AR202037

CLF3H0035-100

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AMPLEON

Application Report

Document information

Info	Content
Status	General Publication
Author(s)	Bob Bartola
Abstract	Test report AR202037 demonstrates the wideband performance of the Ampleon Gen3 CLF3H0035-100 GaN device. Linear operation was measured in the 500-2500 MHz band. >100W P-3dB. was measured with a pulsed signal and >80W with a CW signal applied.

1 Revision History

Table 1. Report revisions

Revision No.	Date	Description	Author
1.0	20200605	Initial document	Bob Bartola
2.0	20211122	Changed to General Publication	Bill Goumas

2 Contents

3 List of Figures

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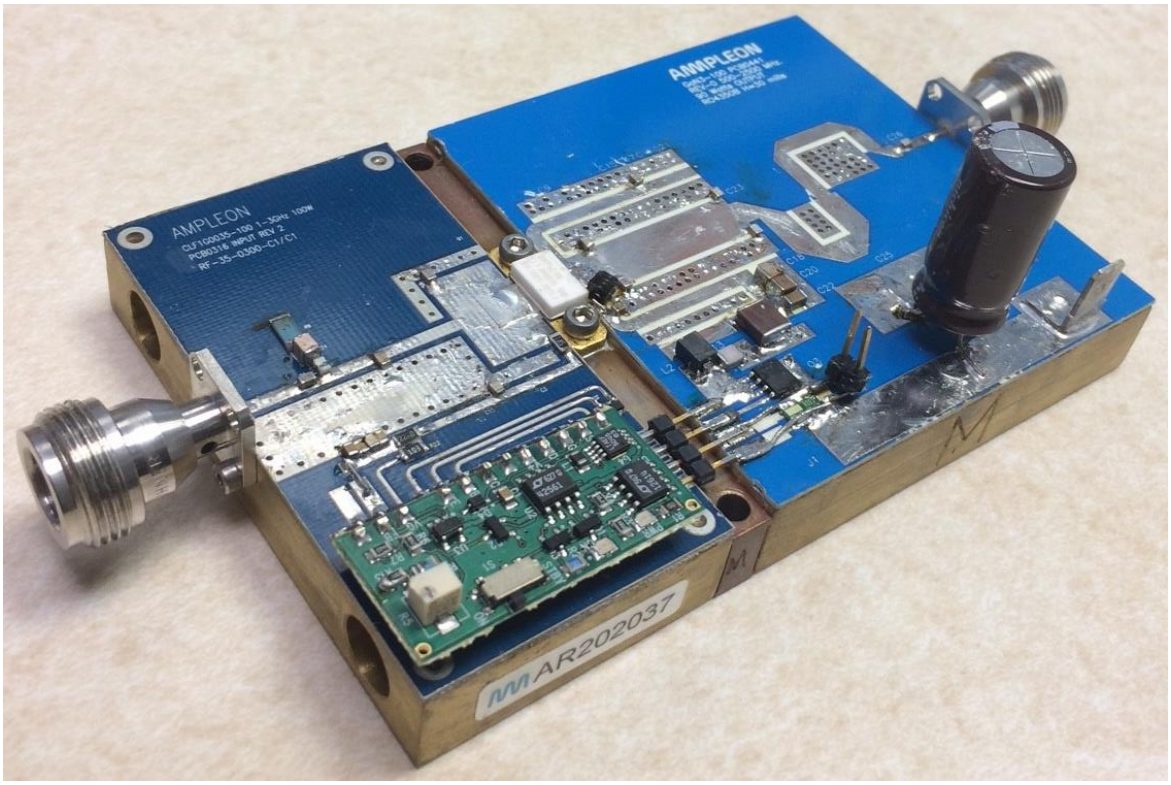
5 General Description

Test report AR202037 demonstrates the wideband performance of the Ampleon Gen3 CLF3H0035-100 GaN device. Linear operation was measured in the 500-2500 MHz band. >100W P-3dB. was measured with a pulsed signal and >80W with a CW signal applied. Good broadband efficiency was also demonstrated. Note that the input PCB and output PCB are different materials. Future demo will have the same PCB types and improved CW 1300 MHz performance will be addressed.

Figure 1. Picture of CLF3H0035-100 AR202037 Demo



Internal on-board Demo Circuit large value Storage Capacitors:

1.) 10uF Chip Cap
2.) 470uF/63V Electrolytic

External Storage Capacitors:

1.) 2 X 470uF/63V
2.) 14,000 uF/75V.

