AR212058

BLP15H9S30, 30-600 MHz

AMPLEON

V2.0 — 27 April 2022

Application Report

Document information

Info	Content
Status	General Publication
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Abstract	Measurement results of BLP15HS30 LDMOS devices in board #AR212058 tested over 30-600MHz at 35-50V

1 Revision History

Table 1. Report revisions

Revision No.	Date	Description	Author
1.0	20210525	Initial document	Bill Goumas
2.0	20220427	Changed to General Publication	Bill Goumas

2 Contents

3 List of Figures

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5 General Description

This report presents the measurement results of the Class AB Demo board AR212058. The devices used are a pair of BLP15H9S30s in push-pull. The BLP15H9S30 is a Gen9 30W LDMOS device in an overmolded plastic package.

An off the shelf SMT balun from Minicircuits is used on the input with a coax balun on the output.

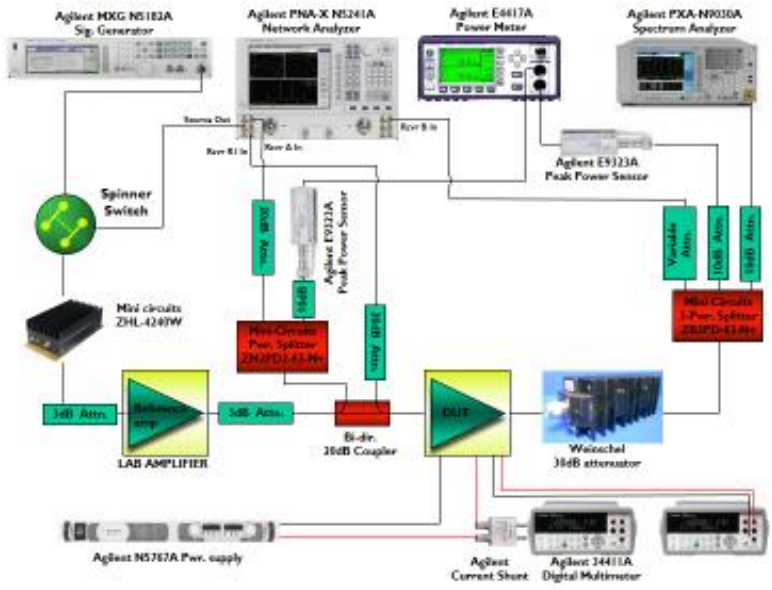
6 Biasing

6.1 Bias Details

For Vdd =40 , Vgs~2.0-2.2 V for Idq =100mA per side set with via the pot on the bias board.

7 Test Bench Set Up

Figure 1.Test Bench Equipment set up



8 Summary

Customer has application for Broad Band Low Power Amp over 30-520MHz. A compact footprint is required. This demo has the RF portion at ~2 x 1.25”, with overall size of ~3 x 1.57”.

Table 2. RF Performance Vdd=35V, Idq=100mA per side

Symbol	Parameter	Range	Unit
Freq.	Frequency Range	30-520	MHz
P1dB	Power at 1dB Gain Compression	>23	W
$\underline{Eff.}_{@18W\ 30\text{-}520MHz}$	Efficiency	>37	%
$\underline{Eff.}_{@40W\ 290\text{-}320MHz}$	Efficiency	>47	%
$\underline{G_{min.}}_{@18W\ 30\text{-}520MHz}$	Minimum Gain	>15	dB
$\underline{G_{min.}}_{@40W\ 290\text{-}320MHz}$	Minimum Gain	>17	dB
$IMD3_{,}$	IMD3at Power Out=20W PEP,	<-32	dBc
$IMD3_{290\text{-}320MHz}$	IMD3 at Power Out=40W PEP	<-29	dBc

All IMD data is with 10kHz tone spacing.

Results and Comments:
At 50V, P1dB is >50W
Sweet spot is 36-40V for meeting requirements at 18W out broadband and 35W narrow band.

