AR231093

ART450FE, 1.8-54MHz

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AMPLEON

Application Report

Document information	
Status	Public
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Abstract	Measurement results of a Class AB design for the 1.8-54MHz band with the ART450FE

1. Revision History

Table 1: Report revisions

Revision	Date	Description	Author
0.1	20230623	Initial document	Tom Brinkman
1.0	20230731	Final	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 AR231093. The device used is a 450W, Advanced Rugged Technology LDMOS, the ART450FE. The presented demo is tuned for maximum efficiency the frequency range: 1.8-54MHz.

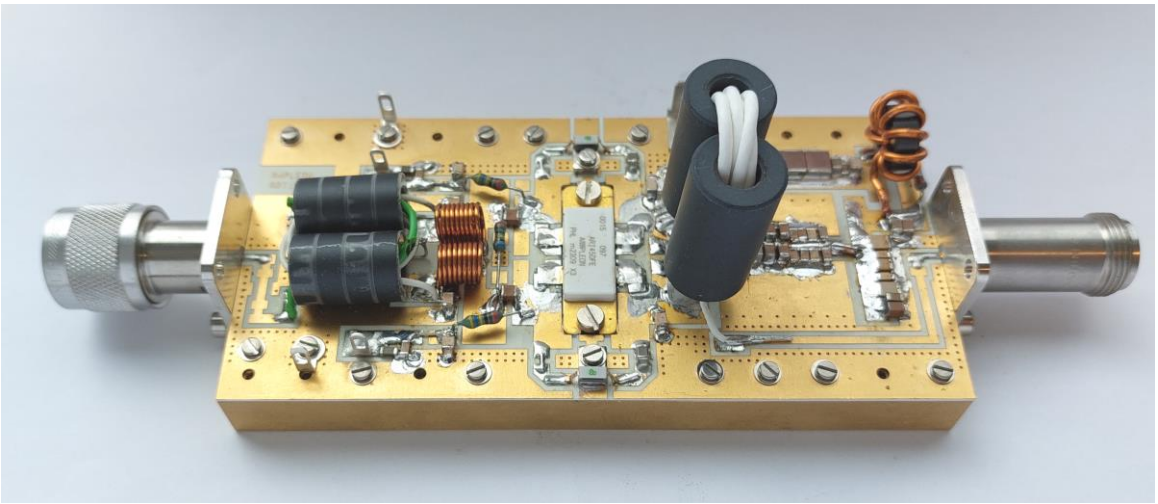

Figure 1 Demo Front view

6. Biasing

The efficiencies presented are based on the currents of the drain feeds only.

I.e. biasing currents for the gate circuitry has not been included.

Unless otherwise stated, the biasing is as follows:

V_{DD}	=	48V
V_{GS1}	=	~2.11V
V_{GS2}	=	~2.08V
I_{DQ}	=	2x 125mA

7. Performance Indication 1.8-54MHz

Table 2: Performance indication, sampled at 1.8-54MHz

Parameter	Condition	Unit	CW
V_{DD}		V	48
S11 at connector		dB	<-2.8
P_{1dB}[1]	G_{MAX}-1dB	Watt	200
P_{3dB}[1]	G_{MAX}-3dB	Watt	275
P_{OUT} of operation	***P_o***[2]	Watt	***200***
Gain	**@P_o**	dB	>21
Drain Efficiency	**@P_o**	%	>50
Drain Efficiency	**@ 3dB comp.**	dB	>60

[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

Swept to 3dB compression

8.1.1 Gain and efficiency (3dB sweep) 48V.

Table 3: CW Performance

Freq [MHz]	MaxGain [dB]	P1dB [W]*	Eff@P1dB [%]*	P3dB [W]*	Eff@P3dB [%]*
1.600	40.7	312.55	70.3	383.46	76.7
1.800	40.6	309.60	70.1	379.19	76.2
2.000	40.6	304.35	69.6	373.93	75.7
3.750	39.9	307.23	69.3	364.92	73.8
5.360	39.2	303.36	69.4	357.49	73.2
7.150	38.4	300.20	69.5	356.79	73.6
10.125	36.7	304.44	67.4	358.54	71.6
14.175	34.7	290.09	66.0	329.69	68.7
18.118	33.2	268.32	64.2	311.47	67.2
21.225	31.8	240.30	61.1	292.60	65.5
24.940	30.6	198.39	54.8	275.14	62.5
28.850	29.4	176.86	51.1	280.77	62.6
50.000	27.1	214.03	53.4	271.69	58.3
54.000	27.0	215.83	52.9	287.24	59.1
60.000	25.8	224.35	52.6	301.20	59.3
58.4	14.850	135.698	19.187	111.770	18.342

