

AN03: Centellax MMIC amplifiers with dynamic gain control

Centellax designs and manufactures GaAs MMIC amplifiers, most which have 30dB of dynamic gain control. These ICs can be controlled with an opamp circuit, or a microprocessor with a lookup table, to enable real time application-adjustable gain.

This type of amplifier can replace an entire amplifier-attenuator sub-circuit; instead of a fixed-gain amp followed by a voltage-controlled digital or analog attenuator, replace both ICs, the connecting substrate, and at least two sets of wirebonds with a single adjustable-gain IC, shown in Figure 1.

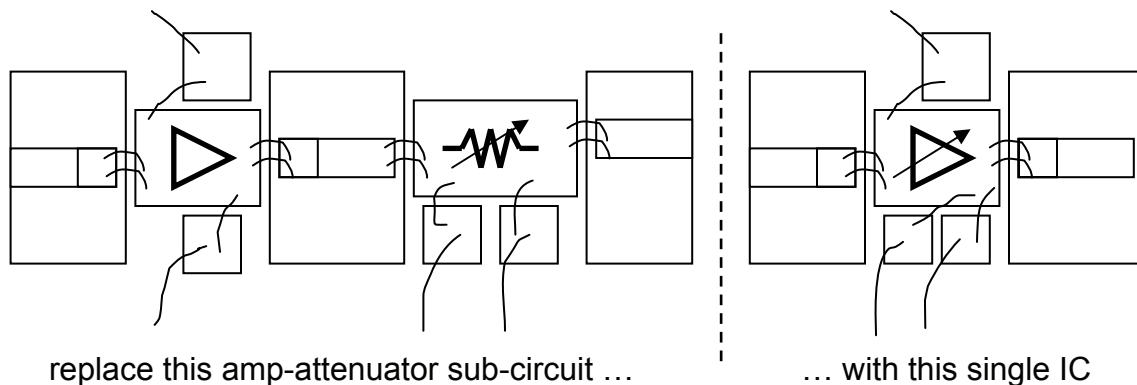


Figure 1 – Replacing amp-attenuator sub-circuit with dynamic-gain amp

Benefits of a dynamic gain amplifier versus an amplifier-attenuator sub-circuit:

- Reduced component count, decreased bill of materials
- Reduced assembly time, reduced MMIC variation (one IC vs. two ICs)
- Similar logic requirements to an analog voltage-controlled attenuator

Limitations of dynamic gain control:

- Control voltages are somewhat non-linear and require opamp or microprocessor with lookup table (see Table 1 and Table 2)
- Output power of dynamic-gain amp decreases when gain is decreased
- Not ideally appropriate for power attenuation due to harmonic distortion and nonlinear gain compression (see Figure 4)
- Drain voltage and 2nd gate voltage must not exceed the process breakdown voltage; users must adhere to the maximum specifications in the datasheet

Table 1 – Typical dynamic gain control performance of Centellax UATM30M2C amplifier

Device	Dynamic range	Max gain (2-20GHz)	Min gain (2-20GHz)	Sensitivity (0-10dB)	Sensitivity (10-30dB)
UATM30M2C	~30dB	18dB	-13dB	5mV/dB	3mV/dB

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Dynamic gain control of UATM30M2C

