AR232026

BLF944P, 30-520 MHz

V1.0 — 3 May 2023

AMPLEON

Application Report

Document information

Info	Content
Status	General Publication
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Abstract	Measurement results of the BLF944P LDMOS device in board #AR232026 tested over 30-520MHz at 28V

1 Revision History

Table 1. Report revisions

Revision No.	Date	Description	Author
1.0	20230503	Initial document	Bill Goumas

2 Contents

3 List of Figures

4 List of Tables

5 General Description

This report presents the measurement results of the Class AB Demo board AR232026. The device used is a an BLF944P which is a 9th generation LDMOS device from Ampleon.

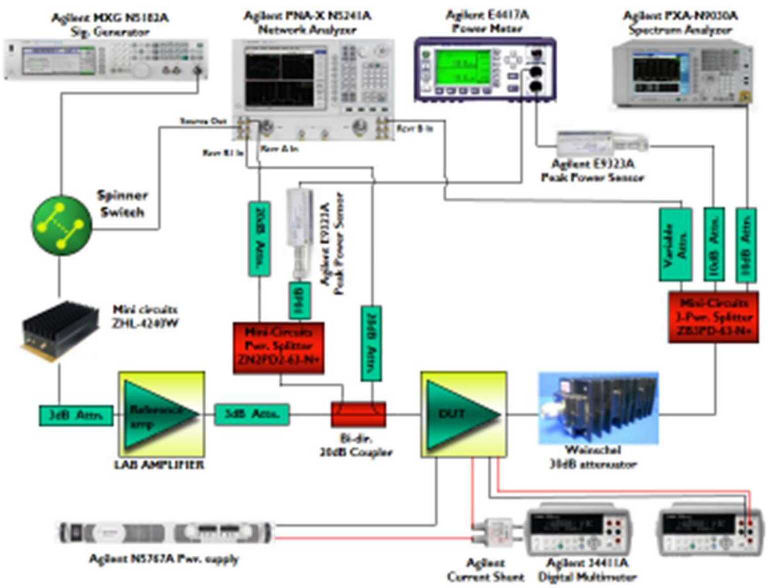
6 Biasing

6.1 Bias Details

Idq is set via the pot on the bias board. Vgs~2.1V for Idq =600mA tptal or 300mA per side.

7 Test Bench Set Up

Figure 1.Test Bench Equipment set up



8 Summary

The BLF944P was dropped in the existing coax transformer circuit that we have been using for most 30-520MHz circuits. Transformer on the output does not have any additional matching components.

Results show >45% efficiency at Power Out=80W at 28V.

Table 2. RF Performance Vdd=28V, Idq=600mA ,CW

Symbol	Parameter	Range	Unit
Freq.	Frequency Range	30-520	MHz
P3dB	Power at 3dB Gain Compression	>85	W
$Eff_{.@80W}$	Efficiency	>45	%
$G_{min.@50W}$	Minimum Gain	>16	dB
$G_{min.@80W}$	Minimum Gain	>14	dB

IR scan results are shown in section 9.9. All component temperatures are <55°C

Stability Notes:

Circuit has a small signal gain peak near 7MHz. No spurs were seen during testing and small signal K-factor shows the circuit as unconditionally stable even with the gain peak. Simulations show that reducing the feedback resistors to 100Ω would eliminate the 5MHz gain peak with a trade-off of reduced gain.

Performance Dip:

Peak Power and IM have a dip near 150MHz. This is unexpected as most of these coax transformer circuits show a gentle roll-off without any additional matching. This may be due to harmonic terminations. Further investigation will be done. Simulated results shown in Section 9.8 show a slight dip near 150MHz so the model will be used as part of this further investigation.

