AR212005

BLP15H9S100 30-900MHz

AMPLEON

V2.0 — 22 April 2022

Application Report

Document information

Info	Content
Status	General Publication
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Abstract	Measurement results of the BLP15H9S100 LDMOS Device Measured at 50V over 30-900MHz

1 Revision History

Table 1. Report revisions

Revision No.	Date	Description	Author
1.0	20210208	Initial document	Bill Goumas
2.0	20220422	Changed to General Publication, fixed typos	Bill Goumas

2 Contents

3 List of Figures

4 List of Tables

5 General Description

This report presents the measurements of BLP15H9S100 in board AR212005. The board has been tested over 30-900 MHz at 50V.

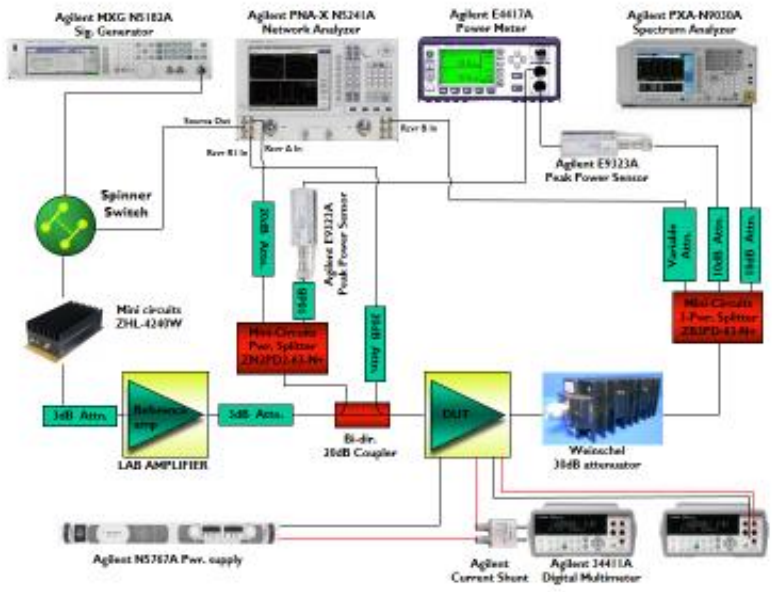
6 Biasing

6.1 Bias Details

Idq is set via the pot on the bias board.
For Vdd =50, Vgs~2.1 V for Idq =300mA.

7 Test Bench Set Up

Figure 1.Test Bench Equipment set up



8 Summary

Customer is interested in Max power over 30-1000MHz and beyond. Initial design is based on IPP-5014 as the key broadband matching element. The IPP-5014 is a broadband 12 Ω to 50 Ω transformer.

Circuit performance rolls off above ~600MHz with just the transformer used as the matching element. Adding a Pi Network on the output can extend the response to ~850-900MHz. Further modifications will be done to try and extend the performance as high as possible. The goal is P3dB=80W(49dBm) CW up to 1GHz The model predicts good response to 1000MHz but this does not appear to be achievable based on all measurements to date. 80W up to ~850-900MHz may be the limit.

Some of the rolloff is due to the increased loss in the transformer. This is shown in Section 10. IR Scans in section 11 also show that the transformer loss is starting to be excessive. The transformer is 15 °C hotter at 800MHz vs 700MHz with less power output.

Output Pi network changed to 1.5pF, 8nH and 0 pF. For best response 30-500MHz, the Pi network is not used

Table 2. RF Performance Vdd=50V, Idq=300mA, CW

Symbol	Parameter	Range	Unit
Freq.	Frequency Range	50-500	MHz
Compr	Gain Compression at Pout=80W	<1.5	dB
$Eff._{@80W}$	Efficiency	40-62	%
$G_{min.@80W}$	Minimum Gain	16.5	dB
$G_{flatness@80W}$	Gain flatness	+/- 1.5	dB

Table 3. RF Performance Vdd=50V, Idq=300mA, CW, High Frequency

Symbol	Parameter	Range	Unit
Freq.	Frequency Range	550-800	MHz
$Eff._{@75W}$	Efficiency	>37	%
$G._{@75W}$	Gain	>11.5	dB

