Application Fixture (CG2H40010F-AMP1) for Counter - IED Power Amplifier Applications Using Two CG2H40010F GaN HEMTs

CG2H40010F-AMP1 Application Fixture from 500 to 3000 MHz

Wolfspeed, a Cree Company, developed an application circuit that demonstrates the ability for the CG2H40010F to operate between 500 MHz to 3000 MHz for counter improvised explosive device (C-IED) / jamming power amplifier applications. The circuit utilizes two devices connected using a hybrid coupler in a balanced configuration. It is an ideal driver for the CG2H30070-AMP1 and AMP2 high power output stage GaN HEMT application fixture design. This application note describes the typical performance that has been achieved and what can be expected when evaluating the application fixture. Key features of the amplifier include:

- Frequency range 500 MHz – 3000 MHz
- Over 16.5 dB of small signal gain
- Over 47 % drain efficiency
- 20 W typical saturated output power
- Gain flatness < 3.5 dB

OVERALL DESIGN

The design goal was to create an application circuit for C-IED applications capable of operating over a large case temperature (25° C to 85° C) and delivering enough power to be a driver for the CG2H30070-AMP2 (requirement of 42.5 dBm at 85° C) application circuit which is intended to be the output stage for such an application. The circuit was constructed on Rogers HTC6035 to match the substrate used for the output stage and mounted on an aluminum plate. It utilizes the CG2H40010F which is a 10 W device housed in a flanged ceramic package. The design uses the same matching network for both RF paths with the splitting and combining facilitated using a hybrid coupler (IPP-7032) on both the input and output sides of the power amplifier. To reduce the capacitance underneath the coupler and increase the overall bandwidth of the design a pocket was milled out underneath the coupler to decrease the parasitic capacitances. A picture of the PCB can be seen in Figure 1.

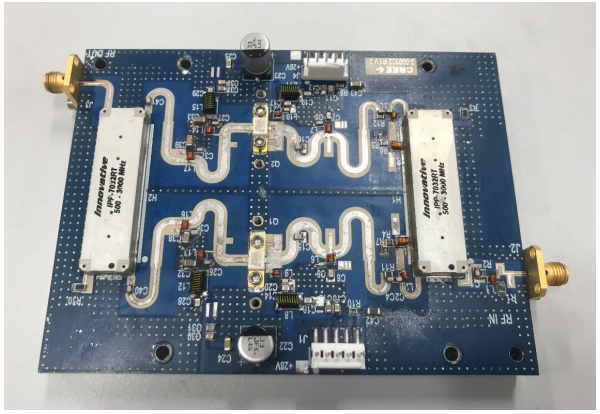

Figure 1

APPLICATION FIXTURE PERFORMANCE

Overall the application fixture operates in the intended band from 500 MHz – 3000 MHz and delivering approximately 43 dBm across the band at room temperature with a constant input power of 31 dBm as shown in Figure 2. Drain efficiency across the band remains over 47% with small signal gain of over 16.5 dB. Under typical back-off conditions third-order intermodulation distortion (IMD3) remains low as seen in Figure 3 for a broadband device. With the hybrid couplers being used in the design the overall return loss remains below -10 dB across the band as shown in Figure 4.

