AR201074

BLP5LA55S, 150-170MHz

V1.2 — 21 oct 2020

AMPLEON

Application Report

Document information	
Status	Public
Author(s)	Tom Brinkman
Abstract	Measurement results of a Class AB design for the 150-170MHz band with the BLP5LA55S

1. Revision History

Table 1: Report revisions

Revision	Date	Description	Author
1.0	20200504	Initial document	Tom Brinkman
1.1	20200505	Typo corrected	Tom Brinkman
1.2	20201021	Typo corrected	Tom Brinkman

2. Contents

3. List of figures

4. List of tables

5. General description

This report presents the measurement results of the Class AB demo AR201074. The device used is a 55W, 9th generation LDMOS, the BLP5LA55S. The presented demo is tuned for the frequency 150-170MHz.

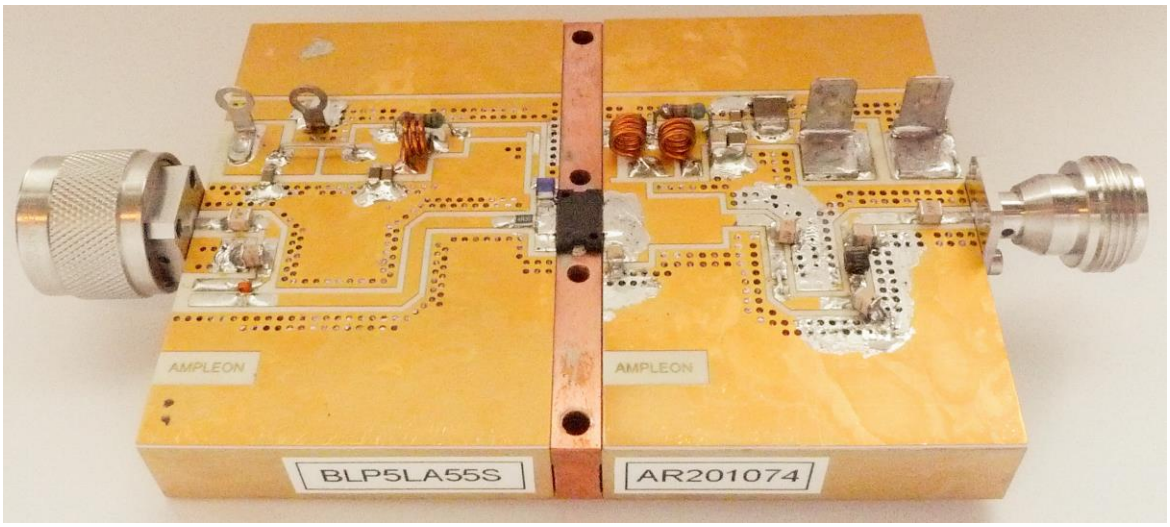

Figure 1 Demo Front view

6. Biasing

The efficiencies presented are based on the currents of the drain feeds only.
I.e. the biasing currents for the gate circuitry has not been included.

Unless otherwise stated, the biasing is as follows:

V_{DD} = 14.4V

V_{GS} = 2.21V, leading to an I_{DQ} = 1110mA

7. Performance Indication 150-170MHz

Table 2: Performance indication, sampled at 150-170MHz

Parameter	Condition	Unit	CW
V_{DD}		V	14.4
S11 at connector		dB	-9
P_{1dB}[1]	G_{MAX}-1dB	W	60
P_{3dB}[1]	G_{MAX}-3dB	W	72
P_{OUT} of operation	***P_o***[2]	W	***12.5***
Gain	**@P_o**	dB	>23
Drain Efficiency	**@P_o**	%	>30
Drain Efficiency	**@ 3dB comp.**	dB	>74

[1] *Pout at 1 and 3dB gain compression relative to the maximum gain in the power sweep*

[2] *Demonstrator is expected to operate at the P_o average power level*

8. Performance Details

8.1 CW signal Power sweeps 145-175MHz

Table 3: CW Performance

Freq [MHz]	MaxGain [dB]	P1dB [W]*	P3dB [W]*	Eff@P3dB [%]*
145.00	23.9	66.18	79.89	76.4
150.00	24.0	63.10	76.61	76.9
155.00	24.0	60.92	74.00	77.0
160.00	23.9	59.99	72.52	76.5
165.00	23.6	60.30	72.37	75.9
170.00	23.3	60.67	72.11	74.7
175.00	22.8	58.34	68.43	71.7
30.0	1.144	7.840	11.467	5.305

Table 4: CW Performance at Pout = 12.5Watts

Freq [MHz]	Obo [dB]@	Gain [dB]@	Eff [%]@	Compr [dB]@	IRL [dB]@	H2 [dBc]@	H3 [dBc]@
145.00	8.0	23.9	29.6	0.00	7.4	-36.5	-53.0
150.00	7.8	24.0	30.3	0.00	9.0	-40.1	-53.2
155.00	7.7	24.0	30.9	0.00	11.0	-44.1	-53.0
160.00	7.6	23.9	31.1	0.00	13.9	-44.9	-52.9
165.00	7.6	23.6	30.9	0.00	18.0	-35.3	-52.9
170.00	7.6	23.3	30.4	-0.01	20.6	-38.2	-53.0
175.00	7.4	22.8	29.8	-0.01	16.9	-41.1	-52.8
30.0	0.673	1.153	1.458	0.009	13.189	9.687	0.329