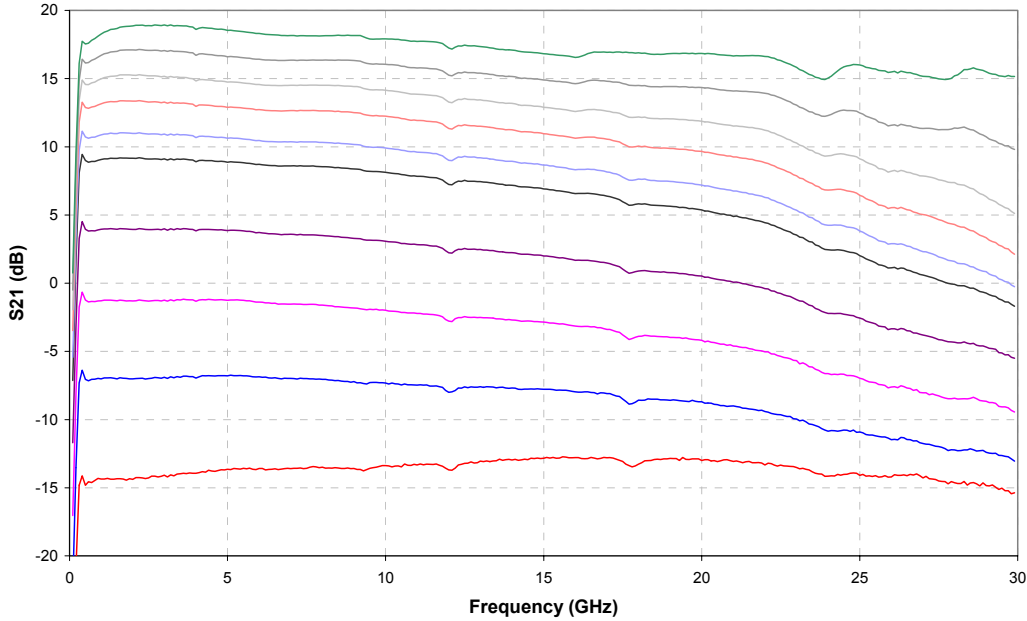


Figure 2 – Typical UATM30M2C S21; bias values shown in Table 2

Psat of UATM30M2C during gain control

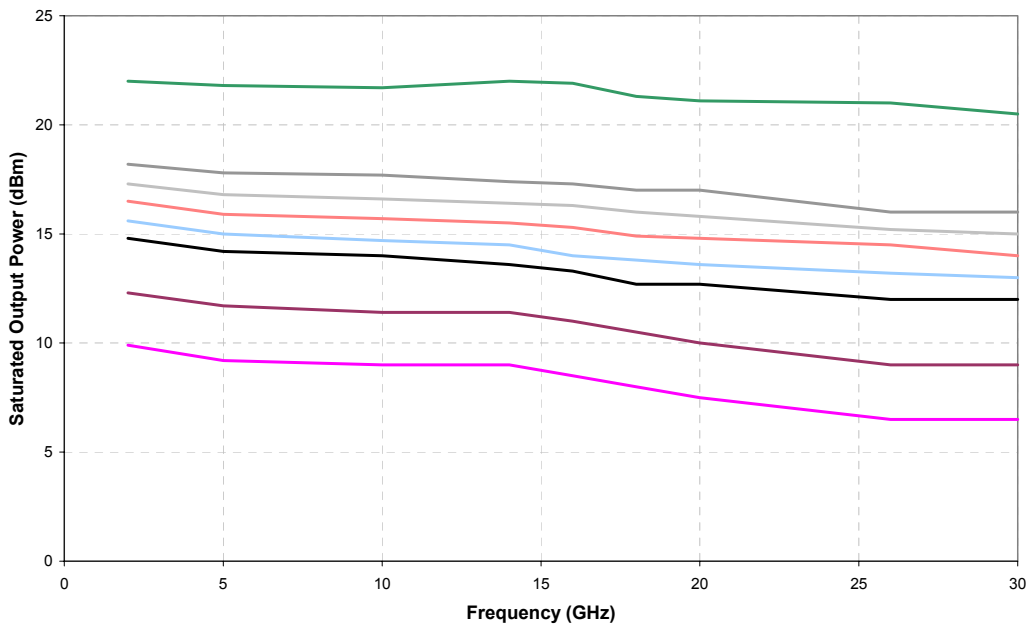


Figure 3 – Typical UATM30M2C Psat; bias values shown in Table 2

AN03: Centellax MMIC amplifiers with dynamic gain control

P-1dB of UATM30M2C during gain control

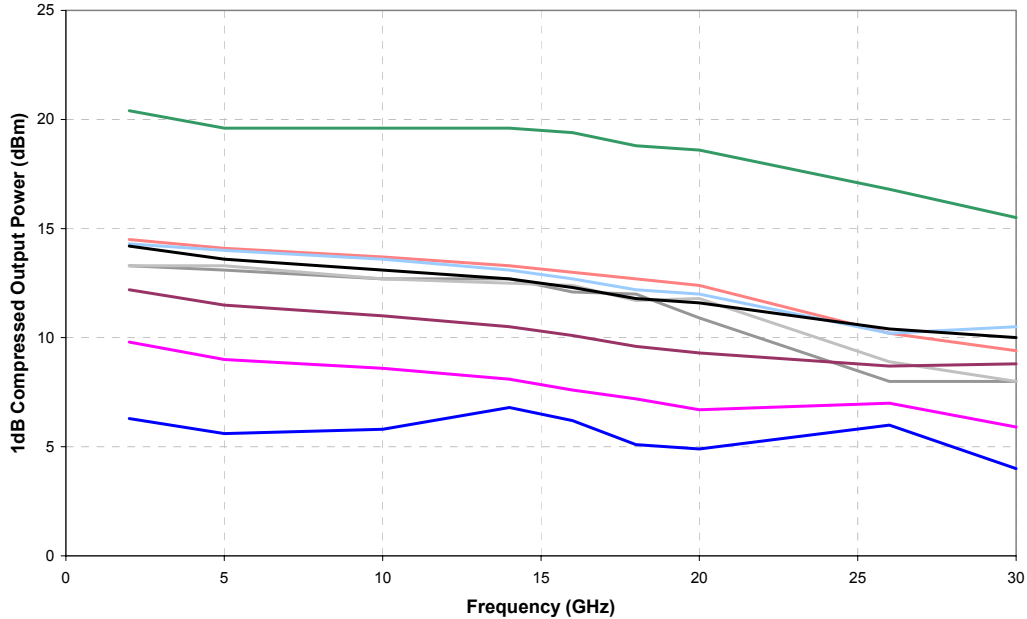


Figure 4 – Typical UATM30M2C P-1; bias values shown in Table 2

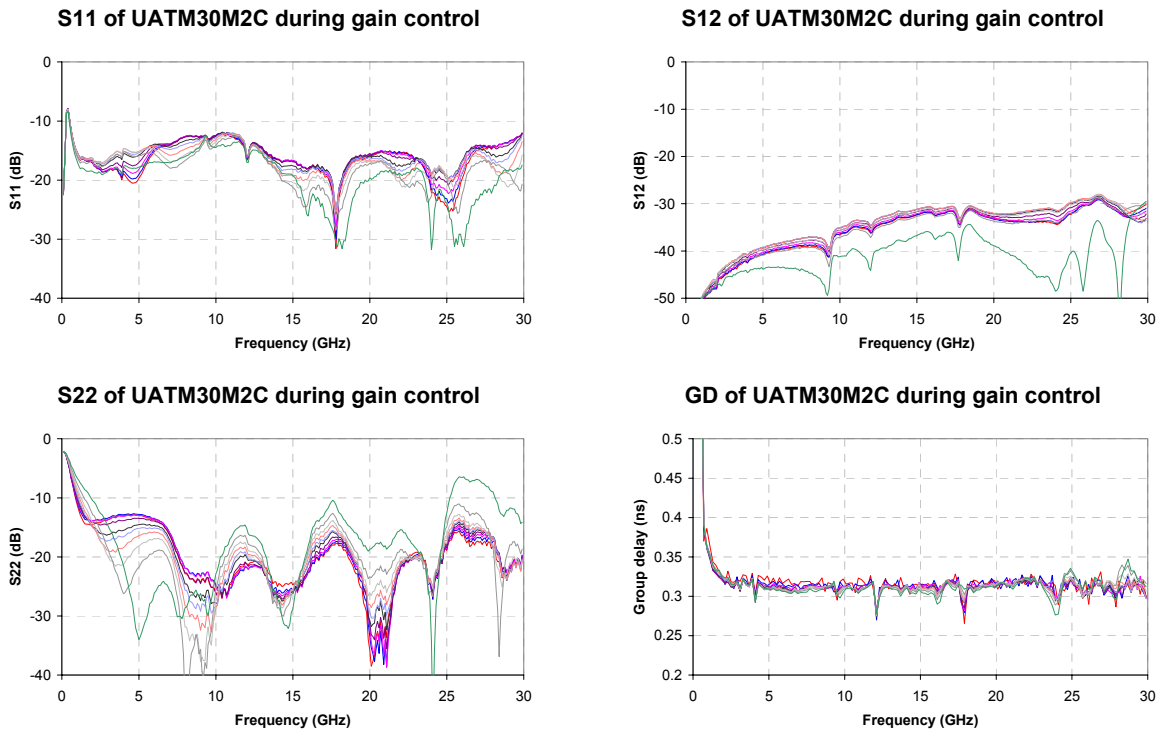


Figure 5 – Typical UATM30M2C performance; bias values shown in Table 2

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Figure 2 through Figure 5 illustrate the typical dynamic gain performance of the Centellax UATM30M2C, a popular 0.04-30GHz