Roll-off near 500MHz
Need to see if LC network on output will improve P1dB and Eff at 500-520MHz

Thermal:
Transistors are < 75°C up to Pout=40W average at 300MHz
Balun may need to be beefed up- RF cable or Ferrite for narrow band higher power operation >30W.
Worst case temperature at Pout=40W CW is <90°C
At Pout=20W CW, Transistors are <65°C, Balun is <60°C

9 Performance Details

9.1 Small Signal Results

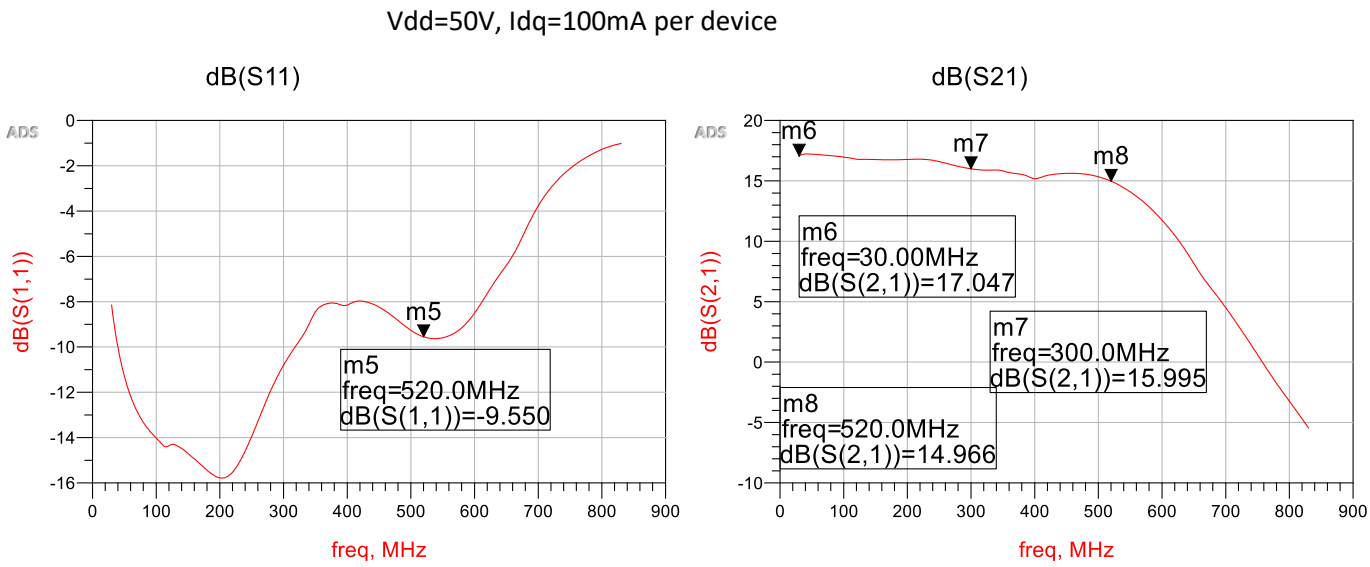