8.1.1 Gain and efficiency (3dB sweep)

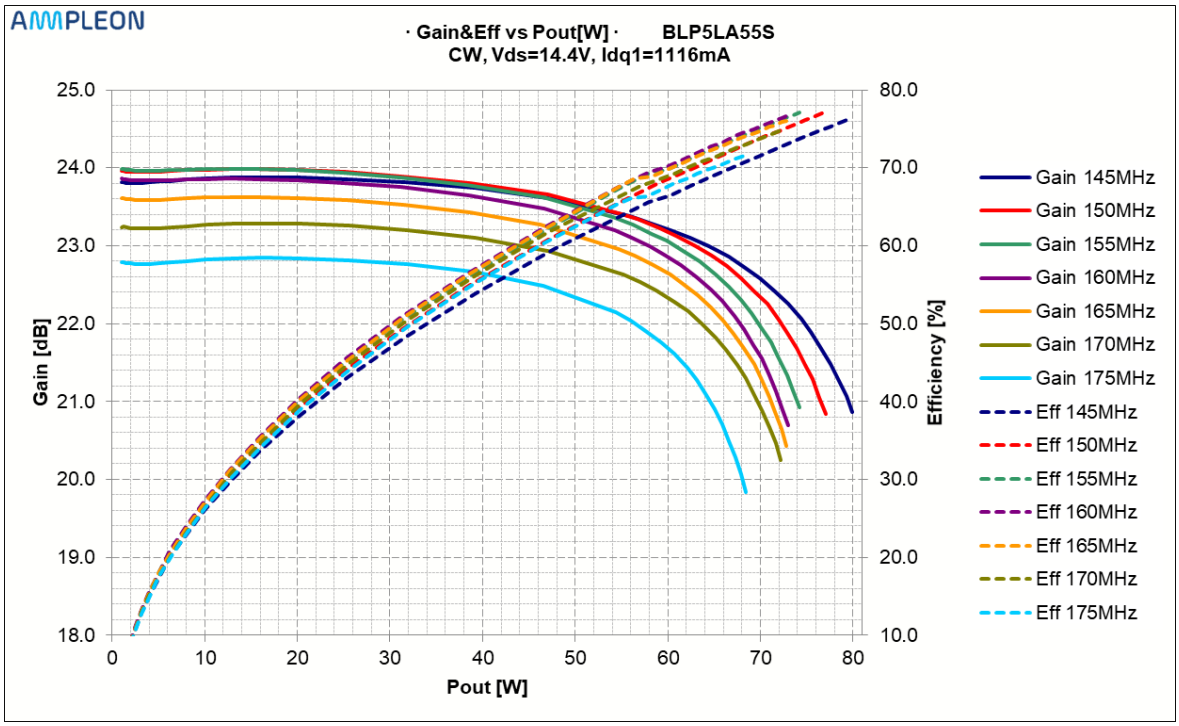

Figure 2 BLP5LA55S_PS_CW_200429_1244 Gain&Eff vs Pout[W]