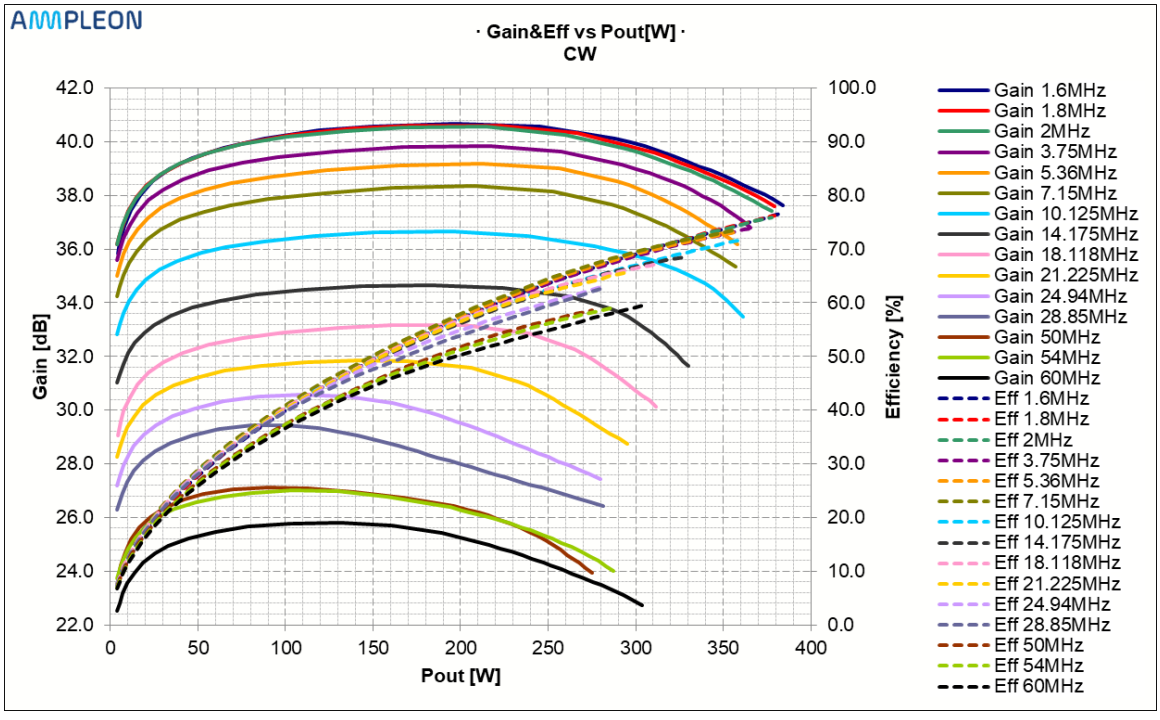

Figure 2 ART450FE_PS_CW_230728_1552_1549_1537 Gain&Eff vs Pout[Watt]

