Abstracts

Power Amplification of Microwave FM Communication Signals Using a Phase-Locked Voltage-Tuned Oscillator

M.E. Hines, R.S. Posner and A.A. Sweet. "Power Amplification of Microwave FM Communication Signals Using a Phase-Locked Voltage-Tuned Oscillator." 1976 Transactions on Microwave Theory and Techniques 24.7 (Jul. 1976 [T-MTT]): 393-404.

An analog phase-locked oscillator is used as a power amplifier for FM communications signals. Intended service is for FDM telephone message service or television relay. The output power is generated in a varactor-tuned oscillator, which is synchronized with a weak input signal using a phase-lock loop. This involves a phase detector and a wide-band direct-coupled video amplifier whose output is applied to the tuning varactor. The paper is largely theoretical, relating the parameters of the feedback loop to the performance of the overall device. Explicit expressions are derived for the noise figure, the frequency response of the modulation characteristic, AM-PM conversion, and nonlinearity effects in terms of differential gain and intermodulation. In addition, two experimental models are described, together with certain measured data. The phase-lock method differs in many ways from multistage reflection amplifiers and appears to offer advantages for many applications. The device has adequate bandwidth and linearity for a single FDM-FM signal with 1800 or more channels, but must be tuned to the intended frequeucy. Tuning procedures are simple. High gain of 25-35 dB is obtainable in a single microwave "stage." Most of this gain may be associated with the functions of phase detection, video amplification, and VCO tuning. Of major importance, with respect to noise, is that the device is functionally equivalent to a high-gain low-noise microwave preamplifier followed by a low-gain power amplifier stage in which the preamplifier has the noise figure of the phase detector combined with the video amplifier, and the power stage has a noise figure appropriate to the class of power diode used. FM noise generation is substantially lower than in a high-gain reflection amplifier using the same class of microwave power diode throughout.

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