Broadband MMIC Low-Noise Amplifier. The gain was attenuated in 2dB increments from the recommended bias point (no attenuation) to 10dB attenuation, and 5dB increments from that point to 30dB attenuation.

Additional information is available from the product library:

<http://www.centellax.com/products/microwave/mmics/UATM30M2C.shtml>

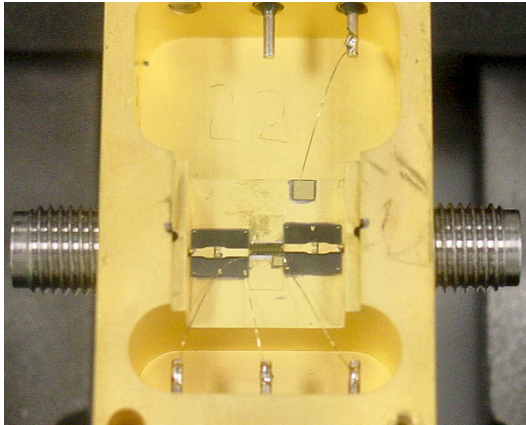


Figure 6 – UATM30M2C evaluation module

UATM30M2C die are mounted in a simple connectorized evaluation module, and assembled according to the 2-30GHz assembly diagram shown in the product library.

The evaluation module is shown in Figure 6. A conductive lid was applied for all measurements.

Typical bias voltages for the UATM30M2C are shown in Table 2.

Table 2 – Typical dynamic gain control bias voltages for Centellax UATM30M2C amplifier

Typ Gain (2-20GHz)	Attenuation (dB)	Gate voltage Vg (V)	2 nd Gate voltage Vg2 (V)	Drain current Id (mA)
18dB	none	-0.16	none	150
16dB	2	-0.16	+0.09	132
14dB	4	-0.16	-0.03	127
12dB	6	-0.16	-0.12	120
10dB	8	-0.16	-0.20	115
8dB	10	-0.16	-0.27	106
3dB	15	-0.16	-0.44	87
-2dB	20	-0.16	-0.58	67
-7dB	25	-0.16	-0.72	47
-13dB	30	-0.16	-0.86	28

Information on Centellax MMIC amplifiers is available from the Centellax website at: http://www.centellax.com/products/microwave/amplifier_ics.shtml

Please contact Centellax application engineers at support@centellax.com for additional information, or sales and marketing at sales@centellax.com for price and delivery information.