the afternoon of April 24, 1970. The peak measured 15.3-GHz signal attenuation and the corresponding 16-GHz radiometer record were 9.8 dB and 10.6 dB respectively.)

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Intersymbol Interference and the P/AR Meter

By J. H. FENNICK

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P/AR stands for peak-to-average ratio. The instrumentation to measure this ratio has been assembled and obtains a single number evaluation to the dispersion in a transmission medium by measuring the peak and the full wave rectified average of a pulse stream.[1,2]

The P/AR meter has been under exploratory study and use for several years now. Many empirical studies have been made relating the P/AR rating to data transmission performance in the presence of gain and phase distortions. This study was undertaken to demonstrate the relationship between P/AR and intersymbol interference in pulse transmission caused by deviations from linear phase of passive networks.

Appropriately weighted peak and rms intersymbol interference has been calculated for 19 passive all-pass networks. The results were correlated with the P/AR ratings of the networks to determine the relationship between P/AR and intersymbol interference due to phase distortion. The values of P/AR ranged from 30.86 to 97.58. The results show that P/AR has a correlation coefficient of -0.94 with rms intersymbol interference and -0.98 with peak intersymbol interference.

E. D. Sunde demonstrated in 1954 that rms and peak intersymbol interference in pulse transmission could be calculated by the following procedure.[3] The departures from a linear phase characteristic may be represented by a Fourier series expansion of the form $f(w) =$

$\sum_{n=1}^{\infty} b_n \sin nwt$. The peak intersymbol interference, based upon small echo theory, then becomes $I_p = \sum | b_n |$ and the rms interference becomes $I_r = [1/2 \sum b_n^2]^{1/2}$.

The phase characteristics of 19 all-pass networks were measured every 50 Hz over the frequency range 300 Hz to 3250 Hz. The departures from linearity were determined by subtracting the actual measured value at each frequency from that obtained by a linear least squares fit to these data. The resulting departures were then weighted by the P/AR spectrum and expanded in a Fourier series by means of the fast Fourier transform (FFT). The FFT generated the first 128 terms of the series, the first 30 of which were sufficiently accurate and significant to give a good estimate of I_p and I_r. The results were then correlated with the calculated P/AR values of the networks.

Scatter diagrams of I_r vs P/AR and I_p vs P/AR are shown in Figs. 1 and 2. The linear correlation coefficients of P/AR with I_r and I_p were −0.941 and −0.978. This study demonstrates the high correlation of the P/AR rating system with rms intersymbol interference and hence with eye openings on data sets, and places more confidence in the value of the P/AR system.

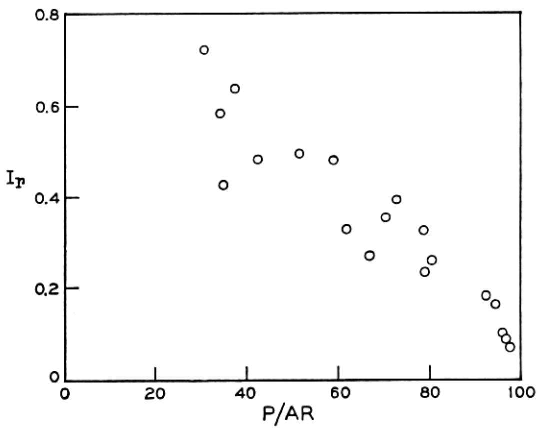

Fig. 1—Scatter diagram of I_r vs P/AR.

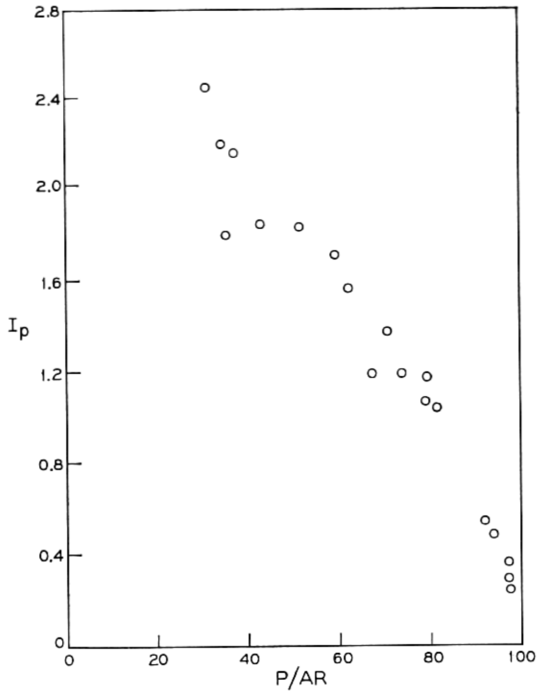

Fig. 2—Scatter diagram of I_p vs P/AR.

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