9 Performance Details

9.1 Small Signal Results

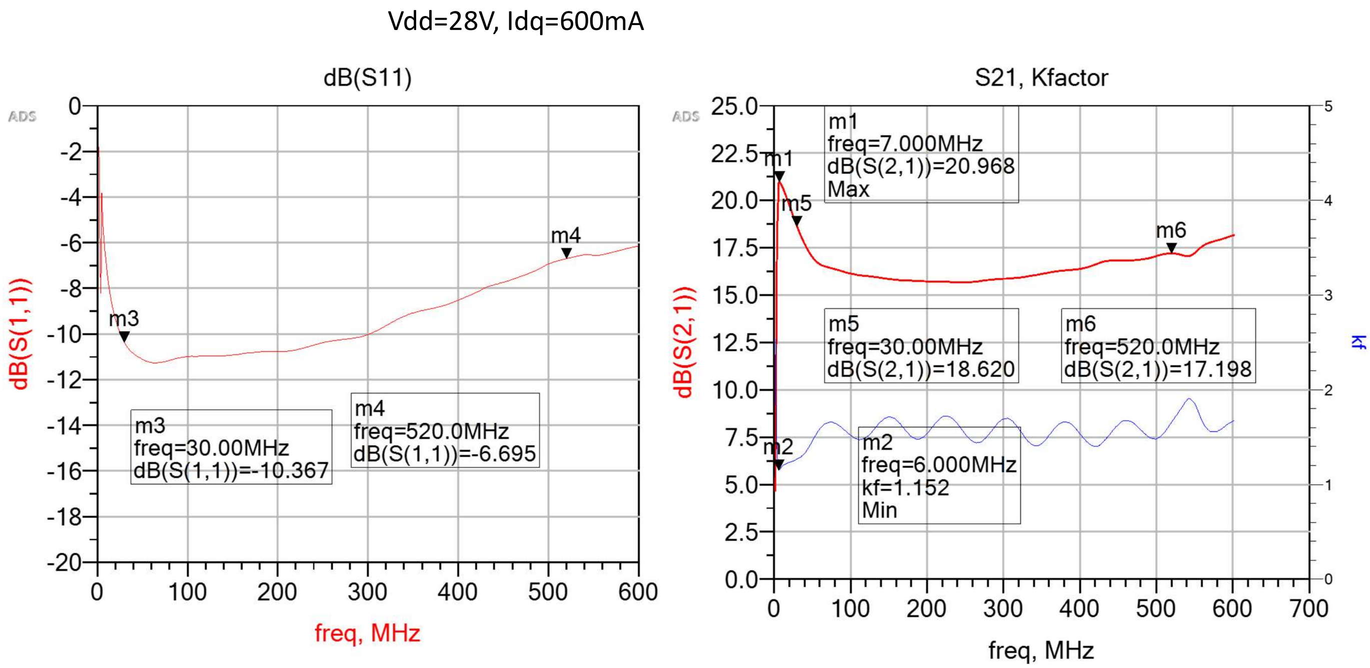


Figure 2. Small Signal Data, V_{dd}=28V, Idq=600mA, Pin=10dBm

9.2 Pulse Gain, Efficiency vs Pout and Frequency

Vdd=28V, Idq=600mA, 10% Duty Cycle, PW=100usec , Low Frequency Range

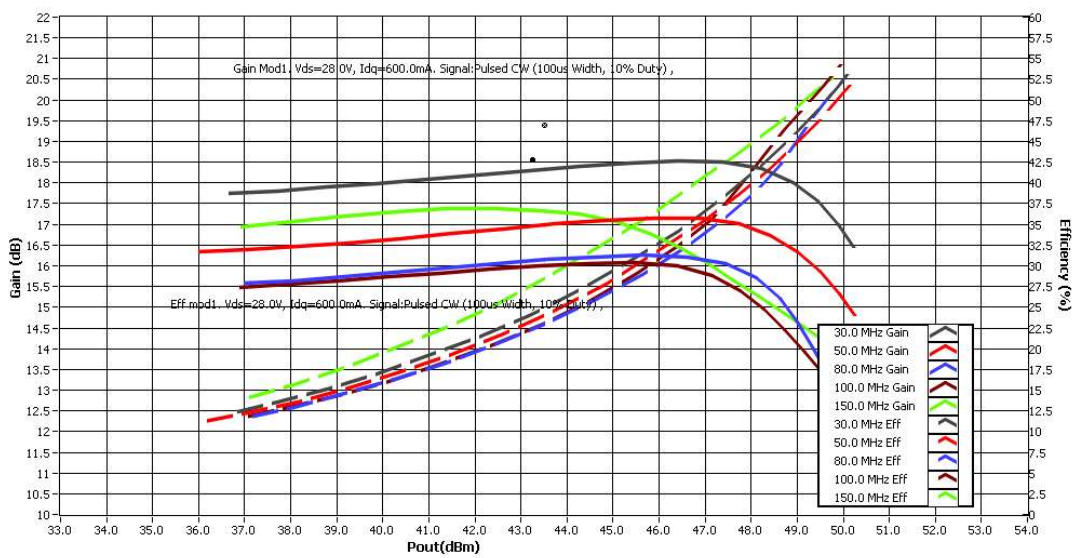


Figure 3. Pulse Gain(dB),Eff(%) vs Power Out(dBm),10% duty

High Frequency Range