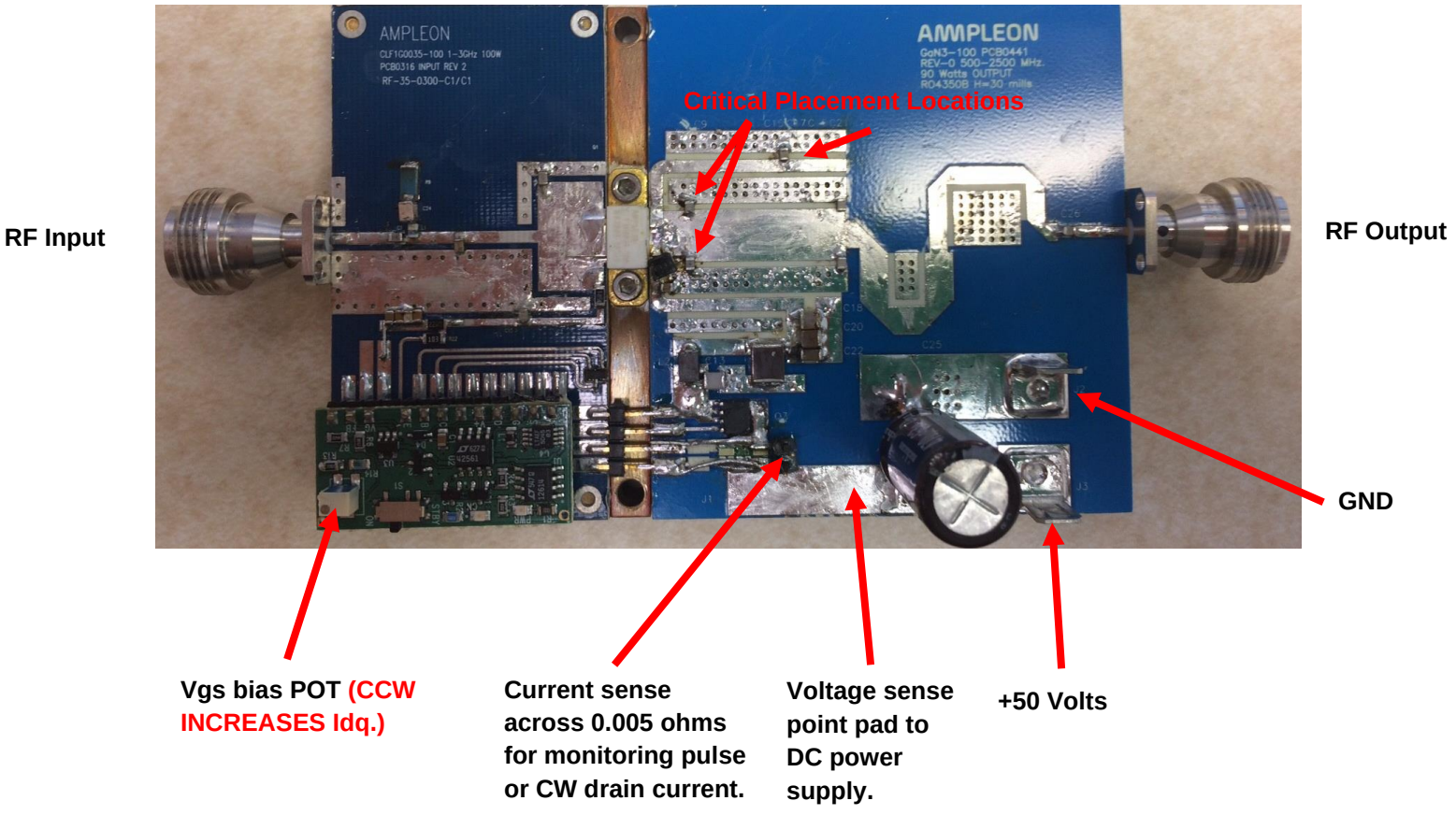
6 Biasing

6.1 AR202037 Bias Levels, DC, and RF locations

The RF performance presented are based on the bias levels below:

Vds = 50V
Idq=300 mA.

Figure 2. Bias control, DC, and RF locations



7 Performance Indicators

Table 2. General performance

Parameter	Condition	Unit			
Vds	N/A	V	50		
Idq	Vds=50V	mA.	300		
Frequency			500 MHz	1500 MHz	2500 MHz
P-1dB	100uS 30%	Watts	75	110	90
P-3dB	100uS 30%	Watts	100	145	110
Gain @ 100 W	100uS 30%	dB.	14	13.5	14
Gain @ P-1dB	100uS 30%	dB.	15.8	13.2	15
Efficiency @ 100 W	100uS 30%	%	72	56	50
Efficiency @ P-1dB	100uS 30%	%	67	58	48
Efficiency @ P-3dB	100uS 30%	%	73	66	50
Small Signal Input Return Loss	Vds=50V Idq=300mA.	dB.	1	3.8	20
Small Signal Gain	Vds=50V Idq=300mA.	dB.	17.4	15.4	16.9
P-1dB	CW	Watts	70	90	75
P-3dB	CW	Watts	102	135	102
Gain @ 90 W	CW	dB.	14.3	12.5	13.5
Gain @ P-1dB	CW	dB.	15.5	12.5	14.4
Efficiency @ 90 W	CW	%	69	53	46
Efficiency @ P-1dB	CW	%	64	53	44
Efficiency @ P-3dB	CW	%	72	64	47

