

EFFICIENT FIBRE AMPLIFIERS

625

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The design criteria for efficient erbium doped fibre amplifiers (EDFAs) are discussed. Results highlighting the effect of NA, concentration and loss are shown with the best efficiency achieved being 8.9dB/mW.

The noise characteristics of an efficient EDFA are characterised and it is shown that at optimum gain efficiency the EDFA exhibits an increased NF¹. In addition it is shown that with the conventional (co-directionally pumped) configuration it is virtually impossible to obtain a combination of high gain (>30dB) and quantum limited NF^{2,3}. Incorporating an isolator in the middle of the EDFA overcomes these problems and an amplifier with 51dB gain and 3.1dB NF for only 45mW of pump power is demonstrated^{2,3}.

Optical limiting amplifiers^{4,5} are discussed and it is shown that by simply inducing a differential loss between pump and signal in the middle of the EDFA achieves this, giving a >30dB dynamic range⁶. Experimental results confirming this are given^{3,6}.

Finally, bandwidth optimisation is discussed. Several techniques are known to broaden the bandwidth of the EDFA^{7,8}. However, owing to the homogeneous nature of erbium in silica based glasses the small remaining ripple in the gain profile will be enhanced in networks employing cascaded amplifiers thus limiting their useful bandwidth. Spectral gain compensation can be achieved either actively⁹ or passively. A possible passive technique is proposed¹⁰.

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