

LMS_Multipath

Where To Find This Example

Select **Help > Open Examples...** from the menus and type either the example name listed above or one of the keywords below.

Or in Version 13 or higher you can open the project directly from this page using this button. Make sure to select the **Enable Guided Help** before clicking this button.

Open Install Example

Design Notes

Least Mean Squares (LMS) Equalizer

This example illustrates the use of the VSS LMS equalizer block.

A modulated QAM signal source is subjected to a multipath channel and AWGN. An LMS equalizer is employed to mitigate the effect of multipath and allow demodulation of the transmitted signal.

Modulation size is defined by the variable M in Global Definitions. The sampling rate and oversampling of the system are defined in the Options/Default System Options...

A MULTIPATH_FADING block is used to simulate the multipath channel environment. In this example it contains a Ricean fading path.

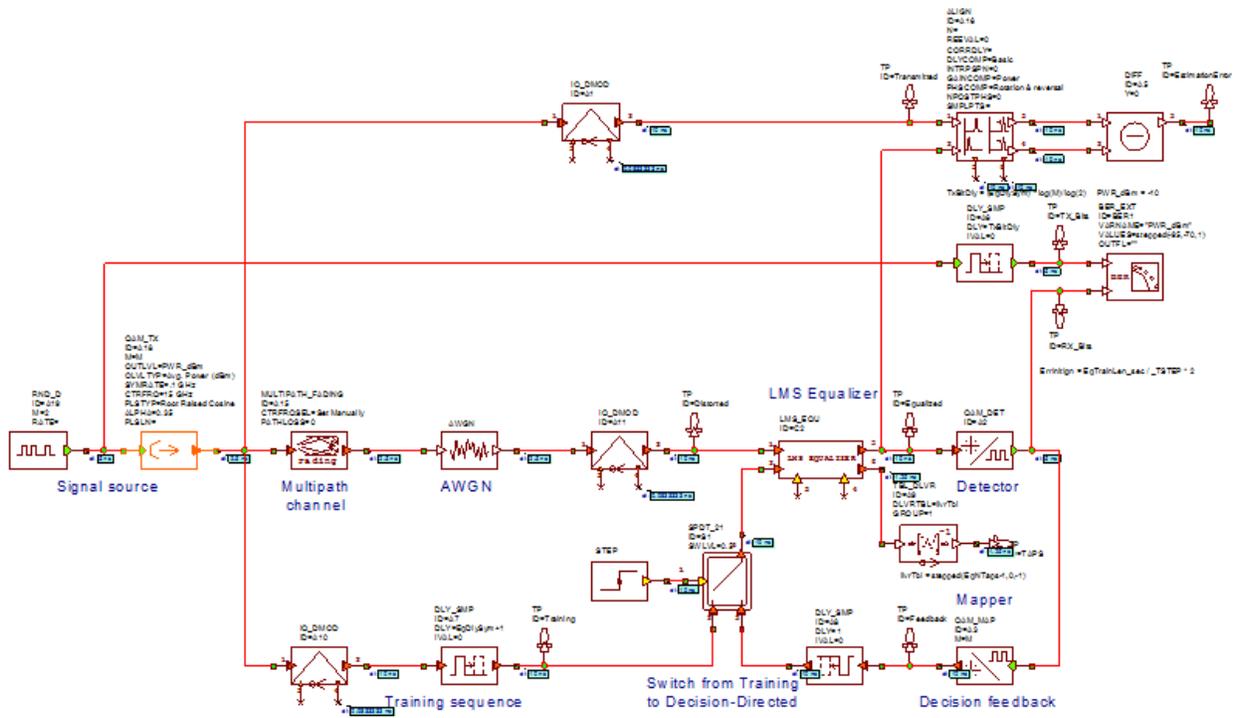
The LMS equalizer first starts operating in training (data-aided) mode, during which a known portion of the transmitted signal is employed for initially estimating the equalizer taps. The number of equalizer taps is defined by variable EqNTaps in the Global Definitions window. The training (reference) signal is delayed in order to ensure that it is aligned correctly with the signal received in port 1 and the energy of estimated equalizer taps is properly centered; this alignment is adjusted through variable EqDlySym in Global Definitions. The length of the training sequence is determined by variable EqTrainLen_sec - note that this variable is defined in seconds. The LMS adaptation constant is defined by variable EqMu.