9 Performance Details

9.1 Small Signal Results

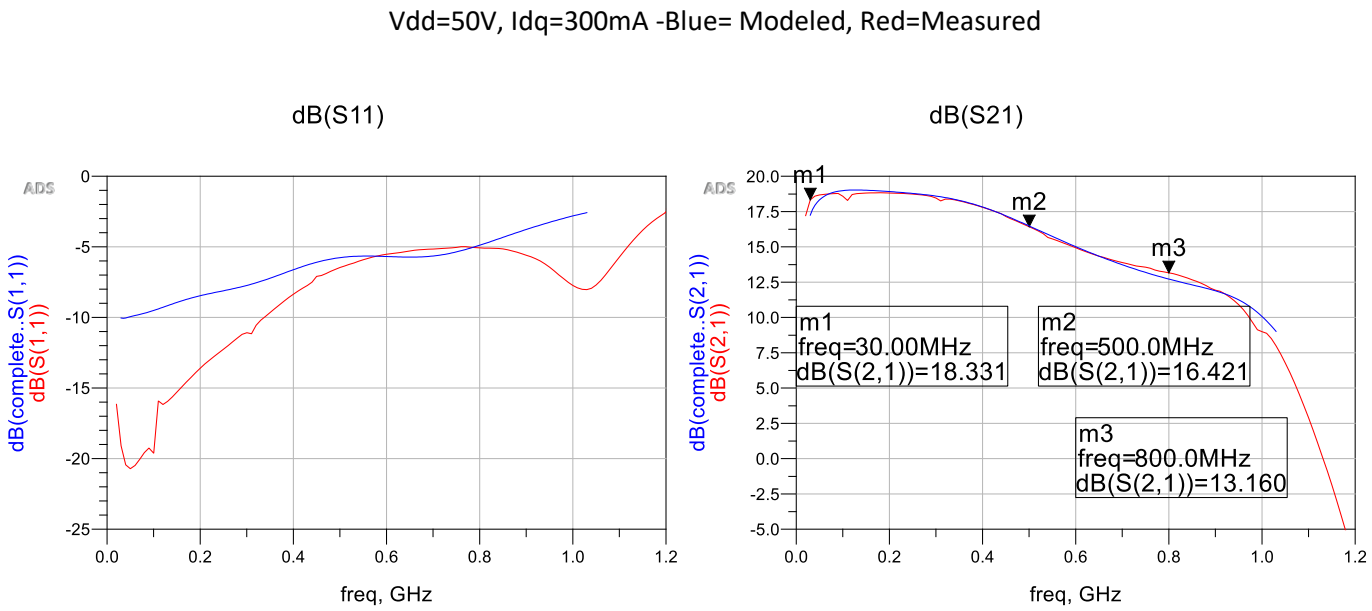


Figure 2. Small SIgnal Data, Vdd=50V, Idq=300mA

9.2 Pulse Gain, Efficiency vs Pout

Vdd=50V, Idq=300mA

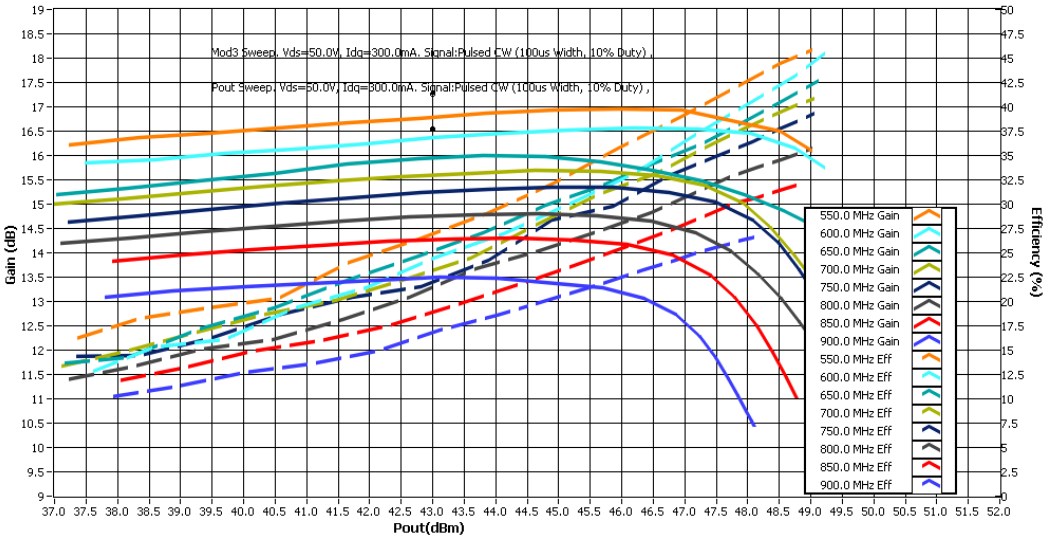


Figure 3. Gain(dB), EFF(%) vs Power Out(dBm)

