AR232016

BLP15M9S70 1025-1150MHz

V2.0 — 17 July 2023

AMPLEON

Application Report

Document information

Info	Content
Status	General Publication
Author(s)	Bill Goumas
Abstract	Measurement results of the BLP15M9S70 LDMOS Device Measured at 28-32V over 950-1200MHz

1 Revision History

Table 1. Report revisions

Revision No.	Date	Description	Author
1.0	20230328	Initial document	Bill Goumas
2.0	202.0717	Changed to General Publication	Bill Goumas

2 Contents

3 List of Figures

4 List of Tables

5 General Description

This report presents the measurements of BLP15M9S70 demo board. The board has been tested over 950-1200 MHz at 28V.

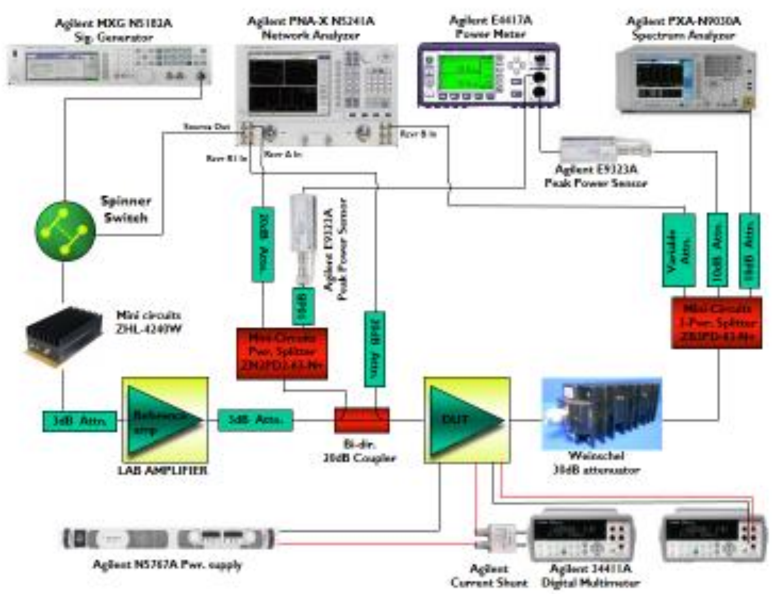
6 Biasing

6.1 Bias Details

Idq is set via the pot on the bias board. Vg~2.3 for Idq=500mA. Board was shipped with pot set for this value.

7 Test Bench Set Up

Figure 1.Test Bench Equipment set up



8 Summary

This board was designed for Avionics applications using the device model. Minor tweaks were required on the output from initial design. Demo delivers 55-65W over 1025-1150MHz at Vdd=28V.

Table 2. RF Performance Vdd=28V, Idq=500mA, 10% duty cycle, 100usec PW

Symbol	Parameter	Range	Unit
Freq.	Frequency Range	1025-1150	MHz
P1dB	Power at 1dB Gain Compression	>55	W
P2dB	Power at 2dB Gain Compression	>67	W
Gain at 50W	Power Power Output=50W	>14.5	dB
Gain at 25W	Power Power Output=25W	>15.0	dB
Eff at 50W	Efficiency	>50	%
Eff at 65W	Efficiency	>55	%

At Vdd=32V, P1, P2dB increase by ~0.5dB and Gain by ~0.75dB compared to Vdd=28V.

Section 9.2 shows initial broadband data before final tuning for best performance over 1025-1150MHz

The difference in final tuning is C20 lowered to 1.5pF from 2.4pF on the output and input return loss is peaked for 1025-1150MHz