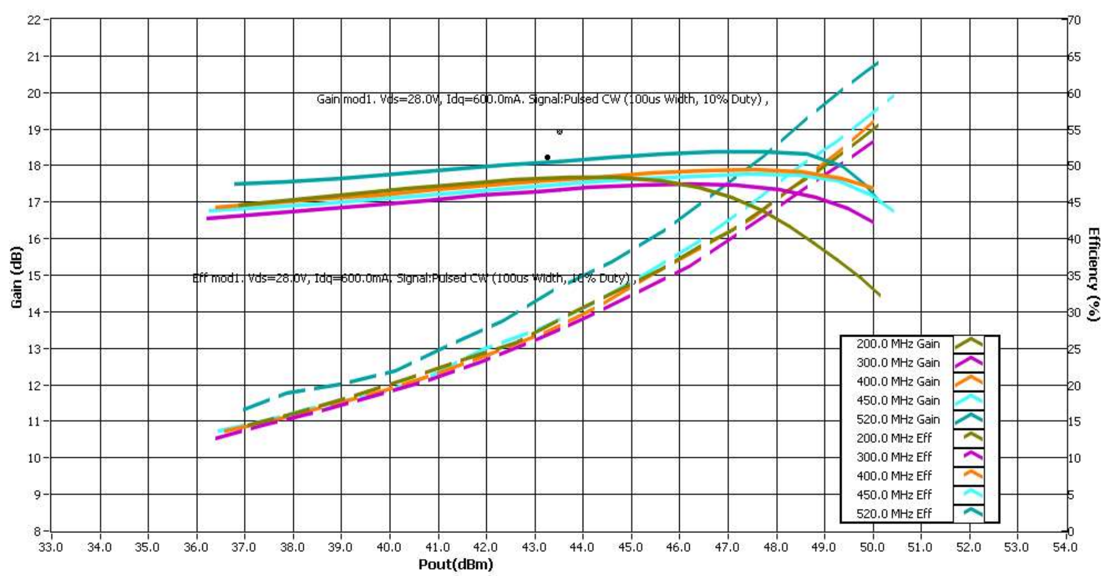


Figure 4.Pulse Gain(dB),Eff(%) vs Power Out(dBm),10% duty

9.3 CW Gain, Efficiency vs Pout and Frequency

Vdd=28V, Idq=600mA, , Low Frequency Range

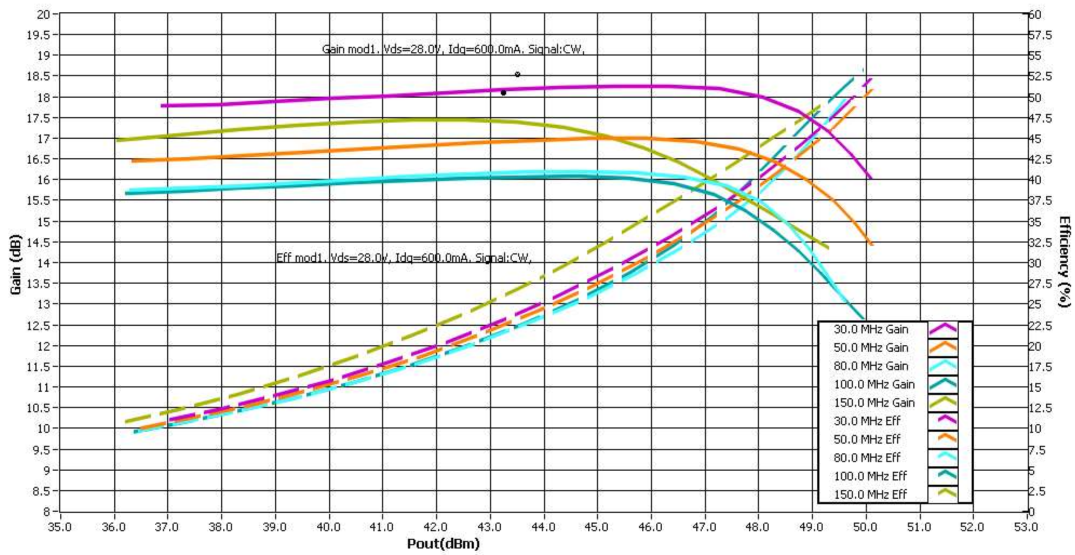


Figure 5. CW Gain(dB),Eff(%) vs Power Out(dBm)

High Frequency Range

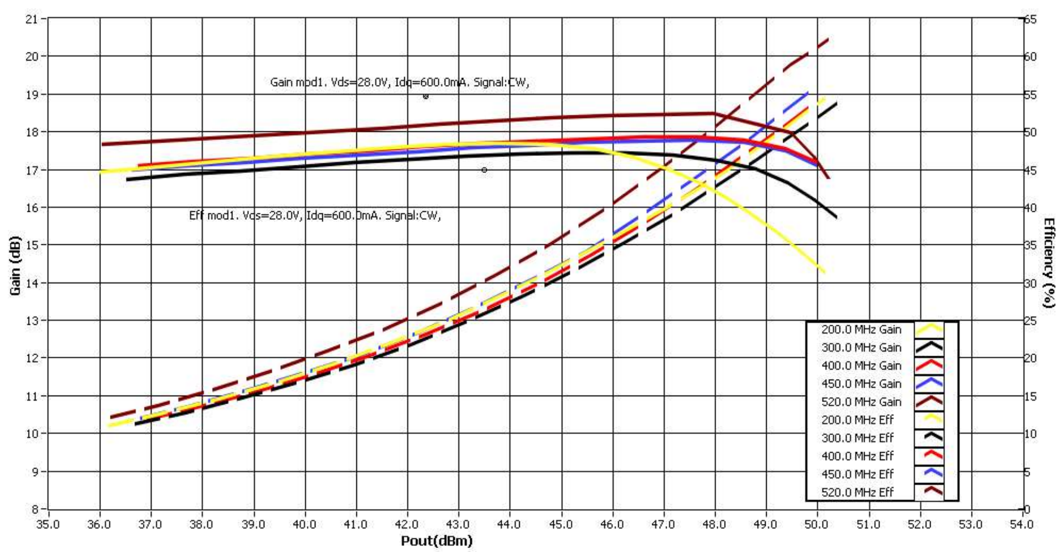


Figure 6.CW Gain(dB),Eff(%) vs Power Out(dBm)