8.2 CW Signal performance over 145-175 MHz

8.2.1 3dB compressed power

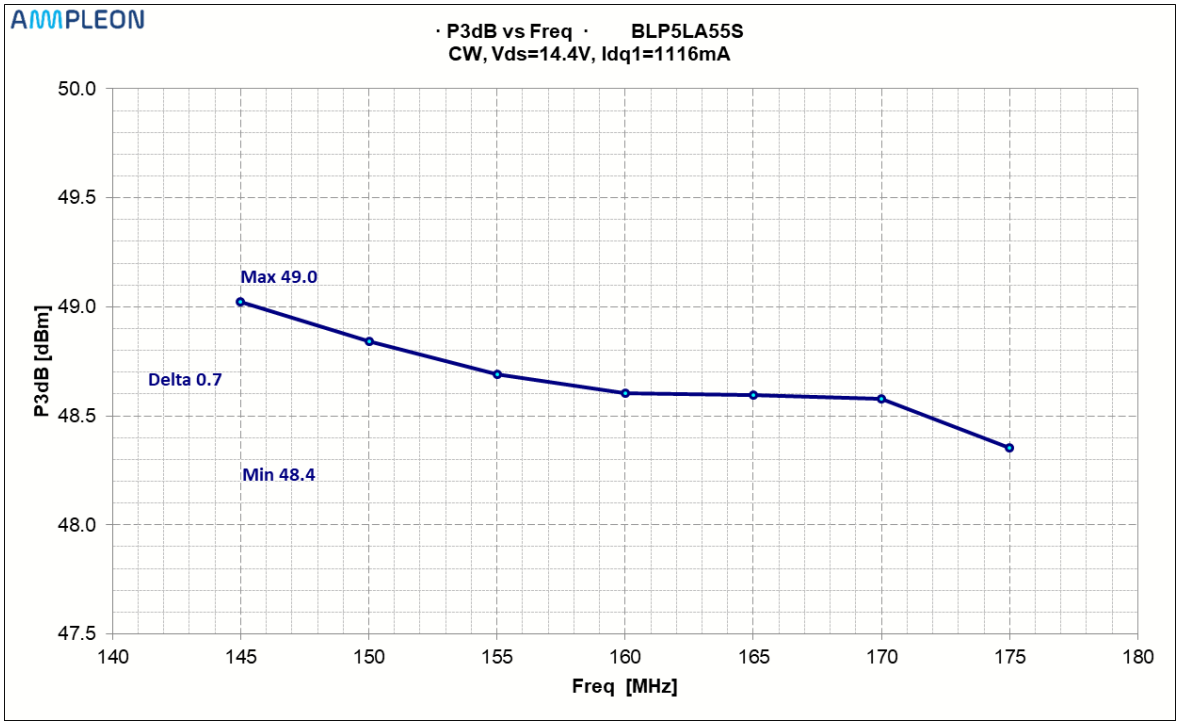

Figure 3 BLP5LA55S_PS_CW_200429_1244 P3dB[W] vs Freq

8.2.2 Gain

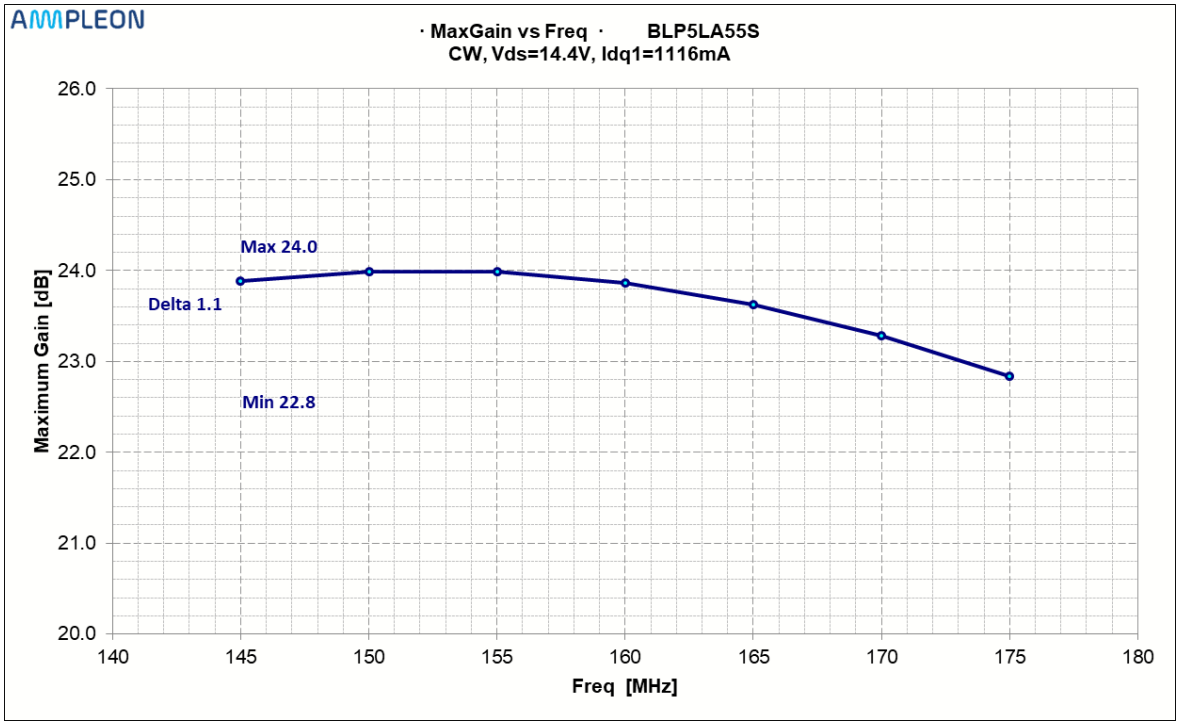

Figure 4 BLP5LA55S_PS_CW_200429_1244 MaxGain vs Freq

8.2.3 Efficiency

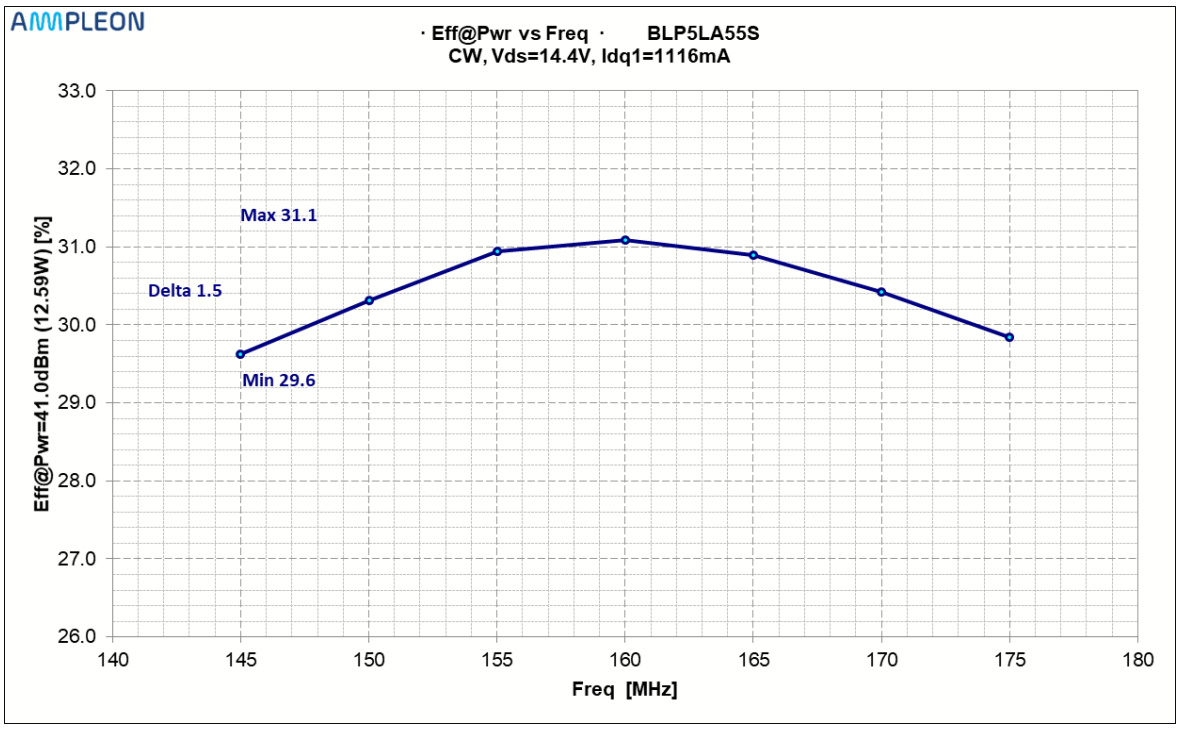

