

Abstract

The fiber amplifier is upgraded to hybrid fiber amplifier (HFA) via the combination of two or more fiber amplifiers having different amplification bands such as combining the erbium doped fiber amplifier (EDFA) in a conventional band (C-band) with Raman fiber amplifier (RFA) in long band (L-band) and create C+L-band HFA. Serial hybrid fiber amplifier (S-HFA) configuration has high average gain level and reasonably noise figure, but the limitation in the 3-dB flat gain bandwidth represents the main drawback with this type of fiber amplifiers. On the other hand, different approaches were proposed to enhance the gain bandwidth in parallel hybrid fiber amplifier (P-HFA), such as splitting pump power and gain control technique. For the splitting pump power, the flatness is degraded at large signal region. Furthermore, in the gain control technique, there is a need to vary the signal coupling ratio in order to maintain the desired gain flatness. In addition, there is a problem with the high dispersion in EDFA branch when HFA is used with DWDM system. In this thesis, a new HFA is proposed based on the combination between serial (EDFA+RFA) and parallel with another RFA. The optimum pump conditions are determined for C+L band combined serial-parallel hybrid fiber amplifier (CSP-HFA), utilizing gain control technique via Opti-System software. The proposed HFA at optimum conditions, produced 65 nm flat gain bandwidth ranging from 1530 nm to 1595 nm. By optimizing the CR from a conventional value of 0.5 to the optimum value at 0.7, the 3-dB gain bandwidth is improved by 44.44 %, within the average gain of 16 dB and average NF of 7.29 dB. The proposed architecture provided many advantages over the design of S-HFA and P-HFA includes; 1) improved flat gain bandwidth by 62.5% and 8.33 as compared with S-HFA and P-HFA respectively, 2) constant optimum CR for both small and large signals at 0.7 as compared with IX P-HFA, 3) high saturation gain (wide dynamic range) in the L-band window, 4) higher quality factor, 5) lower bit error rate. And 6) wide and clear eye opening.