After training the equalizer is switched to a decision-directed mode, during which detected symbols at the output of the equalizer are employed for the update of equalizer taps. More information about the operation and implementation of the LMS equalizer block can be found through online help. The convergence rate depends on mu, the normalization, etc.

The estimation error at the output of the LMS equalizer can be monitored in the graph "Estimation Error." The graph "Distorted Symbols" displays the symbols prior to equalization, while the graph "Equalized Symbols vs. Reference IQ" displays the resulting IQ plot after equalization. The estimated LMS equalizer taps are displayed in the graph "LMS Equalizer Taps."

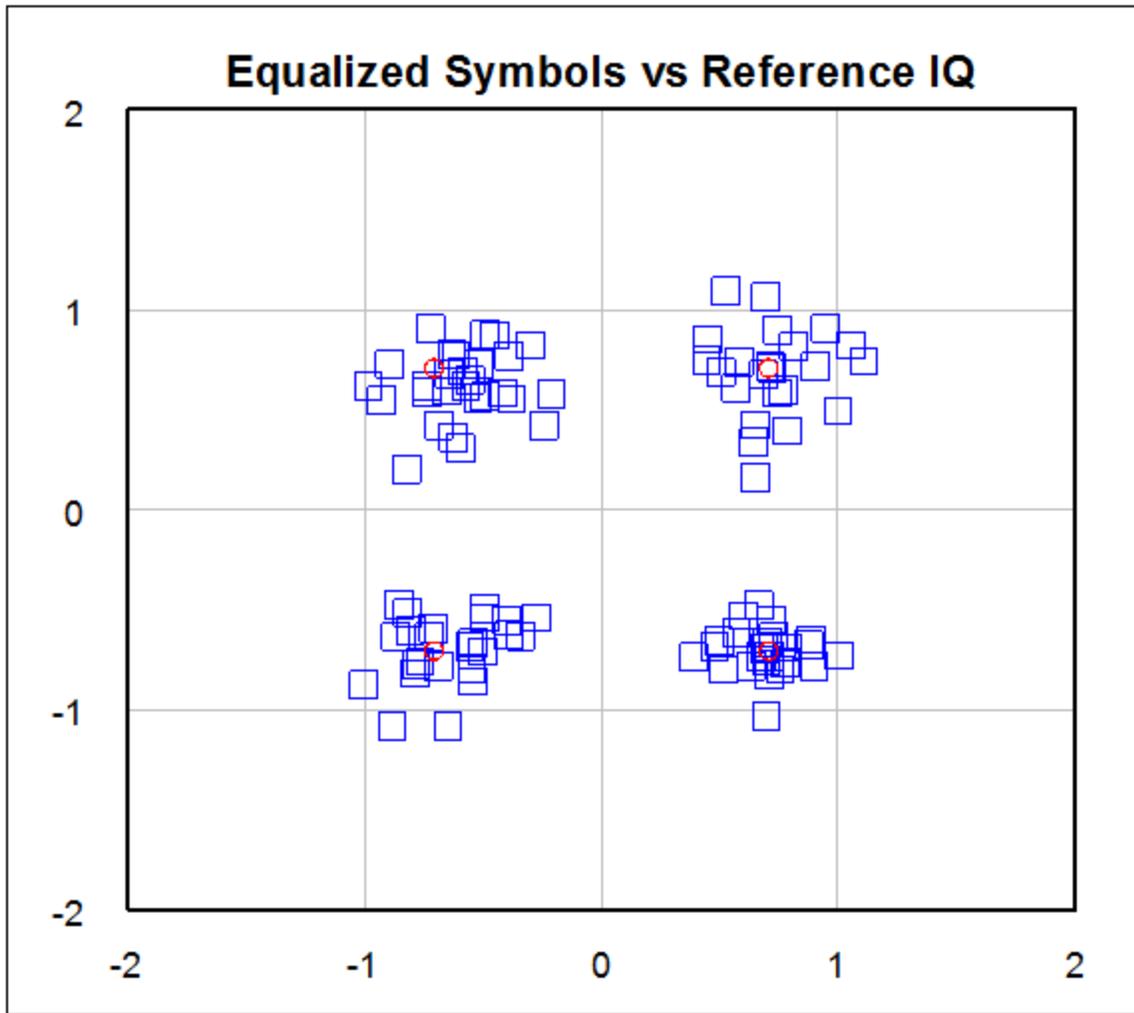
The BER graph shows the error rate vs. signal level measured after the LMS equalizer converges to a steady state.