Figure 5 BLP5LA55S_PS_CW_200429_1244 Eff (12.5W) vs Freq

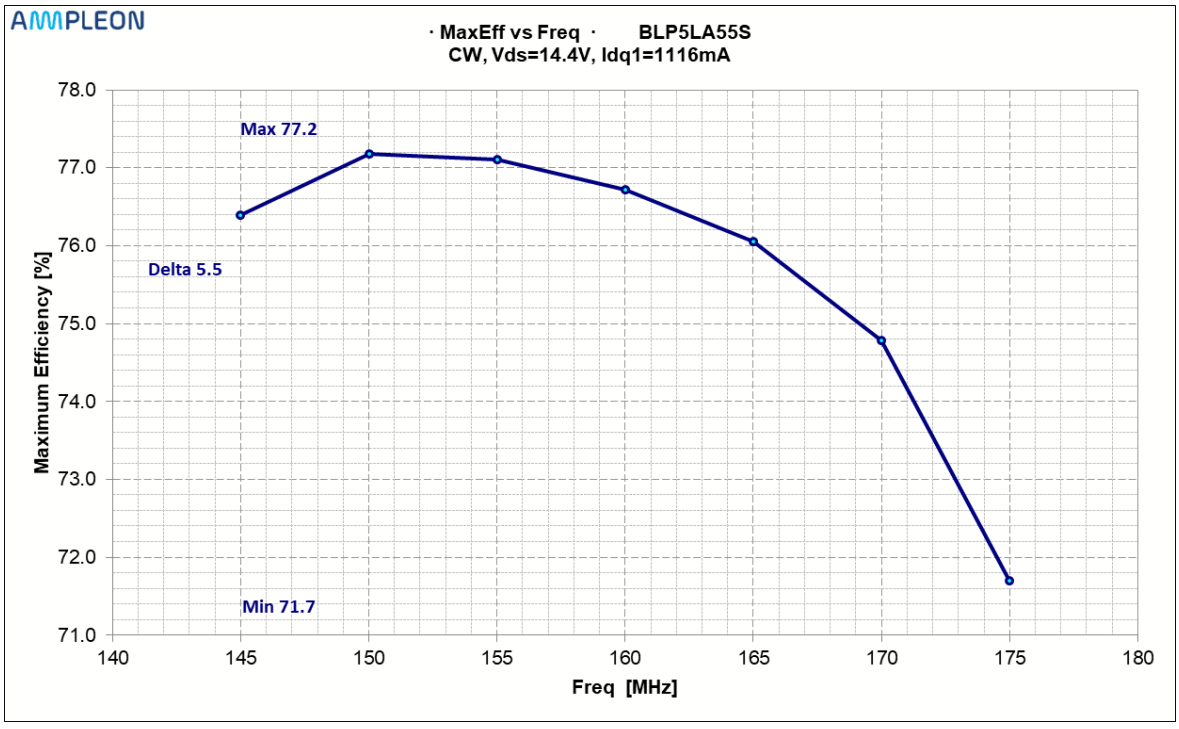

Figure 6 BLP5LA55S_PS_CW_200429_1244 MaxEff vs Freq

8.2.4 Return loss

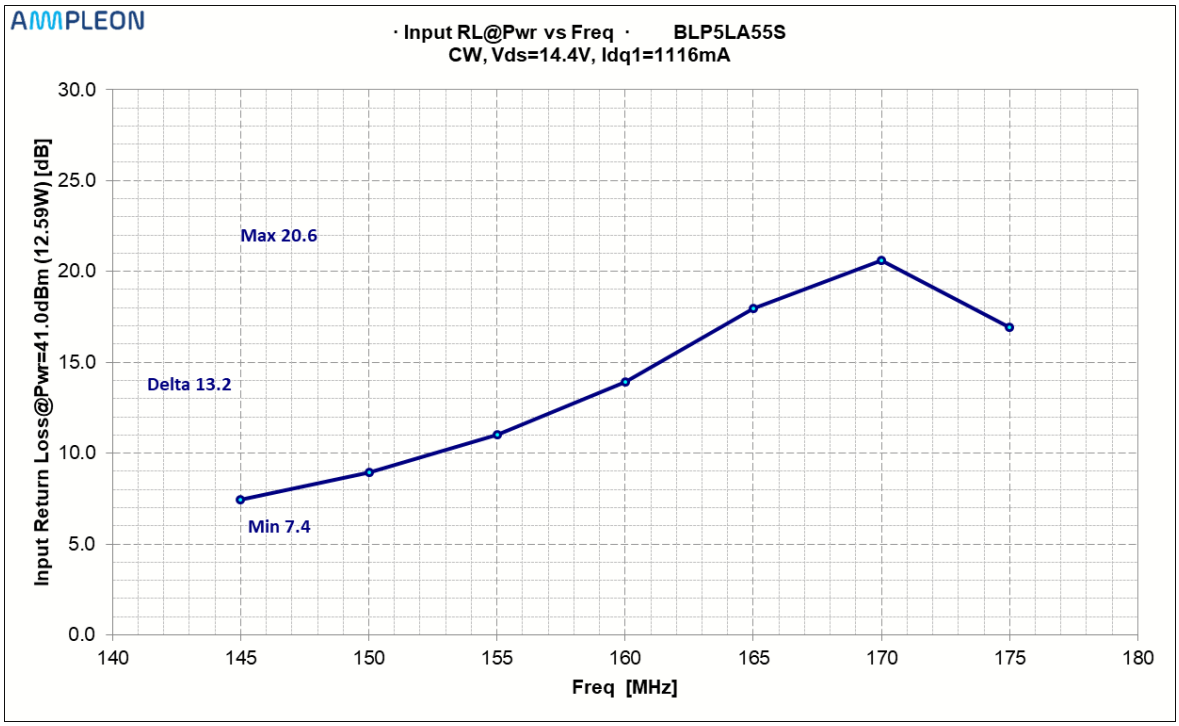

Figure 7 BLP5LA55S_PS_CW_200429_1244 IRL vs Pout

8.3 Harmonics

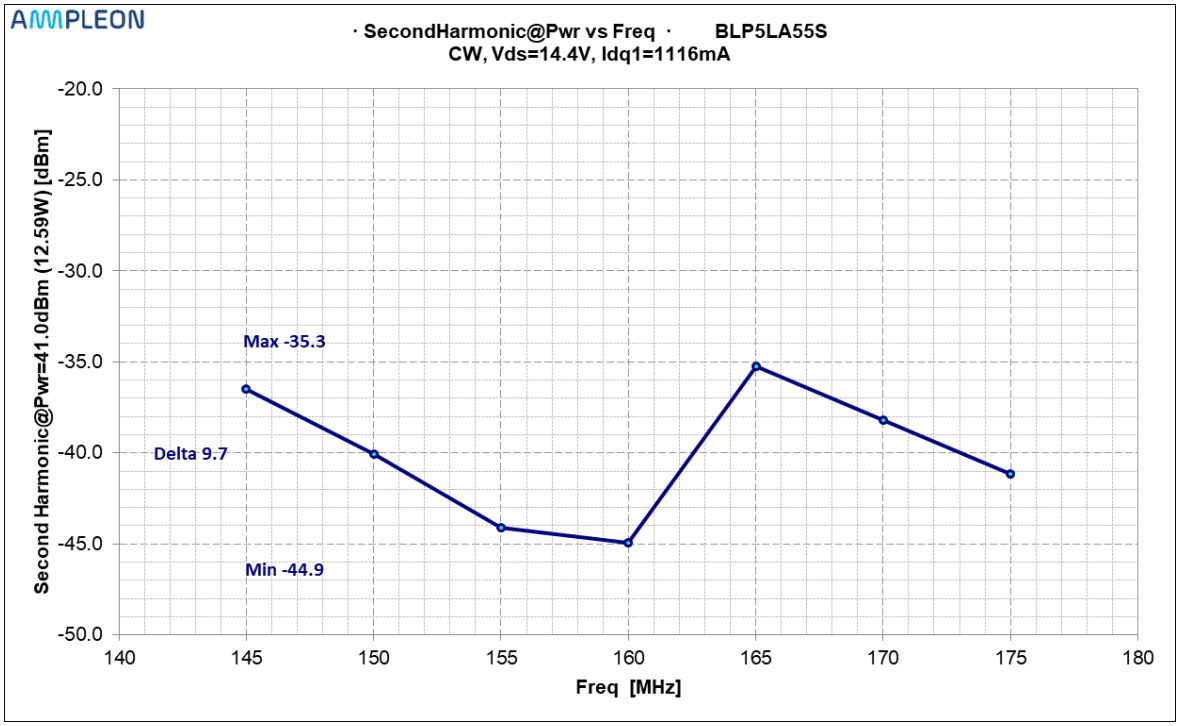

Figure 8 BLP5LA55S_PS_CW_200429_1244 2nd Harmonic vs Pout

8.4 Thermal behavior

The temperature of the demo board is measured with a thermal camera during CW operation.
The bias setting are as follows: Vds=13.8V; Vgs=2.18V; Idq=890mA; Frequency= 175MHz; Pout=60W.
A water-cooled copper plate, with water of 20°C, is used to cool the demo. The inductor at the output gets about 90°C. Other components can get about 55°C.

