Broadband Microwave Amplification Made Easy

By Henrik Morkner | MACOM

Many microwave applications within the semiconductor industry demand maximum performance and low cost and are therefore narrow band (< 10% bandwidth). Consequentially, most component manufactures provide amplifiers in octave bandwidths or less.

The problem with this approach is that in some systems the frequencies are not pre-set. This is true for electronic warfare, instrumentation, and emerging cognitive radio systems that can hop across the ultra-wide bandwidth (UWB) 3-11GHz spectrum. This problem also persists when multiple narrow band applications are desired in one radio - for example a radio that receives both 802.11abg and LTE. A solution to this is to use a broadband amplifier that covers all the desired frequencies.

Keeping these challenges in mind, MACOM introduced the MAAM-011100, MAAM-011101, and MAAM-011109 broadband amplifiers. These amplifiers offer 10 to 15dB of gain with excellent 50Ω match over different power and frequency ranges. The devices are easy to use, low cost and cover a broad frequency range to encompass multiple bands or applications.

The simplest of the three devices is the MAAM-011101 general purpose amplifier (GPA). This two stage amplifier covers 4 to 20 GHz with 15dB of gain and +18dBm power, while matching is achieved using lossy feedback networks. These networks are selected to shape the gain curve to be flat and match the input and output to 50Ω. Being a two stage GPA, the DC current is low because it is “re-used” by both stages, however this raises the supply voltage to +5V minimum and +8V optimum. The product is housed in an ultra-small 1.5x1.2mm PDFN surface mount package. A simplified schematic is shown in Figure 1 and typical performance in Figure 2.

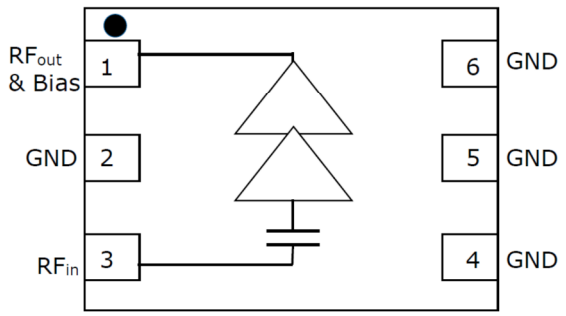

Figure 1. MAAM-011101 GPA Schematic

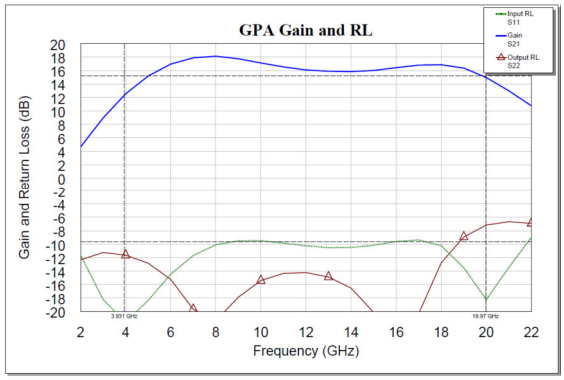

Figure 2. MAAM-011101 performance

The second device from MACOM, the MAAM-011100, tackles broadband variable gain amplification by creating a mini-traveling wave amplifier with 400 MHz to 20 GHz frequency bandwidth, 10dB gain and a 50 Ω match across band. In this solution a two section distributed amplifier topology was selected since the I/O match is dominated by FET parasitic capacitance at the high frequencies, and a termination resistor at the low frequencies. Since the FETs are in a cascode arrangement, gain control is achieved by varying the voltage on the common gate stage. This allows a monotonic gain variation since we are controlling transconductance while the match remains constant. The net result is over 30dB of gain control with a single control pin. The VGA is also housed in an ultra-small 1.5x1.2mm PDFN surface mount package. A simplified schematic is shown in Figure 3 and typical performance in Figure 4.

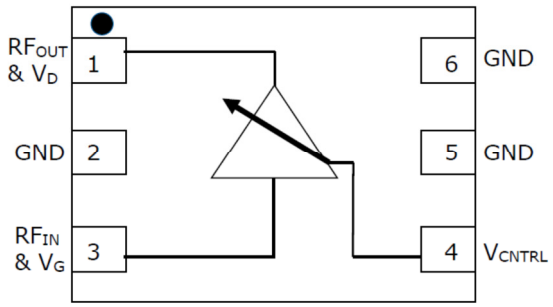

Figure 3. MAAM-011100 VGA Schematic

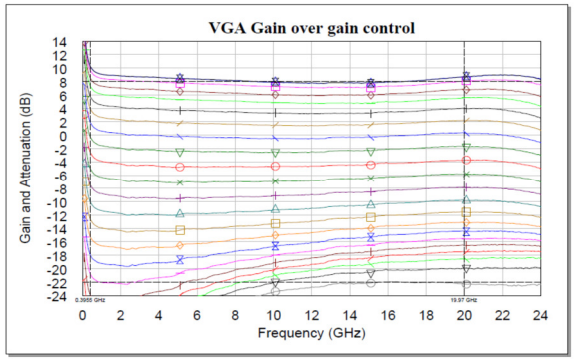

Figure 4. MAAM-011100 performance

Of the 3 solutions offered by MACOM, the MAAM-011109 is the most integrated solution with 10 MHz to 40 GHz amplification at 13dB gain, 50Ω match, and +16dBm power. What is unique

in the market about this amplifier is that the DC bias tee, DC blocks, gain control, and output power detector are all integrated into the simple 5x5mm surface mount package. The amplifier achieves this performance by using a 9 section distributed 0.15u gate PHEMT MMIC, combined with laminate based SMD capacitors and inductors. Gain control is achieved in similar fashion to the MAAM-011100 VGA. The power detector is clever in detecting the RMS voltage off the distributed line termination resistor versus power that would normally be lost. The device can efficiently operate between the +5V and -5V range. A simplified schematic is shown in Figure 5 and a typical performance for gain and RL in Figure 6.

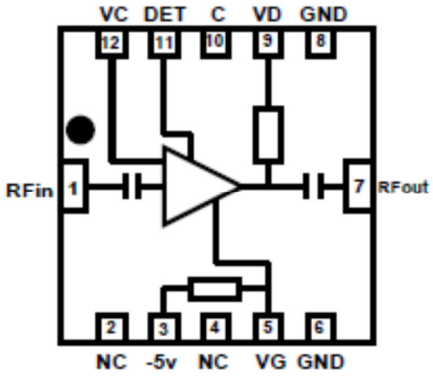

Figure 5. MAAM-011109 Amplifier

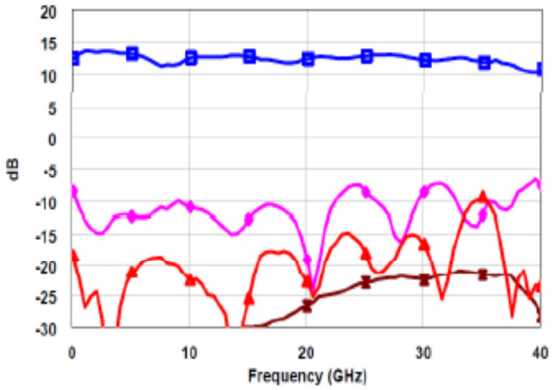

Figure 6. MAAM-011109 Performance

These three amplifiers represent state-of-the-art broadband performance. Each uses plastic over-mold for excellent reliability and environmental resistance. All are available today for purchase or on sample board to simplify your broadband needs.