Part Number: HSWN2520

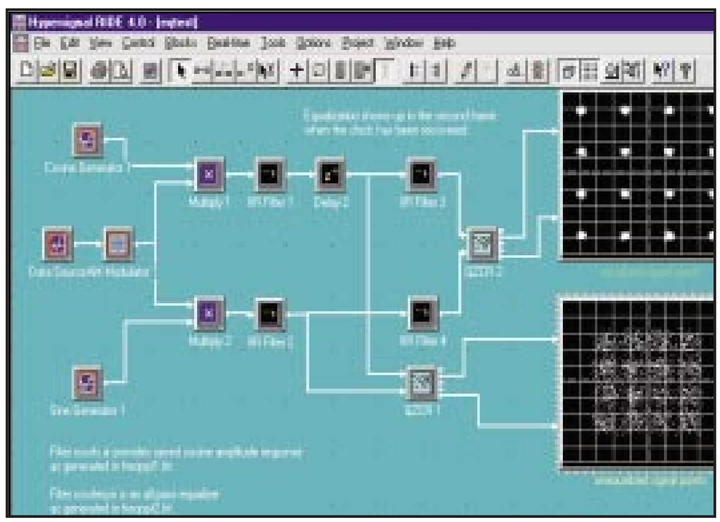
Advanced Transmission Library

Optional Block Function Library for Hypersignal® Block Diagram/RIDE™

Overview

The Advanced Transmission Library (ATL) available for Hypersignal Block Diagram and RIDE provides a complete simulation set of design and analysis blocks for radio, wireline, and fiber transmission systems. As indicated by the list of library functions, both baseband and carrier transmission systems can be modeled with a wide variety of line codes and modulation formats. Carrier recovery and clock recovery models are included. New filter design facilities are provided to enable modeling of transmission links or the design and testing of various types of equalizers. Available performance measures include Bit Error Rate (BER) simulations, BER calculations, eye patterns, and jitter analysis. Included with the library are example applications demonstrating usage of each block.

Developed by a leading expert in advanced transmission systems, this function library closely follows the standard textbook, Digital Telephony, in its implementation.



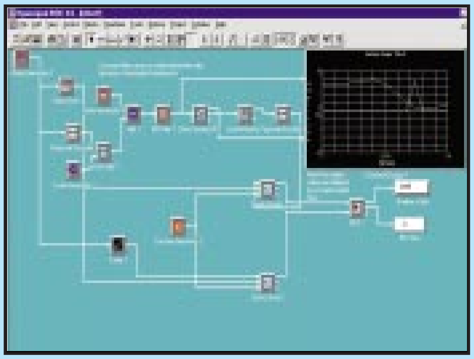
Modem Equalizer Example using Advanced Transmission Library

Equalization Application Example

This example worksheet demonstrates the use of an All Pass filter as a phase/delay equalizer. A filter was used to create the channel impairments, and as can be seen, the filter introduces significant inter-symbol interference from its significantly non-linear phase characteristic. A subsequent filtering remedies the distortion to produce a signal constellation that is very compact.

The delay block in the I channel is inserted to align the I channel sample times with the Q channel sample times. A single sample of delay is needed because the QAM modulator is configured (in this particular instance) to cause the sine channel to always cross zero at the same instant that new data creates a level shift. Thus, the time of the level shift is essentially delayed by one sample time. This effect can be easily seen by using two storage displays to simultaneously observe the eye patterns of the I and Q channels.

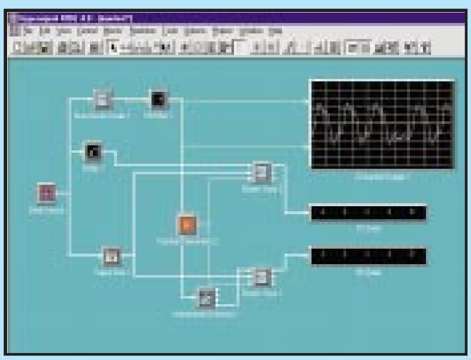
Examples



Multi-Level Baseband Transmission

This worksheet provides example usage of the Multi-Level Encoder and Multi-Level Decoder blocks. As shown in the following figure, this worksheet included usage of Gray coding to ensure that all symbol errors between adjacent signal levels produce single bit errors. Noise is added to the signal before it is filtered and detected by the combination of the Zero Crossing Clock Recovery circuit and the Multi-level Detector. The detected data is compared to the source data by a BER block to determine the bit error rate.

A Storage Display has been included to generate eye patterns. Because of the unequalized transmission characteristics in the given example, the eye pattern is just barely open when there is no noise. When only low levels of noise are injected into the channel, the eye pattern gets closed.



Manchester Line Code Example

This worksheet provides example usage of the Manchester line coder and the Manchester decoder blocks. As shown in the following figure, the detected data is compared to the source data by a BER block to determine the bit error rate. An Elastic Store block has been included to smooth the framesize of detected data bits. Depending on the IIR filter delay fluctuations in the framesize may occur as a result of clock recovery jitter. The Elastic Store is configured to accumulate five data bits before any source data bits are output. After the first frame, the elastic store produces a framesize of five bits in every frame even though the input framesize may fluctuate. The source data is delayed by a DELAY block to align the data streams for the bit error rate comparison.