8.2 CW Signal performance over 1.8-54 MHz

8.2.1 Gain

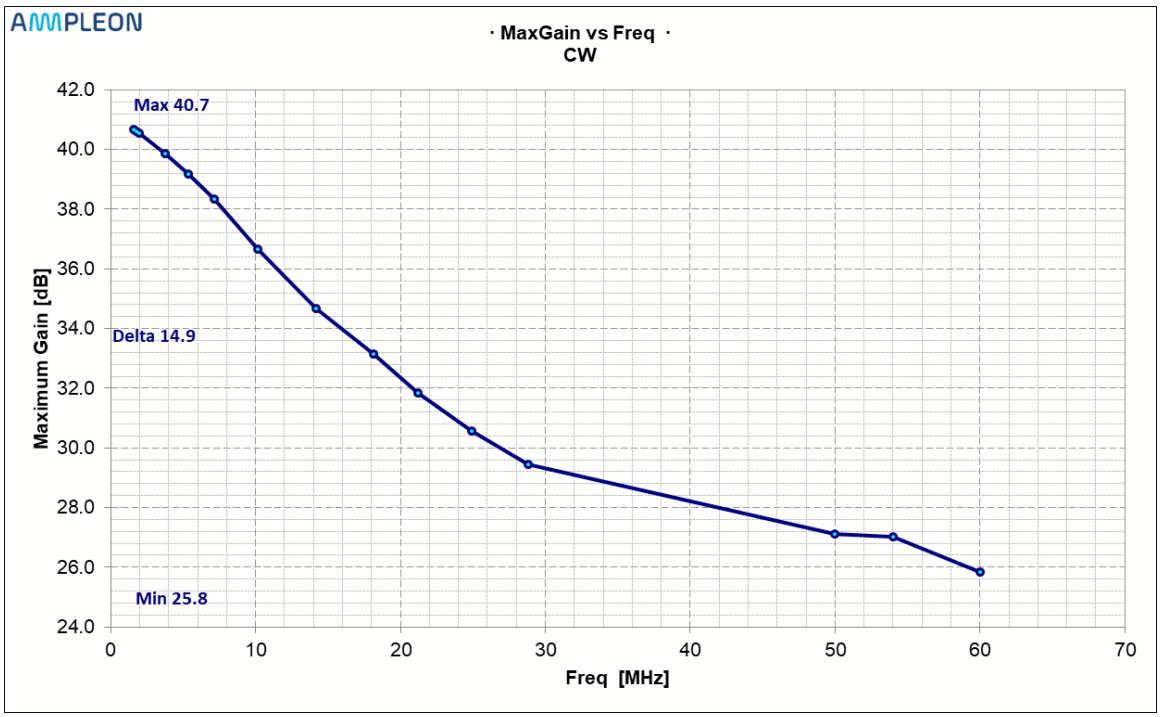

Figure 3 ART450FE_PS_CW_230728_1552_1549_1537 MaxGain vs Freq

8.2.2 Efficiency at Pout = 200 Watt

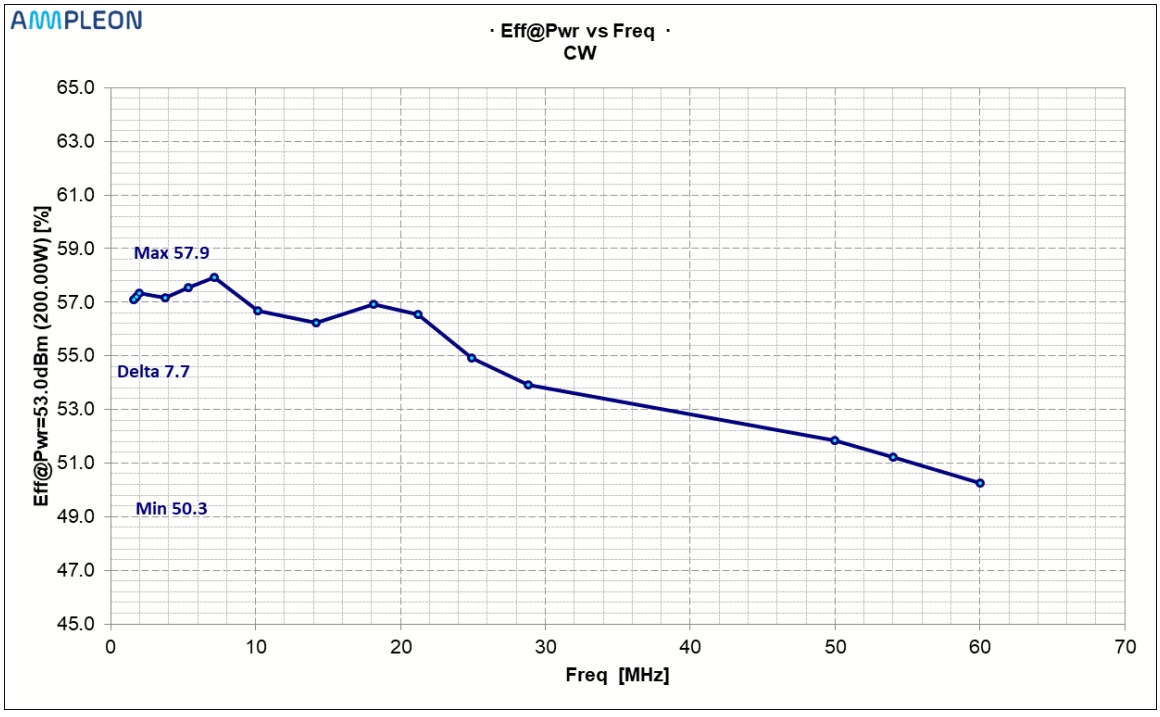

Figure 4 ART450FE_PS_CW_230728_1552_1549_1537 Eff (200W) vs Freq