9 Performance Details

9.1 Small Signal Results

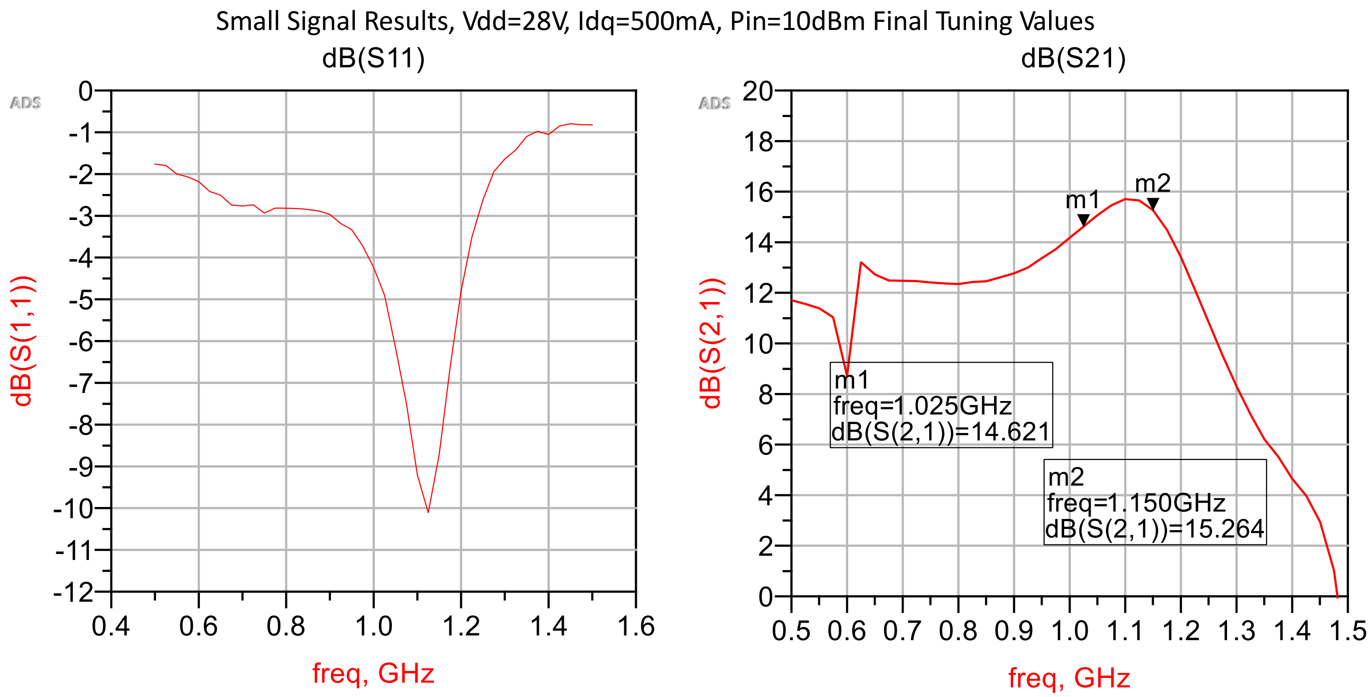


Figure 2. Small SIgnal Data, Vdd=28V, Idq=500mA

9.2 Initial Pulse Gain, Efficiency vs Pout Broadband

Vdd=28, Idq=500mA, Duty=10%, Pulse Width=100usec

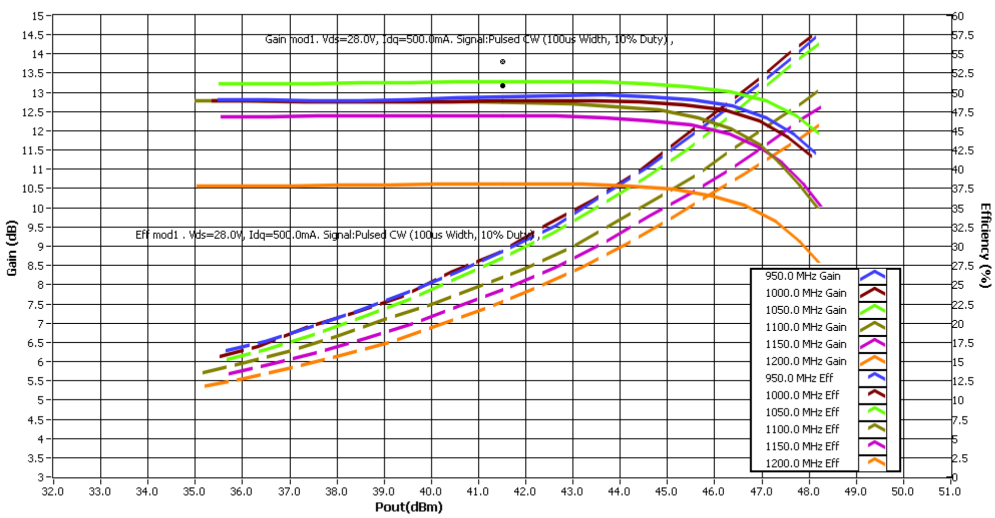


Figure 3. Gain(dB), Eff(%) vs Power Out(dBm), 10% duty