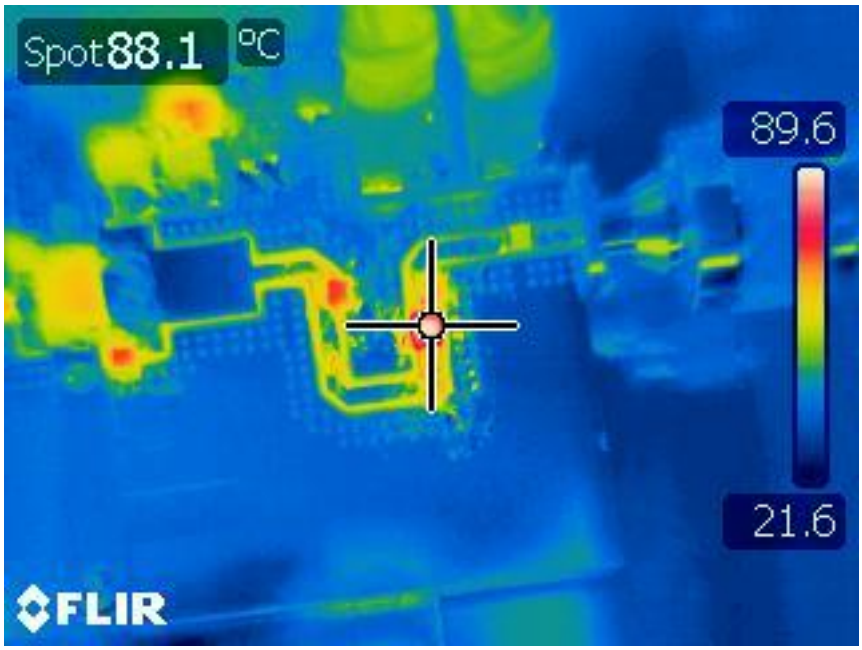

Figure 9 IR_5915 Thermal picture

8.5 Two Carrier signal Intermodulation 145-175 MHz

8.5.1 Gain and efficiency power sweep (two carrier)

Up to 0.6dB Gain compression with two carrier separation of 100kHz.

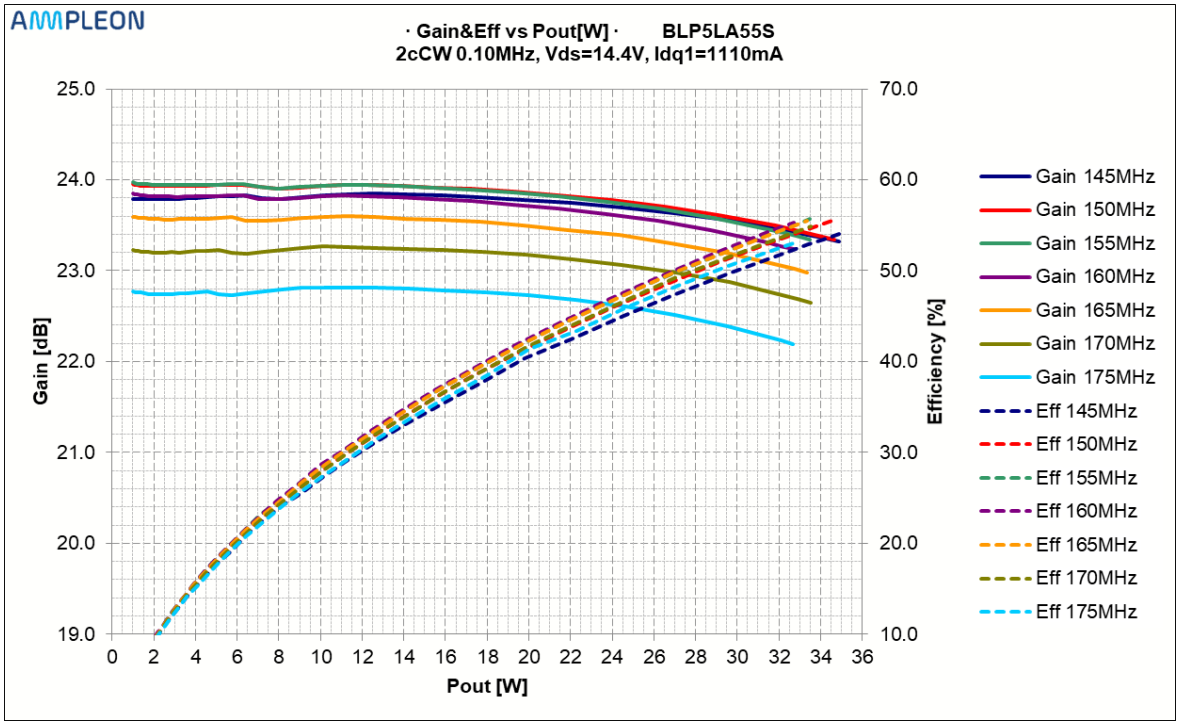

Figure 10 BLP5LA55S_PS_CW_200429_1318 Two carrier Gain&Eff vs Pout[W]

8.5.2 IMD3 & IMD5 (max)

Up to 0.6dB Gain compression with two carrier separation of 100kHz.