9.4 Performance at Fixed Power Output

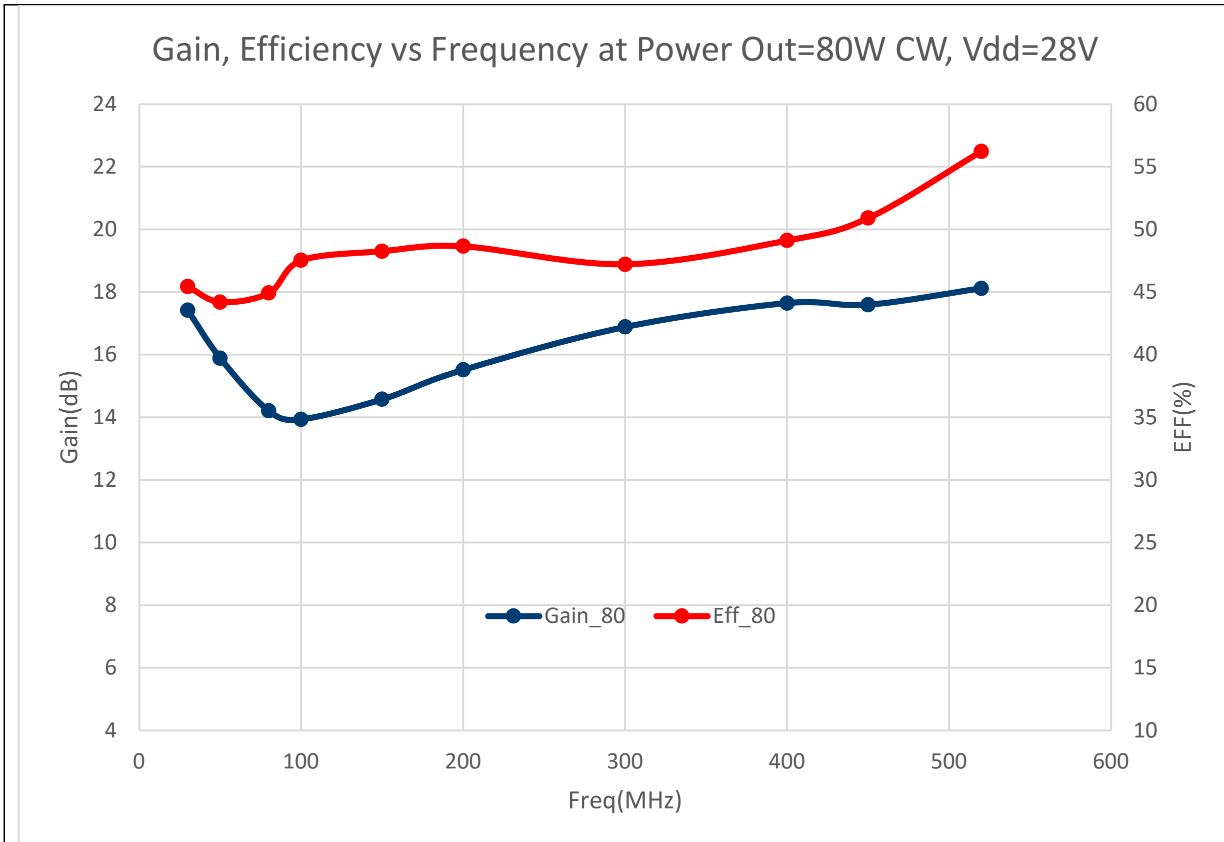


Figure 7. Gain(dB),Eff(%) vs Freq(MHz)

9.5 Performance at Fixed Power Output

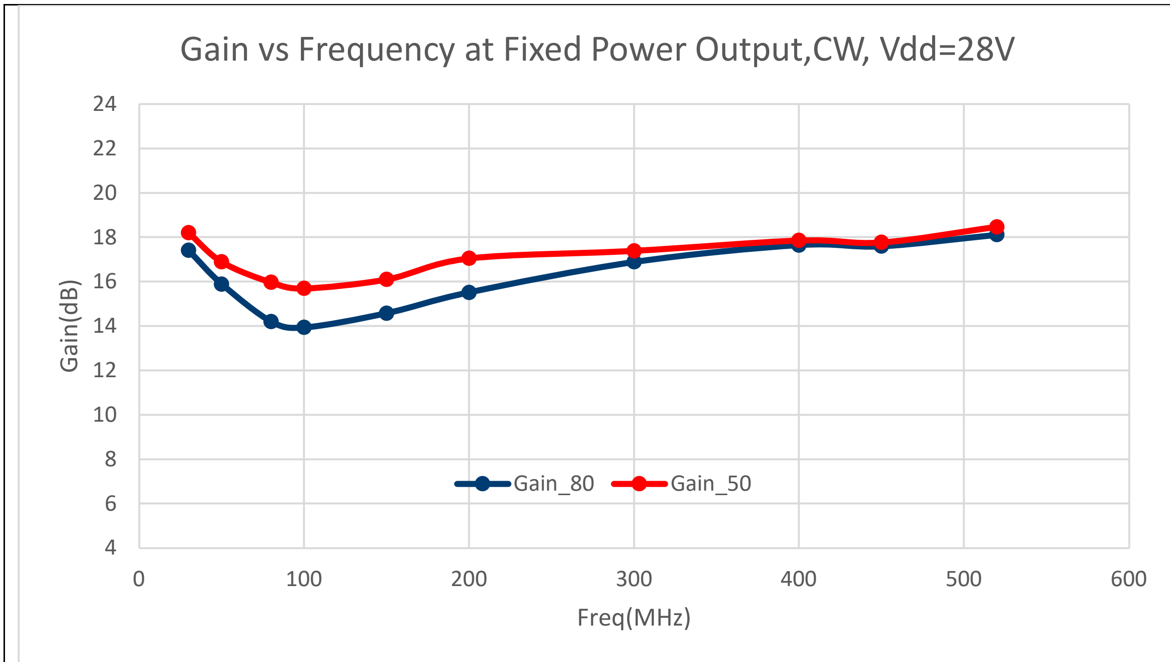


Figure 8. Gain(dB) vs Freq(MHz)

