KTech TELECOMMUNICATIONS, INC.

Application Note

8-VSB Modulator
Model Number: VSB-ENC-200

INTRODUCTION

This application note describes the VSB-ENC-200 8-VSB Modulator and its applications.

FUNCTIONAL DESCRIPTION

The main features of the VSB-ENC-200 are as follows:

- Modulates MPEG2 transport stream into an 8-VSB signal
- SMPTE-310M or DVB-ASI @ 19.392 Mbps MPEG2 TS input
- 44.0 MHZ IF 8-VSB Signal Output
- Easy to use front panel interface with LCD screen display
- 3 input source modes SMPTE, ASI or PNGEN
- Front panel 44.0 MHz IF Output Testpoint, -20 dB coupled
- Built in 23 stage PN Generator used for testing BER conditions to the transmitter receiver chain
- PLL Lock Detector indicates when MPEG2 source data is valid from the SMPTE-310M or DVB-ASI @ 19.392 Mbps MPEG2 TS input
- Complies with ATSC A53 specification for 8-VSB modulation for terrestrial broadcast of a high definition digital TV signal
- Option 325: Linear and Non-linear precorrector

APPLICATIONS

One application of the VSB-ENC-200 is at a digital television station transmitter site, as shown in Figure 1. The TS Generator is used to generate an MPEG2 transport stream for the VSB-ENC-200 8-VSB Modulator. The VSB-ENC-200 modulates the transport stream into 8-VSB 44 MHz IF format. The 8-VSB 44 MHz output is upconverted into the desired channel frequency by an Upconverter and input into a Power Amplifier. The 8-VSB RF signal is then transmitted over the coverage range.

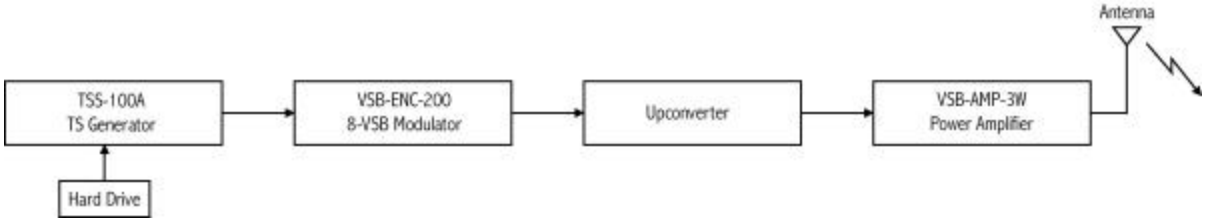


Figure 1: Application of the VSB-ENC-200 at a DTV Transmitter Site

The VSB-ENC-200 can also be used at DTV Repeater Stations, as shown in Figure 2. An 8-VSB Reference Receiver demodulates the 8-VSB RF signal into an MPEG2 Transport Stream. The Transport Stream is input into the VSB-ENC-200 8-VSB Modulator that proceeds to remove channel errors and remodulate the signal. The 8-VSB 44MHz output is upconverted into the desired channel frequency by an Upconverter and input into a Power Amplifier. The 8-VSB RF signal is then transmitted over the extended coverage range.

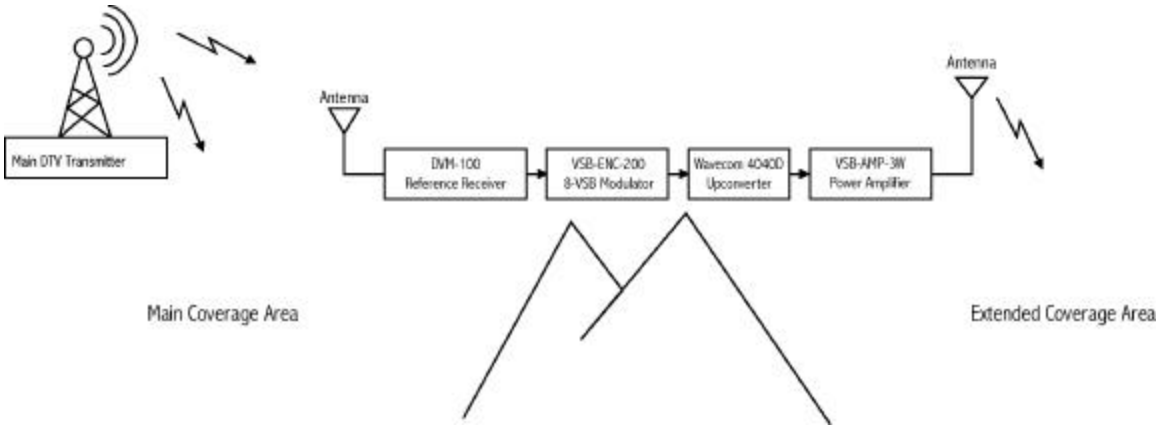


Figure 2: Application of the VSB-ENC-200 in a DTV Repeater Station

One of the main benefits of a DTV Repeater Station is its extended coverage area. In the configuration shown in Figure 2, the 8-VSB signal quality is preserved by baseband demodulation and the 8-VSB remodulation technique. After the signal is re-modulated into 8-VSB, the resulting copy of the DTV signal can be translated to a different channel and additional power amplification may be added for increased coverage area.

