

OPTIMUM DIGITAL DATA STORAGE ON MAGNETIC TAPE

W. R. Hedeman, Jr.
Consultant
Annapolis, MD

E. L. Law
Telemetry Engineer
Pacific Missile Test Center
Point Mugu, CA



Abstract

An instrumentation magnetic tape recorder, free of tape drop-outs, wow and flutter, is simulated by filters and a chromatic noise source. At a fixed bit error probability the capacity of the link is measured as a function of rms signal-to-noise ratio for NRZ-L, Manchester and Miller codes. Two operating regions are observed: (1) noise limited at low values of SNR and (2) band limited at high values of SNR. In the noise limited region doubling the data rate requires a 6 dB increase in SNR; in the band limited region an increase of approximately 12 dB is required to produce the same result. The conclusion is that, for baseband recording of digital data, operation should be in the noise limited region slightly below the transition to the band limited region. If SNR margin is available at this operating point more data per square of tape can be stored by increasing the number of tracks rather than increasing the storage per track.

The theoretical penalty of 3.5 dB for the Miller code bit detector should, and does, result in a data rate decrease to .67 of the data rate with the NRZ-L code at the same SNR in the noise limited region. For the Manchester code the transition to the band limited region occurs at a lower SNR than for either NRZ-L or Miller codes. It is concluded that the Manchester code would result in approximately the same data storage per square of tape as NRZ-L, and more than Miller, if the number of tracks is doubled.