9.6 P1,P2,P3dB vs Frequency

CW P1, P2, P3dB, Vdd=28V, Idq=600mA

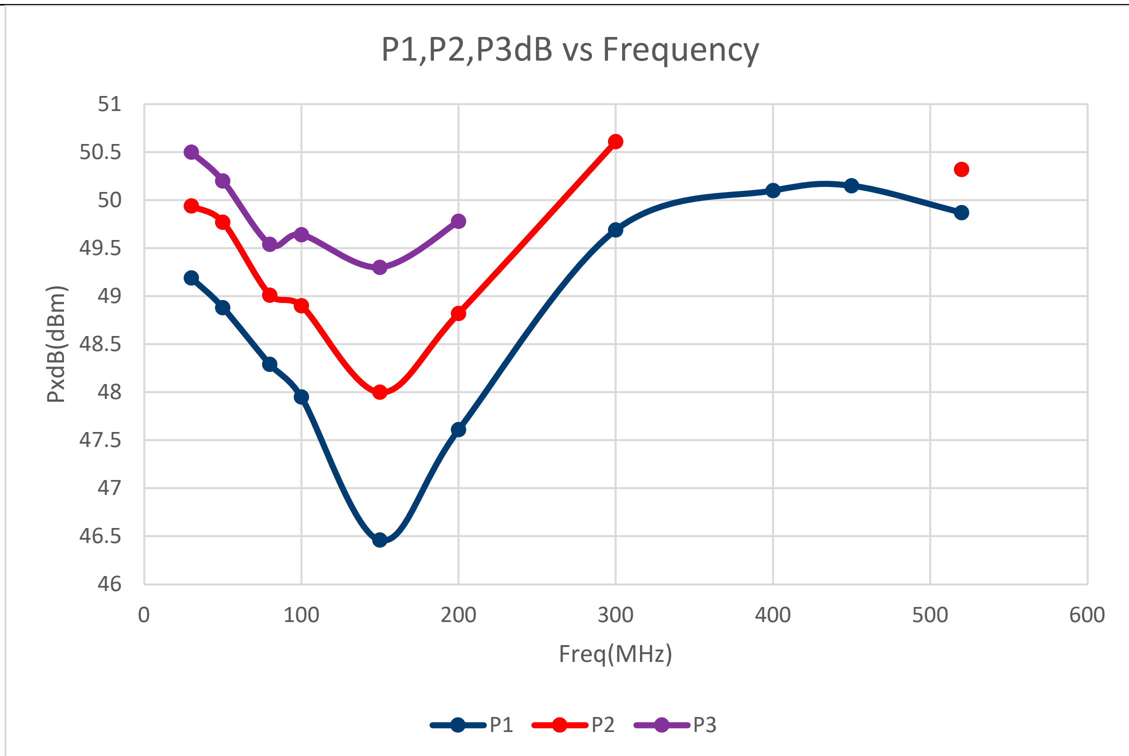


Figure 9. P1,P2,P3dB vs Freq(MHz)

9.7 IMD Data vs Pout and Frequency

Worst Case IMD3, Tone Spacing =100kHz

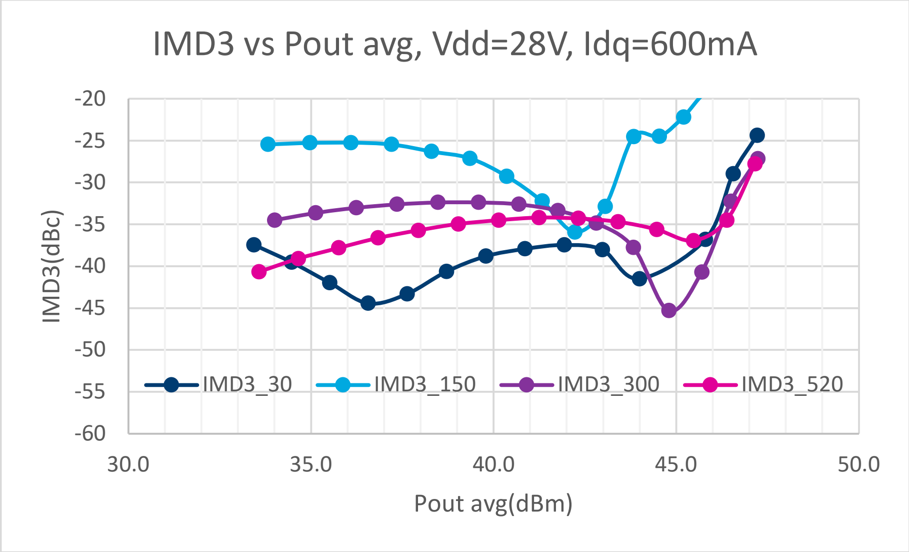


Figure 10. IMD(dBc) vs Power Out Average(dBm)