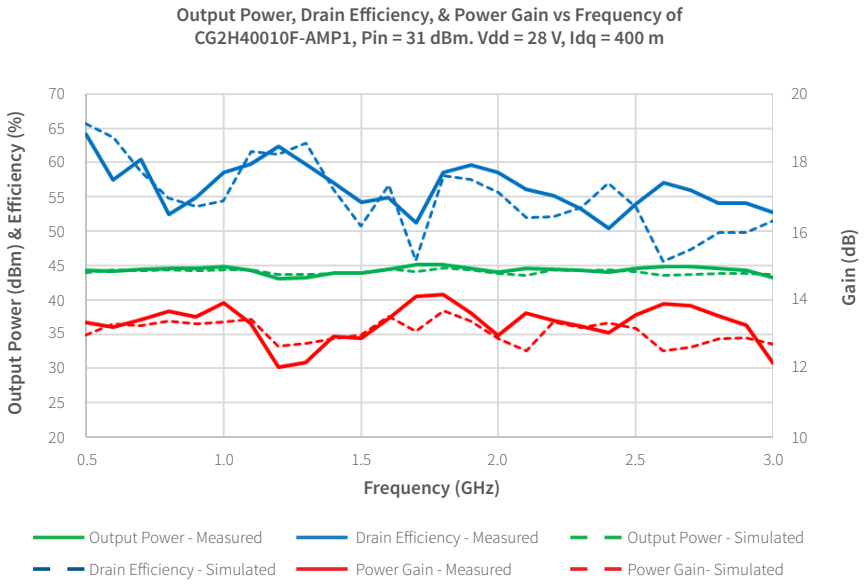

Figure 2

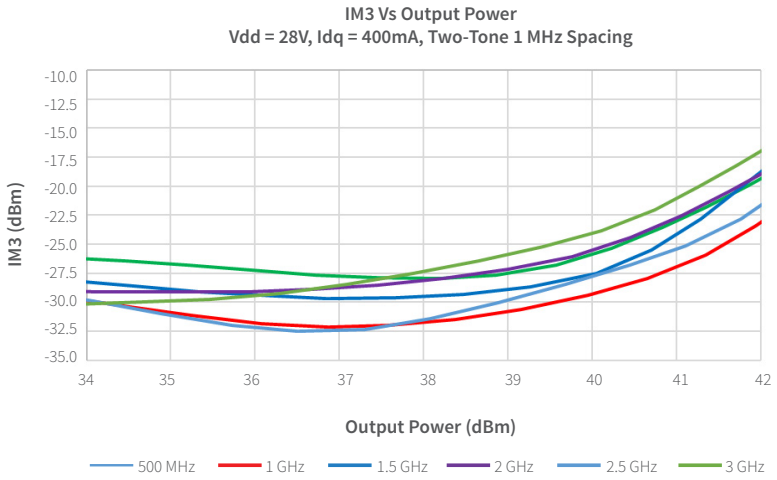

Figure 3

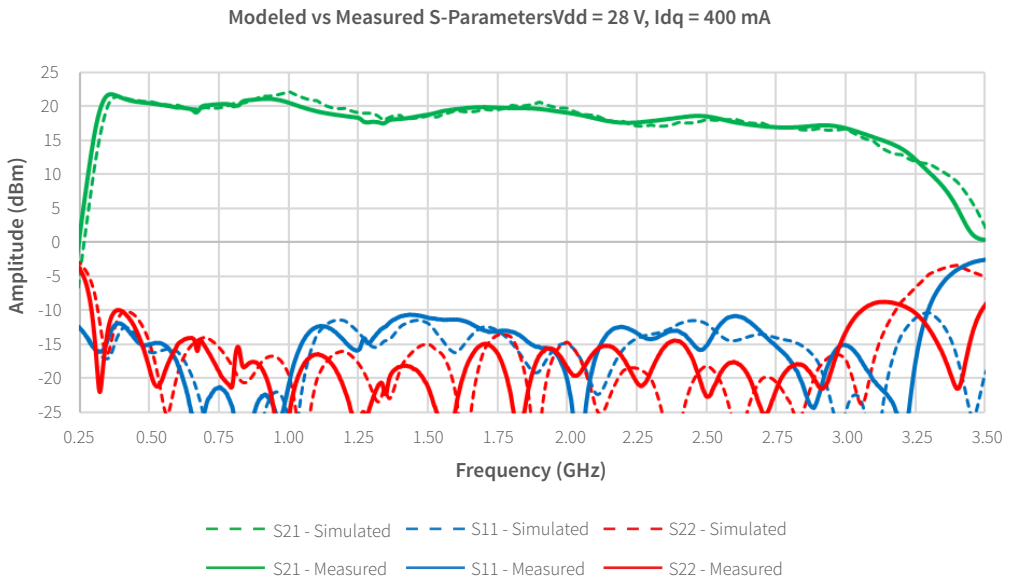

Figure 4

MODELED TO MEASURED CORRELATION

The design was completed in National Instruments AWR Design Environment using Cree's proprietary large signal transistor model for the CG2H40010. All passive components used in the design were modelled using the Modelithics component library to include the effect of pad parasitics. Figure 2 shows the measured to modelled large signal performance and Figure 4 shows the small signal measured to modelled results. As can be seen very tight alignment can be seen in the large signal data with an efficiency deviating at spot frequencies above 2 GHz. Small signal gain alignment remained within 1 dB across the design band.

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DESCRIPTION	QTY.	DESIGNATOR
RES, 1/8W, 0805, 2%, 10 OHMS	2	R8,9
RES, 70W, 1206, 2%, 50 OHMS, IMS ND3-1206EW50R0G	3	R1,3,10
RES, 0.35W, 0805, 18 OHMS, IMS RCX0805S	5	R2,4-7
RES, 0.35W, 0805, 27 OHMS, IMS RCX0805S	2	R11,12
CAP, 0.9pF, +/-0.1pF, 0805N, PPI	2	C15,16
CAP, 27pF, +/-0.1pF, 0603N, ATC600S	2	C26,27
CAP, 10pF, +/-2%, 0505N, PPI	4	C4,5,40,41
CAP, 10pF, +/-2%, 0603N, PPI	6	C8,9,20,21
CAP, 39pF, +/-0.1pF, 0603N, ATC600S	2	36,37
CAP, 18pF, +/-2%, 0505N, PPI	1	C1
CAP, 22pF, +/-2%, 0505N, PPI	2	C2,3
CAP, 18pF, +/-2%, 0505N, PPI	8	C6,7,14,17-19,28, 29
CAP, 470pF, +/-5%, ATC800B	4	32,33,38,39
CAP,1NF, 0805,100V, X7R	4	C12,13,31,34
CAP,10NF, 0805,100V, X7R	4	C10,11,30,35
CAP,100NF, 1206,100V, X7R	2	C24,25
CAP, 10UF, 10%, 1206,16V, X5R	2	C42,43
CAP, 33UF, 20%, F CASE, 63V	2	C22,23
IND, 8.1nH, 2% Air Core, Coilcraft 0908SQ	2	L9,10
IND, 8.9nH, 2% Air Core, Coilcraft 0806SQ	2	L2,4
IND, 15.7nH, 2% Air Core, Coilcraft 0806SQ	3	L1,13,14
IND, 17.0nH, 2% Air Core, Coilcraft 0807SQ	4	L6,7,16,17
IND, 25nH, 2% Air Core, Coilcraft 0908SQ	2	L3,5
IND, 82nH, 5% Air Core, Coilcraft 1515SQ	4	L8,11,12,15
IPP-7032 Quadrature Hybrid SM 500-3000MHz	2	H1,2
CONN, SMA, Panel Mount Jack	2	J2,J3
PCB, Rogers HTC6035, 10mils, CG2H40010F-AMP2	1	
BASEPLATE, CG2H40010F-AMP2	1	
HEADER RT>PLZ .1CEN LK 5POS	2	J1,4
Transistor CG2H40010F	2	Q1,2

