MMIC TECHNOLOGY AND ITS APPLICATIONS TO COMMUNICATION SYSTEMS

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ABSTRACT

MMIC technology has recently progressed rapidly to practical application in communication areas. However, practical application is not yet proceeding very actively. This article will survey the obstacles to promoting the MMIC applications to communication equipment as well as some solutions to the obstacles. Some examples of MMIC technology which increase the attractiveness of MMICs are also described, including their practical application to communication equipment.

Keywords: MMIC, MMIC Frequency Synthesizer, MMIC Variable Gain Amplifier, Digital Microwave Radio

1. INTRODUCTION

MMIC technology has already attained practical-use level in the last several years. The technology applications are expected in a very wide area. For instance, in the communication field, there are several kinds of systems, such as a satellite communication, terrestrial trunk radio transmission, mobile communication, subscriber radio, wireless LAN, etc. . However, there are not many communication systems in which MMICs are actually employed. This is because there are still some technical obstacles to overcome in developing MMICs.

This article surveys obstacles to MMIC application, and some approaches to overcome the obstacles, and focuses on devising high-performance and sophisticated-functions which are attractive for communication systems, including their applications to actual communication systems.

2. OBSTACLES TO APPLYING MMICS TO COMMUNICATION EQUIPMENT

As mentioned above, practical MMIC application to communication equipment is not sufficient yet. The objectives of MMIC application strongly depend on the systems they are applied.

There are a number of obstacles in the application of MMICs, the most important of which are as follows:

(1)MMIC performance and functions have not been so attractive so far, compared with conventional and competitive technology such as microwave integrated circuits (MIC, HIC);
(2)MMIC cost is comparatively high at present;
(3)MMICs have some disadvantages in performance, as compared with MICs and HICs;
(4)From the view-point of the applied systems, the performance and physical configuration of MMICs are not always suitable for the system requirements and equipment.

(3)MMIC designers should research and develop more sophisticated and functional MMICs, which act as the key modules in the system equipment and consequently determine the system's functionability. Moreover, MMIC designers should propose the possibility of designing future systems.

3. EXAMPLES OF "FEATURES UNIQUE TO MMICS" AND APPLICATIONS

For the purpose of promoting MMIC applications in communication fields, MMICs should be as attractiveness as possible in terms of performance, functions, cost, size and so on. The best way to increase MMIC application is to devise features unique to MMICs. This chapter describes examples of such MMIC technology and their application to communication systems.

3.1 LOW-DISTORTION VARIABLE-GAIN AMPLIFIER AND ITS APPLICATION

The first example is a low-distortion variable-gain MMIC amplifier(Ref.5), whose configuration is shown in Fig. 1. The amplifier employs a variable negative feedback scheme, which can improve the linearity of the amplifier. In addition, the monolithic configuration enhances high frequency operation up to the Ku band, since it can reduce the phase delay effect and parasitic influence of the feedback circuit. This type of amplifier very effectively improves third-order intermodulation distortion. For example, a Ku-band amplifier has third-order intermodulation distortion about 40 dB less than that of conventional variable gain amplifiers.

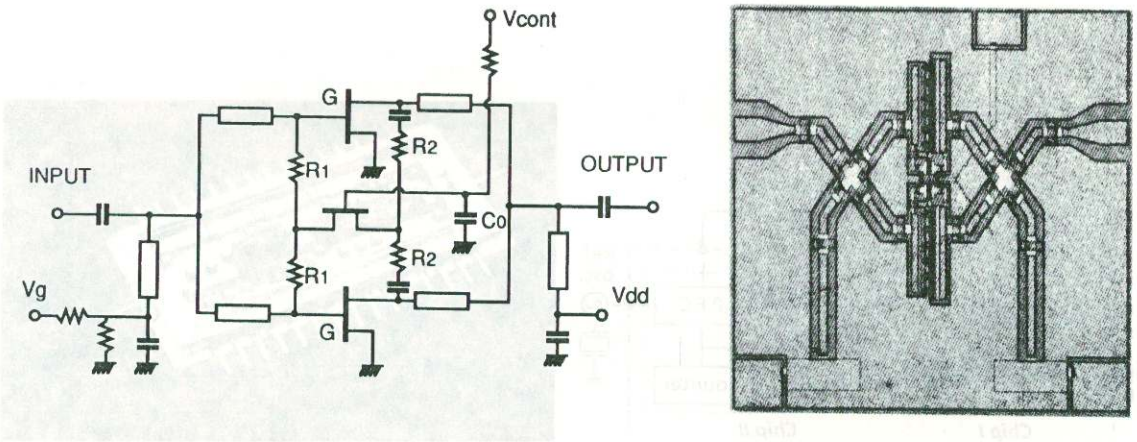

Figure 1: *Monolithic low-distortion variable gain amplifier(1.5x1.5mm)*

This is a very attractive feature when applying this variable gain amplifier to digital microwave radio systems with high modulation schemes such as 16QAM and 256QAM. This is why digital radio systems require very wide dynamic range ($-66dB_m$ to $-10dB_m$) of receiving signal level and excellent linearity in the receivers. Figure 2 shows a block diagram of a 16QAM digital microwave radio system, where MMIC modules are indicated by parallel slashes within blocks. The RX modules include low distortion variable gain amplifiers which are very effective to overcome the up-fading. In this digital radio transmission system, the low-distortion variable-gain amplifier is one of the most important key modules.

upconverter selects the assigned block, and upconverts it into a BS band signal. The BS TV receiver selects the desired channel out of 8 channels.

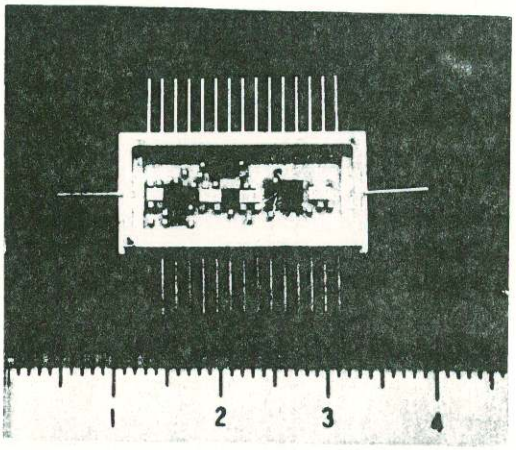

Figure 4: *Synthesized upconverter for FM-FDM video tuners.*

4. CONCLUSION

The best way to promote the application of MMICs is to develop performances or functions which are "unique to MMICs". The cost problem can potentially be solved by way of increasing MMIC attractiveness through such "unique to MMIC" performance or functions. MMIC designers should now devote themselves to achieving excellent performance through MMICs, such as low-distortion, variable-gain amplifiers, or advanced functional modules such as microwave frequency synthesizers.

5. REFERENCES

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