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By selecting a filter type which has both good white-noise performance and steep attenuation skirts, excellent noncoherent FSK demodulation is possible in either white or nonwhite noise interference. The filter bandwidths and center frequencies must be independently variable over a wide range to optimally match the signal parameters of keying speed and shift.

DECISION THRESHOLD SELECTION

The decision element of Figure 15 can be realized by several different circuit configurations. The simplest decision circuit is a voltage comparator which decides that a mark signal was received if the output from the mark detector is greater than the “noise” output from the space detector. With equal amplitude transmitted signals and no selective fading, this is the theoretically optimum decision circuit. The error performance of this type of decision for binary noncoherent FSK in white noise is shown in Figure 17. If the FSK signal is subject to selective fading (Rayleigh amplitude statistics), the performance of the demodulator is severely degraded.

If the mark and space tones are separated in frequency so that they fade independently, it is possible to differentially sum the outputs of the mark and space detectors to diversity-combine the signals. Figure 18(a) shows the combined output for alternating mark and space transmissions. The envelopes of the mark and space detector voltages vary with the fading mark and space signal amplitudes. In the summing configuration, the decision circuit compares the differential sum with a voltage reference, which determines the decision “threshold.” When the sum is greater than the threshold, a mark decision is made and when the sum is less than the threshold, a space decision is made. When the signal has equal mark and space amplitudes, the optimum threshold is a fixed zero-voltage reference. However, during selective fading conditions, it is necessary to dynamically vary the

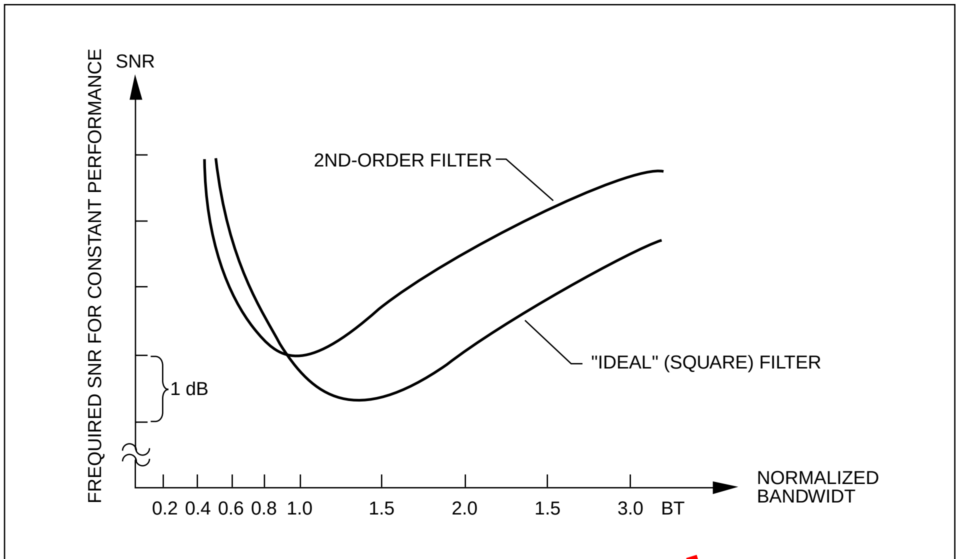

Figure 16. Constant error performnce curves for two FSK filter types.

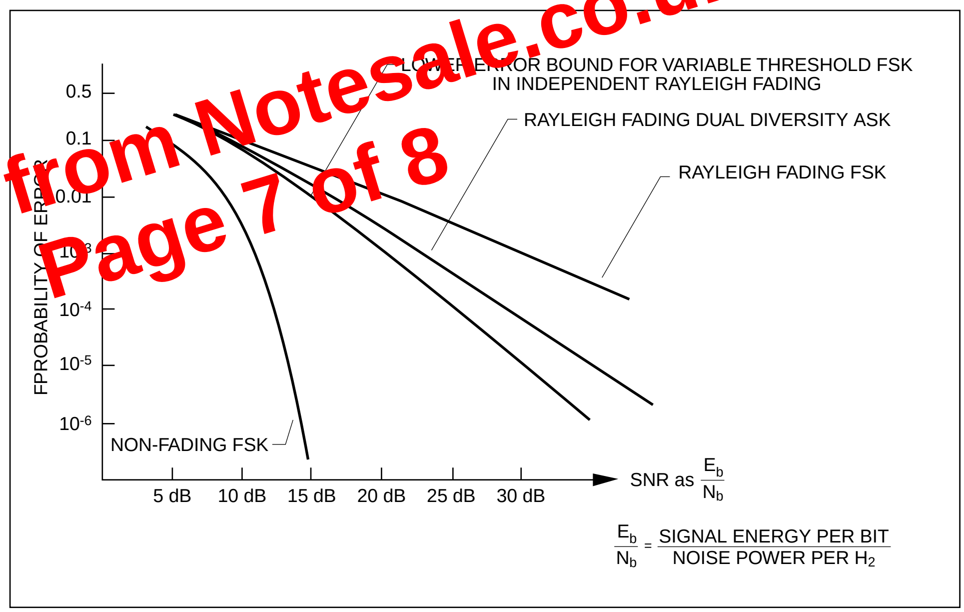

Figure 17. Constant error performnce curves for two FSK filter types.

decision threshold to achieve optimum demodulation. The effect of selective fading on signal data with fixed and variable thresholds is demonstrated in Figure 18(b) and (c).

Performance of a variable-threshold detector can be compared to diversity demodulation of two independently fading, amplitude-shift-keyed (ASK) signals. In fact, because of the differential nature of the mark and space signals, error performance can be better than that predicted for diversity ASK. The error performance of diversity ASK and a lower error bound limit of performance for variable threshold FSK are shown in Figure 17. For best performance, the parameters of the variable threshold detection circuitry must be optimized with respect to the signal characteristics.