From the initial configuration (Fig. 2), we started the optimization process at a high temperature with $T_w = 2$ nm and $T_p = 2$ mW. At each temperature, essentially enough displacements (Basic Steps), e.g., 50, are performed. Then the system is cooled exponentially, $T_n = 0.9^n T_i$. If the expected number of acceptance (e.g., five) is not achieved at three successive temperatures, the optimization process stops.

Figure 3 is the resulting configuration. The gain fluctuation is optimized to within 1.7557 dB, significantly below 3 dB, and the average gain is above 22 dB. For the random principle of the algorithm, more trials as well as suitable parameters and an initial configuration could be employed to reach a more satisfactory result.

4. CONCLUSION

In conclusion, a new scheme for designing multiple pump Raman fiber amplifiers by the use of simulated annealing is presented. The configuration of a Raman fiber amplifier for a 64-channel WDM system with five laser diode pumps is demonstrated as an example. The algorithm can automatically yield a gain profile with a fluctuation of less than 1.8 dB in the amplification bandwidth of interest.

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applied to the input port (gate-to-source) of the MESFET through the balanced slot-line mode of the FGCPW. The IF output is extracted by the unbalanced coplanar mode of the FGCPW. The two parallel dipole antennas spaced a half-wavelength apart with a metal ground plane behind them produce a single centrally directed broadside lobe antenna pattern perpendicular to the GaAs substrate. Half-wavelength rather than full-wavelength dipole antennas were used in order to minimize the chip size. Since the FET is located midway between two dipole antennas, the distance between the FET and any one of the antennas is a quarter-wavelength. Thus, the balanced slot-line mode of the FGCPW can be used as quarter-wavelength transformers to fulfill the impedance matching between the twin-dipole antenna and the FET. A 0.1 nH inductor is inserted between the quarter-wavelength transformers and the MESFET to resonate out the imaginary part (gate-to-source capacitance C_{gs}) of the FET input impedance.

The antenna mixer was designed at 10 GHz. The single-gate mixer is based on a four-finger (total gate width 200 μm) MESFET with 1 μm gate length. The MESFET device has 1.5 V knee voltage, 200 mA/mm I_{ds}, −1.7 V pinch-off voltage, and 160 mS/mm transconductance at V_{gs} = 0 V.

EXPERIMENTAL RESULTS

To achieve a higher degree of nonlinearity for frequency mixing, a gate-to-source bias voltage of −1.6 V near the pinch-off region is used. A drain-to-source voltage of 2 V is chosen to ensure that the FET is operated properly in the saturation region when the FET is turned on by the LO signal.

The experimental setup for the testing of the integrated twin-dipole antenna mixer is shown in Figure 2. The RF and LO signals are provided by an X-band horn antenna (antenna gain = 18 dBi), which is placed above the mixer 6 cm away in the direction of the main beam of the twin-dipole antenna. The IF power was measured by a GS Cascade Microtech probe at the output terminal of the FGCPW transmission line connected to the drain port of the FET. Since the direct measurement of the actual RF and LO power level received by the twin-dipole antenna or the FET is not available at this time in our laboratory, the Friis transmission formula is used to obtain the available power received by the antenna. The twin-dipole antenna gain is calculated by IE3D software. The conversion gain is defined as the ratio of the IF output power dissipated in a 50 Ω load to the RF available power received by the twin-dipole antenna. In Figure 3, the conversion loss is plotted as a function of IF frequency under the conditions that the RF signal is fixed at 10 GHz and the RF and LO available power levels received by the antenna before entering the gate of the FET are fixed at 7.2 and 6.5 dBm, respectively. From this figure, it is clear that the IF signal peaks at 1 GHz with a mixer conversion loss of 22 dB. The large loss is suspected to be caused by the mismatch between the twin-dipole antenna and the FET. Figure 4 shows the measured results of the conversion loss versus LO signal (9 GHz) power level for a fixed RF (10 GHz) available power of 7.2 dBm before entering the gate port of the FET. Clearly, the conversion loss has not reached its saturation value, which means that a lower conversion loss still can be expected if the LO power is further increased or the mismatch between the antenna and the FET is improved.

CONCLUSION

The fully monolithic integration of an X-band twin-dipole antenna with a MESFET single-gate mixer on the same
GaAs substrate is successfully demonstrated for the first time. This integrated antenna mixer exhibits a mixer conversion loss of 22 dB, which can be improved further by increasing the LO power level and impedance matching optimization. The success of our work suggests that this topology is promising for millimeter-wave receivers for smart munitions seekers and automotive–collision-avoidance radars, where the requirements for low cost, compact size, and wide bandwidth are needed.

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Figure 4  Measured antenna mixer conversion gain versus LO power level. $V_{ds} = 2$ V, $V_{gs} = -1.6$ V, RF freq. = 10 GHz, LO freq. = 9 GHz, IF freq. = 1 GHz, $P_{RF} = 7.2$ dBm

OPTICAL AMPLIFIER WITH FEEDFORWARD SEMICONDUCTOR OPTICAL AMPLIFIER WITH CHIRP-CONTROLLED FILTERING

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ABSTRACT: Optical pulse regeneration and reshaping using nonlinear optical pulse amplification followed by a chirp-controlled filtering is simulated. The nonlinear amplification and chirp control are obtained by feedforward current injection in a semiconductor optical amplifier. The nonlinear amplification provides pulse regeneration, and the controlled chirp, in association with an optical frequency discriminator, can be used to optimize the shape of several Gbit/s pulse streams. The simulator model has been confirmed experimentally using eye diagram techniques. In addition, the switching action of an optical semiconductor amplifier with a dynamically arbitrarily injected current can be simulated. © 2001 John Wiley & Sons, Inc. Microwave Opt Technol Lett 30: 438–442, 2001.

Key words: chirped optical regenerator; semiconductor optical amplifier; waveform shaping; optical pulse reshaping; optical remodulator; optical filtering

INTRODUCTION

The semiconductor optical amplifier (SOA) can be an alternative to costly wavelength-flattened erbium-doped optical amplifiers in wavelength-division multiplexing (WDM) networks [1], and is a promising device for add-and-drop links and wavelength routing. Besides providing optical signal amplification, the SOA can be employed for the regeneration and reshaping (2R) of optical pulsed signals after its degradation by the combined effect of fiber dispersion and nonzero signal bandwidth. Given a WDM channel, the 2R modulation can ensure that the level crossings of the optical pulses are recovered, amplified, and forwarded, providing bandwidth and protocol transparency. The technique is different from that of an optical repeater since the incoming pulses are reshaped without the need for a clock extraction circuit.

A 2R remodulator employing SOAs can be built using different techniques. In the interferometric technique [3], an optical decision circuit is implemented by placing one or two SOAs (polarized with distinct dc bias currents) inside the arms of a Mach–Zehnder interferometer (MZI). In this way, both wavelength conversion and 2R are achieved using the nonlinear transfer function of this SOA–MZI wavelength converter [4], with rates up to 80 Gbits/s [5]. An approach without MZI was implemented using an integrated...

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