ABSTRACT

A hybrid fiber amplifier (HFA) was proposed to improve the performance of the optical fiber amplifier, such as: expanding the flatness gain bandwidth, increasing pump efficiency, extending repeater distance, furthermore, to solve the problem of consuming most of the applicable communication band (C–band); as the aim of HFA is to increase the communication bandwidth, by combining two or more amplifiers with different operating bands. In the first section of this thesis, two hybrid fiber amplifiers were investigated using OptiSystem7.0 software, namely, serial and parallel hybrid fiber amplifier, to study the performance of S– and P–HFA under the same design parameters except for pumping power that should be settled at its optimum condition. The results show that S–HFA has a high overall average gain level of 19.2 dB and an appropriate noise figure NF of 4.3 dB. However, the narrow gain bandwidth is about 40 nm, which is considered a primary issue in S–HFA design. While P–HFA has wide 3–dB gain bandwidth of approximately 60 nm, the overall gain level achieved was low, around 13.5 dB, and higher average noise figure about 8.3 dB. To overcome the drawbacks in both configurations, a novel full double-pass based on serial hybrid fiber amplifier utilizing L-shape was demonstrated to decrease the cascading amplification effect between the combined amplifiers by making an individual full double-pass for the input signal in each amplifier stage. Under optimum conditions, the proposed hybrid fiber amplifier maintained 23.6 dB average gain, wide gain bandwidth of about 60 nm and 65 nm for small signal -25 dBm and large signal -10 dBm regions, respectively, in addition to an acceptable average noise figure of 7 dB.