8 Performance Details

8.1 Graph Data

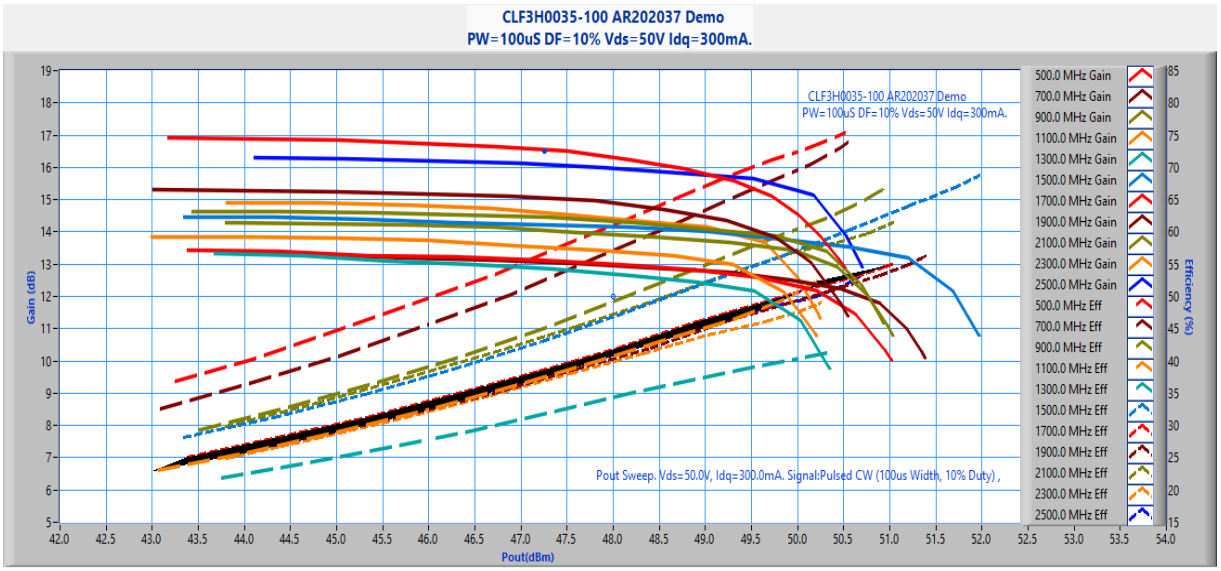


Figure 3. 500-2500 MHz Pulsed CW Gain and Efficiency vs. Pload(dBm.) PW=100uS DF=10%

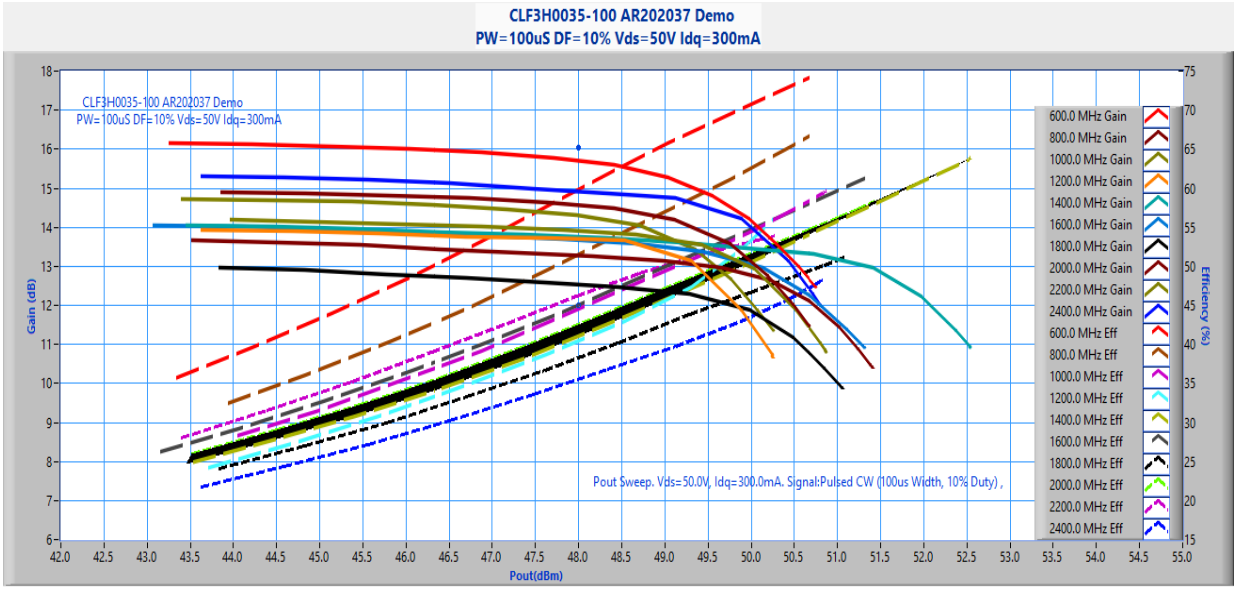


Figure 4. 600-2400 MHz Pulsed CW Gain and Efficiency vs. Pload(dBm.) PW=100uS DF=10%

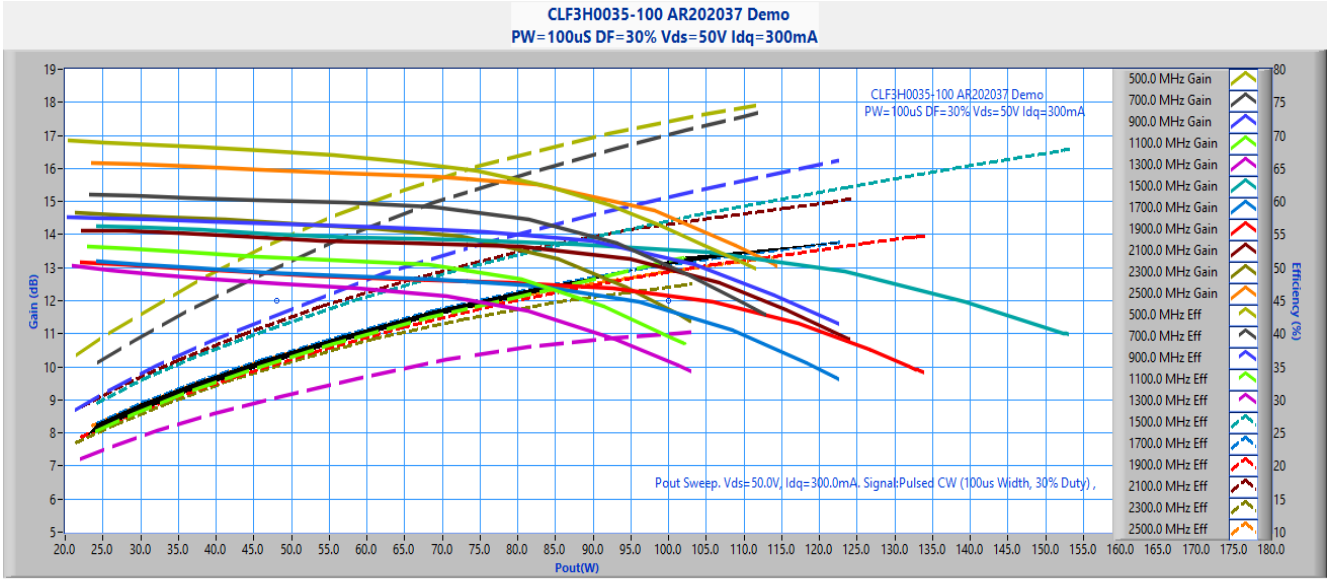


Figure 5. 500-2500 MHz Pulsed CW Gain and Efficiency vs. Pload (Watts) PW=100uS DF=30%

