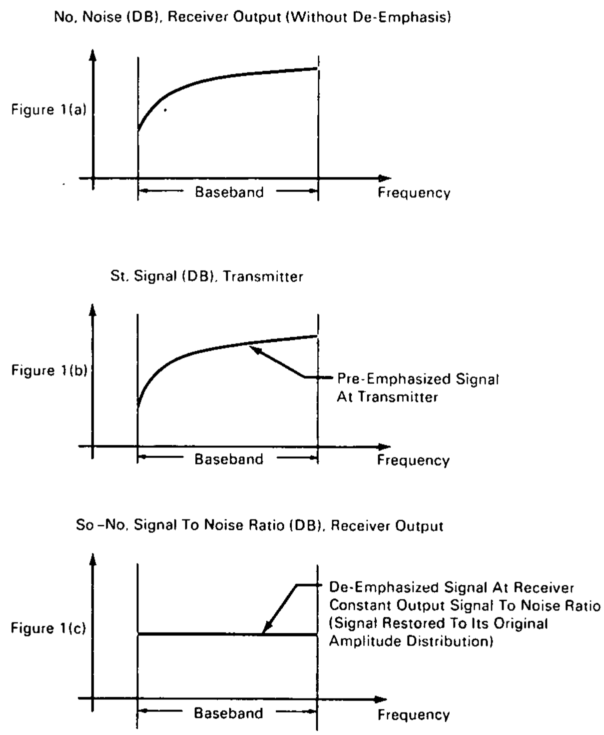
September 1969 Brief 69-10359

NASA TECH BRIEF

Optimum FM Pre-Emphasis



The problem:

Typical fm systems are not frequency modulated with a constant modulation index for all baseband frequencies. Instead, they use a signal pre-emphasis circuit at the transmitter and a complementary de-emphasis circuit at the receiver to optimize system operation. Pre-emphasis and de-emphasis are required whenever the noise amplitude varies significantly for different frequencies in the receiver baseband (figure 1a). FM pre-emphasis at the transmitter accentuates certain baseband frequencies with respect to other frequencies in the baseband (figure 1b). The complementary fm de-emphasis at the receiver de-accentuates both those frequencies in the baseband that were originally pre-emphasized by the transmitter including the receiver noise output itself, and maintains a constant output signal-to-noise ratio density throughout the baseband (figure 1c).

A typical pre-emphasis schedule assumes that the noise-power amplitude (given in units of db) in the receiver baseband is a linear function of baseband frequency and that this linear relationship is independent of receiver rf input power. These assumptions provide acceptable results for generalized communication systems operating under varying-receiving-system rf input-power conditions.

(continued overleaf)

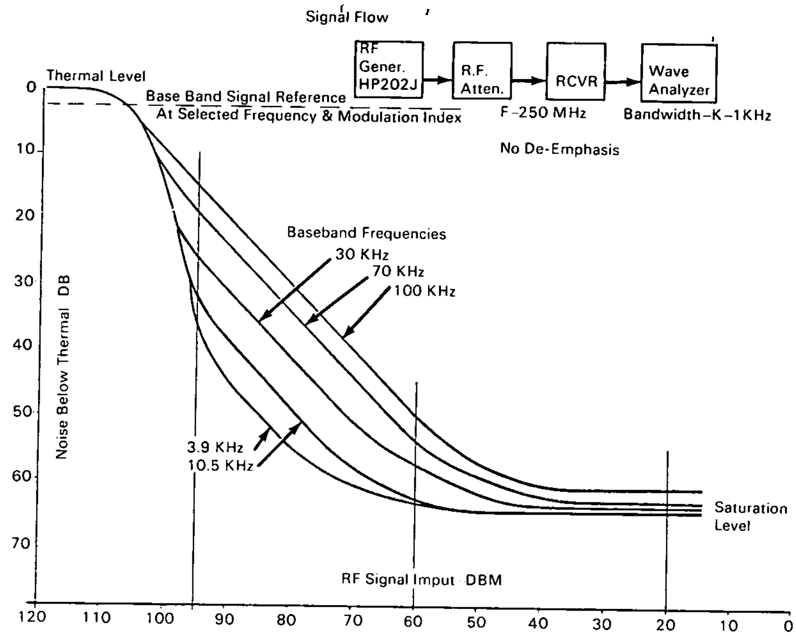


Figure 2
Receiver Quieting Characteristics vs Baseband Frequency

The solution:

The test setup used to determine the spectral noise characteristics in the baseband of receiver (without de-emphasis) as a function of rf input power is shown in figure 2. A calibrated rf signal generator and precision rf attenuator are connected to a wave analyzer (tunable voltmeter). The wave analyzer measures the noise in a small frequency slot centered at a specified baseband frequency. The rf generator and fm receiver are set to the operating carrier frequency. The wave analyzer is then tuned to a frequency near the low end of the baseband frequency spectrum. The rf signal generator output power is varied in discrete increments over the dynamic range of the fm receiver. The wave analyzer measures the noise in the selected baseband frequency slot for each discrete increment of rf input power. The results (output noise (db) vs rf input power (dbm) for the specific baseband center frequency) are shown in figure 2.

Notes:

1. This technique should be of interest throughout the communications industry.
2. No further documentation is available. Inquiries may be directed to:

   Technology Utilization Officer
   Kennedy Space Center
   Kennedy Space Center, Florida 32899
   Reference: B69-10359

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Karl W. Merz of
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under contract to
Kennedy Space Center
(KSC-10151)