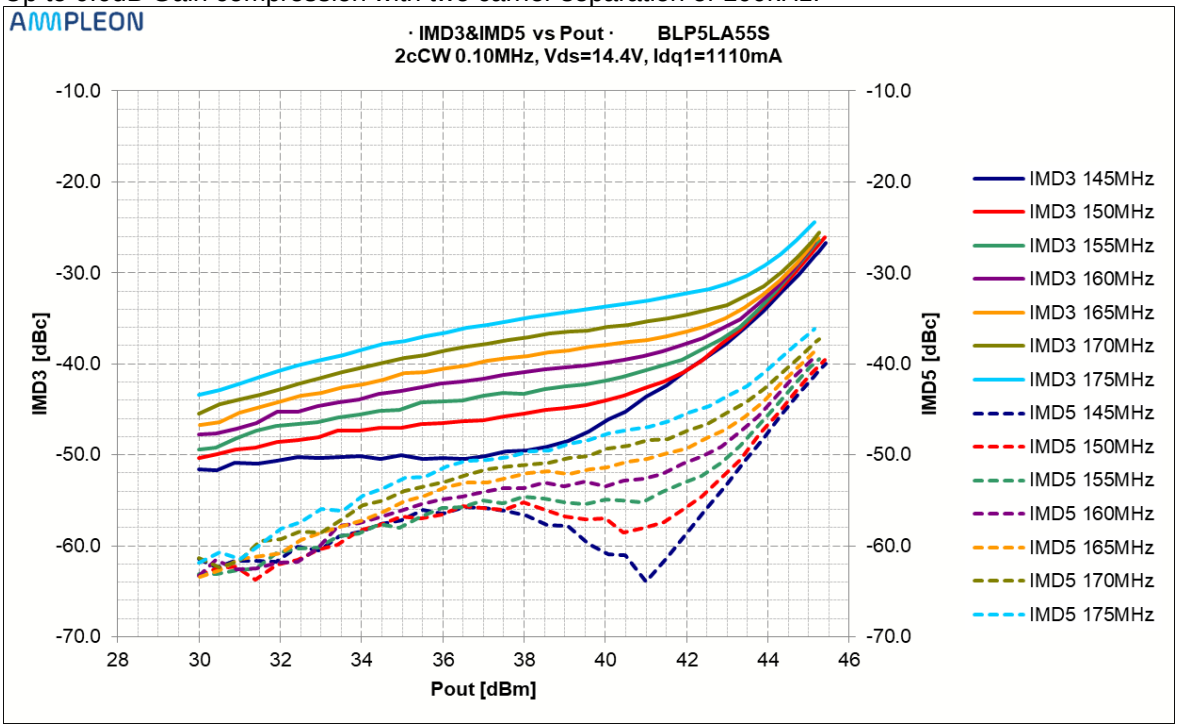

Figure 11 BLP5LA55S_PS_CW_200429_1318 Two carrier IMD3&IMD5 vs Pout[W]