8.2.3 Input Return loss at Pout = 200 Watt

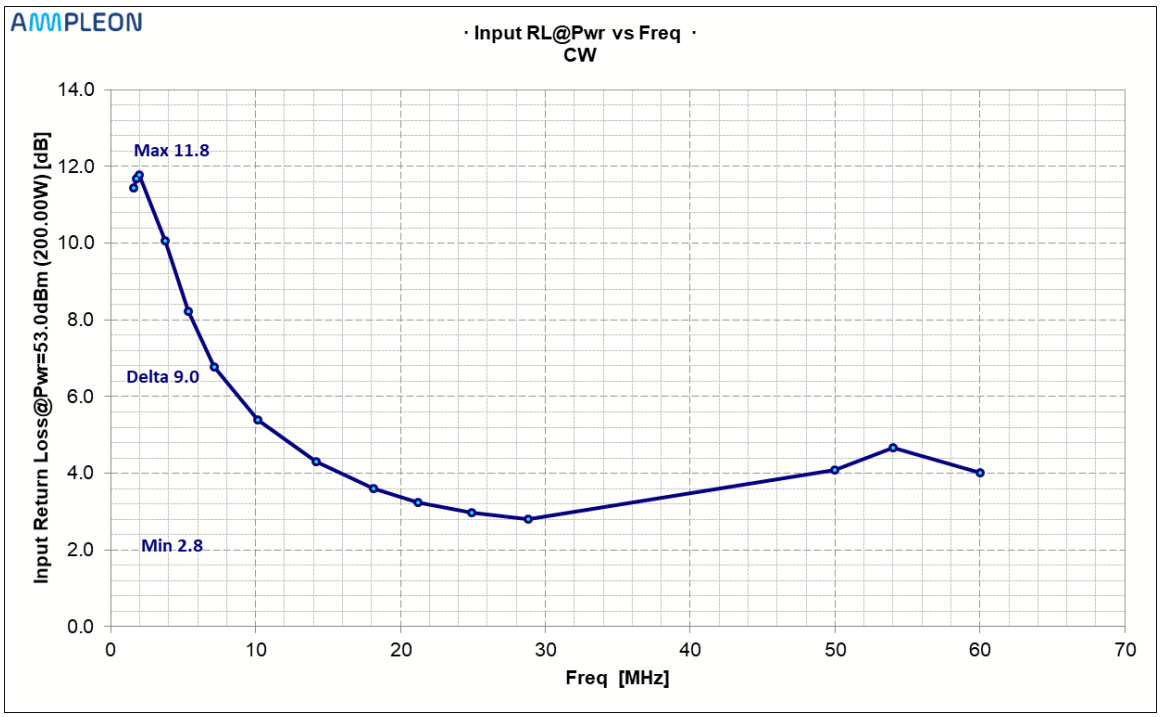

Figure 5 ART450FE_PS_CW_230728_1552_1549_1537 IRL vs Freq

8.2.4 1dB compression power

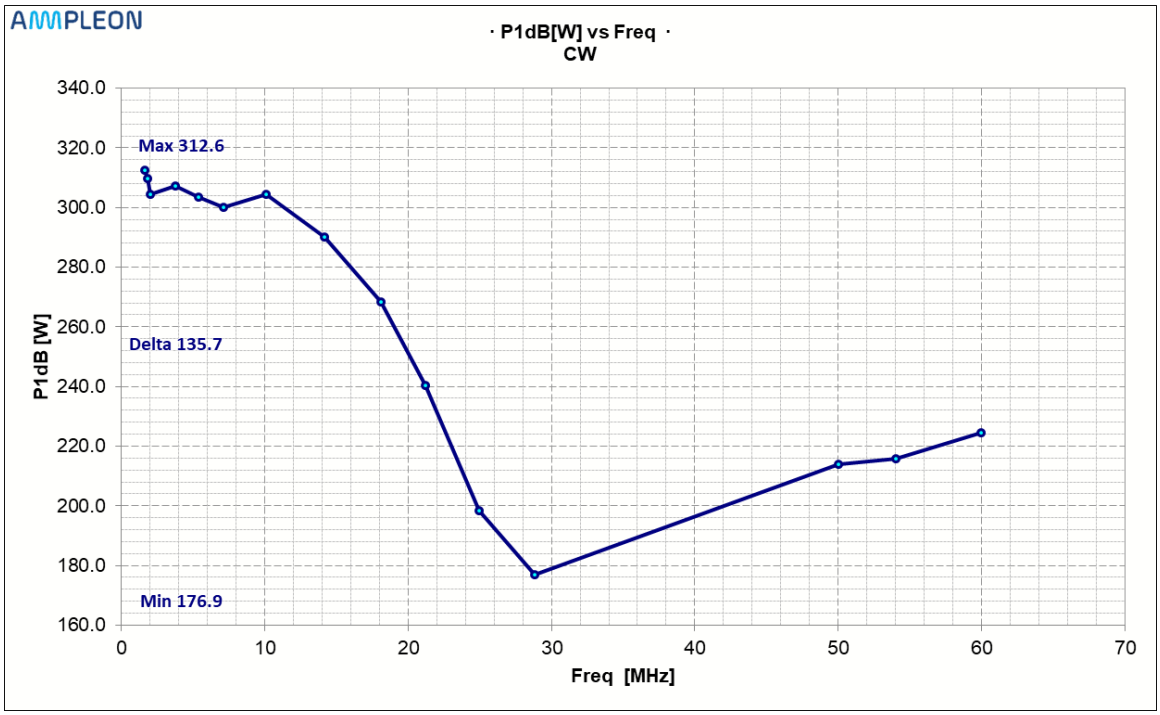

Figure 6 ART450FE_PS_CW_230728_1552_1549_1537 P1dB vs Freq

9. Thermal behavior

9.1 Frequency 14.175 MHz

The baseplate of the demo board is mounted on a copper cooling plate which is cooled with water of 20°C. After one minute of operation at Pout = ~200 Watts (CW), the temperature of the ART450FE stabilizes around 80°C. The 100nF bias capacitors get around 90°C.