9.3 CW Gain, Efficiency vs Pout

Vdd=50V, Idq=300mA

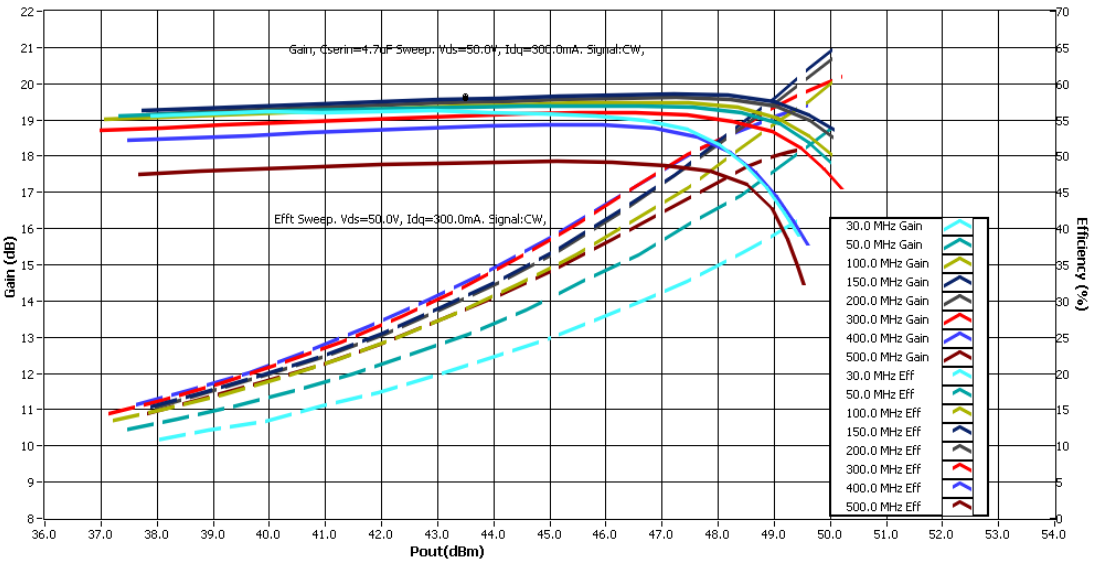


Figure 4. Gain(dB), EFF(%) vs Power Out(dBm)

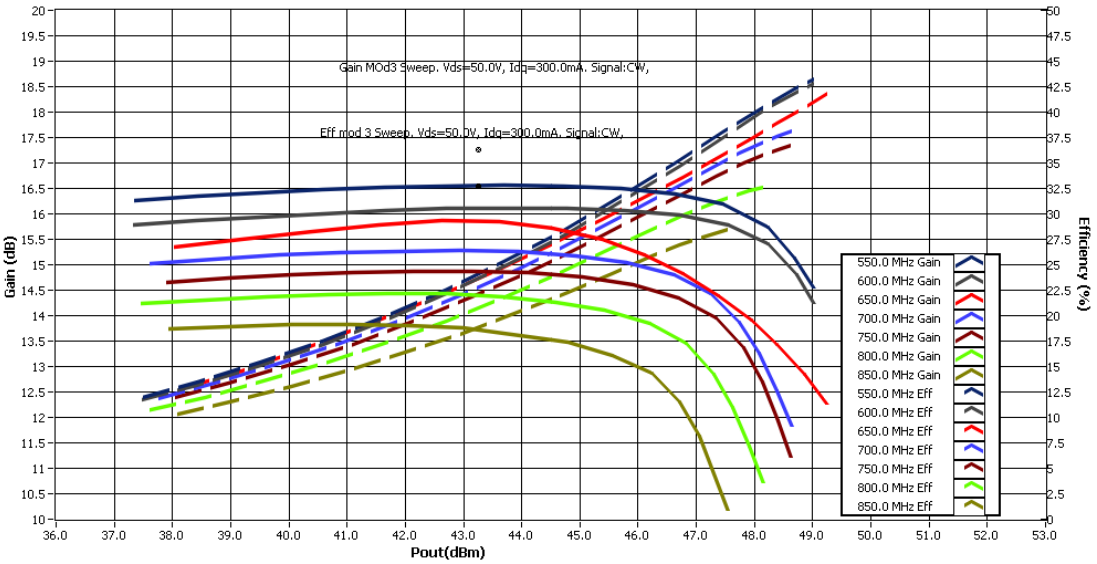


Figure 5. Gain(dB), EFF(%) vs Power Out(dBm)

9.4 P1, P3 vs Frequency

P1,P3 (dBm) vs Frequency, Vdd=50V, Idq=300mA

Optimized for 30-500MHz range

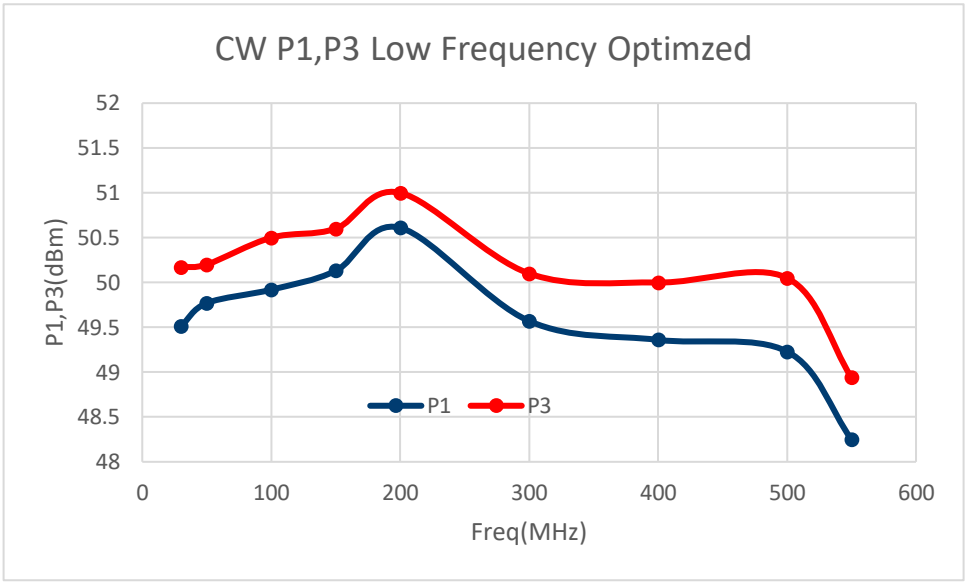


Figure 6. P1,P3(dBm) vs Freq(MHz)