To use the precorrector option the VSB-ENC-200 is set up as shown in Figure 3. A valid SMPTE-310M MPEG2 DTV transport stream is connected to the VSB-ENC-200's SMPTE Input. The 44.0 MHz IF output of the modulator is connected to an Upconverter that sets the desired RF channel number. The Upconverter's RF Output monitor point is connected to the VSB-ENC-200's CAL Input through an attenuator. The Calibration Input is used to take sample of the Modulator to Upconverter to Pre-corrector signal chain and to perform self-calibration. This process corrects for the units internal degradations caused by filters and other linear distortions. The RF Output of the Upconverter is connected to the input of a High Power Amplifier (HPA). The HPA Output sampling point is connected to the RF Input of the VSB-ENC-200's RF Input through an attenuator. The HPA sampling point must be at the final output stage after its bandpass filter. The RF and Calibration Input power should be between –20 dBm and –30 dBm into a 50 ohm load. The RF input power must also be within +/- 1 dB of the Calibration input power.

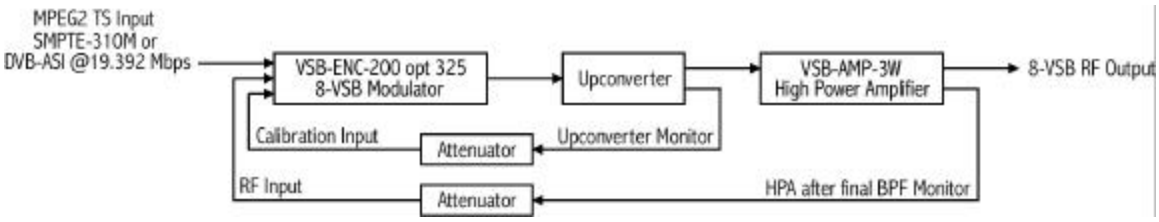


Figure 3: Set up for VSB-ENC-200 Opt 325 Pre-corrector

FUNCTIONAL BLOCK DIAGRAM

An internal block diagram of the signal flow through the VSB-ENC-200 is shown in Figure 4. In the PLL, the VSB-ENC-200 receives MPEG2 data packets and synchronizes itself to the incoming signal. The PLL locks when a valid MPEG2 TS is detected and lock detection is displayed on the LCD screen. The MPEG2 TS is then formatted into an 8-VSB baseband DTV signal. Randomization, forward error correction, sync and pilot insertion occur during baseband formatting. The 8-VSB baseband DTV signal is then filtered by a Finite Impulse Response (FIR) digital filter, converted to an analog signal by a Digital to Analog Converter and made available at the 44.0 MHz IF Output. If the pre-corrector option has been purchased, linear and non-linear pre-correction will occur during digital filtration. After the modulator output has been connected to an external amplifier and filter networks, a small portion of the final output signal is injected into the 8-VSB Demodulator's RF feedback input. This signal is used to demodulate and generate an error signal that is used to adjust the FIR filter coefficients to pre-correct the linear distortions in the transmitter's signal chain. The non-linear pre-correction algorithm works by using the front panel interface to select one of the 31 ROM tables stored for a target power amplifier.

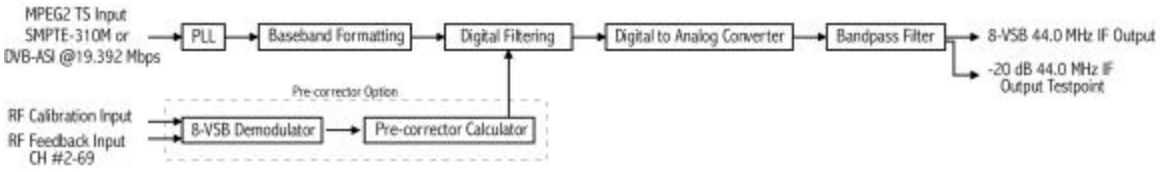
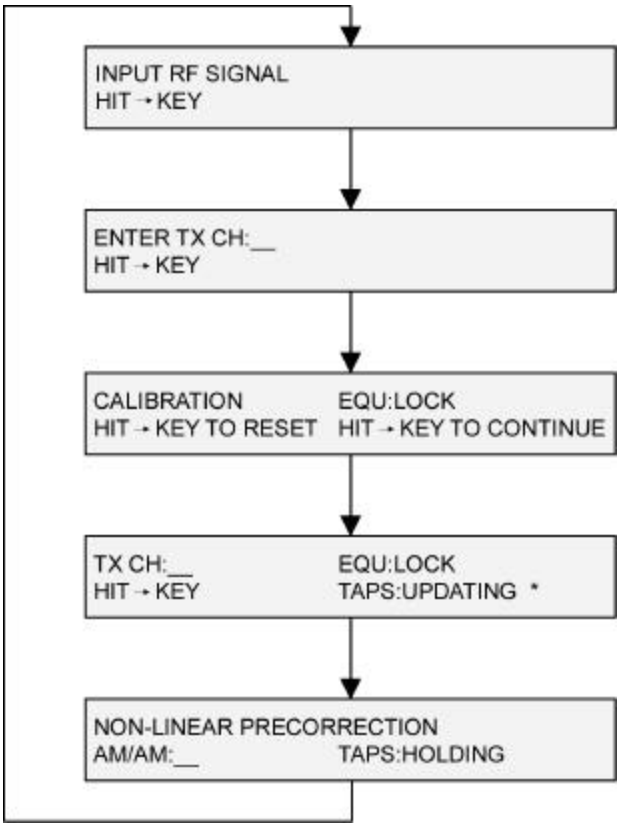


