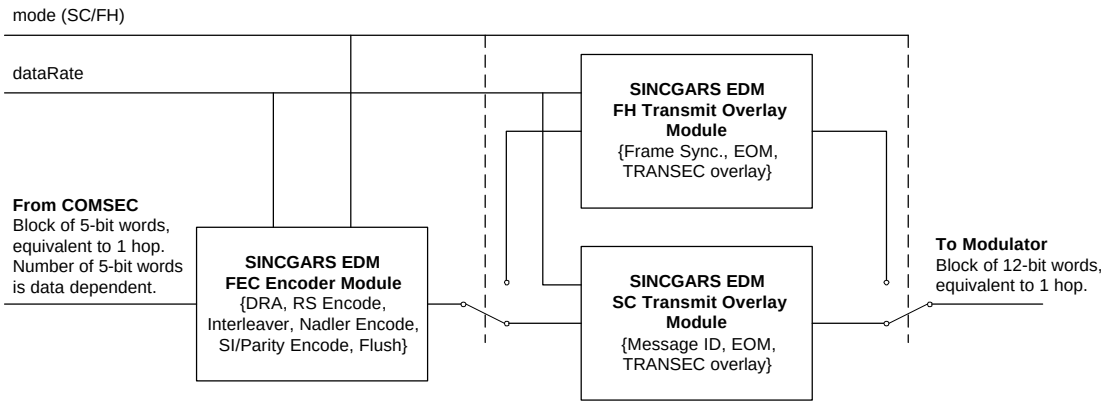


Figure CD-1: System Context for EDM transmit operation.