9.5 Performance at Fixed Power Output

Gain(dB) vs Frequency, Power Out=80W CW,Vdd=50V, Idq=300mA

Gain(black), Efficiency(red)

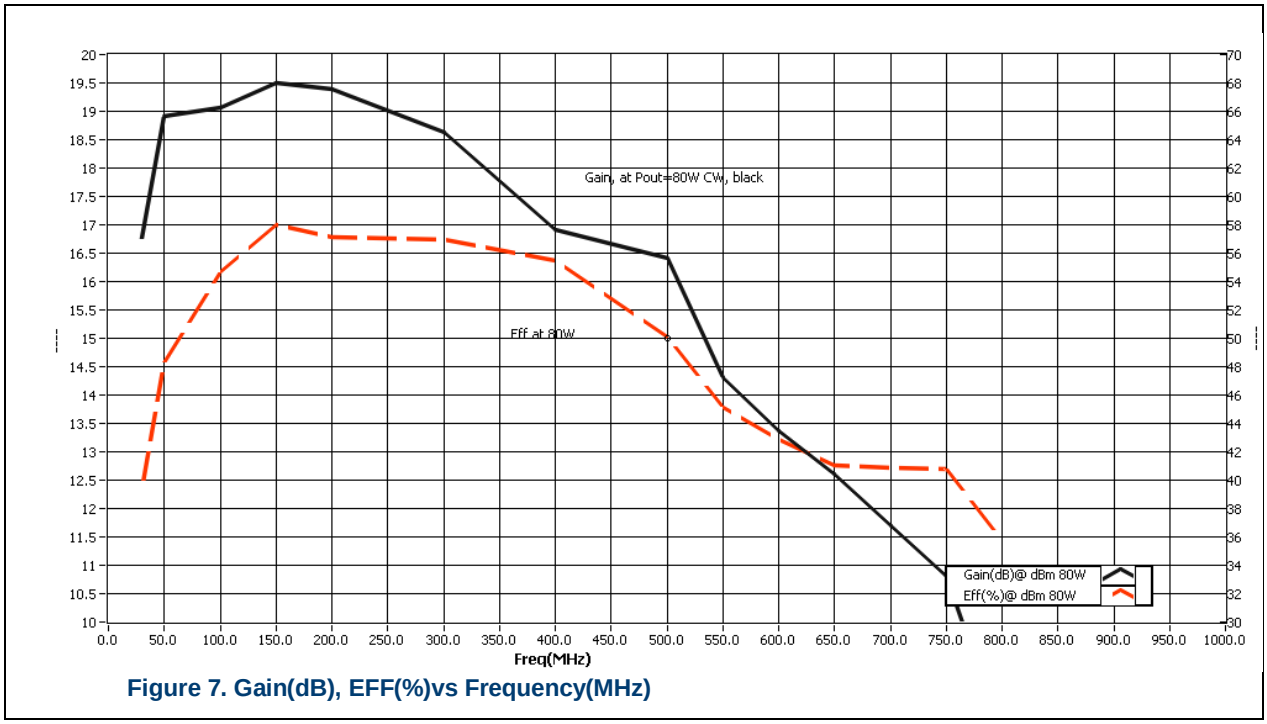


Figure 7. Gain(dB), EFF(%)vs Frequency(MHz)