Figure 2. Small Signal Data, V_{dd}=50V, Idq=100mA per device, Pin=10dBm

9.2 Pulse Gain, Efficiency vs Pout and Frequency,

Vdd=50V, Idq=100mA per side, 10% Duty Cycle, PW=100usec

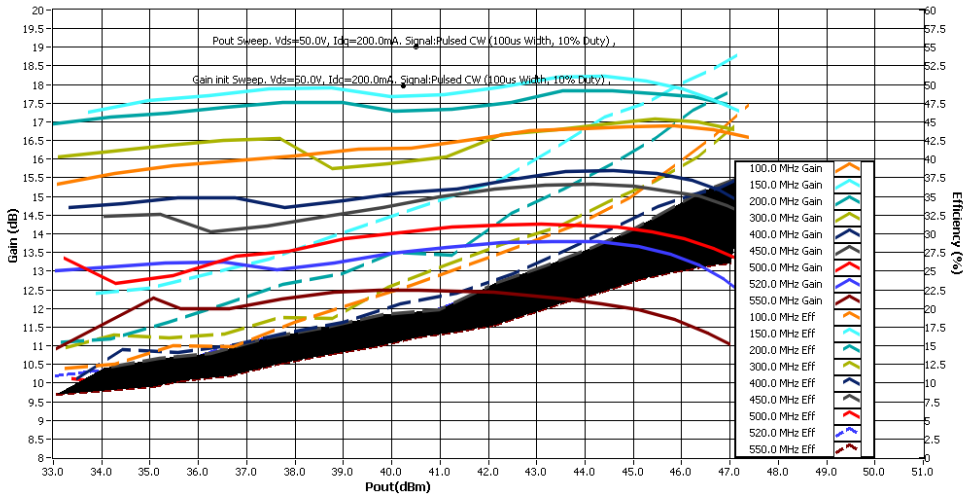


Figure 3. Pulse Gain(dB),Eff(%) vs Power Out(W),10% duty

Vdd=40V, Idq=100mA per side, 10% Duty Cycle

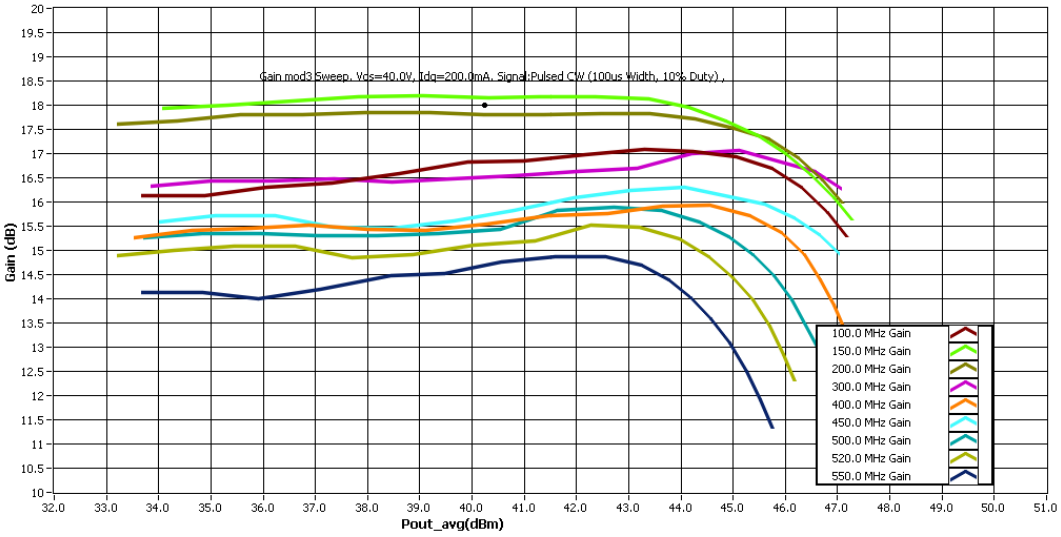


Figure 4. Gain(dB),Eff(%) vs Power Out(dBm),10% duty

9.3 Pulse Gain, Efficiency vs Pout and Frequency,