9. Hardware

9.1 Mechanical drawing

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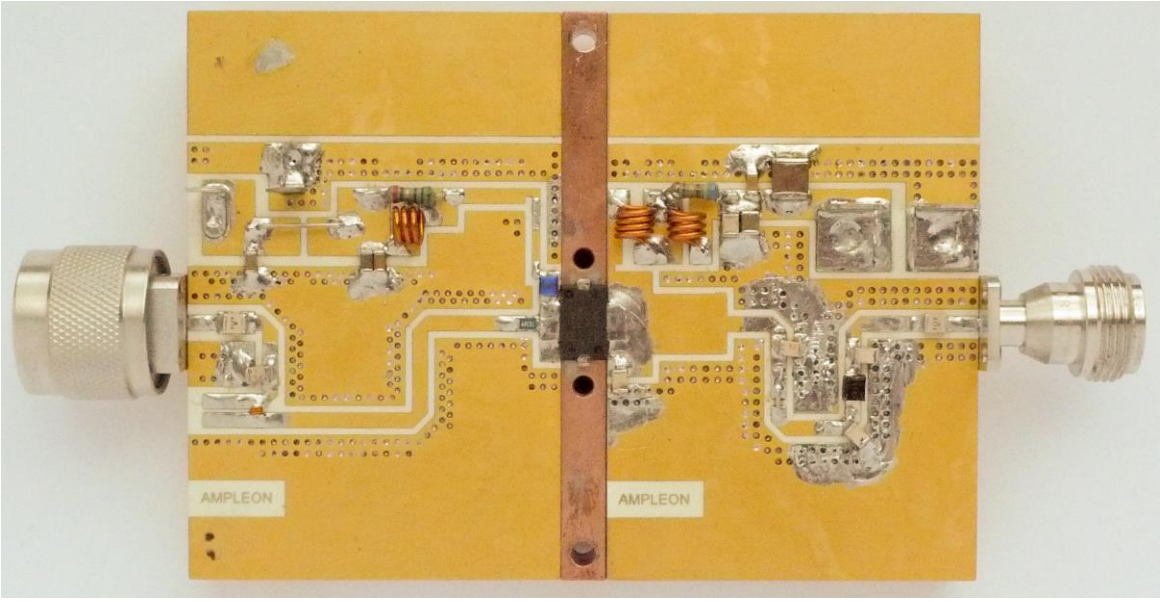
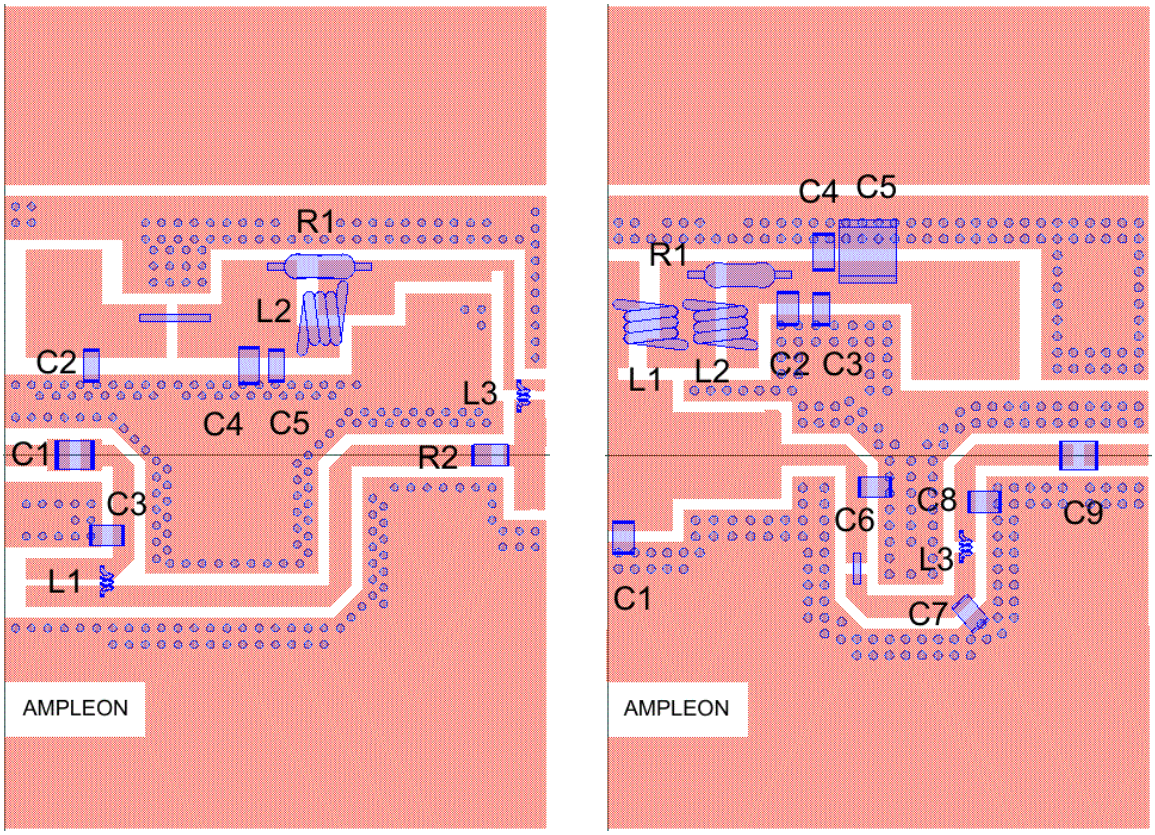
9.2 Board Image



9.3 Board layout

9.3.1 Input & Output



9.4 Bill of materials

9.4.1 Input & Output

Table 5: Bill of Materials input board

Description	Identifier	Value	Manufacturer	Specification
Capacitor	C1	470 pF	ATC	ATC100B
Capacitor	C2, C5	100 nF	KEMET	C1206C104K1RAC
Capacitor	C3	43 pF	ATC	ATC100B
Capacitor	C4	1 uF / 25V	MURATA	GRM31MR71E105KA01L
Inductor	L1	6.9 nH	Coilcraft	0807SQ-6N9
Inductor	L2	~30 nH	wire wound	WD=0.8 mm; N=3; D=3.5 mm; L=3.5 mm
Inductor	L3	39 nH	Coilcraft	1008CS-390XJE
Resistor	R1	51.1 Ohm		0.6 Watt
Resistor	R2	4.3 Ohm		1206

Table 6: Bill of Materials output board

Description	Identifier	Value	Manufacturer	Specification
Capacitor	C1	180 pF	ATC	ATC100B
Capacitor	C2	1 nF	ATC	ATC100B
Capacitor	C3	100 nF	KEMET	C1206C104K1RAC
Capacitor	C4	1 uF / 50V	MURATA	GRM32RR71H105KA01L
Capacitor	C5	10 uF / 50V		50V
Capacitor	C6	160 pF	ATC	ATC100B
Capacitor	C7	62 pF	ATC	ATC100B
Capacitor	C8	33 pF	ATC	ATC100B
Capacitor	C9	330 pF	ATC	ATC100B
Inductor	L1	~60 nH	wire wound	WD=0.8 mm; N=4; D=3.5 mm; L=3.5 mm
Inductor	L2	~30 nH	wire wound	WD=0.8 mm; N=3; D=3.5 mm; L=3.5 mm
Inductor	L3	18.5 nH	Coilcraft	A05TGLB
Resistor	R1	68.1 Ohm		0.6 Watt

9.5 Board material

Table 7: Board specifications

Parameter	Value
Manufacturer	Rogers
Type	RO4350B
Thickness	30mil, 0.762mm>
Layers	Top layer: “cond” ; bottom layer: “cond2”
Layer thickness	35um

9.6 Device markings

Table 8: Device specifics

Parameter	Value
Manufacturer	Ampleon
Device	BLP5LA55S
Marking	BLP5LA55S
Comments	Engineering sample

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