Worst Case IMD5

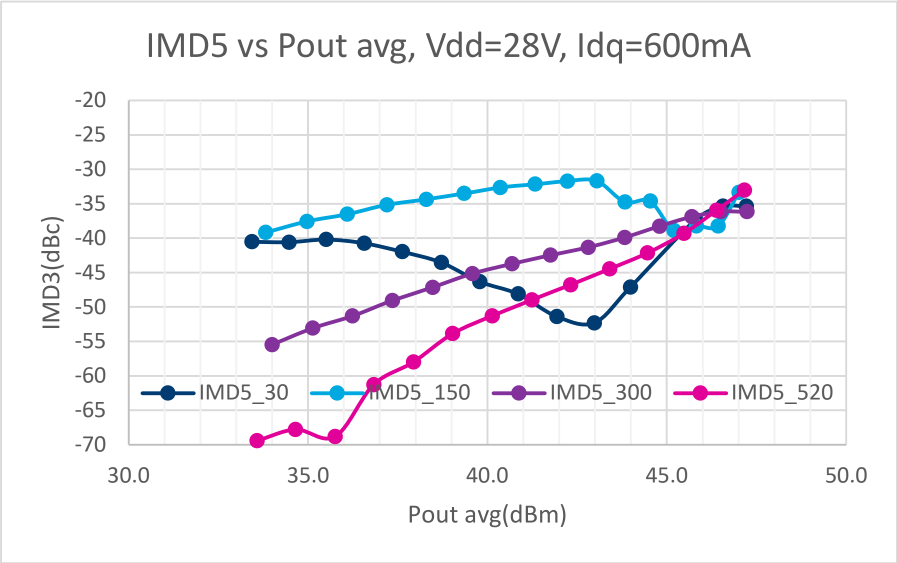


Figure 11. IMD(dBc) vs Power Out Average(dBm)

