

AN04 MMIC Amplifier Low-Frequency Gain Flattening Networks

Microsemi offers MMIC amplifiers that have excellent performance across a wide frequency range, but several of these amplifiers have undesirable excess gain at frequencies below 5GHz. For optical modulator driver applications, broadband gain flatness is critical for low jitter with no 0-to-1 overshoot or 1-to-0 undershoot.

Microsemi recommends the use of a low-frequency gain reduction network (LFGR) to selectively attenuate the gain below ~5GHz. The flattening effect of an LFGR applied to the Microsemi MMIC amplifier is shown below in *Figure 1*.

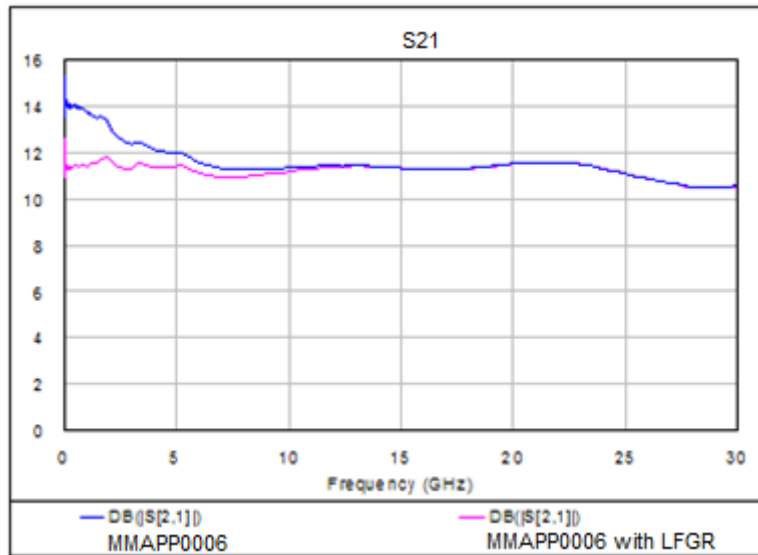


Figure 1. Microsemi MMIC Amplifier S21 with and without LFGR network

The LFGR network is a shunt RLC connected to the output of the amplifier as shown in *Figure 2*.

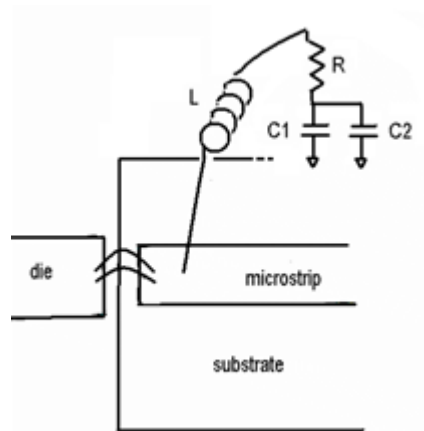


Figure 2. LFGR application

The network can be connected directly to the output microstrip line, or the left side of a DC blocking cap. It consists of a wirebond to a discrete resistor, connected to ground by two discrete capacitors.

The inductance of the wirebond limits the upper frequency range of the LFGR. For example, shorter bonds increase the bandwidth of the LFGR. The capacitors limit the lower frequency range, and the resistor determines the amount of attenuation. These tuning values are summarized in *Table 1*.

Table 1 - Tuning summary of LFGR network

Tuning component	Change	Effect
wirebond length	shorter	LFGR attenuates to higher frequency
resistor value	smaller	increases amount of LFGR attenuation

The suggested implementation of the LFGR network is shown in *Figure 3*. This shows a wirebond (L) connected to the top of a discrete resistor (R) standing on end on a chip capacitor (C1). A discrete capacitor (C2) extends from the top of the chip capacitor to a pedestal on the grounded package floor.

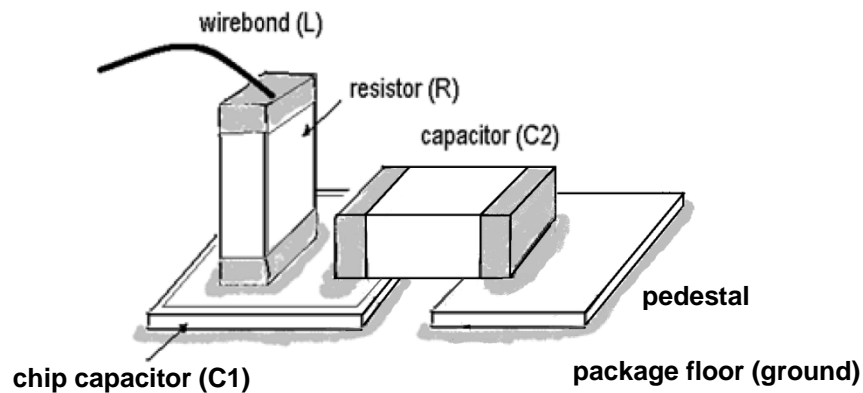


Figure 3. Suggested implementation of the LFGR

Table 2 lists several suggested component values for use in your simulations; the LFGR should be optimized for your particular package design. Note that the parasitics of the resistor and capacitors must be considered when simulating the effects of an LFGR network.

Table 2 - Suggested component values for the LFGR

L (nH)	R (ohm)	C1 (pF)	C2 (uF)	Application
1.5	47	400	1.0	attenuation below 12GHz; multiple MMIC die in package
5.0	70	400	1.0	minor attenuation below 5GHz; single Microsemi MMIC Amplifier die in package



Microsemi Corporate Headquarters
One Enterprise, Aliso Viejo CA 92656 USA
Within the USA: +1 (800) 713-4113
Outside the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996
E-mail: sales.support@microsemi.com

Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for communications, defense and security, aerospace, and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs, and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; security technologies and scalable anti-tamper products; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, Calif. and has approximately 3,400 employees globally. Learn more at www.microsemi.com.

© 2014 Microsemi Corporation. All rights reserved. Microsemi and the Microsemi logo are trademarks of Microsemi Corporation. All other trademarks and service marks are the property of their respective owners.