Figure 4: VSB-ENC-200 Internal Block Diagram

USER INTERFACE

The VSB-ENC-200 is controlled by a front panel user interface. The front panel features an LCD screen and four directional arrows keys. The directional arrows keys are used to scroll through and make selections in the menus displayed on the LCD screen. The menus for the VSB-ENC-200 Opt 325 with pre-corrector is shown in Figure 5.



This menu appears when the VSB-ENC-200 is powered on. Connect the Upconverter's monitor output to the VSB-ENC-200's Calibration Input and press the ? arrow key.

Use the ? and ? arrow keys to select the RF channel number for the feedback signals. Press the ? arrow key.

The VSB-ENC-200's calibration is running. When EQU:LOCK appears, the unit has completed its self-calibration. Press the ? arrow key to continue or ? arrow key to reset. If EQU:UNLOCK appears, the unit will automatically reset itself. Check to make sure that connections are correct.

The VSB-ENC-200's linear pre-correction is running. Press the ? and ? arrow keys to make the pre-corrector hold or update its equalizer taps calculations. The rotating * is a 3 minute timer. After 3 minutes, the TAPS will switch to HOLDING mode to fix the taps.

Press the ? and ? arrow keys to select one of 31 pre-stored tables used for non-linear pre-correction. The number next to AM/AM indicates the table number. Press the ? arrow key to reset and start over.

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SPECIFICATIONS

General Specification

Parameter	Min	Typical	Max	Units	Comments
AC Power Usage					
Frequency	47	60	63	Hz	
Current	0.3	0.35	0.4	Amps, AC	
Voltage	90	120	264	Volts, AC	
Operating Conditions					
Temperature	0	25	50	Deg, C	
Altitude			8000	Ft	
Humidity			95	%	Non-condensing
Cooling Mechanism					Convection cooling
Weight		15		lbs	net, 25 lbs gross box
Physical Dimensions:					19" rack mount front panel
Height		3.5		Inches	2U height
Width		19.0		Inches	
Dept		18.0		Inches	
Power Dissipation		35.0		Watts	
Operational Modes					Self Contained and Self Controlled. No PC needed to control the equipment.
Operational VSB Modes		8VSB			8VSB Only
Compliance					ATSC Spec per ATSC A53 Document

Baseband Digital Input Specification

Parameter	Min	Typical	Max	Units	Comments
PRE-Correction					
Linear distortion		500		Nsec	Group Delay
		8		DB	Magnitude Tilt
Non-linear distortion		3		DB	
In-band SNR		30		dB	Measured by VSA
Switch					
Power On/Off					Light On for power On

I.F. Output Specification

Parameter	Min	Typical	Max	Units	Comments
IF Output					
Output Frequency Band	41.00	44.00	47.00	MHz	
SQRT Raised Cos filter		11.5		%	Square root raised cosine
Carrier Phase Noise			-105	'dbc/Hz	20KHz Offset
Output Connector Type		BNC			
Output Impedance		50		Ohms	
Output Power Level		-14		dBm	Over 6MHZ
In-Band SNR		30		dB	Over 6MHZ
Stopband IMD Level	-50			dB	
In-Band Flatness		0.5		dB	Over 6MHZ

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R.F. Output Specification (using opt 200)

(using user provided L.O.)

Parameter	Min	Typical	Max	Units	Comments
RF Output					
Output Frequency Band	50		810	MHz	
Input Connector Type		SMA			
Input Impedance		50		Ohms	
Input Ext L.O. Power		+8		dBm	
Input Ext L.O. Freq	1690.0		2450.0	MHz	user provided external source sets the output spectrum frequency
Output Connector Type		BNC			
Output Impedance		50		Ohms	
Output Power Level		-17		dBm	Over 6MHZ
In-Band SNR		30		dB	Over 6MHZ
Stopband IMD Level	-45			dB	
In-Band Flatness		0.5		dB	Over 6MHZ

Ordering Information

Part Number	**Description**
VSB-ENC-200	8-VSB Modulator, 44.00 MHZ I.F. output input modes: SMPTE-310M 19.392658MBPS data rate
Options	
-200-CHxx	UHF Up-Converter to a fixed TV channel #2 - #69
-325	Linear and nonlinear pre-correction
-4040D	Frequency Agile up converter TV Channel #2- #69

Additional Information at K Tech Web Site: www.ktechtelecom.com
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