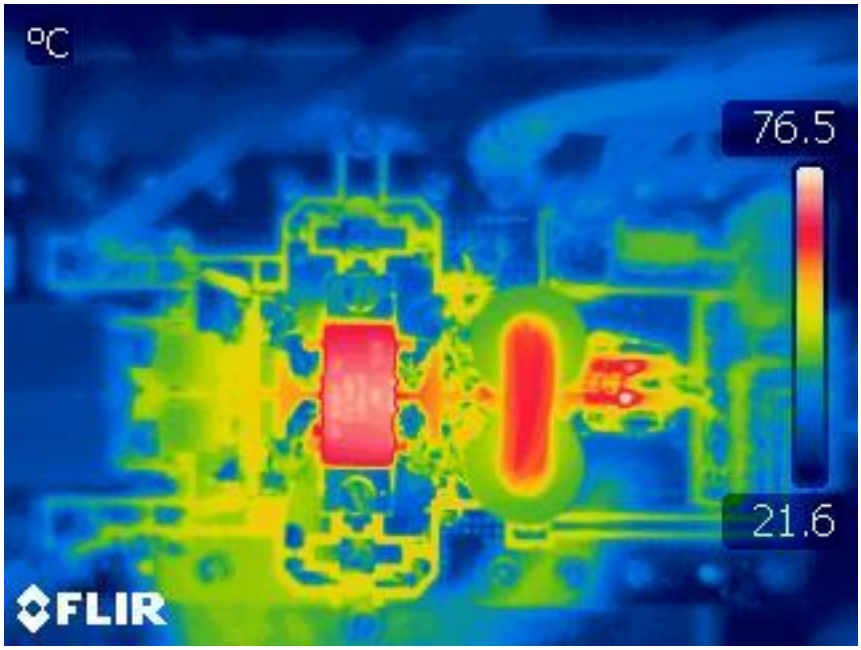

Figure 7 Infrared picture 14.175 MHz Transistor 80° C

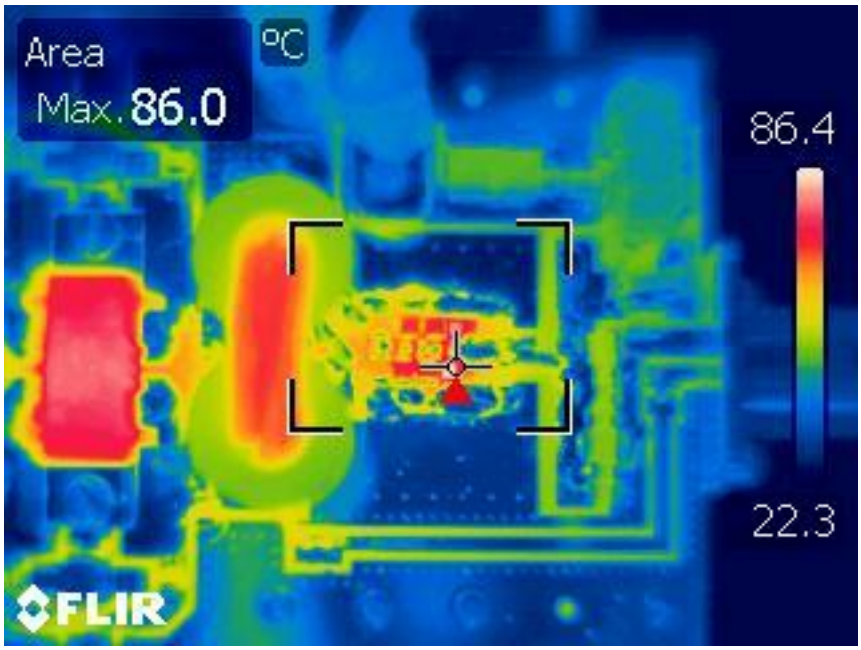

Figure 8 Infrared picture 14.175 MHz Bias capacitor 90° C

9.2 Frequency 54 MHz

At this frequency the temperature of the coax (TC-24) used in the output transformer gets **very hot** when running 200 Watts CW at 54 MHz. Therefore, at this frequency the pictures below are taken after a few seconds.