Vdd=32V, Idq=500mA, 10% Duty, 100usec PW

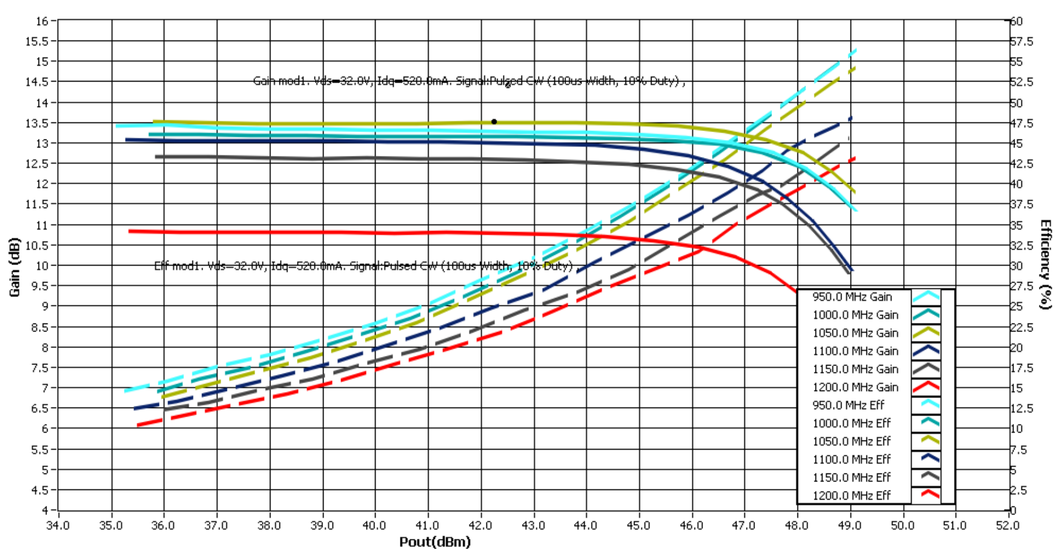


Figure 4.Gain(dB), Eff(%) vs Power Out(dBm), 10% duty

9.3 Final Values- Gain, Efficiency vs Pout, 1025-1150MHz

Vdd=50, Idq=500mA, 10% duty, 100usec PW Final Tuning

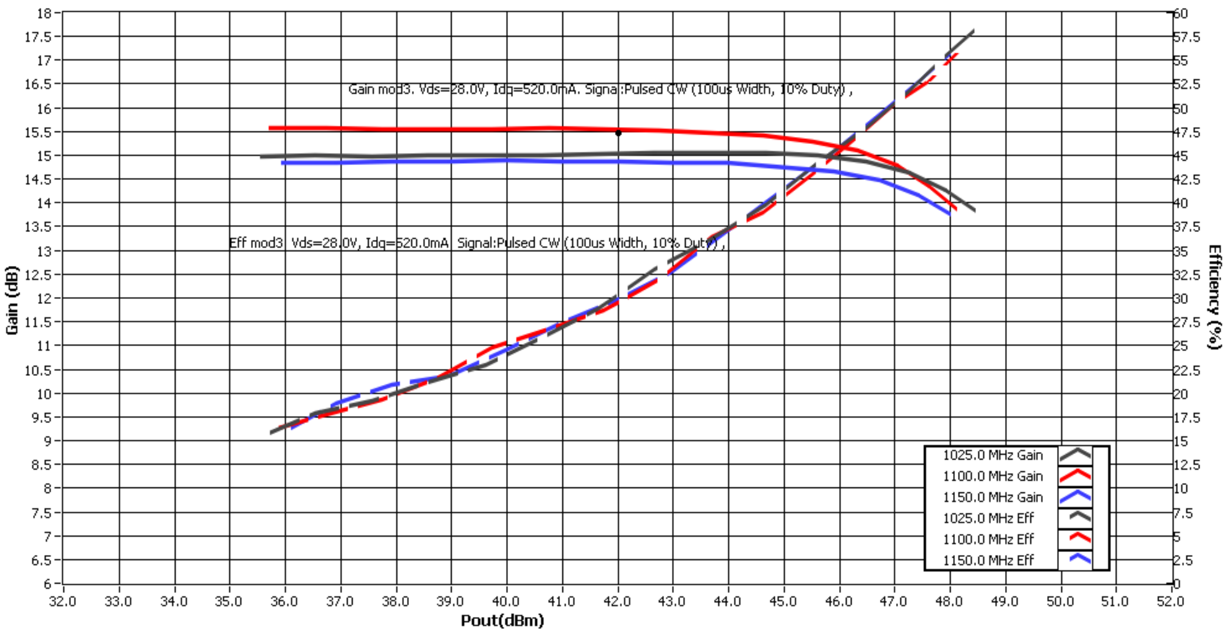


Figure 5. Gain(dB), EFF(%) vs Power Out(dBm)

