

1. AWGN Channel

- It takes in four 16 bit numbers at one time and adds noise to all four signals based on the implemented state machine which switches between the Good Channel noise (21db) and Bad Channel Noise (9db). It also has a noise_off input to turn the noise on and off.
- The module has two look up tables set up using two different ROM's containing 9db and 21db noise values generated using python/MATLAB scripts.
- We tested the whole AWGN channel at first by turning the noise off and see if the output matches input for almost all 16 bit numbers and then tested it with the noise values on and using waveforms checked if the output was correctly adding the noise based on the which state the state machine is in.

2. Error Encoder and Error Decoder

- We used Hamming (7,4) Encoding scheme which has a 4 bit input and a 7 bit output.
- We tested both the blocks connected together with all the input combinations to see if the output of the decoder matched with the input of the Encoder.
- We tested the error correction scheme by adding the noise to the signals when testing with rest of the system blocks to see if the decoder removed any 1 bit errors.

3. Modulation and Demodulation

- For Modulation and Demodulation, we are using QPSK modulation scheme, and it takes in two bits at one time and converts them into two 16 bit numbers.
- For testing it we used the same method as error encoder. We tested them separate with all four input combinations and verified if the output matched what was expected.

4. Transmitter/Receiver

- For Transmitter, we just send those complex values through the channel and for the receiver, it matches the output from the channel to closest positive or negative 1 value the input data matches.
- We tested it the same way as Error Encoder, without noise first and then with noise.

5. Encoder_System-Medium_Decoder

- This module combines Error Encoder, Error Decoder and System Medium Modules.
- The System Module itself combines Modulation, transmission, Channel, receiver and Demodulation.