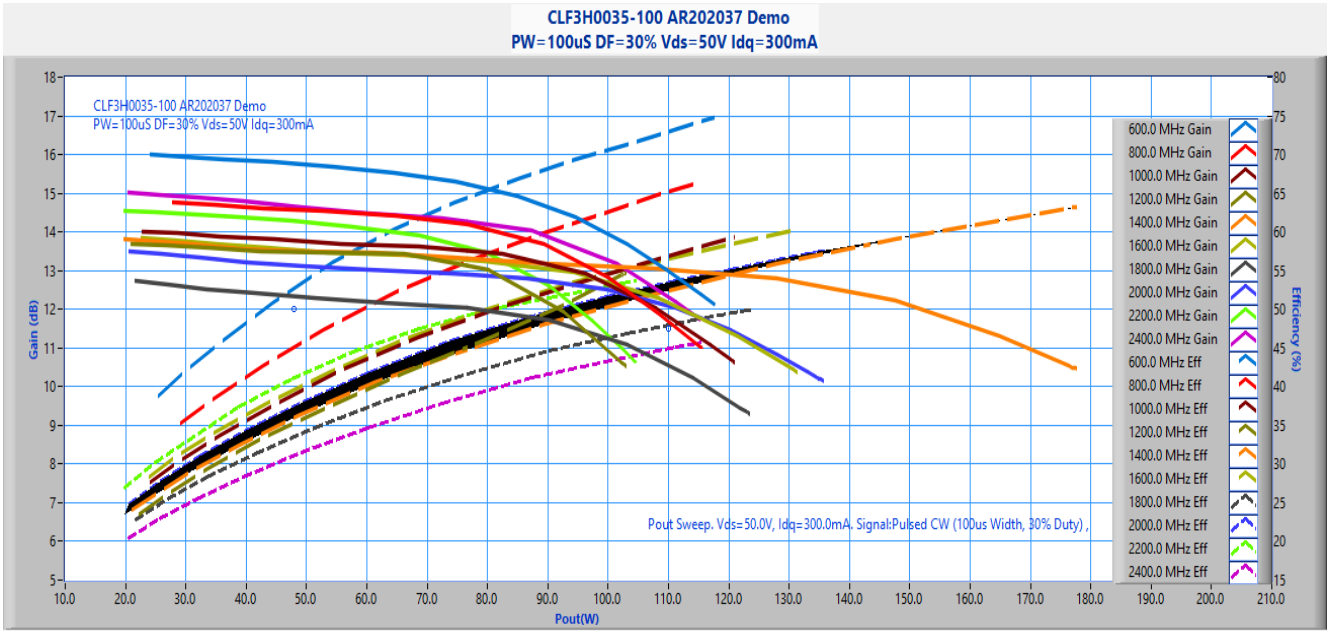


Figure 6. 600-2400 MHz Pulsed CW Gain and Efficiency vs. Pload (Watts) PW=100uS DF=30%

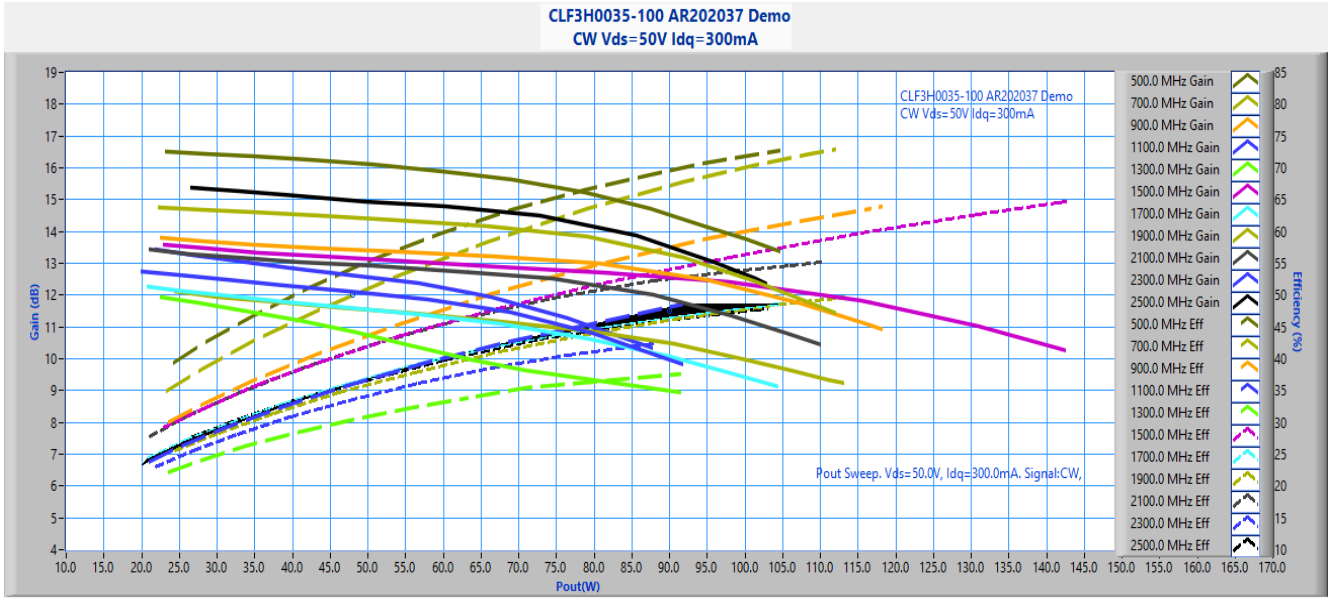


Figure 7. 500-2500 MHz CW Gain and Efficiency vs. Pload (Watts)

