GSM/UMTS/MMDS Amplifiers

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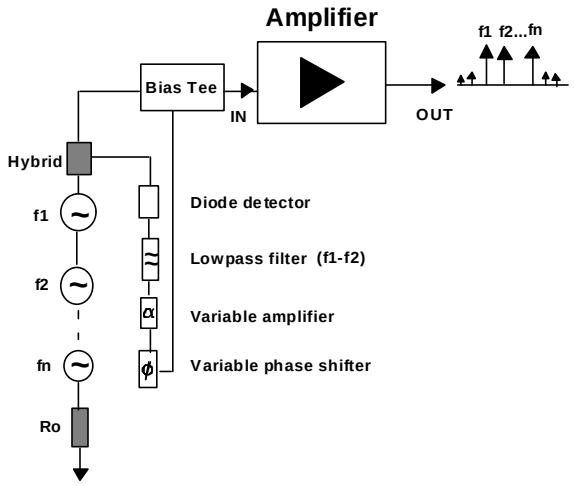
Abstract: An amplifier for GSM/UMTS/MMDS applications where the third order IM distortion has been reduced by two alternative injection techniques is presented. The first is the injection of the difference frequency of the two input signals in the amplifier together with the *n* fundamental signals will produce additional IM products at the output. By proper selection of phase and amplitude of the injected difference frequency signal, it is possible to make the third order IM products produced by the second harmonics and the original third order IM products out of phase and equal in amplitude. The second is the addition to the amplifier input of the second harmonics of the input spectrum As a result third order IM products will be eliminated, in principle. The experimental and simulated results are presented.

INTRODUCTION

The IM products, especially the third order are regarded as the most troublesome in multichannel wireless communication systems and they cause some undesired effects. In many communication systems the ratio of carrier to the third order IM products of the transmitter output is a system figure of merit. The desirability of reducing the IM distortion has led to the devising of a number of techniques. Applying these techniques may prevent the designer from using the full capability of the active device or alternatively the required circuitry may be complex, expensive and large in size. Reducing the third order IM products at the output ideally should not affect the fundamental output power levels. Reducing the fundamental power levels means that the amplifier power efficiency has been reduced which is not a desired result. This paper presents the experimental results obtained at 880 MHz in which the level of the third order IM products is reduced without affecting the fundamental power levels.



EXPERIMENTAL AND SIMULATED RESULTS

Functional block diagram of the experimental setup.is shown in Figure 1. The corresponding spectrum with the difference frequency signal injected at 1 MHz without the optimum amplitude and phase is shown in Figure 2.

Figure 1. The Amplifier Schematic Circuit
Diagram with a low-frequency injection at *f2-f1*.

In this figure, the fundamental signals are at 880, 881, 882, 883, 884, 885 and 886 MHz.
Figure 3 shows the corresponding spectrum with the difference frequency signal injected at 1MHz without the optimum amplitude and phase. The fundamental signals are at 880, 881, 882, 883, 884, 885, 886 and 887 MHz are shown in the same Figure..

The power amplifier configuration considered in the second injection technique is shown in Figure 4. In CAD simulation

the MESFET model (NEC-eefet3) from HP ADS library was used as the non-linear active device. The chosen frequencies of the two main input fundamental signals are 2.5 GHz and 2.51 GHz and their input power levels are -20 dBm.

The spectrum obtained at the output is shown in Fig.5 which includes fundamental signals and the third order IM products at 2.49 GHz and 2.52 GHz

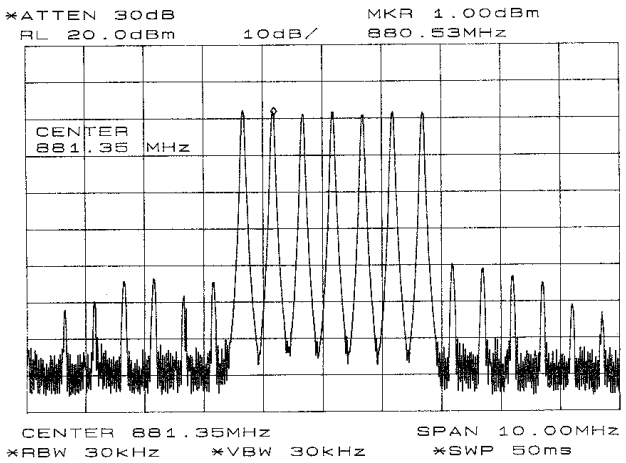


Figure 2. The measured fundamental powers (n=7) and the higher order IM powers after employing the technique.

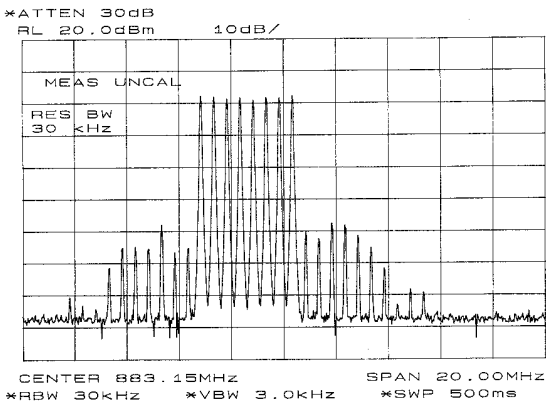


Figure 3. The measured fundamental powers (n=8)

and the higher order IM powers after employing the technique.

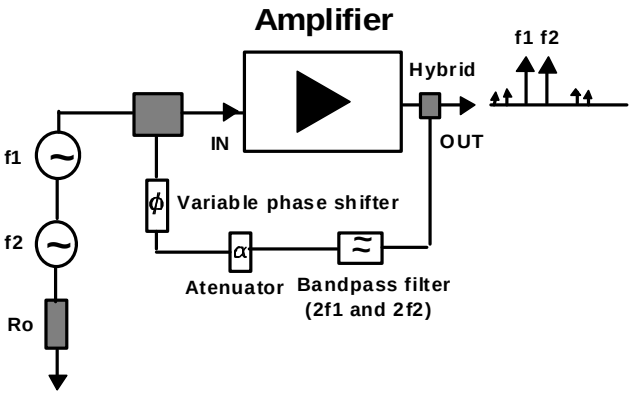
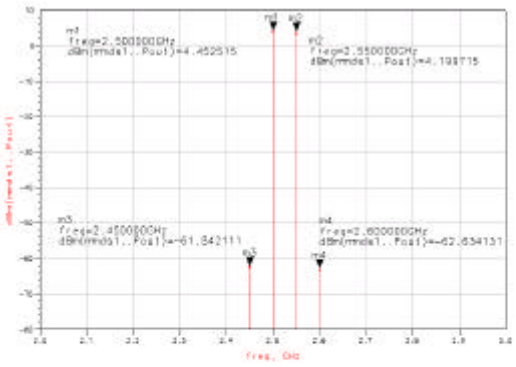


Figure 4. The Amplifier Schematic Circuit Diagram with second harmonics injection at *2f1 and 2f2*.

Figure 5 The Simulated Fundamental Powers and the Third Order IM Powers



CONCLUSION

A high efficiency low distortion amplifier for GSM/UMTS/MMDS applications is presented. Experiment shows that the third order IM level at the output of a non-linear amplifier can be reduced by the injection of the low frequency signal and second harmonics in the amplifier together with the fundamental signals. The reduction in the third order IM products can be considered as a huge improvement in the amplifier distortion performance.

REFERENCES

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