THE METHODS TO IMPROVE THE LINEARITY OF INGAP/GAAS HBT MMIC UPCONVERSION DOUBLE BALANCED MIXER WITH AN ACTIVE BALUN FOR AFICS

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Abstract:

This paper describes the MMIC double balanced mixer (DBM) which is designed for the adaptive feedback interference cancellation system (AFICS). It is optimized for the dual-band operation for PCS and IMT-2000 applications. The basic topology of the mixer is shown in Fig. 1. It is composed of a double balanced mixer that consists of transconductace stage Q1 and Q2 and differential switching pair Q3, Q4, Q5, and Q6. And an active balun is added to combine the differential outputs of the double balanced mixer. To improve the linearity of the mixer, the resistors for the degeneration and the current injection of transconductance stage are used. By using the emitter degeneration resistors of R1 and R2 at the transistors of Q1 and Q2, the noise and the current are reduced from the current source. Thus the IMD of the mixer is increased while the gain of the mixer is decreased due to the trade-off. And the linearity of transconductance stage is more important than that of switching stage for the whole linearity of the mixer because of its cascode structure. So the current injection resistors (R3, R4) are used to increase the linearity of DBM, because it makes the current flowing though the Q1 and Q2 is increased and maintain the amount of the current flowing through the switching stage transistors (Q3, Q4, Q5, and Q6). Additionally by using an integrated active balun at the RF port, it provides single RF output signals. The balun is shown in Fig. 2. In order to improve the performance of the balun, RF choke (L1, L2) and bypass capacitor (C1, C2) with large value is used in off-chip. Also the value of degeneration resistor R5 is optimized to obtain the same amount of gain for two signals which are common emitter path signal and common collector path signal.

As the result of using the resistors for the degeneration and the current injection of ransconductance stage, the mixer conversion gain is decreased from 8.03 dB to 0.85 dB, a third-order intermodulation distortion (IMD3) is improved from 56.4 dBc to 80.2 dBc, a 1-dB compression point (P1dB) is increased from -12.0 to -1.5 dBm, a third-order input intercept point (IIP3) is improved from -1.7 dBm to 10.0 dBm, a third-order output intercept point (OIP3) is improved from 6.2 dBm to 10.9 dBm, and the total current consumption is increased from 11.69 mA to 17.50 mA. Therefor the linearity of the mixer is improved by using the degeneration resistors and the current injection resistors.