9.8 Simulated Results

Circuit Simulation with Ideal Transformers, Vdd=28V, Idq=600mA

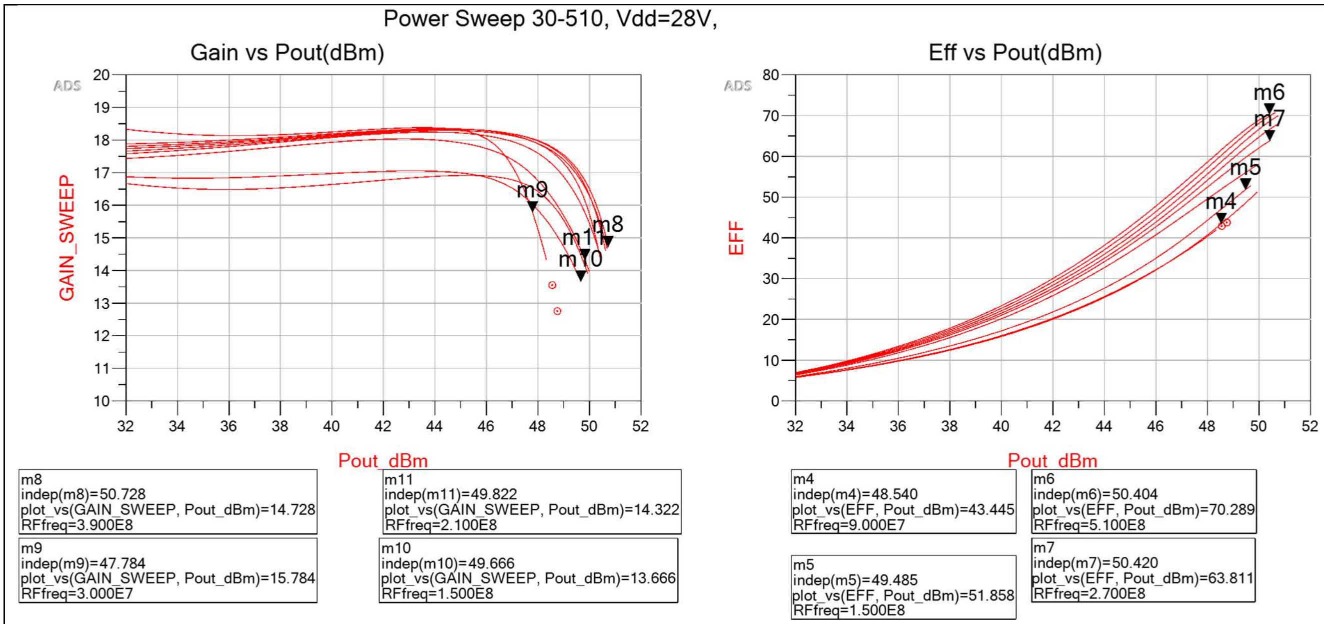


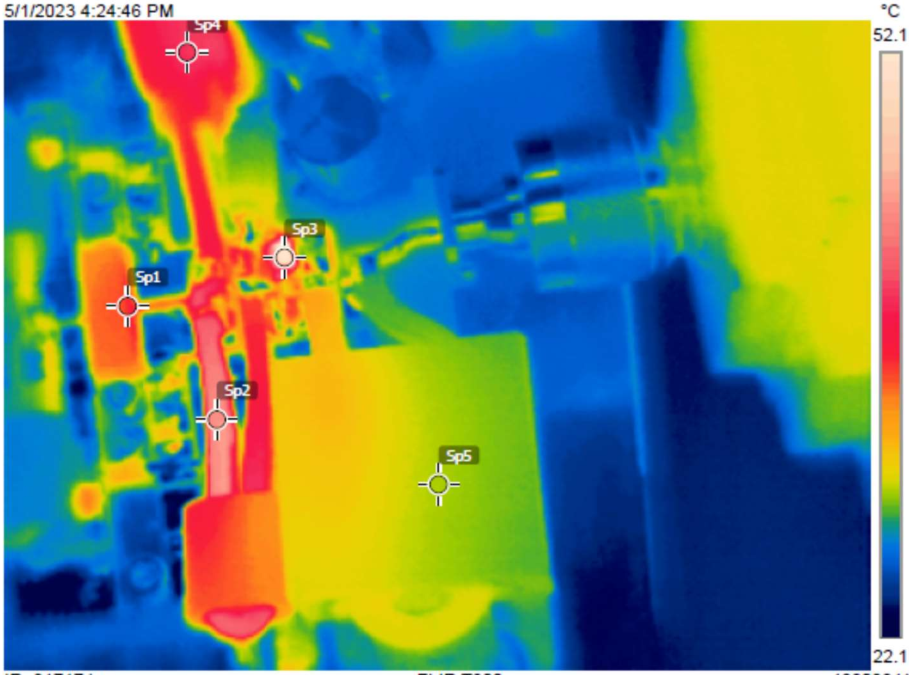
Figure 12. Gain, Eff(%) vs Power Out(dBm)

9.9 IR Scan Results

BLF944P in Bd 232026, Vdd=28V, Idq=600mA, CW

Board232026, Pout=90W CW, Vdd=28V, Freq=520MHz

5/1/2023 4:24:46 PM



IR_81717.jpg FLIR T300 48803811

Measurements

Sp1	37.0 °C
Sp2	44.9 °C
Sp3	53.6 °C
Sp4	40.5 °C
Sp5	30.3 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Figure 13. IR Scan

