PSEUDO-RANDOM NOISE LOADING FOR SYSTEM EVALUATION

Richard B. Swerdlow
Bell Telephone Laboratories
North Andover, Massachusetts 01845

The design of high capacity, long haul carrier transmission systems for telecommunication service demands strict control of noise due to intermodulation distortion. The intermodulation noise at any point in such a system depends on both the magnitude of the distortion and the manner in which it accumulates.

Intermodulation distortion at the output of any one repeater may be well below the thermal noise level for a purely coherent mode of addition. Previous methods of measurement in the laboratory have usually been confined to measurement of the magnitude of the noise and have used two and three tone measurements primarily for device characterization. Noise loading is a preferred system measurement but has been limited because of thermal noise.

Our approach for overcoming the thermal noise limitation on noise loading is signal averaging. The intermodulation signal is made periodic, then coherently detected and averaged to achieve a 3 dB intermodulation-to-thermal noise enhancement for each doubling of the number of periods averaged. The signal load is generated from a high-speed, repetitive, digital bit stream and filtered to about one-sixteenth its bandwidth to produce a signal close to Gaussian during a period.

This pseudorandom signal is treated just as in conventional noise loading. A notch is inserted at a desired frequency, and the signal is modulated up to the band of interest and placed on the system. The intermodulation signal that falls in the notch is preselected and demodulated.

The digital source period is adjusted to maintain coherence during demodulation. The averager is a commercially available instrument which digitizes successive periods and accumulates them in a memory.

The law of addition of intermodulation products can be examined by connecting a computer to the noise loading set and the repeater. Selected repeater parameters can be altered, and noise loading measurements made under computer control at high speed. The digitized intermodulation signals are stored and processed in the computer to provide information on the effect of various parameters on the law of addition.

Noise Comparisons in Low and Medium Power Devices

J. Robert Ashley
University of Colorado
at
Colorado Springs, CO 80907

Measured FM and AM noise data will be presented for the following microwave signal sources: Reflex klystron, two-resonator low noise klystron, IMPATT diode oscillators, transferred electron (Gunn diode) oscillators, TRAPATT mode avalanche oscillators, and VHF crystal-multiplier chain sources. The pros and cons of using an oscillator figure of merit to compare active devices will be discussed.

Possible improvement in FM noise of some of the oscillators by cavity or injection stabilization will be briefly considered. The use of combined oscillator systems to achieve optimum noise properties will be indicated.

The philosophical difficulties of comparing noise performance of active devices as oscillators and amplifiers will be introduced for discussion by the other panelists. An attempt will be made to indicate the state of the art for low-level, low-noise amplifier devices in the microwave region.

It is a pleasure to acknowledge that most of the experimental data to be reported was either taken by or with the able assistance of my colleague, Frank Palka. Discussions with Paul Goud, David Leeson, Donald Halford and Walter Cox have been most useful in preparing this presentation.