10 Modeling

10.1 Transformer Insertion Loss

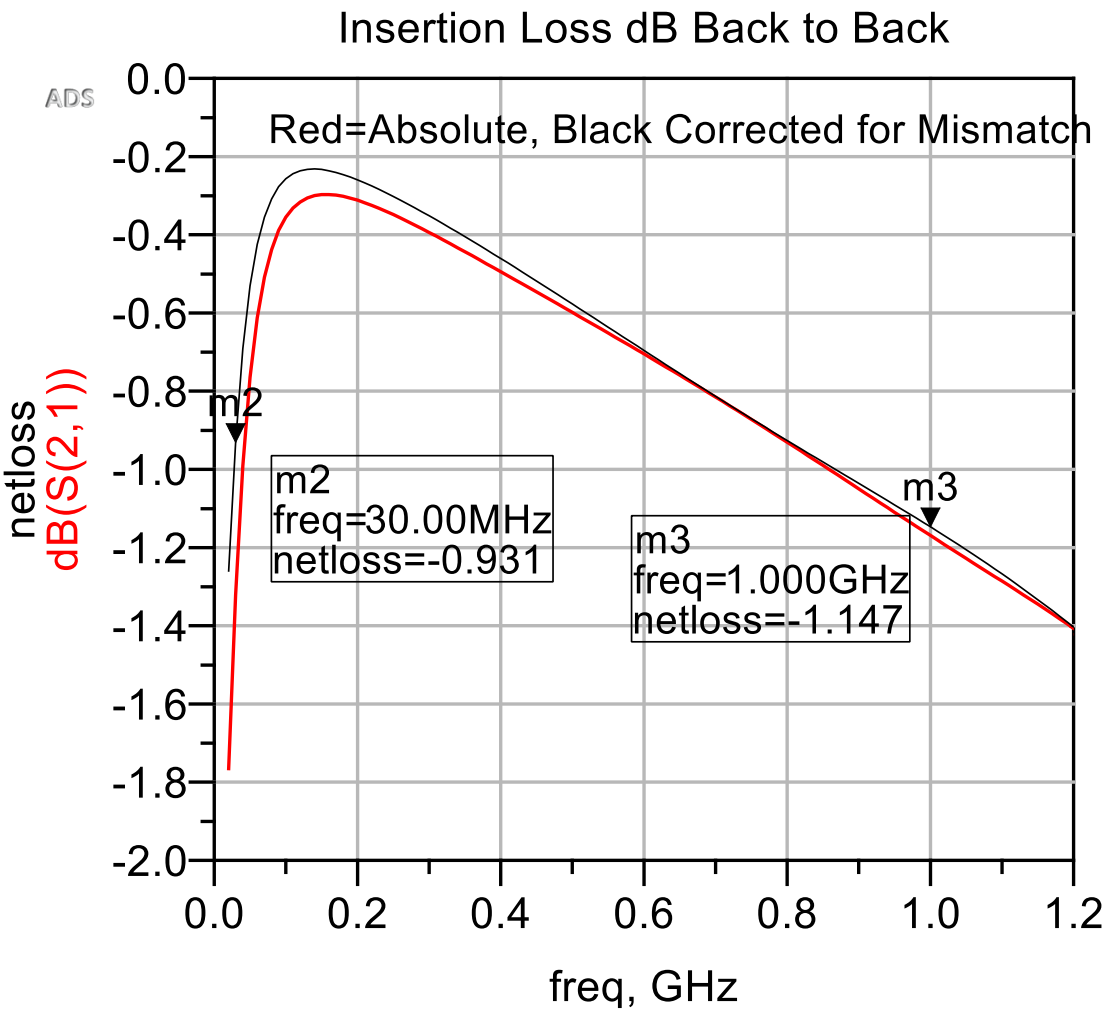


Figure 8. Insertion Loss of 2 Transformers Back to Back

10.2 Large Signal Simulation

Gain, Eff vs Pout, Vdd=50V, With Pi Network

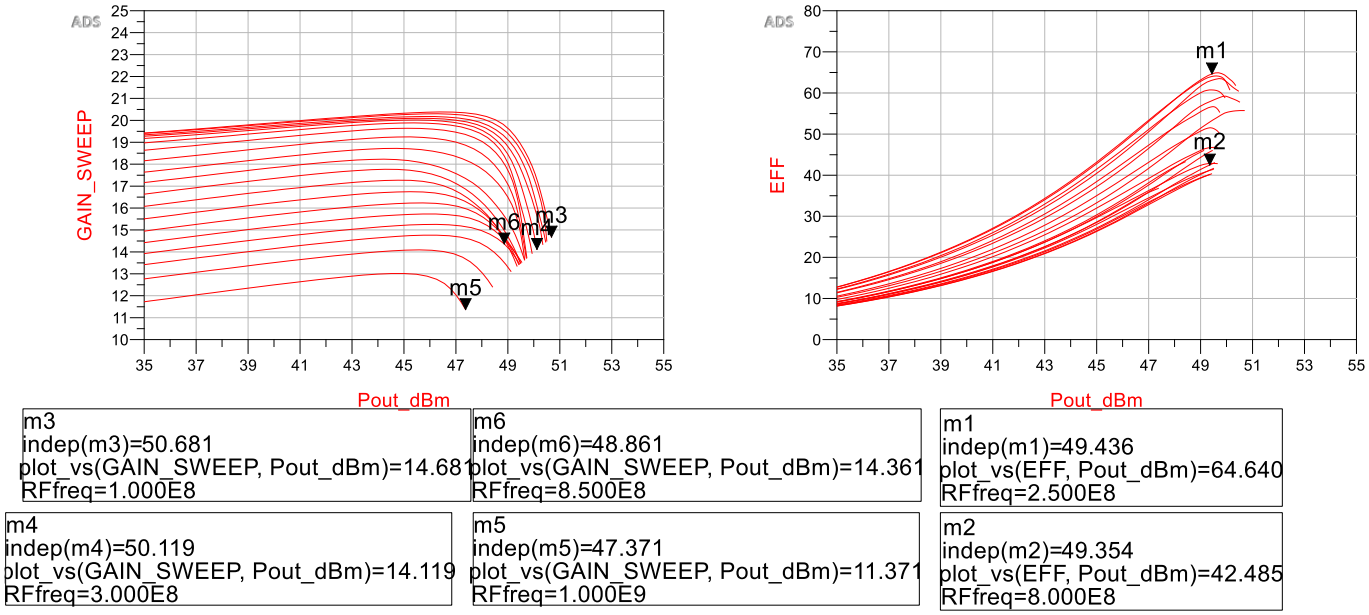


Figure 9. Simulated Gain, Efficiency vs Power Out

11 THERMAL TESTS

11.1 IR Scan at 700MHz

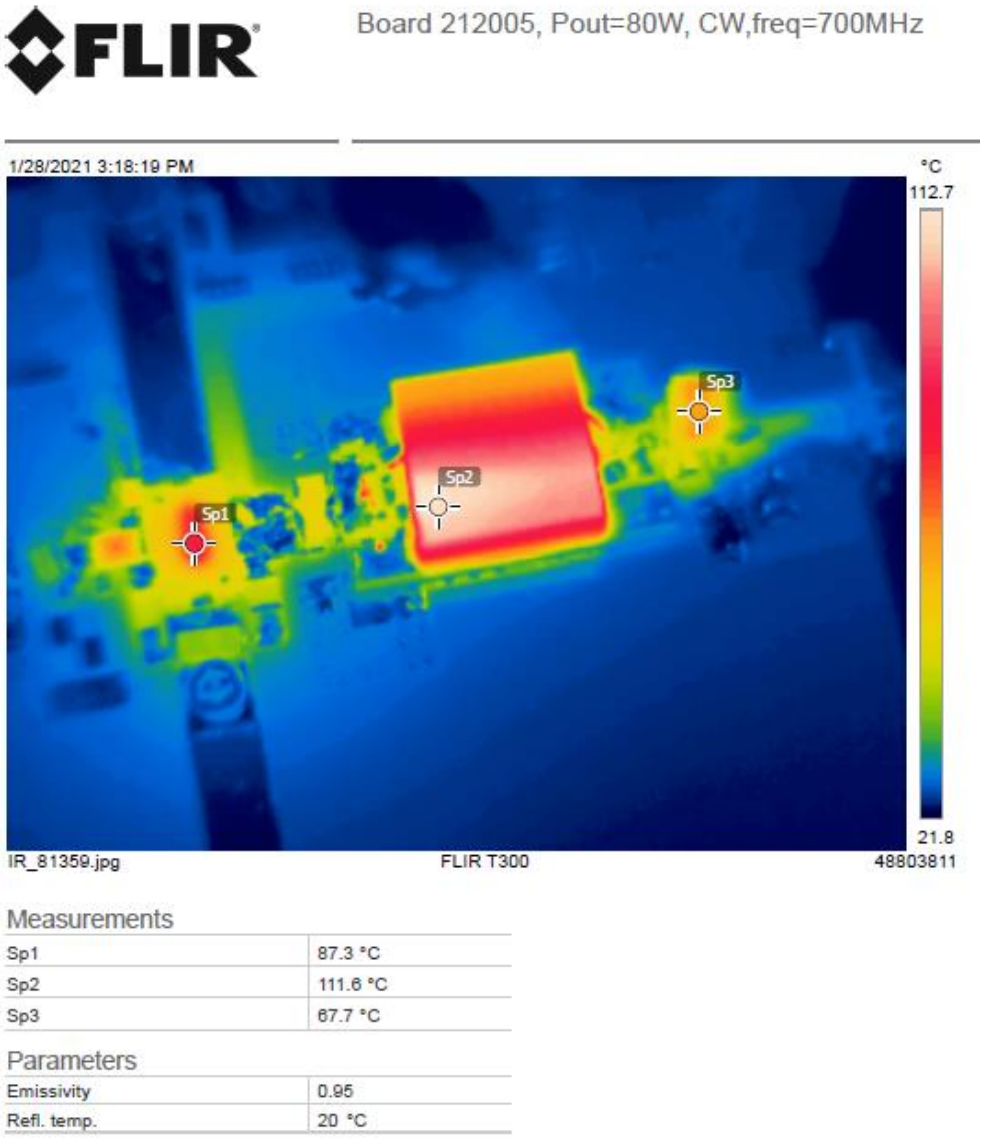


Figure 10. IR Scan Results, Freq=700MHz

11.2 IR SCAN at 800MHz

Freq=800MHz, Pout=75W CW

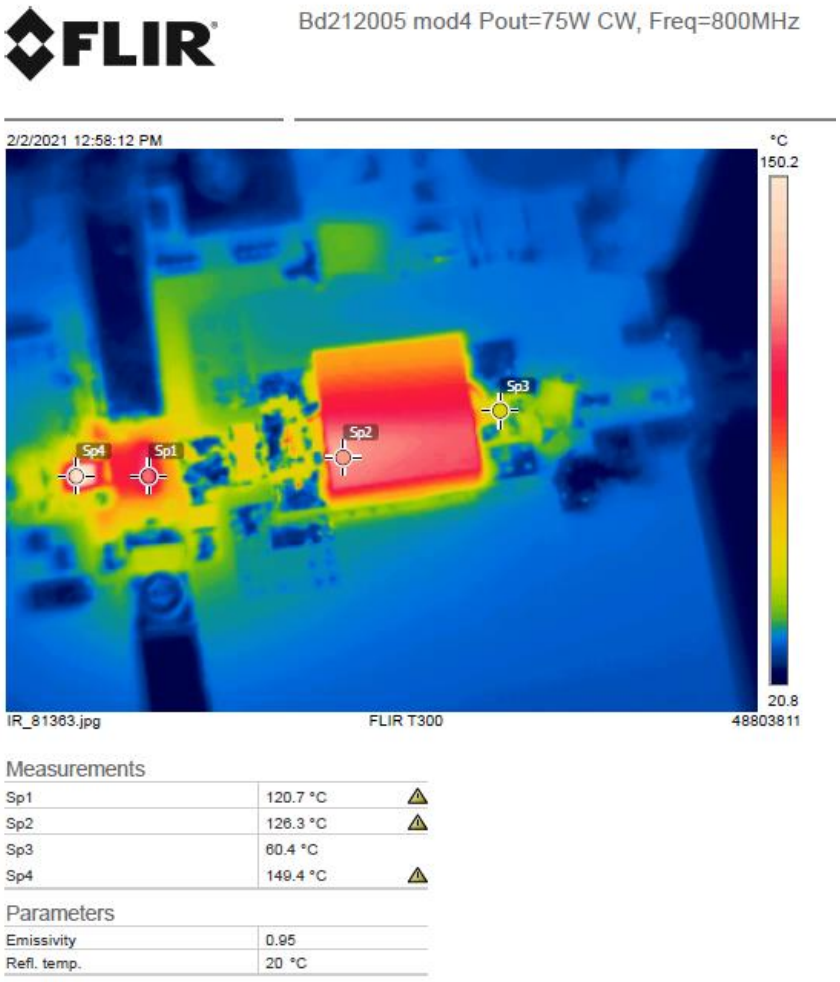


Figure 11. IR Scan Results, Freq=700MHz

12 Hardware

12.1 Board photograph

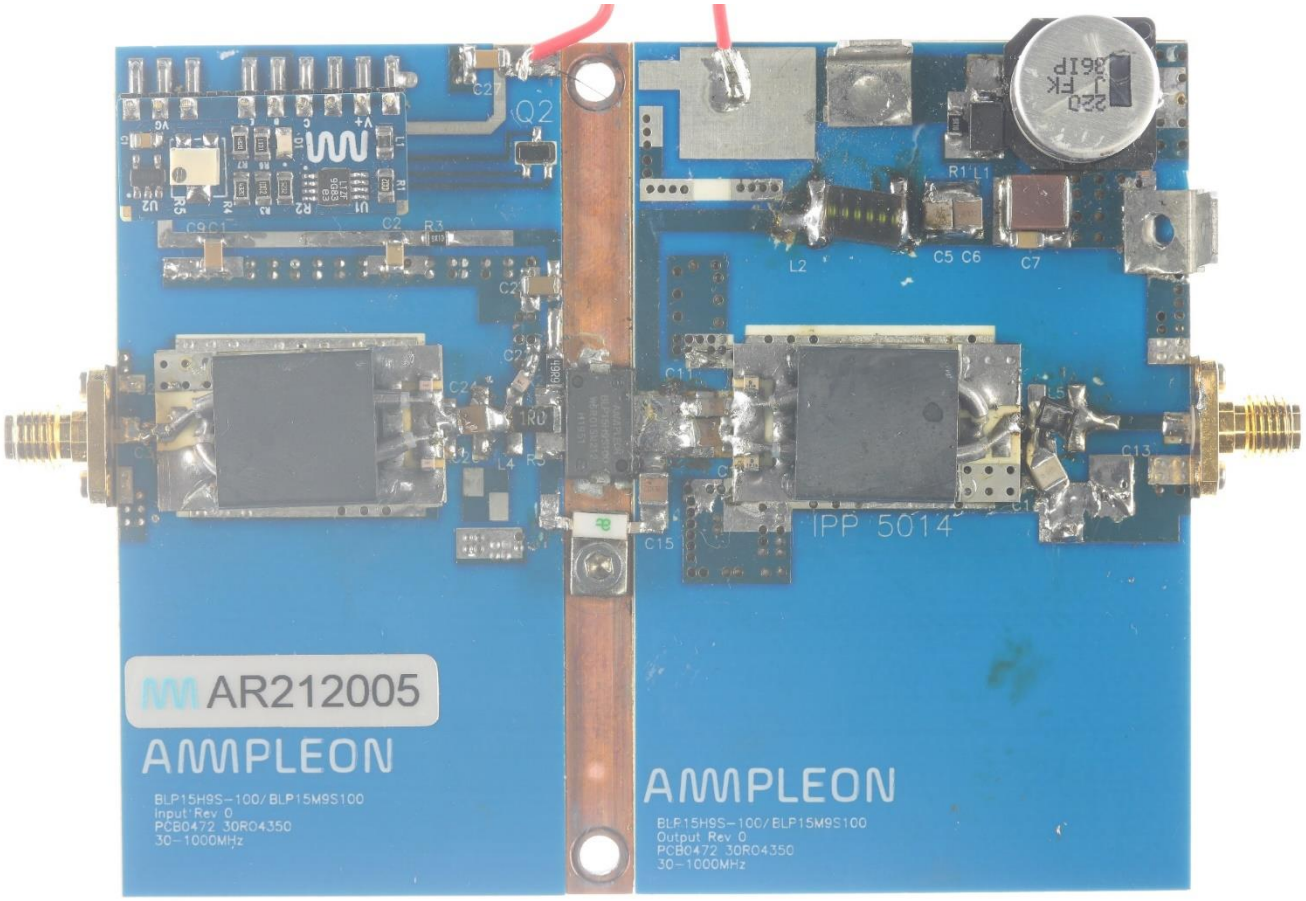