System Diagram - LMS Equalizer

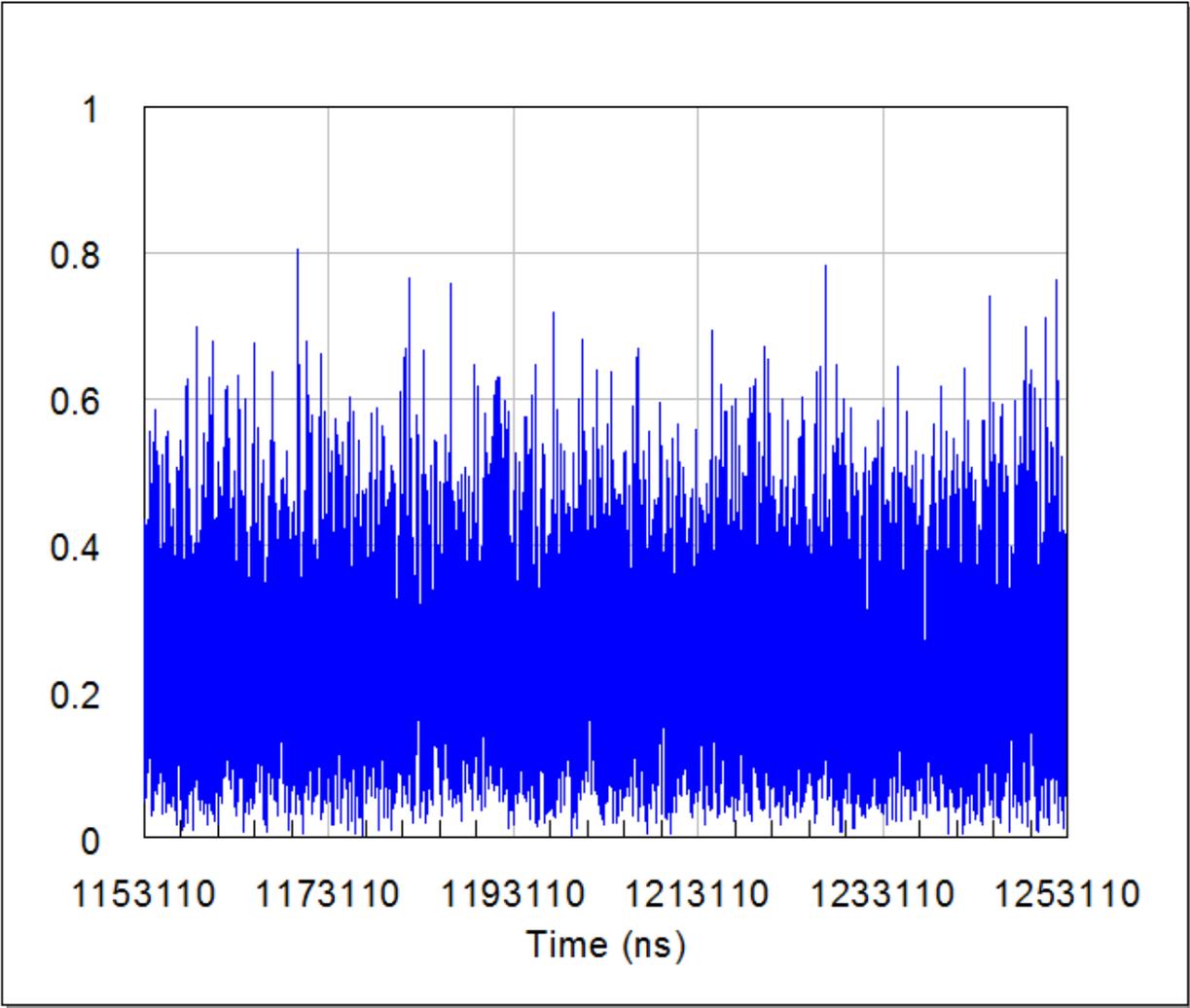


Graph - Equalized Symbols vs Reference IQ