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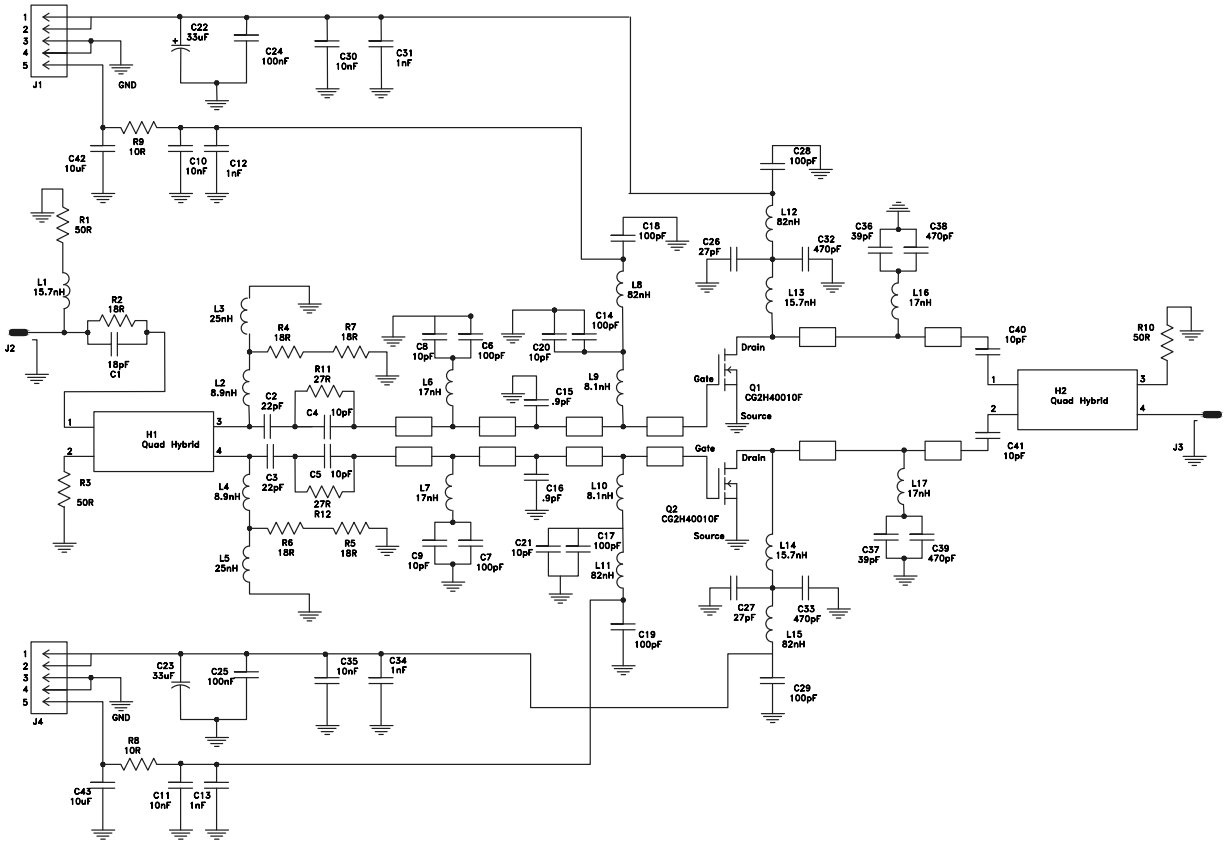

CONCLUSIONS

The application note demonstrates the performance of the CG2H40010F-AMP2 which shows great performance from 500 – 3000 MHz. The modeled to measured correlation shows that first pass success is achievable using Cree's propriety large signal models.