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Broad-Band Microwave - Optical Fiber Links Transmitting Over Long Distances with Optical Amplification

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Abstract

We describe long distance, analog microwave-fiber optic links with bandwidths larger than six and a half octaves at an upper frequency in the 1.5–2 GHz range. The links exhibit highly linear performance with harmonic and inter-modulation distortions determining the overall spurious-free dynamic ranges. Two configurations are presented, each capable of overcoming limitations imposed by fiber nonlinearities and each employing a custom optical amplifier which maintains a low noise figure under saturated conditions. For fiber lengths of tens of km, representing losses of 10–16 dB, the basic links have a noise figure of 38 dB and second and third order spurious free dynamic ranges of 103 dB/Hz$^{1/2}$ and 105 dB/Hz$^{2/3}$ respectively, over their entire bandwidth.