Vdd=35V, Idq=100mA per side, 10% Duty Cycle, PW=100usec Narrow Band at 300MHz

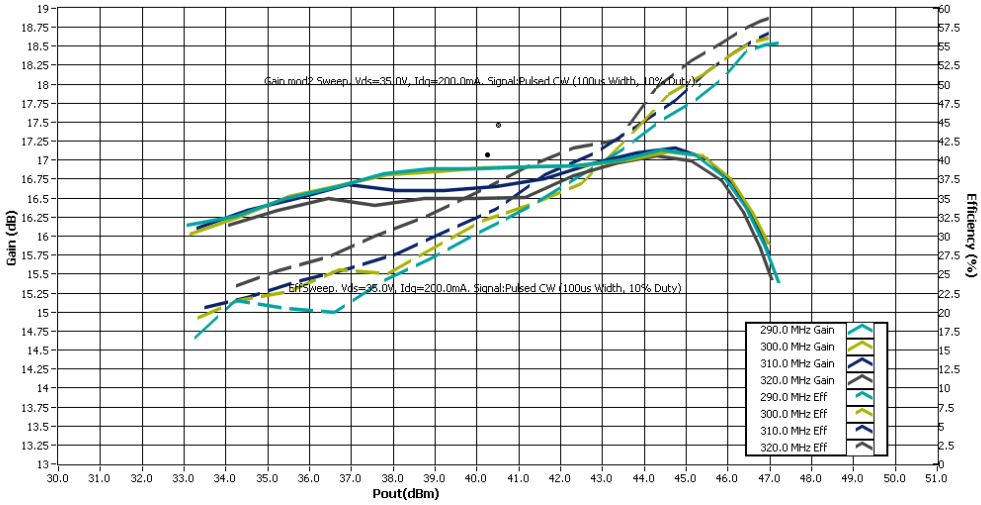


Figure 5. Pulse Gain(dB),Eff(%) vs Power Out(W),10% duty

Vdd=35 and 40V, Idq=100mA per side, 10% Duty Cycle, PW=100usec Low Freq range

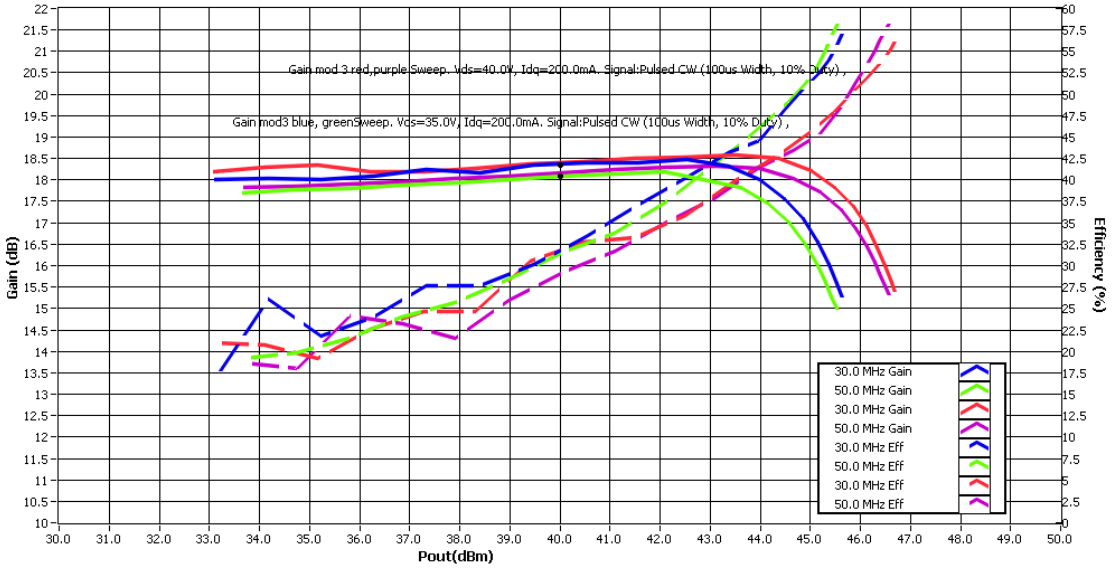


Figure 6. Gain(dB),Eff(%) vs Power Out(dBm),10% duty

9.4 IMD Data

IMD3 vs Power Out(avg)Vdd=40V, Idq=100mA per side

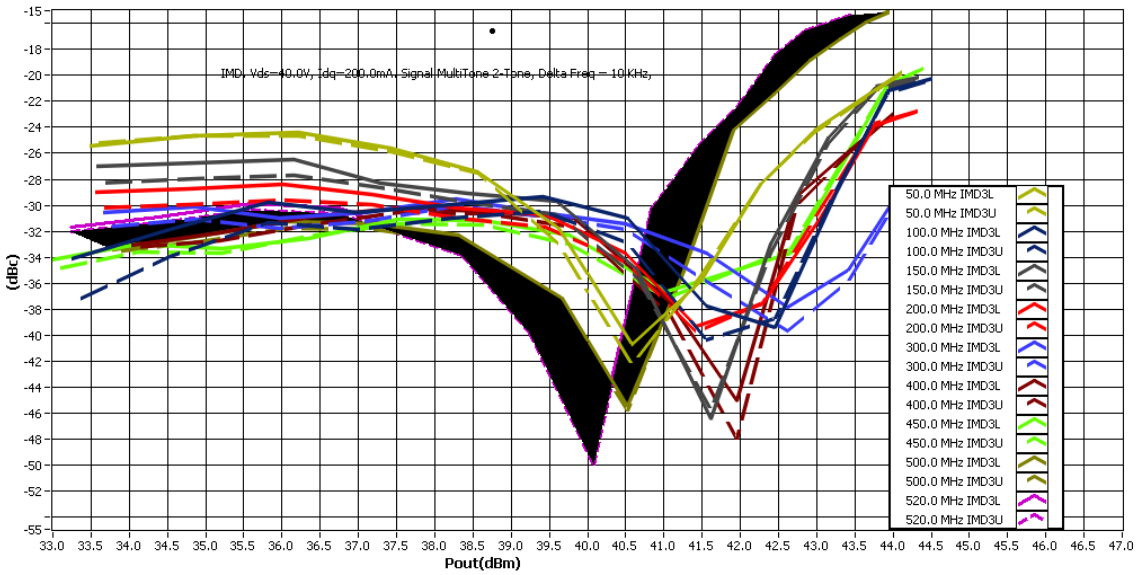


Figure 7. IMD3dBc) vs Avg. Power Out(dBm)