9.4 P1, P2 dB vs Frequency, final tune

Vdd=28V, Idq=500mA

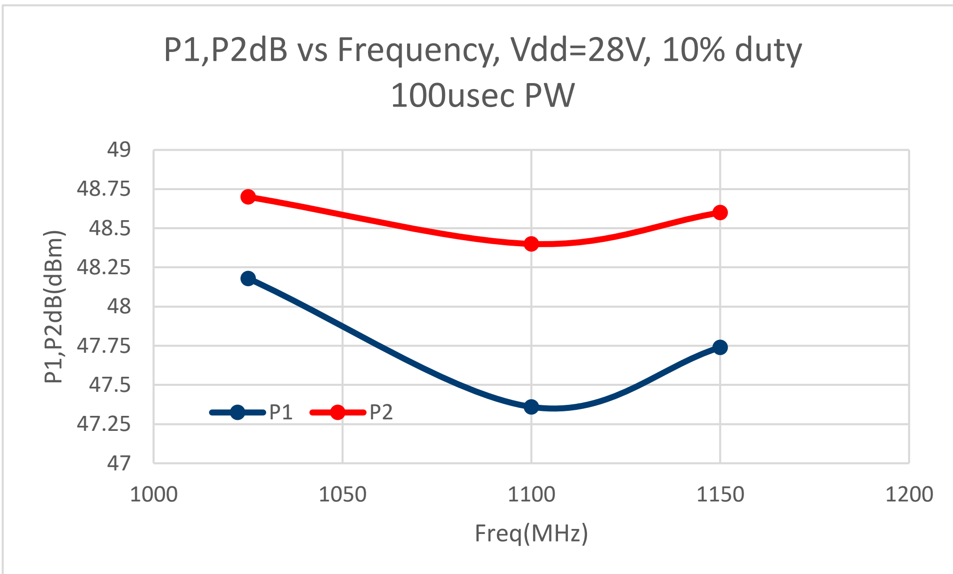


Figure 6. P1, and P2dB vs Frequency

9.5 Gain, Efficiency at Fixed Power Output

Vdd=28V, Idq=500mA, 10% duty, 100usec PW

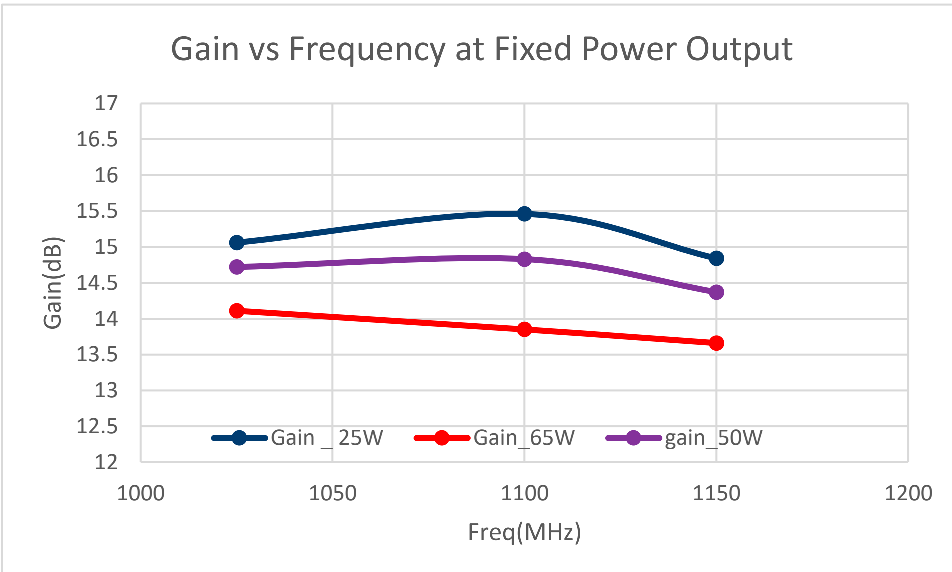


Figure 7. Gain(dB), vs Freq

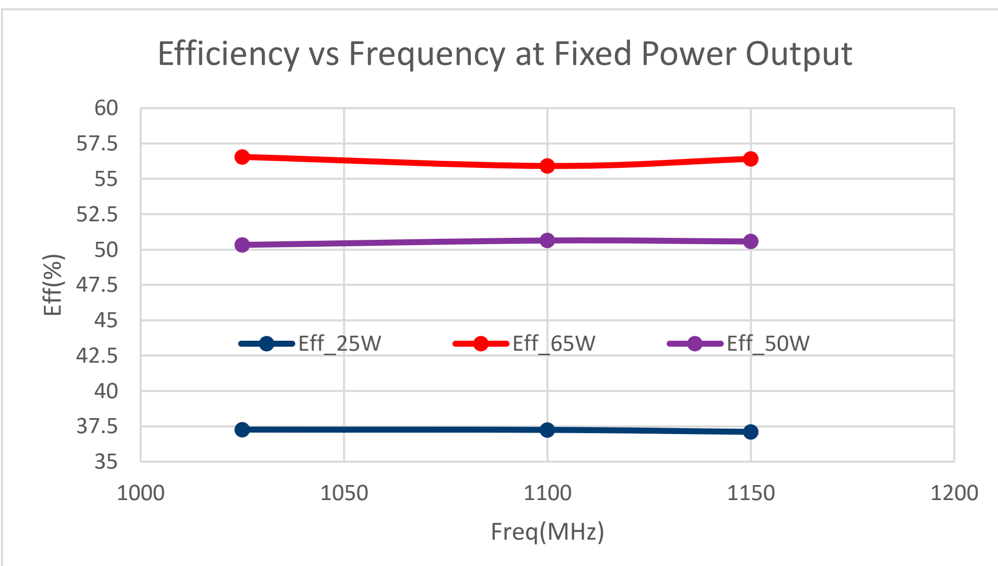