Figure 12. Board Photograph

12.2 PCB layout

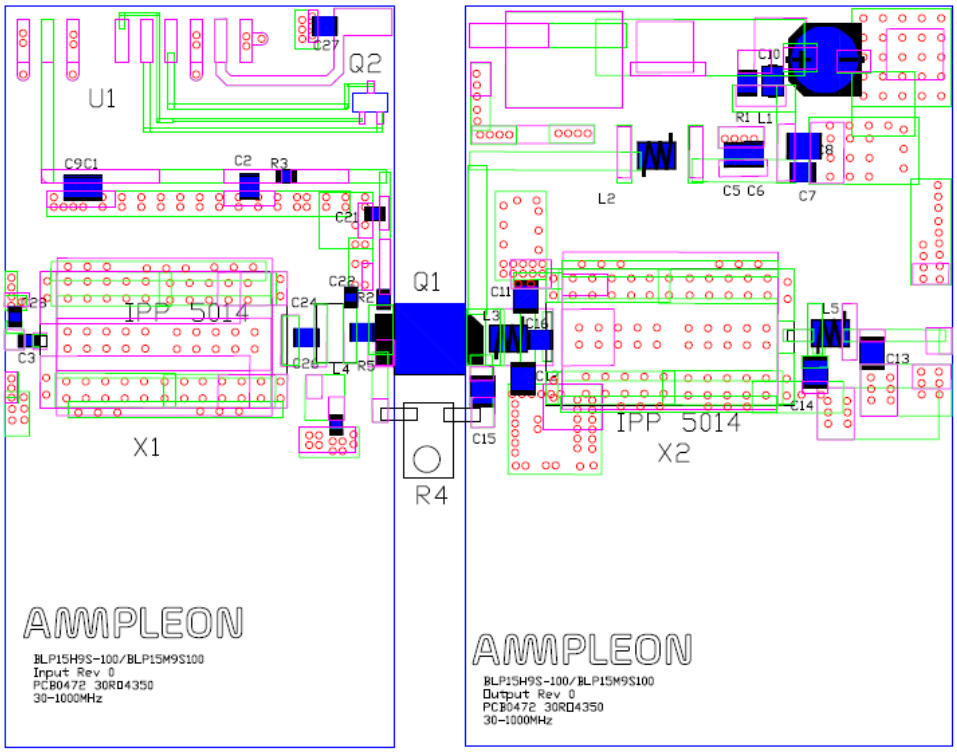


Figure 13.PCB Layout

12.3 Bill of materials

Table 4. BOM

Designator	Description	Manufacturer	Part#
PCB Input	30 mil thk. Rogers 4350	Avanti Circuits	PCB0472 Input Rev0
PCB Output	30 mil thk. Rogers 4350	Avanti Circuits	PCB0472 Output Rev0
Q1	RF Transistor 100W 50V LDMOS	Ampleon	BLP15H9S100
Q2	2N2222 NPN Transistor	Fairchild	MMBT2222
U1	LDMOS bias module	Ampleon	CA-330-11
X1,X2	12.5Ω Matching element	IPP	5014
C1,C27	0.01uF,100V,X7R,1206	Murata	GRM319R72A103KA01D
C2	0.1uF 100V,X7R	Murata	GRM319R72A104KA01D
C3	Short out		
C4	Capacitor	DNP	