IMD3 vs Pout(avg) Vdd=35V, Idq=100mA per side

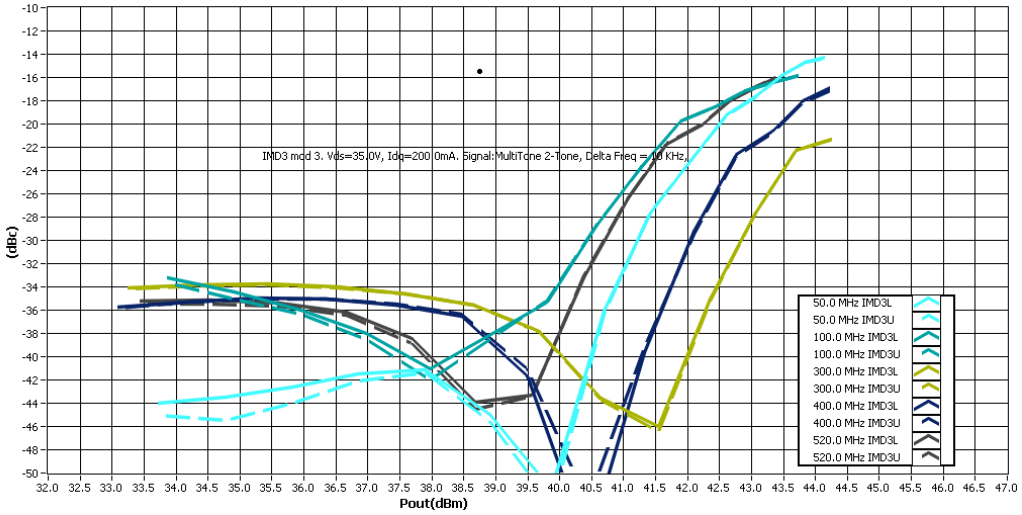


Figure 8.IMD3(dBc) vs Avg. Power Out(dBm)

9.5 IMD3 Data, Sweep Idq, Freq=300MHz

Vdd=35V, Idq per side=50mA(purple), 100mA(blue), 200mA(black

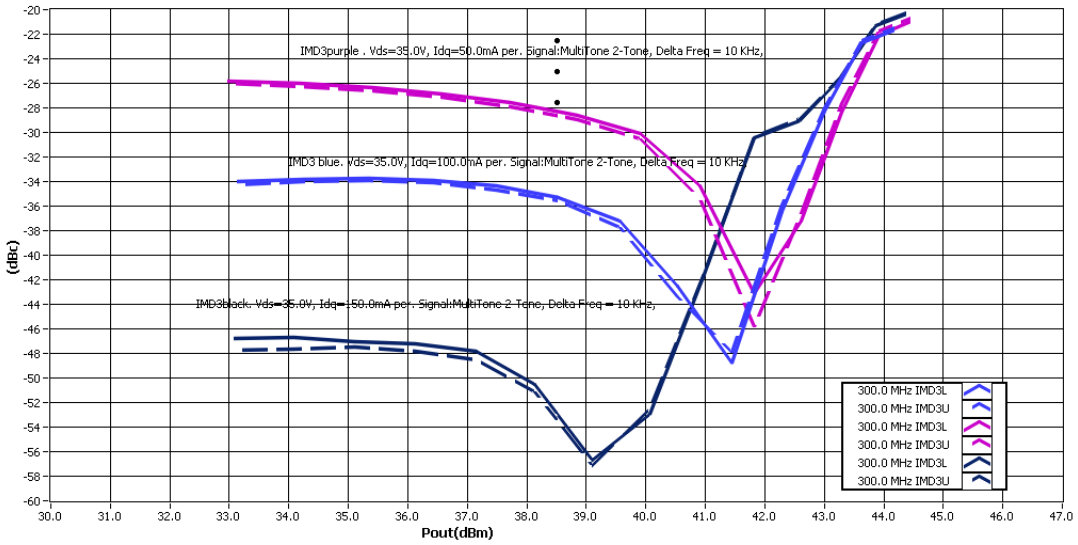


Figure 9. IMD3(dBc) vs Avg. Power Out(dBm)