Figure 8. Eff(%) vs Freq

10 Modeling and Stability

10.1 Modeling

This board was designed using the Device Model. Comparison is shown below

Modeled results-Final Values, Vdd=28V, Idq=500mA, Gain(dB), Eff(%) vs Pout(dBm)

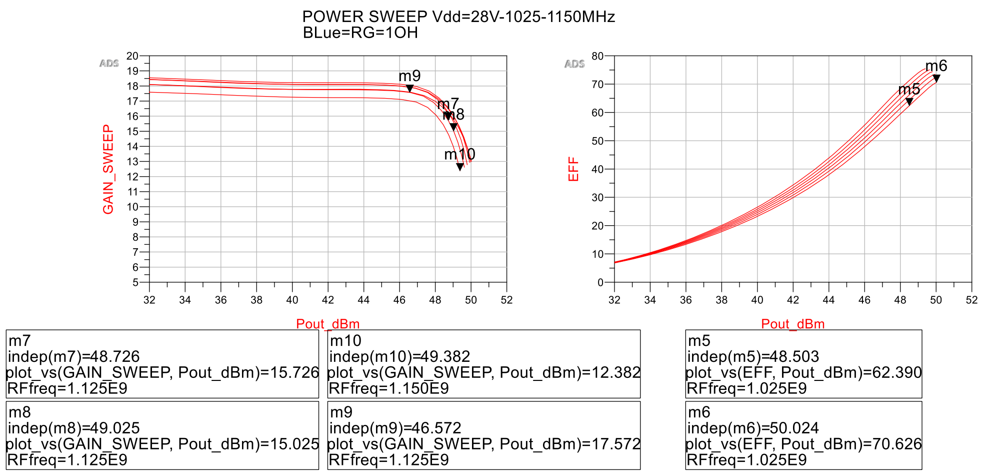


Figure 9. Modeled Results

Measured Results, Same Values-Gain(dB), Eff(%) vs Pout(dBm)