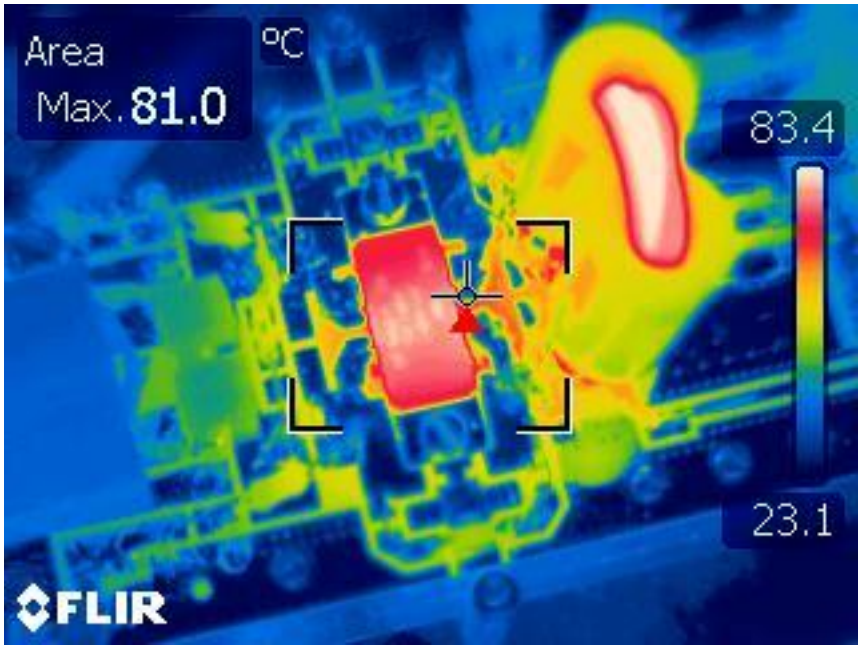

Figure 9 Infrared picture 54 MHz Transistor 80° C

Figure 10 Infrared picture 54 MHz Output transformer cable >90° C

10.Hardware

10.1 Board Image

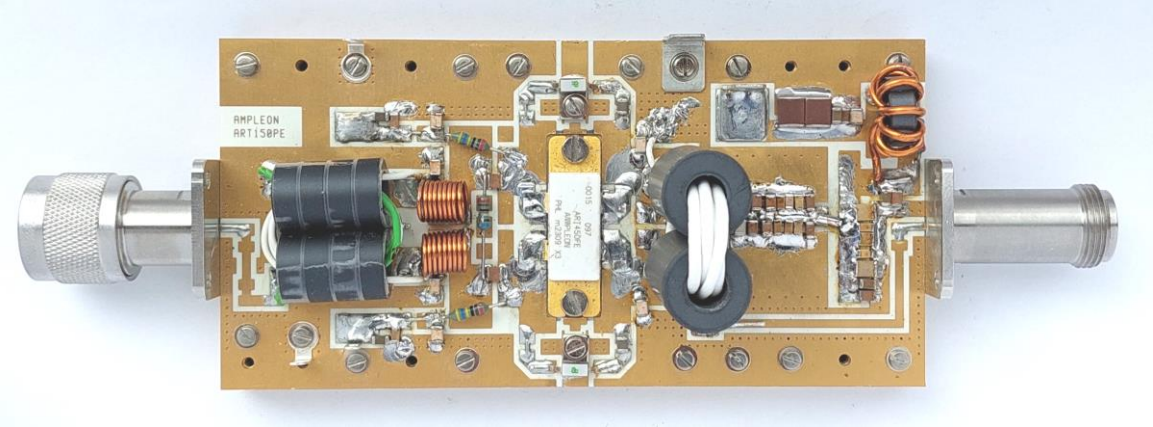

Figure 11 Demo Top View

10.2 Board layout

10.2.1 Input & Output

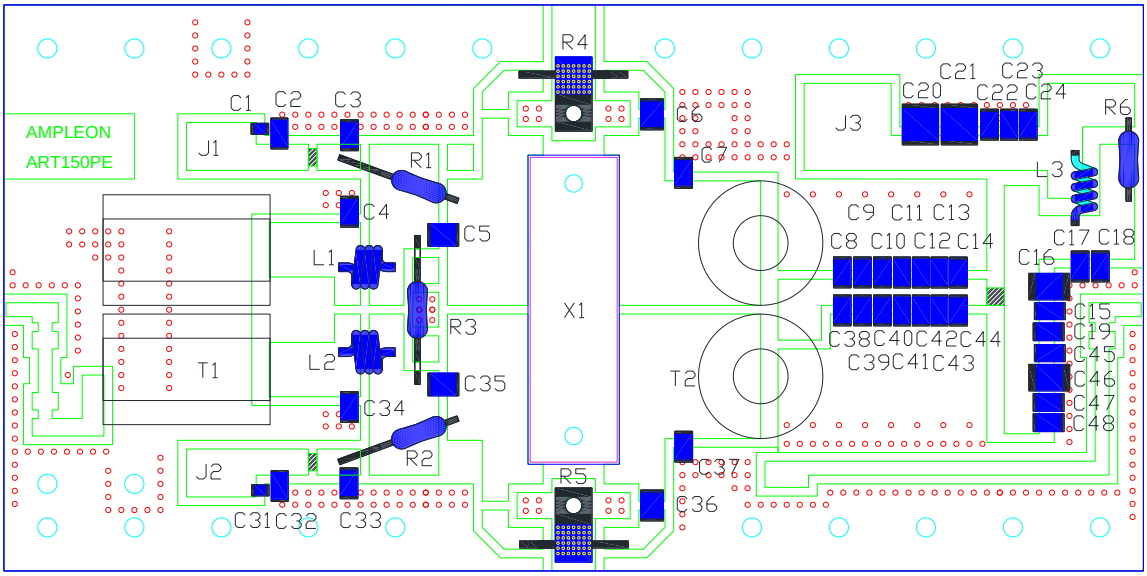

Figure 12 Demo PCB component placement

10.3 Bill of materials

10.3.1 Input & Output

Table 4: Bill of Materials

Description	Identifier	Value	Manufacturer	Specification
Circuit board	PCB	-	Cibel	Rogers 4350 / thickness 30 mil
Transistor	X1		Ampleon	ART450FE
Input balun	T1	1:4 balun	-	#43 material (8x Amidon FT-50-43)/ wire
Output balun	T2	1:4 balun	-	2x Fair-rite #61 material 26-61 54 0002 / TC-24 24 Ohm flexible coax cable from Communication Concepts Inc.
Resistor	R1, R2	464 Ohm		
Resistor	R3	604 Ohm		
Resistor	R4, R5	200 Ohm / 20W	ATC	FR10300N0200J
Resistor	R6	7.97 Ohm		
Inductor	L1, L2		wirewound	Wire diameter = 0.8mm; Diameter = 6mm; Turns = 9
Inductor	L3		wirewound	Wire diameter = 1.5mm; Turns = 8; Ferrite material = FT-50-43 (#43 material)
Capacitor	C1, C31	1 uF		25V