C5	39pF	ATC	800B orPassive Plus 1111N series
C6,C15	1000pF	ATC	800B orPassive Plus 1111N series
C7	0.1uF 100V,X7R	Murata	GRM319R72A104KA01D
C8	10uF, 100V 10% X7S, 2220	TDK	C5750X7S2A106M
C10	Capacitor, 63V 20%, alum elec	220uF	Panasonic EEV-FK1J221Q
C11	Capacitor	DNP	800B orPassive Plus 1111N series
C12	Capacitor	DNP	800B orPassive Plus 1111N series
C13	DNP	ATC	800B orPassive Plus 1111N series
C14	Capacitor,1.5pF	ATC	800B orPassive Plus 1111N series
C16	680pF x2	ATC	800B orPassive Plus 1111N series
C21	1uF, ceramic, 50V, ±10%	Murata	GRM31CR71H105K
C22	Capacitor,10pF	ATC	600F series
C24	4.7uF	Murata	50 V 1210
L1	Ferrite Bead		Fair Rite, 2743019447
L2	Inductor ,30nH	Coilcraft	WA3097
L3	Inductor	DNP	Short Out with Copper
L4	Inductor	DNP	Short Out with Copper
L5	Inductor,8nH	Coilcraft	A03T
R1	9.1Ω	Vishay Dale	CRCW08059R09FKEA
R2	50Ω	Generic	1206
R3	9.1Ω	Vishay Dale	CRCW08059R09FKEA
R4	200Ω	ATC-Flanged	
R5	Resistor 1Ω, 2010	Generic	

12.4 PCB materials

Table 5. Board Specifications

Parameter	Value
Manufacturer	Rogers
Type	4350
Thickness	30 mils, 1oz. copper
Layers	2, top/bottom. Bottom all copper

12.5 Device markings

Table 6. Device Specifications

Parameter	Value
Manufacturer	Ampleon
Device	BLP15H9S100
Date Code	M2015

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