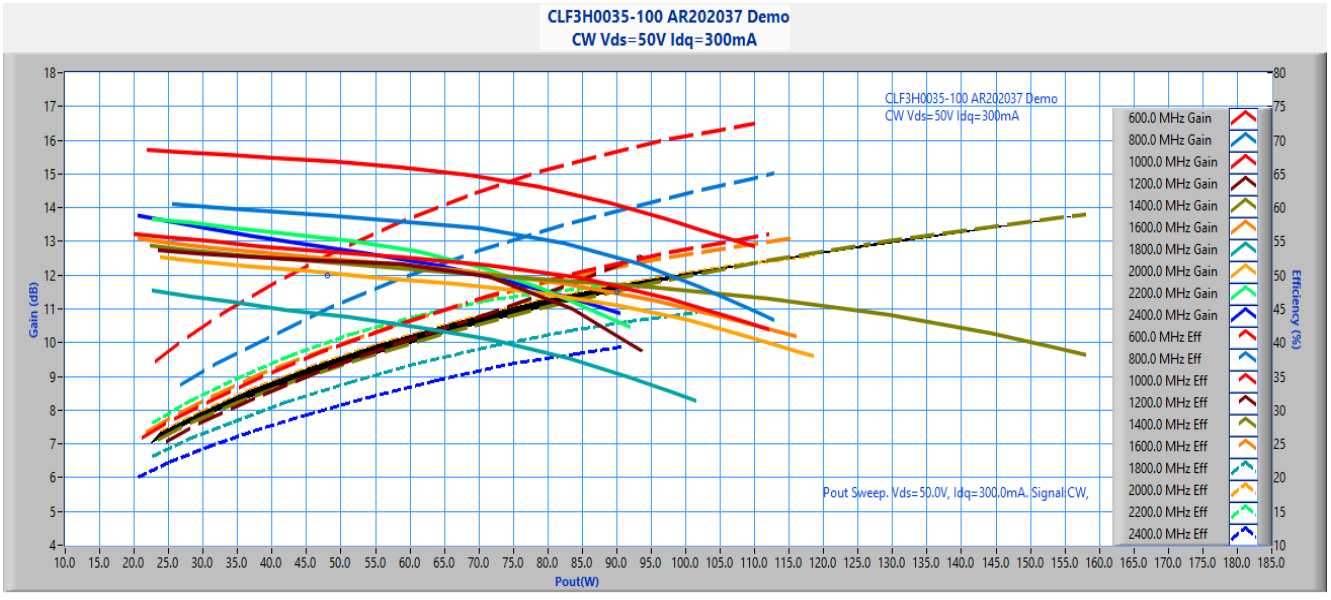


Figure 8. 600-2400 MHz CW Gain and Efficiency vs. Pload (Watts)

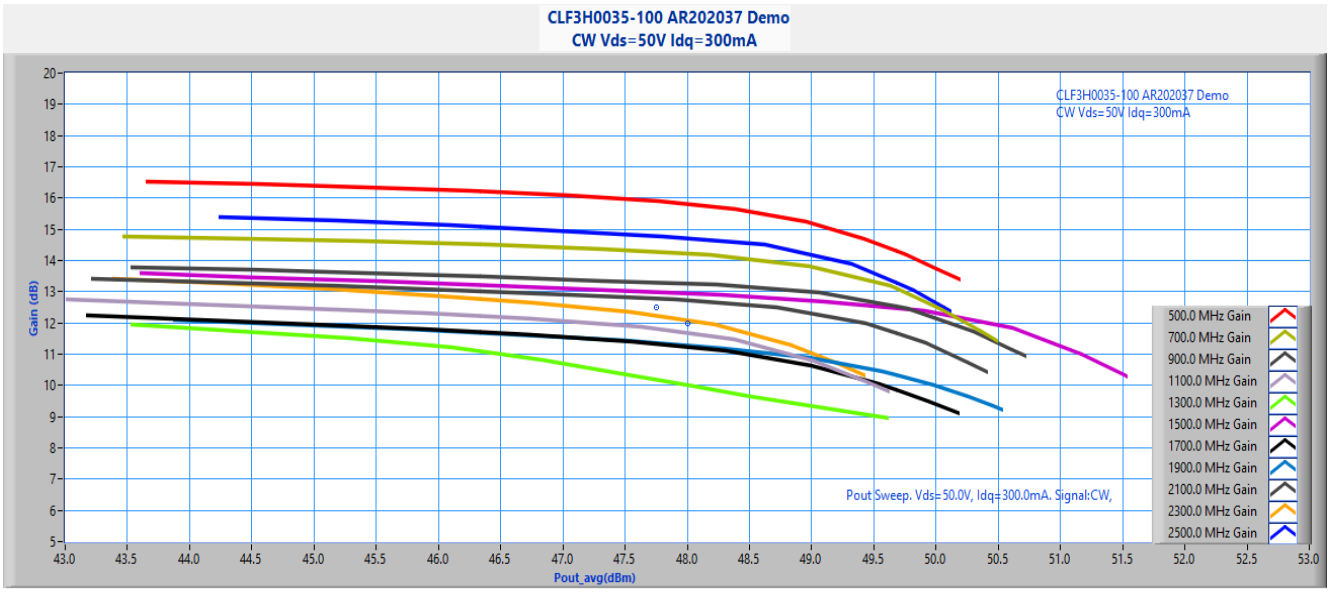


Figure 9. 500-2500 MHz CW Gain vs. Pload (dBm.)