9.6 Performance at Fixed Power Output and P1dB

Sweep Vdd Red, Purple=40V, Blue and Black=35V, Idq=100mA per device

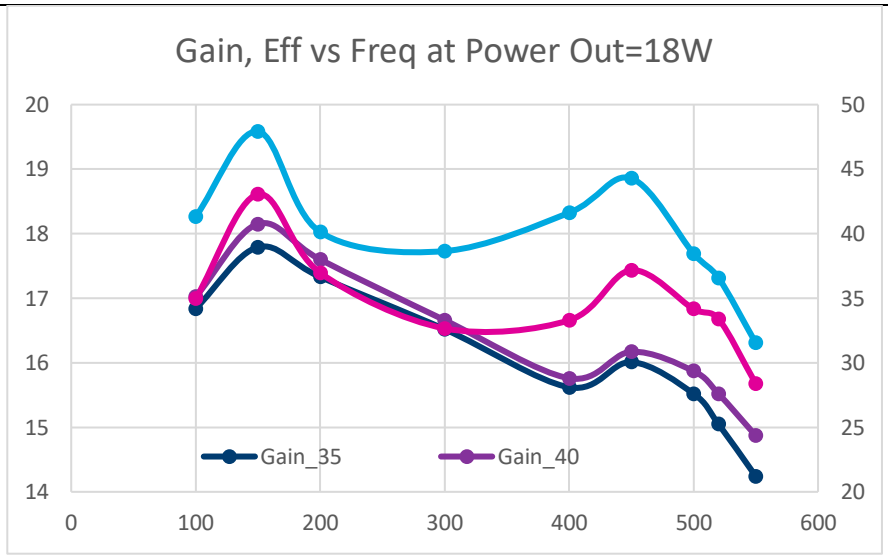


Figure 10. Gain(dB), Eff(%) vs Freq(MHz) at Pout=18W

P1dB vs Frequency, Vdd=35V(blue), Vdd=40V(red), Idq=100mA per side

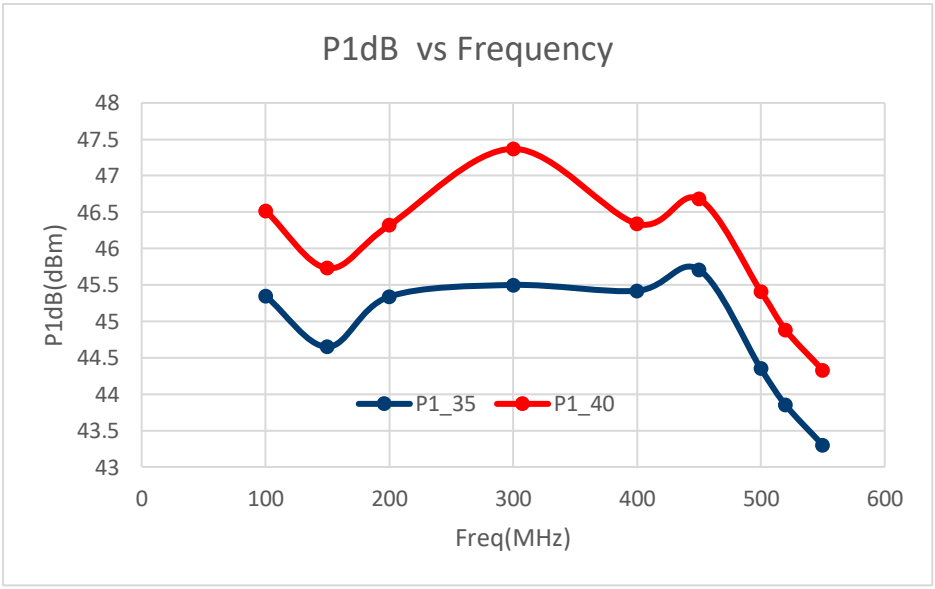


Figure 11. P1dB(dBm) vs Freq(MHz)

9.7 IR SCAN

Vdd=40V, Idq per side=50mA(purple)