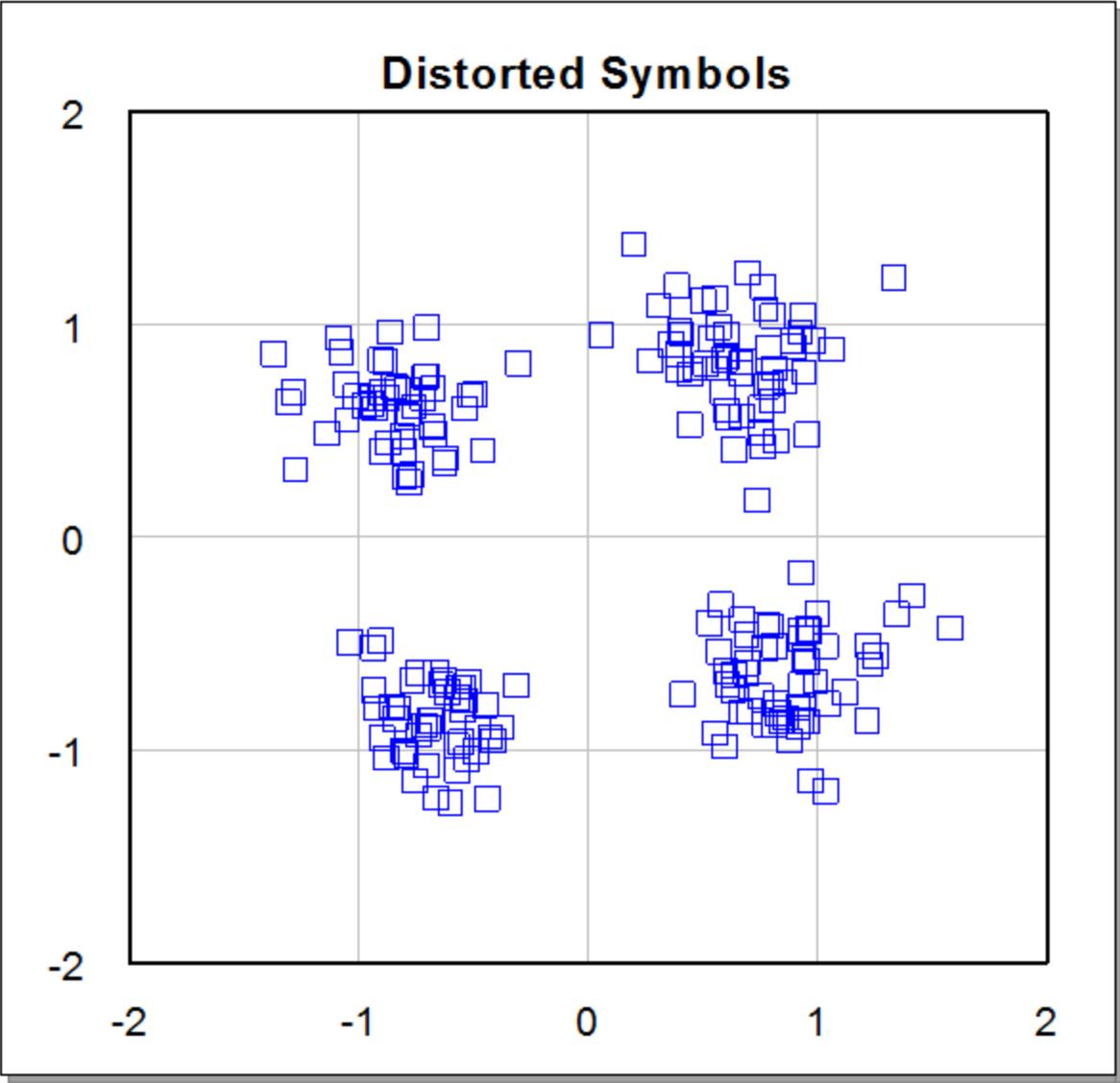
○ Transmitted □ Equalized



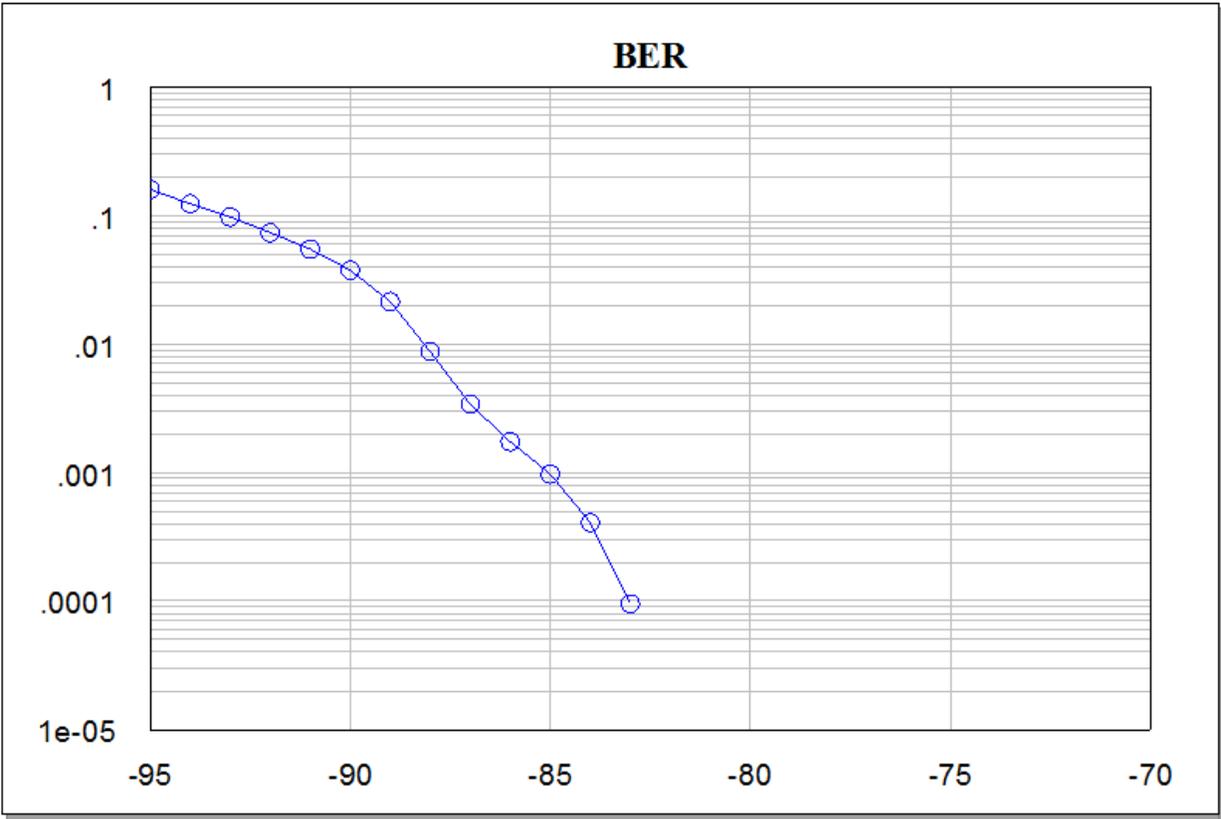
Graph - Estimation Error



Graph - Distorted Symbols



Graph - BER



Graph - LMS Equalizer Taps