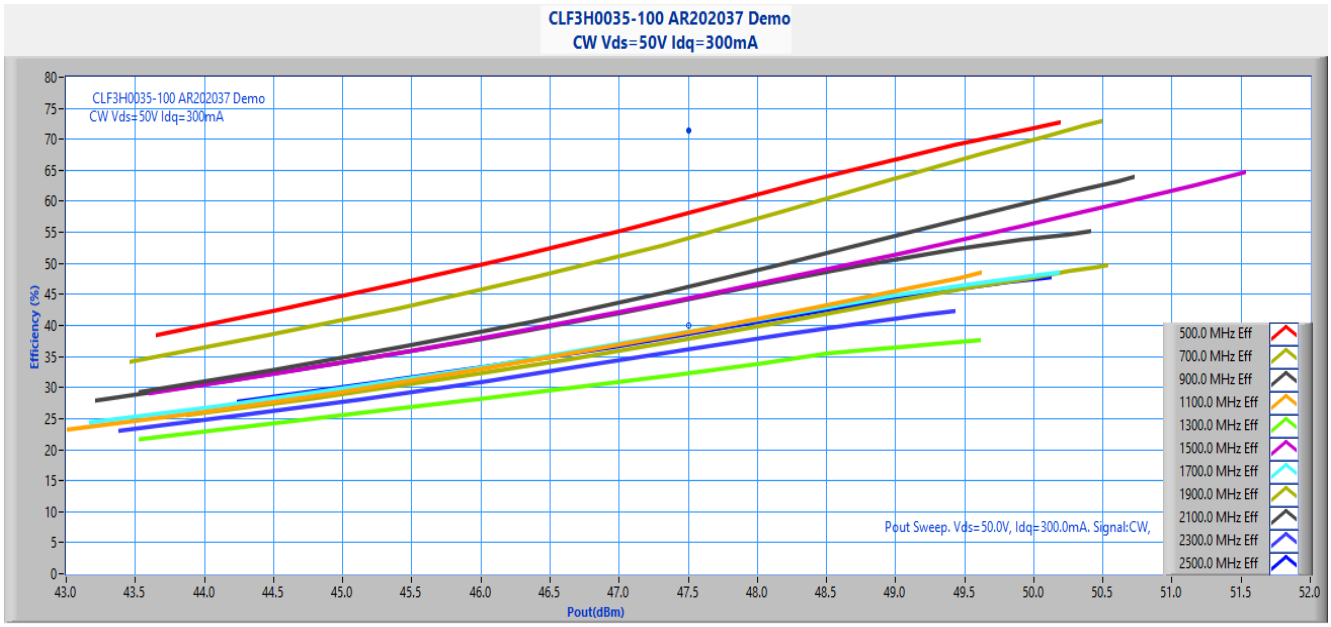


Figure 10. 500-2500 MHz CW Efficiency vs. Pload (dBm.)

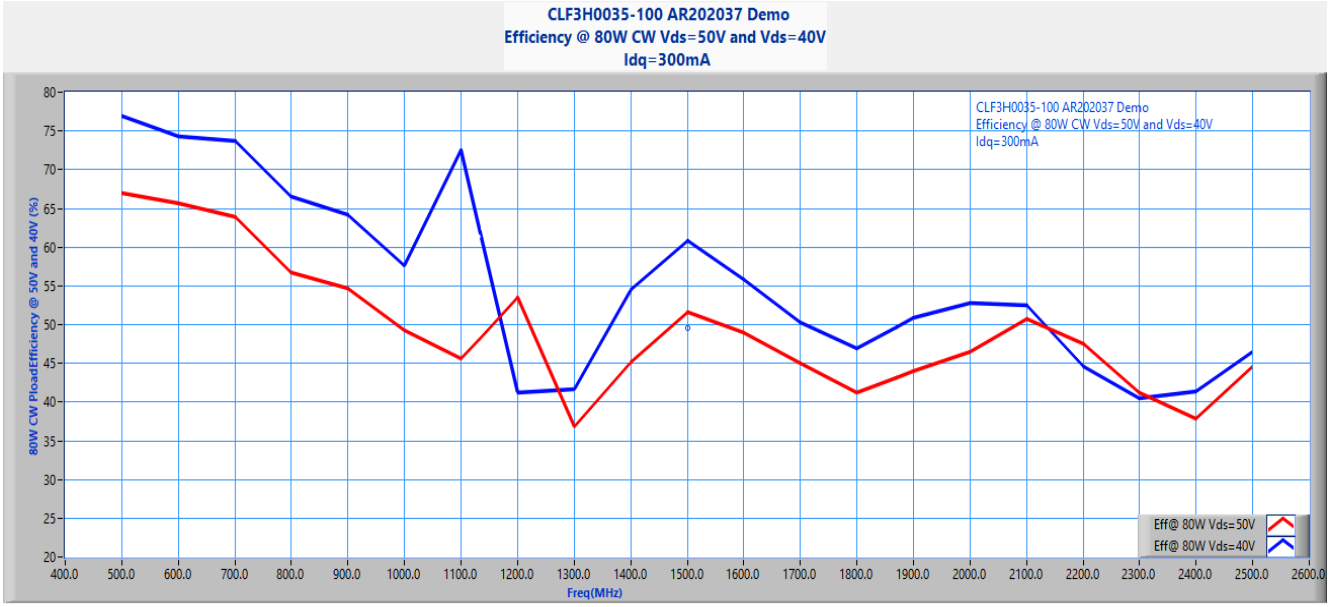


Figure 11. Compare Efficiency at 80W CW Vds= 50V and 40V vs. Frequency (MHz.)