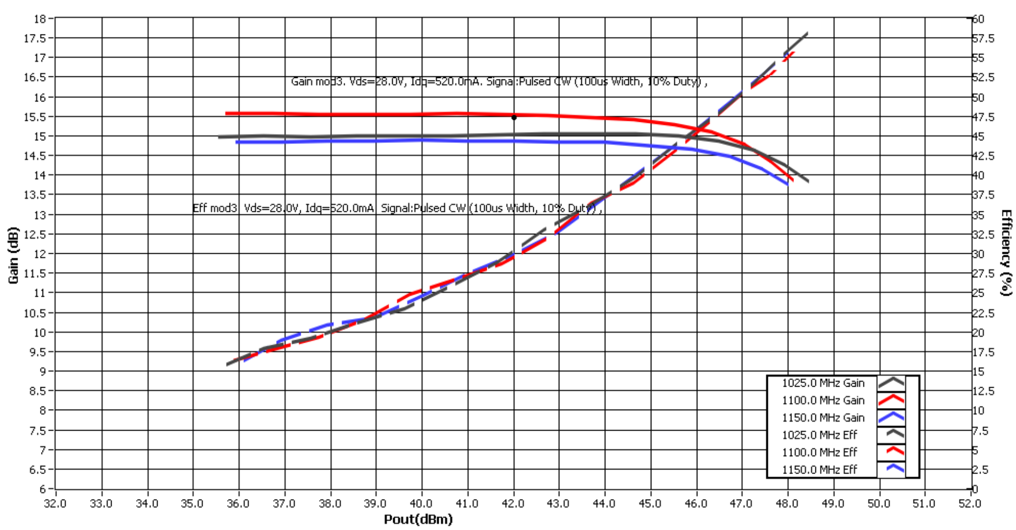


Figure 10. Measured Results

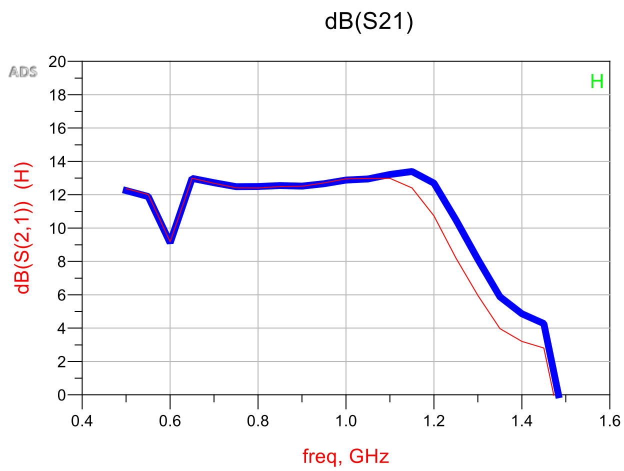
10.2 Small Signal Stability

Simulations and measurements show that the small signal stability is worse at lower frequencies. The key element to tradeoff gain vs stability is R2. Value can be increased for better stability or decreased for more gain.

Simulations predicted a dip in K-factor above band near 1.5GHz. This is not evident in any measurements, probably due to circuit losses.

Measurements shown below are with R2=1.1(red) and 0.55Ohm(blue). Resistor can be bypassed in band for more gain if desired.