	C2, C11, C12, C23, C32, C41, C42	100 nF		50V; C1206C104K1RAC
Capacitor	C3, C8, C24, C33, C38	1 nF	ATC	ATC100B
Capacitor	C4, C34	430 pF	ATC	ATC100B
Capacitor	C5, C9, C18 C35, C39, C48	10 nF	ATC	ATC200B
Capacitor	C6, C36	1.8 nF	Passive Plus	
Capacitor	C7, C37	120 pF	ATC	ATC100B
Capacitor	C10, C40	20 nF	ATC	ATC200B
Capacitor	C13, C15, C43, C45	220 nF	AVX	50V; 12065C224KAT2A
Capacitor	C14, C44	330 nF		
Capacitor	C16, C46	470 nF		
Capacitor	C17, C22, C47	1 uF	Mutata	GRM32RR71H105KA01L
Capacitor	C19	10 nF	AVX	AVX 0.01u/100V 12101C103KAT2A
Capacitor	C20, C21	10 uF	TDK	50V; TDK C3225X7R 2A 106K

10.4 Schematic

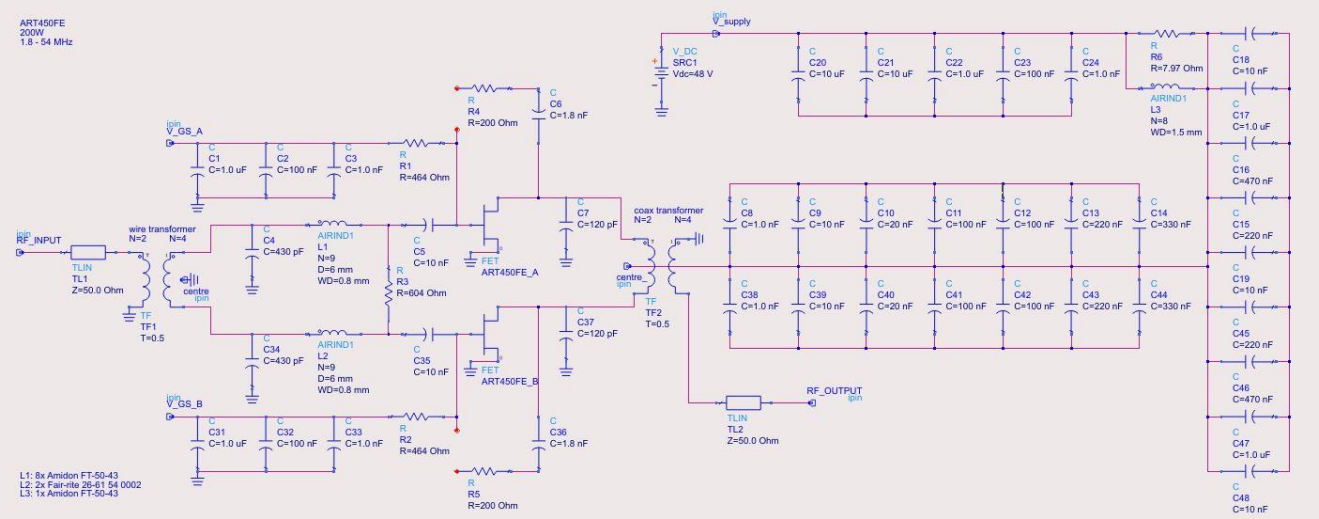

Figure 13 Schematic Components number and values

10.5 Board material

Table 5: Board specifications

Parameter	Value
Manufacturer	Rogers
Type	Rogers RO4350B
Thickness	30mil, 0.762 mm
Layers	Two layers. Bottom layer: all copper
Layer thickness	35um

10.6 Device markings

Table 6: Device specifics

Parameter	Value
Manufacturer	Ampleon
Device	ART450FE
Marking	M2309 X3
Comments	Engineering samples

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