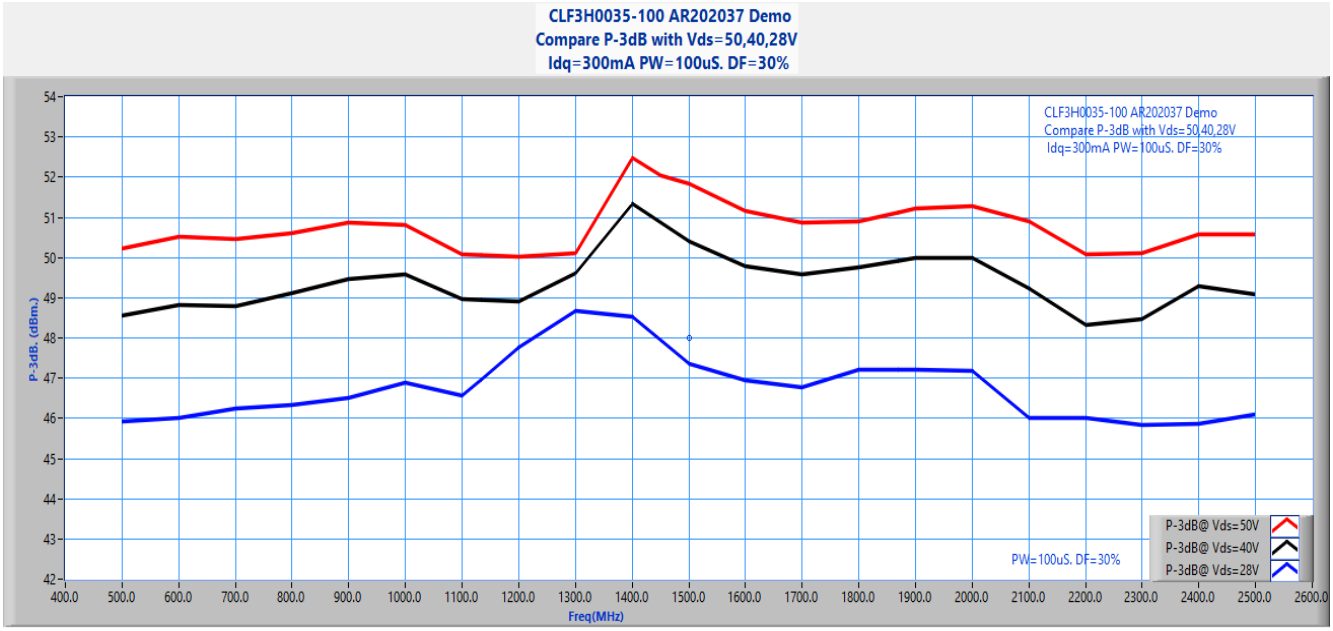


Figure 12. Compare P-3dB. Pulsed CW PW=100uS DF=30% Vds= 50V,40V, and 28V vs. Frequency (MHz.)

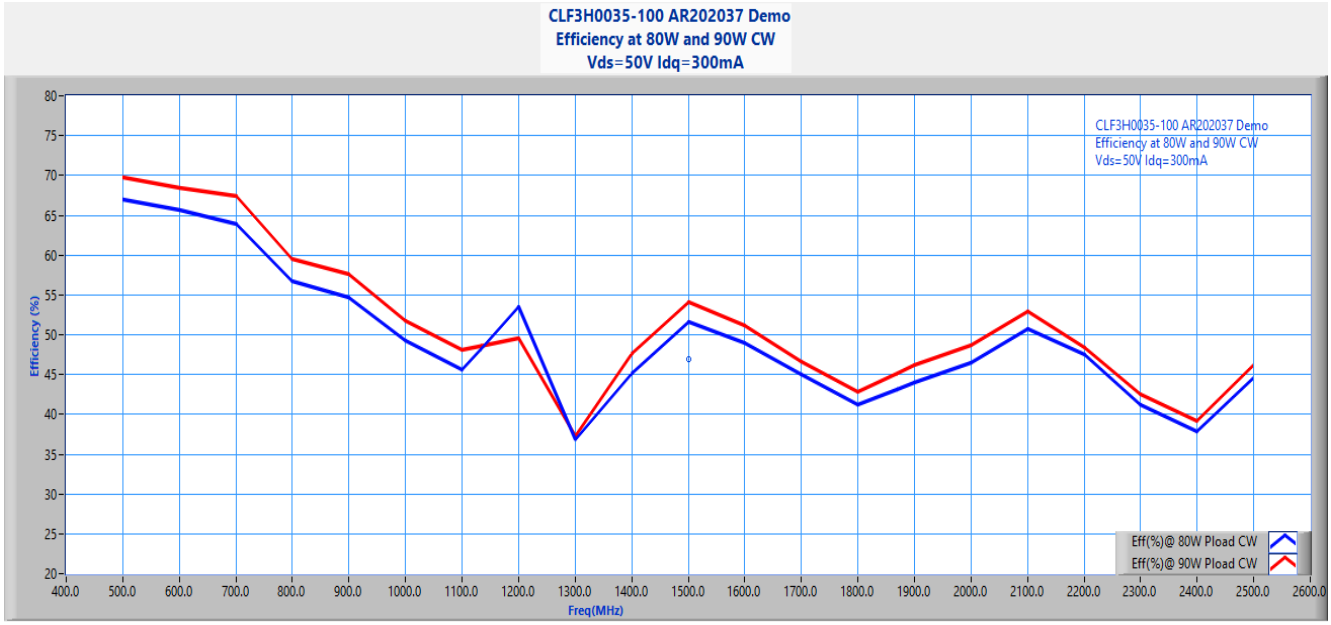


Figure 13. Compare CW Efficiency at 80W and 90W Vds= 50V Idq=300mA. vs. Frequency (MHz.)

