

2.28 bps/Hz Pragmatic Trellis Coded Modulation (PTCM) Decoder for TMS320C54xx

A reusable (XDAIS compliant), MIPS and memory-efficient 2.28 bps/ Hz PTCM decoder is now available. Traditionally, satellite communications (SATCOM) systems have been viewed as power-limited. As channel capacity, C , decreases when bits per second per Hz, r , is increased (i.e., required $E_b/N_0 > (2^r - 1)/r$), satellite systems have traditionally used QPSK with rate $\frac{1}{2}$ coding (i.e., $r=1$). However, orbital spectrum congestion has led to increased efforts to use higher order modulations in SATCOM. A recent satellite standard proposal suggests using a rate $\frac{1}{2}$ convolutional code on every fifth bit and mapping the resulting 6 bits to two 8-PSK signal constellations (Figures 1 and 2). An IESS-308 (Appendix G) outer (225, 205) Reed-Solomon (R-S) code over $GF(2^8)$ is used to provide an additional 2dB coding gain. As per the standard, the 32 bit unique word, split into two sets of 2 bytes and inserted in every 15th and 16th blocks for R-S codeword synchronization, is also used for phase and odd-even baud ambiguity resolution at the decoder.

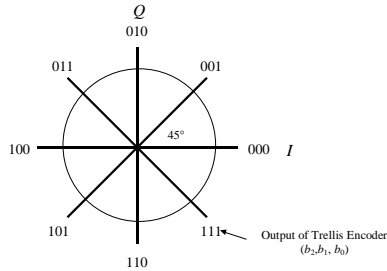


Figure 1. 8-PSK constellation and mapping

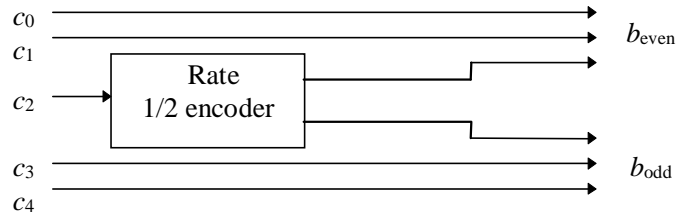


Figure 2. PTCM encoder

Signion's PTCM decoder, diagrammed in Figure 3, accepts 16 in-phase (I) and quadrature (Q) values (for 16 symbols or 40 output bits), each quantized to 11 bits. The PTCM decoder's performance (test software- in C- that exercises the C callable PTCM routine is also provided), shown in Figure 4, meets all requirements of the new proposal. The PTCM decoder is available for the TMS320C54xx processors and consumes 515 cycles per decoded bit. The PTCM decoder self-synchronizes (when valid, but possibly erroneous, data is present at its input) within 292 symbol durations. Code size is 2600 bytes and data size (including heap) is 782 bytes. A minimum of 100 bytes of memory must be allocated to the system stack.

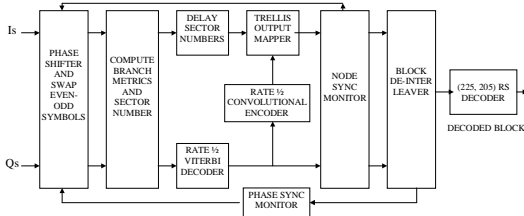


Figure 3. PTCM decoder Block Diagram

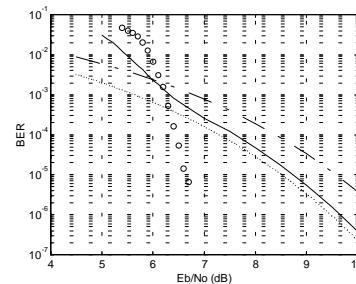


Figure 4. PTCM decoder's AWGN performance (line with 'o's is BER of the decoder, solid line - BER without the RS outer code, dashed line is uncoded QPSK BER, and dotted line is lower bound for PTCM decoder's BER without RS outer code)

This PTCM decoder, that may be used as a component in implementing the new proposal¹, has two flavors. Object module: USD 395 (includes C test software) Source module: USD2500 (includes C test software). To order, please contact ptcm@signion.com.

¹ Users of this software must be aware of the existence US patent 6,078,625 assigned to Sicom, Inc. While Signion's implementation simplifies branch metric calculations and does not entirely follow the methodology described by the patent, purchasers of Signion's software must be aware that the applicability of the patent to software implementations is unclear. Purchasers agree to use the software at their own risk and shall indemnify Signion against all proceedings that may be brought against Signion or the purchaser with respect to possible patent infringement.