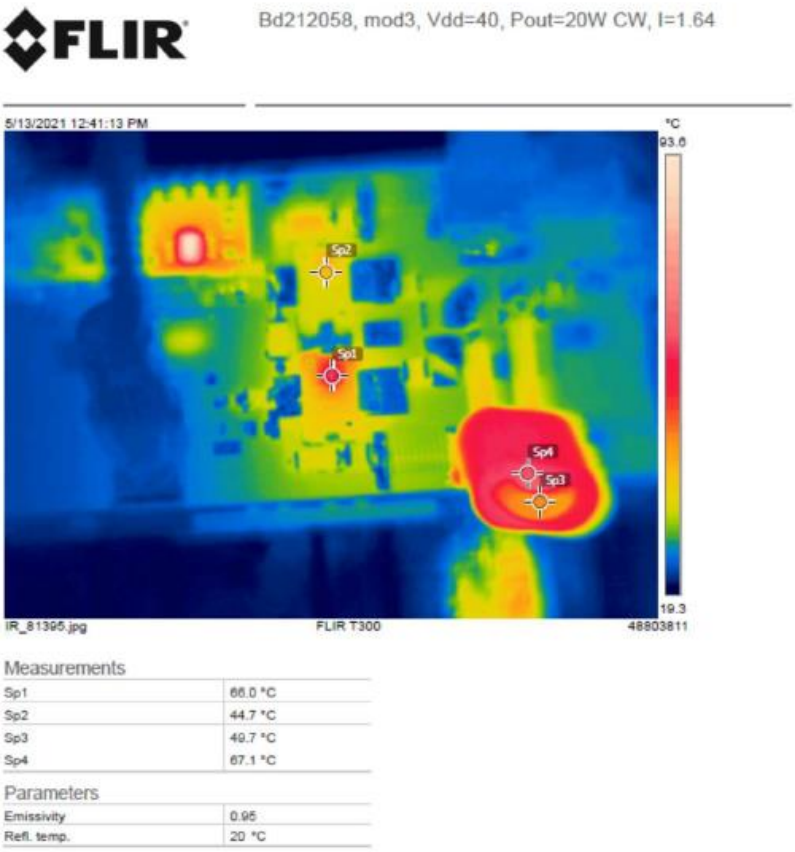


Figure 12. IR Scan Results, Pout=20W CW, Freq=300MHz

10 Hardware

10.1 Board photograph

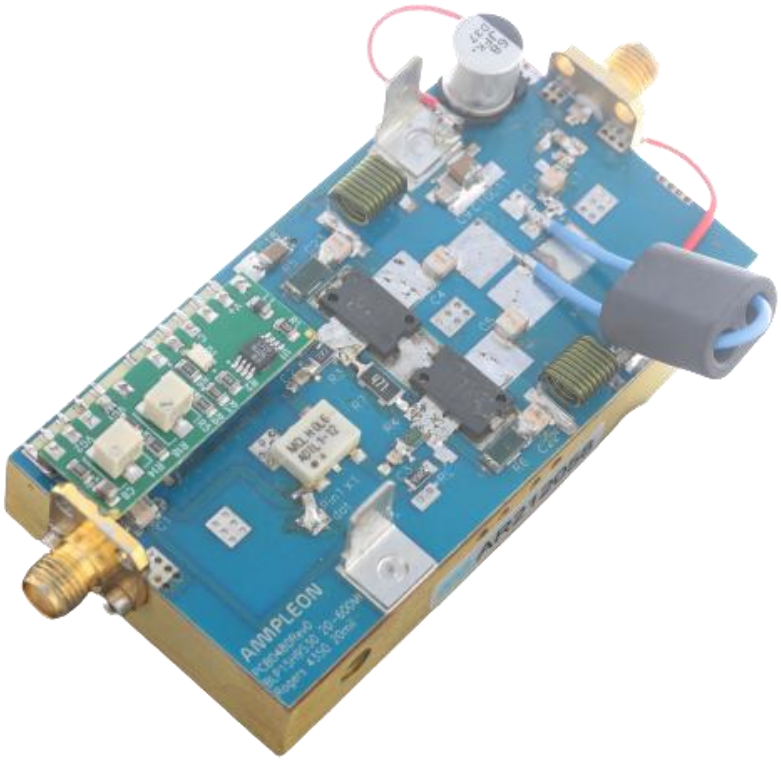


Figure 13. Board Photograph

10.2 PCB layout

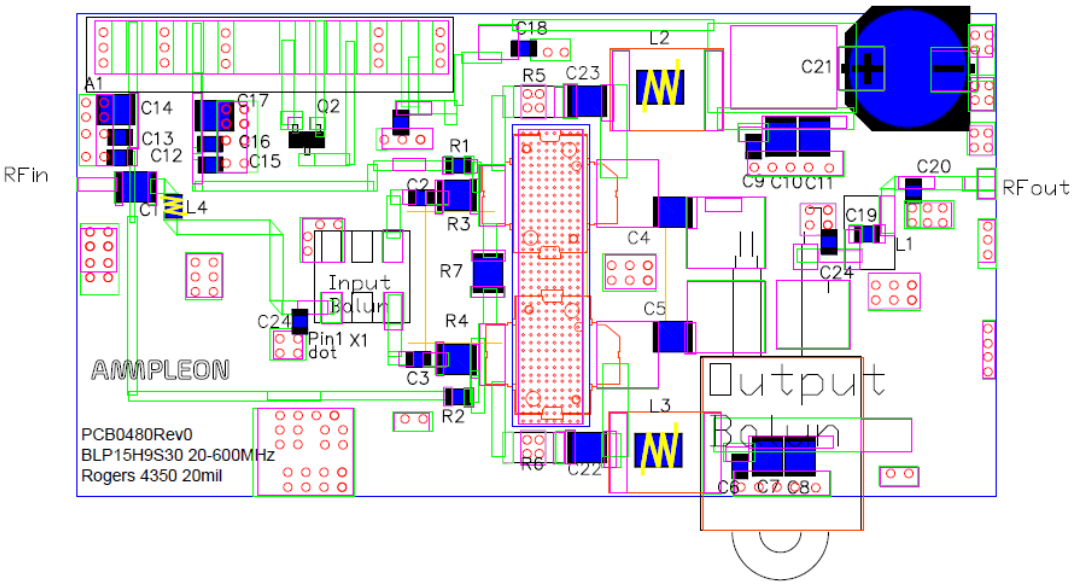


Figure 14.PCB Layout

10.3 Bill of materials

Table 3. BOM

Designator	Description	Manufacturer	Part#
PCB	20mil thk. Rogers 4350	Avanti Circuits	PCB0480 Rev 0
U1	LDMOS Dual bias module	Ampleon	
Q1,Q3	RF Transistor	Ampleon	BLP15H9S30
2N2222	2N2222 NPN Transistor	Fairchild	MMBT2222
X1	Input Balun	Minicircuits	ADTL1-12+
R1,R2	50 Ω	Generic	1206
R3,R4	2Ω	Generic	1210
R5,R6	500 Ω	Barry	RYC2010CT-5000JN-2T
R7	50 Ω	Generic	2512
L2,L3	160nH	Coilcraft	2222SQ-161
L4	12nH	Coilcraft	0805CS-120
C1,C4,C5,C22,C23	1000pF	Passive Plus or ATC	1111N or 100B
C2,C3	240pF	Passive Plus or ATC	600F
C6,C9	39pF	Passive Plus or ATC	600F
C7, C10	0.01uF,100V,X7R,1206	Murata	GRM319R72A103KA01D
C8,C11	10uF, ceramic, 50V, ±10%	Murata	GRM55DR61H106KA88L
C12,C15,C11A	220pF	Passive Plus or ATC	600F
C13,C16,C21,C22	0.01uF,100V,X7R,1206	Murata	GRM319R72A103KA01D
C14,C17,C18	1uF, ceramic, 50V, ±10%	Murata	GRM31CR71H105K
C21	68uF, 63 V electrolytic SMT	Panasonic	EEE-FK1J680UP
C19	1000pF on side	Passive Plus or ATC	1111N or 100B
C24input	3pF	Passive Plus or ATC	600F
X2	1:1 output balun w 1 core	Pasternack	2.5” PE-P047 50 flexible ohm coax
		Fair-Rite	with one 2861000202 core

10.4 PCB materials

Table 4. Board Specifications

Parameter	Value
Manufacturer	Rogers
Type	4350
Thickness	20 mils, 1oz. copper
Layers	2, top/bottom. Bottom all copper

10.5 Device markings

Table 5. Device Specifications

Parameter	Value
Manufacturer	Ampleon
Device	BLP15H9S30
Date Code	M2015

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