A Multi-Band GSM/GPRS Power Amplifier Controller

As shown in Figure 1, the LMV243 consists of a 45 dB log amp detector for sensing the RF output power level of a PA and an error amplifier to close the control loop as in a servo control.

Advantage Of Using 45 dB Log Amp Detector

Typically, a GSM/GPRS PA requires a control voltage Vapc from 0.1+ to 2.0+ Volts for power levels from 0 dBm to 35 dBm. The baseband chip can usually provide a DC pulse voltage of 100 mV to 2V through a Digital-to-Analog Converter (DAC). The resolution of the profile and min./max. range depends on the firmware and performance of the DAC. With a 45 dB detection range, the LMV243 can detect RF power from about 0 dBm down to -45 dBm. For a GSM band, it requires a coupling factor of 35 dB or higher. This loosely-coupled coupler can easily be implemented by a resistive divider or a microstrip line.

Equations For Calculating The Attenuation

On the other hand, if an off-the-shelf LTCC coupler is used, an additional attenuation, L in dB, between the RF input of the LMV243 and the output of the LTCC coupler is needed. Depending on PCB layout constraints and personal preference of RF engineers, either the T- or π-networks (Figure 2) can be used to add the additional attenuation.

Following are the equations for calculating the necessary resistors for the π-network:

\[
R_1 = \frac{50}{10^{-L/10}} \quad \text{and} \quad R_2 = \frac{1}{10^{L/10} \cdot \frac{1}{R_3}}
\]
Following are the equations for calculating the necessary resistors for the T-network, and where L is the attenuator loss in dB and is a positive number:

\[ R_1 = \frac{10^{0.1L}}{10} \quad \text{and} \quad R_2 = R_1 \times 10^{0.1L} + R_1 \]

**Choose The Right \( R_c \), \( C_f \) To Match The Performance Of Different PA**

After choosing the right coupling factor (-35 dB or even more), you must then choose the feedback capacitor \( C_f \) to close the control loop. Typically, you can choose the \( C_f \) between 22 pF to 100+ pF depending on the performance of individual power amplifiers and the voltage profile of Vamp. Sometimes, a small \( R_p \) may be needed to compensate the stability of the servo loop. A small \( C_f \) will have a fast response in the envelope and may cause overshoot in the time mask and a big \( C_f \) may cause delay. So an optimized \( C_f \) and \( R_p \) should be chosen together with a set of Vamp profiles to meet the GSM specification. A recommended application circuit is shown in Figure 3.

**LMV243 Evaluation Board Meets GSM Spec**

National has developed an LMV243 demo-board for multi-band GSM/GPRS power amplifiers with a single Vapc pin. The LMV243 has been tested in the demo-board to control the GSM/GPRS power amplifier. A picture of the demo-board can be seen in Figure 4, and Figure 5 shows how the LMV243 passes the GSM transmit time mask at a high-output power level.

![Figure 4: Demoboard](image)

![Figure 5: GSM Transmit Time Mask at Full Output Power](image)

**Additional Information**

- amplifiers.national.com

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