10 Hardware

10.1 Board photographs

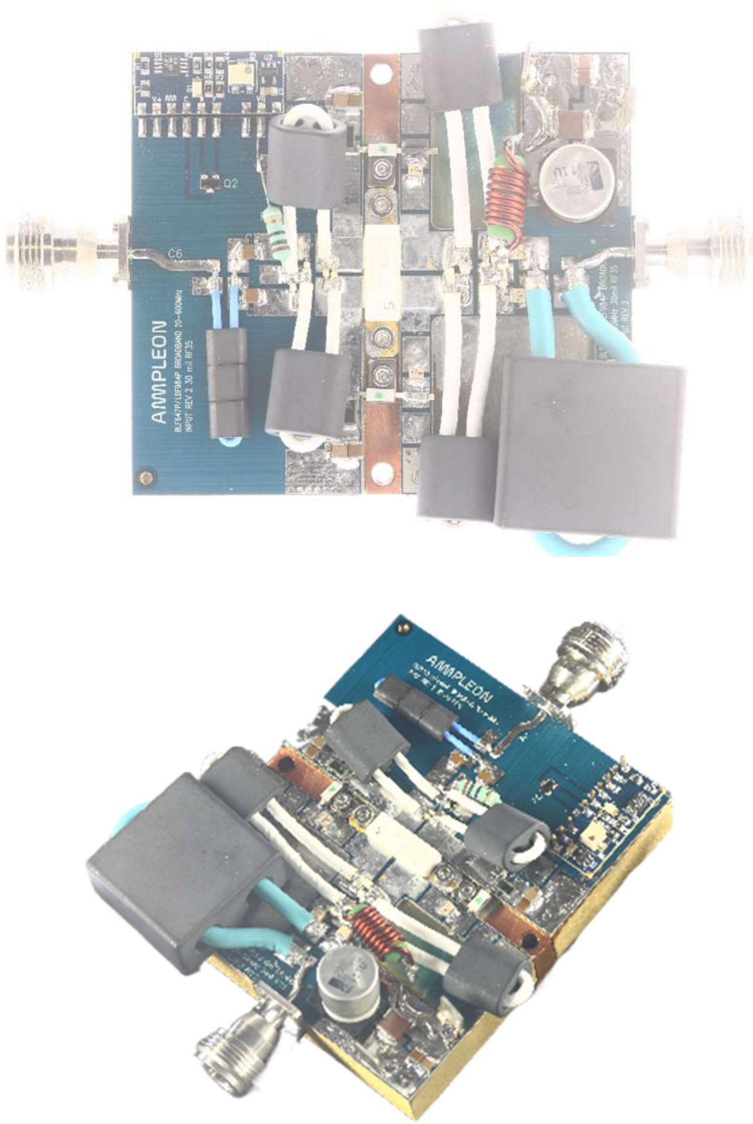


Figure 14. Board Photograph

10.2 PCB layout

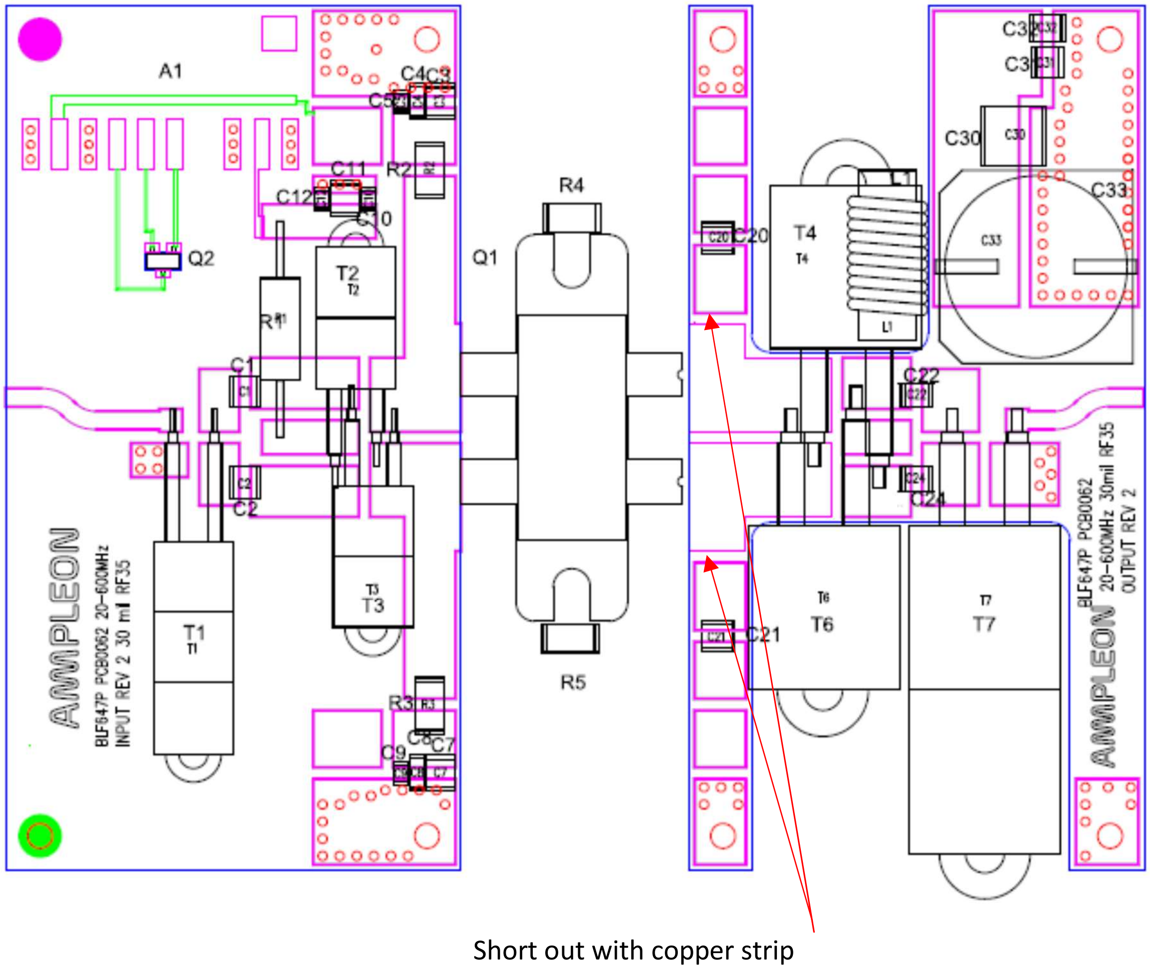


Figure 15.PCB Layout

10.3 Bill of materials

Table 3. BOM

Designator	Description	Manufacturer	Part#
PCB Input PCB	Input PCB, 30mil thk. RF35	Avanti Circuits	PCB00062 Input Rev2
PCB Output PCB	Output PCB, 30 mil thk. RF35	Avanti Circuits	PCB00062 Output Rev2
A1	LDMOS bias module	Ampleon	CA-330-11
Q1	RF Transistor	Ampleon	BLF944P
Q2	2N2222 NPN Transistor	Fairchild	MMBT2222
R1	10Ω 0.5W5%	Generic	
R2, R3	20 Ω 5%	IMS	NADC-2010WA20R0J
R4,R5	20W 200Ω Flange mount	ATC	FR10300N0200J
R6	10 Ω 3W	Generic	
L1	8 turn 18AWG wrapped onto R6	Internal	
C5, C9, C12	100nF, 50V 10% X7R, 0805	Generic	
C1,C2,C3, C7, C11,C31	4.7nF,100V 5% NPO, 1210	Generic	
C4,C8,C10	10uF,100V 10% X7R, 1206	Generic	
C32	100nF,100V 10% X7R, 1210	Generic	
C30	10uF, 100V 10% X7S, 2220	TDK	C5750X7S2A106M
C22,C24	510pF, 500V 5%	Passive Plus or ATC	1111N or 100B
C20,C21	1000pF	Passive Plus or ATC	1111N or 100B
C23,C25	DNP		
C33	220uF, 50V, alum electrolytic	Generic	
T1	1:1 Input Balun	Pasternack	55mm PE-P047 50 flexible ohm coax + (3)
		Fair-Rite	Fair-Rite 2861002402 cores
T2, T3	4:1 input transformer	PCS	60mm TF-25 25 ohm flexible coax
		Fair-Rite	+1 Fair-Rite 2861000202 core each
T4, T6	4:1 output transformer	Micro Coax	3.5” UT-0C-18 18 ohm coax
			+1 Fair-Rite 2861000202 core each
T7	1:1 output balun w 1 core	Micro Coax	4.1” UT-141 50 ohm coax
		Fair-Rite	with one BN-61-002 core

10.4 PCB materials

Table 4. Board Specifications

Parameter	Value
Manufacturer	Taconic
Type	RF35
Thickness	30 mils, 1oz. copper
Layers	2, top/bottom. Bottom all copper

10.5 Device markings

Table 5. Device Specifications

Parameter	Value
Manufacturer	Ampleon
Device	BLF944P
Date Code	M2304

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