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Advanced Transmission Library

List of Functions

AMI Coder (AMICODE)
Converts frames of binary data bits into Alternate Mark Inversion (AMI) line code pulses.

AMI Detector (AMIDET)
Detects binary data in samples of an AMI line code as produced by the Pulse Detector Clock Recovery module (PDCR).

Amplitude Equalizer (AMPEQLZR)
FIR filter block with a symmetric impulse response to produce a linear phase (constant group delay) characteristic.

Amplitude Optimization (AMPOPT)
A stand alone module that can be used to design linear phase FIR filters with an arbitrary frequency response.

Automatic Peak Control (APC)
Scales an input signal waveform to produce a waveform with a prescribed peak amplitude.

Bit Error Calculation (BERCALC)
Determines the analytical symbol error rate vs. a specified range of signal-to-noise levels.

Elastic Store (ESTORE)
A circular First-In-First-Out (FIFO) buffer for integer data that stores data under the control of one clock and outputs data under control of a different clock.

Event Generator (EVENTGEN)
Generates sequences of monotonically increasing event times as typically used as a timing source for pulse generation.

FSK Demodulator (FSKDEMOD)
Detects Frequency Shift Keyed (FSK) signals utilizing a Phase Locked Loop (PLL) carrier recovery model.

Filter Analysis (FILTANAL)
Reads a filter specification file and outputs three analyses of the specified filter: the amplitude response, the phase response, and the group delay.

Frequency Shift Keyed Modulation
A simple two-frequency FSK modulator can be implemented with the proper configuration of a Numerically Controlled Oscillator (NCO).

Graycode Decoder (GRAYDECO)
Converts successive groups (words) of Gray coded binary data into Inverse Gray coded words.

Graycode Encoder (GRAYCODE)
Converts successive groups (words) of NB binary data bits into Gray coded words with NB bits.

Level Coder (LVLCODE)
Converts successive groups of NB binary data bits into 2NB voltage levels.

Level Detector (LVLDET)
Decodes samples of a multi-level signal with L levels into NB = log2 (L) bits per sample. Manchester Coder (MANCODE): Converts frames of NB binary data bits into a Manchester encoded line code. A Manchester line code always transmits one positive pulse and one negative pulse during every signal interval.

Manchester Decoder (MANDET)
Detects Binary data in a Manchester encoded signal waveform by synchronizing a local clock to the input signal, multiplying the input signal by the recovered clock to create two-level baseband pulses, and integrating the baseband pulse across a signal interval for data detection.

MultiMode Light Source (MMLS)
Generates multimode light pulses in the form of a pulse spectrum amplitude at specified wavelengths.

Optical Fiber (FIBER)
Simulates the chromatic dispersion of an optical fiber using input signal waveforms (such as produced by PULSEGEN or MANCODE), optical source specifications as produced by MMLS, and internally specifiable chromatic dispersion parameters.

Phase Detector (PHASEDET)
Compares the phase of two clock signals to produce an output that is proportional to the phase offset between them.

Phase Equalizer (PHZEQLZR)
IIR filter block wherein the poles and zeros are harmonic conjugates of each other. The conjugate locations of the poles and zeros provides an all-pass frequency response while producing a non-constant group delay.

Phase Optimization (PHASEOPT)
A stand alone module that can be used to design all-pass IIR filters with an arbitrary phase (group delay) response.

PSK Demodulator (PSKDEMOD)
Demodulates Phase Shift Keyed (PSK) waveforms as produced by PSKMOD.

PSK Modulator (PSKMOD)
Generates 2NB evenly spaced phase values of a specified carrier to encode NB bits per signal interval. NB can be any positive integer.

Pulse Detection Clock Recovery
Recovers a clock for pulse encoded data signals by aligning the middle of received pulses to 0-to-1 transitions in the recovered clock.

Pulse Generator (PULSEGEN)
Produces a train of NP pulses of configurable Amplitude (A), Width (W), and Delay (D). The Number (N) of samples per signal interval is determined as SR/BR where SR is the sampling rate and BR is the baud rate.

Pulse Response Optimization (PULSEOPT)
Provides time domain optimization of a channel pulse response by adjusting Z-transform poles and filters of an equalizing filter to match a specified response.

QAM Demodulator (QAMDEMOD)
Processes a QAM input signal to produce two separate sets of outputs: one set of outputs for the phase (I) channel and one set for the quadrature-phase (Q) channel.

QAM Modulator (QAMMOD)
Provides multi-level amplitude modulation of an In-phase (I or cosine) carrier and a Quadrature phase (Q or sine) carrier at a specified frequency.

TIE Measurement (TIE)
Measures clock instability in terms of time interval error measurements between a test signal and an internally specified reference (with a frequency of FR Hz).

Universal Asynchronous Receiver (UAR)
Provides the receiver functions of a Universal Asynchronous Receiver Transmitter (UART). A companion block (UAT) provides the transmitter functions.

Universal Asynchronous Transmitter (UAT)
Provides the transmitter functions of a Universal Asynchronous Receiver Transmitter.

Zero Crossing Clock Recovery (ZXCR)
Recovers a data clock for level encoded (amplitude modulated) baseband data signals by aligning input signal transitions (neg-to-pos or pos-to-neg) to 1-to-0 transitions in the recovered clock.

Ordering Information

Part Number:
HSWN2520 - Advanced Transmission Library

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