Small SIgnal test Comparison, Vdd=28V, Red=Rgate=1.1OH, Blue=0.55OH



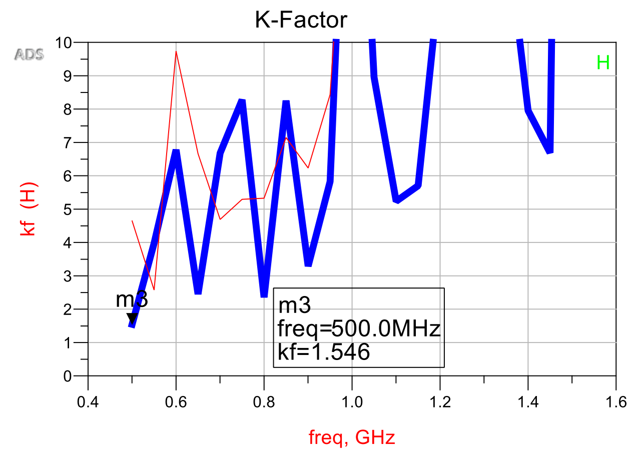


Figure 11. Sparameter Measurements, dB(S21) and K-Factor

11 Hardware

11.1 Board photograph

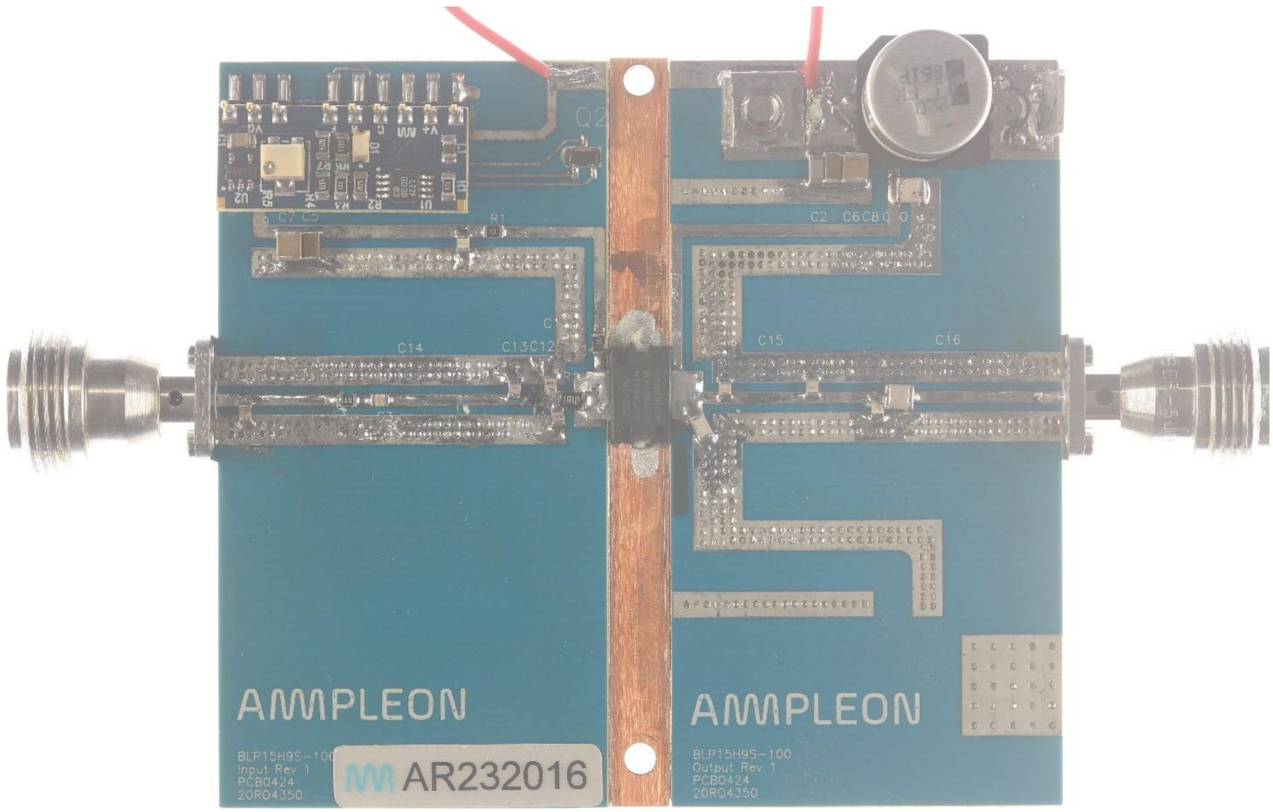


Figure 12. Board Photograph

11.2 PCB layout

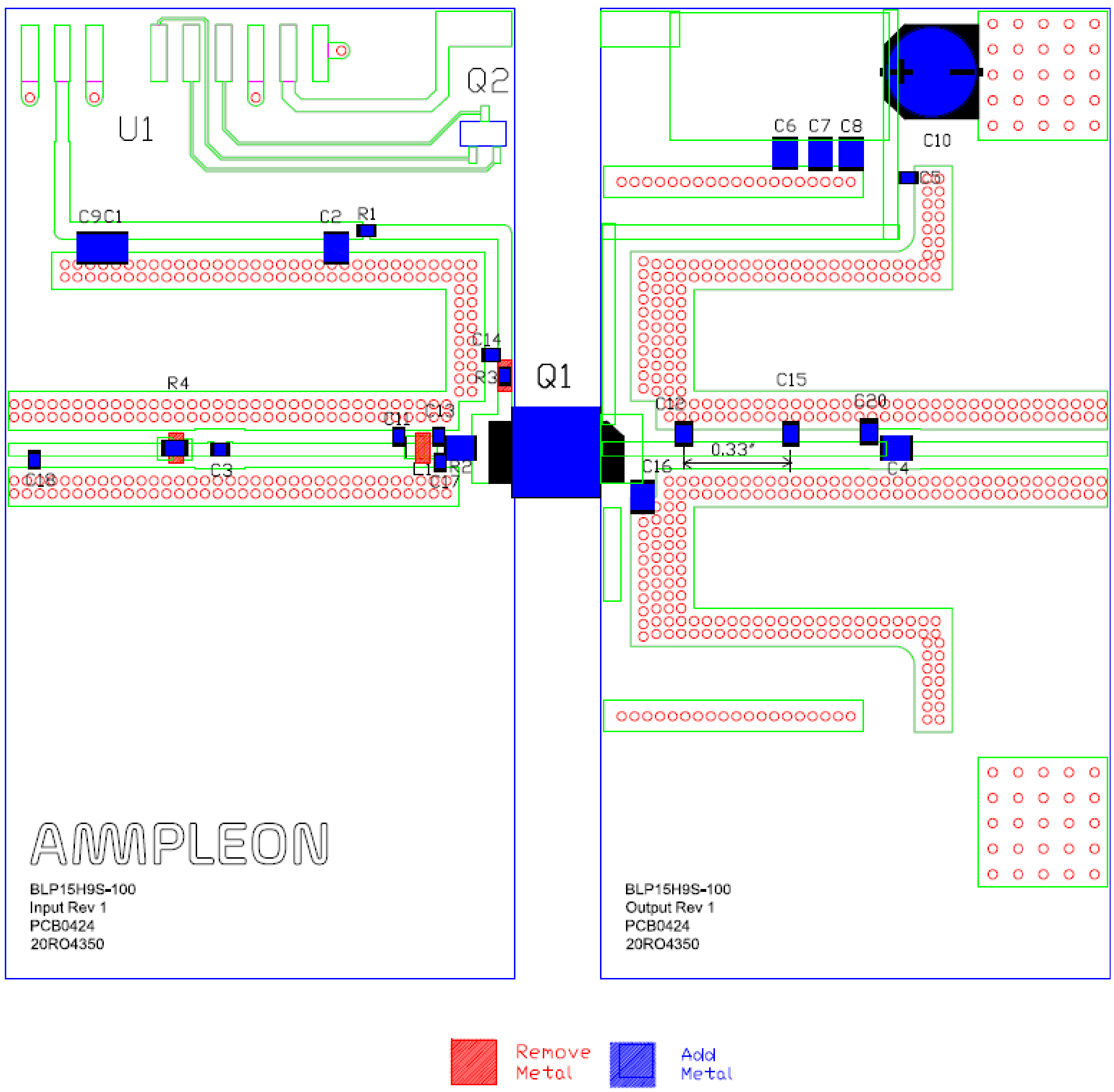


Figure 13.PCB Layout

11.3 Bill of materials

Table 3. BOM

Designator	Description	Manufacturer	Part#
Input Board	20mil RO4350B 1oz	Avanti	PCB0424 Input Rev 1
Output Board	20mil RO4350B 1oz	Avanti	PCB0424 Output Rev 1
Q1	LDMOS, Class AB 100W	Ampleon	BLP15M9S70
Q2	2N2222 NPN Transistor	Fairchild	MMBT2222
U1	LDMOS bias module	Ampleon	CA-330-11
C1, C7	1uF, ceramic, 50V, ±10%	Murata	GRM31CR71H105K
C2,C3	33pF, 0805, 250V	ATC or Passive Plus	600F or 0805N
C4,C5	33pF,	ATC or Passive Plus	800B or 1111N
C6	0.01uF,100V,X7R,1206	Murata	GRM319R72A103KA01D
C8, C9	10uF	Murata	GRM55DR61H106KA88L
C10	220uF	Panasonic	63V, Electrolytic capacitor
C11,C17	4.7pF	ATC or Passive Plus	600F or 0805N
C12	12pF	ATC or Passive Plus	600F or 0805N
C13	6.8pF	ATC or Passive Plus	600F or 0805N
C15	3.0pF	ATC or Passive Plus	600F or 0805N
C16	10pF	ATC or Passive Plus	800B or 1111N on side
C20	1.5pF	ATC or Passive Plus	600F or 0805N
L1	1.6nH	Coilcraft	0906-2
R1,R4	0 Ohm jumper	Generic	0805
R2	1.1 Ohm x 2 in parallel	Generic	1206
R3	100 Ohm	Generic	0805

11.4 PCB materials

Table 4. Board Specifications

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

11.5 Device markings

Table 5. Device Specifications

Parameter	Value
Manufacturer	Ampleon
Device	BLP15M9S70
Date Code	M2118

12 Legal Information

Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Ampleon does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, Ampleon does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Ampleon takes no responsibility for the content in this document if provided by an information source outside of Ampleon.

In no event shall Ampleon be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Ampleon' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of Ampleon.

Right to make changes — Ampleon reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — Ampleon products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an Ampleon product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Ampleon and its suppliers accept no liability for inclusion and/or use of Ampleon products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Ampleon makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Ampleon products, and Ampleon accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Ampleon product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Ampleon does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Ampleon products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Ampleon does not accept any liability in this respect.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

Any reference or use of any 'NXP' trademark in this document or in or on the surface of Ampleon products does not result in any claim, liability or entitlement vis-à-vis the owner of this trademark. Ampleon is no longer part of the NXP group of companies and any reference to or use of the 'NXP' trademarks will be replaced by reference to or use of Ampleon's own trademarks.

12.1 Contact information

For more information, please visit: http://www.ampleon.com

For sales office addresses, please visit: http://www.ampleon.com/sales