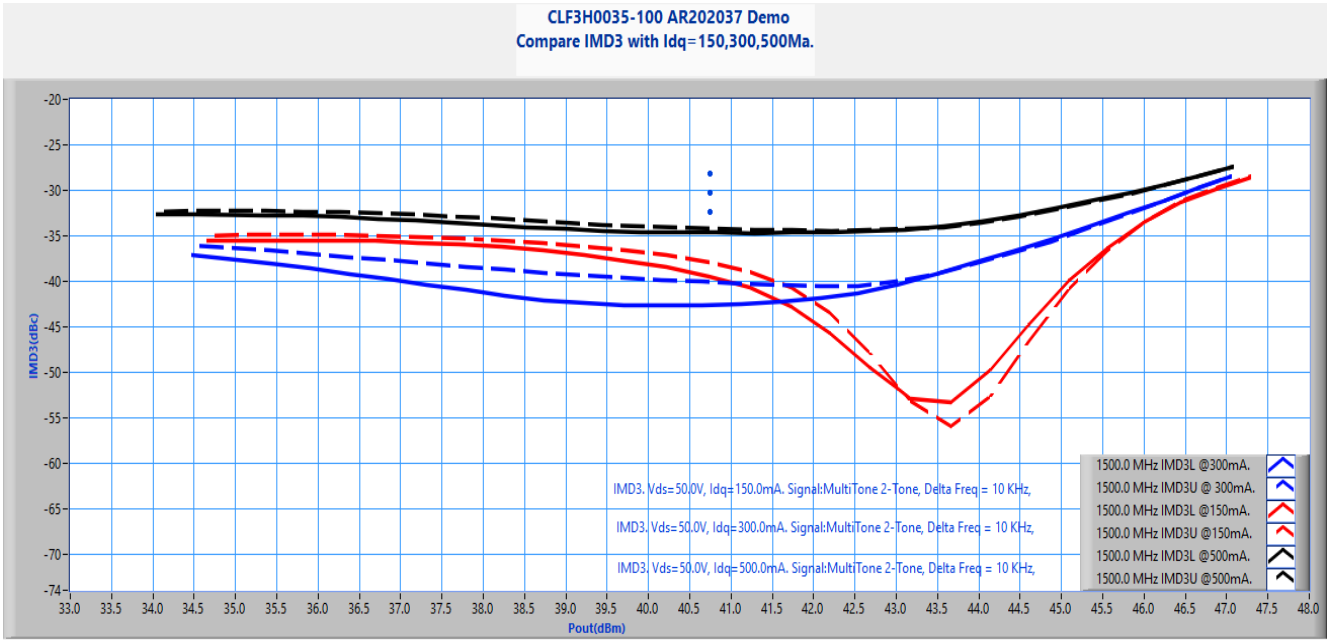


Figure 14. IMD3 Swept Idq. Vs Average Pload @1500MHz.

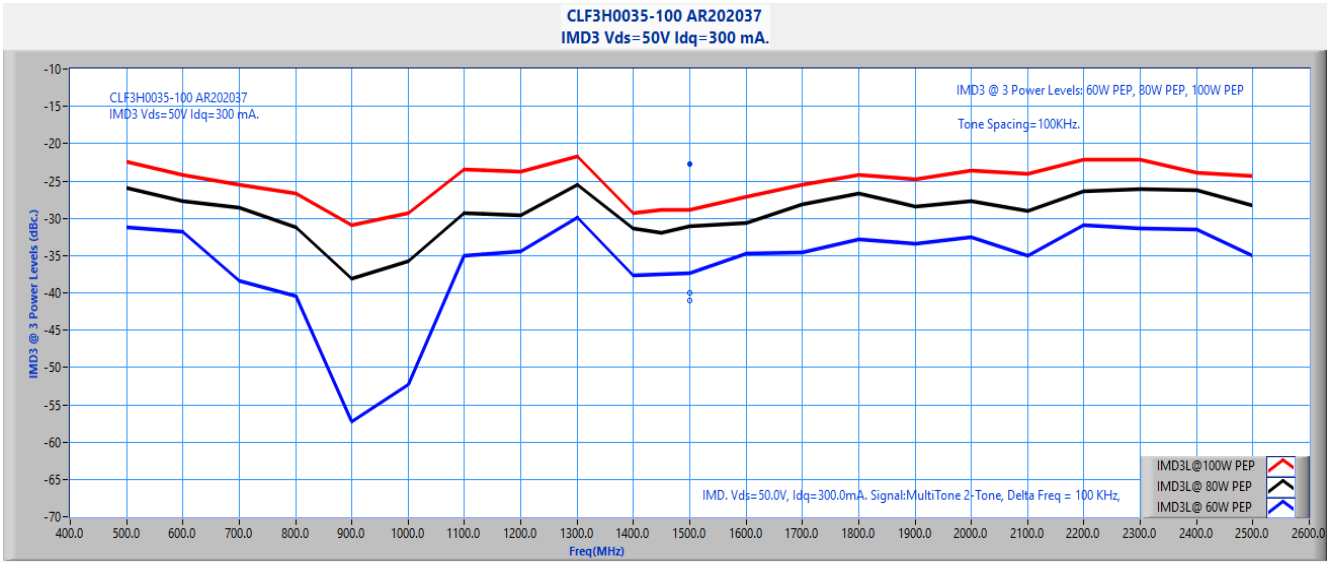


Figure 15. IMD3 at 3 Power output levels Vds=50V Idq=300mA.

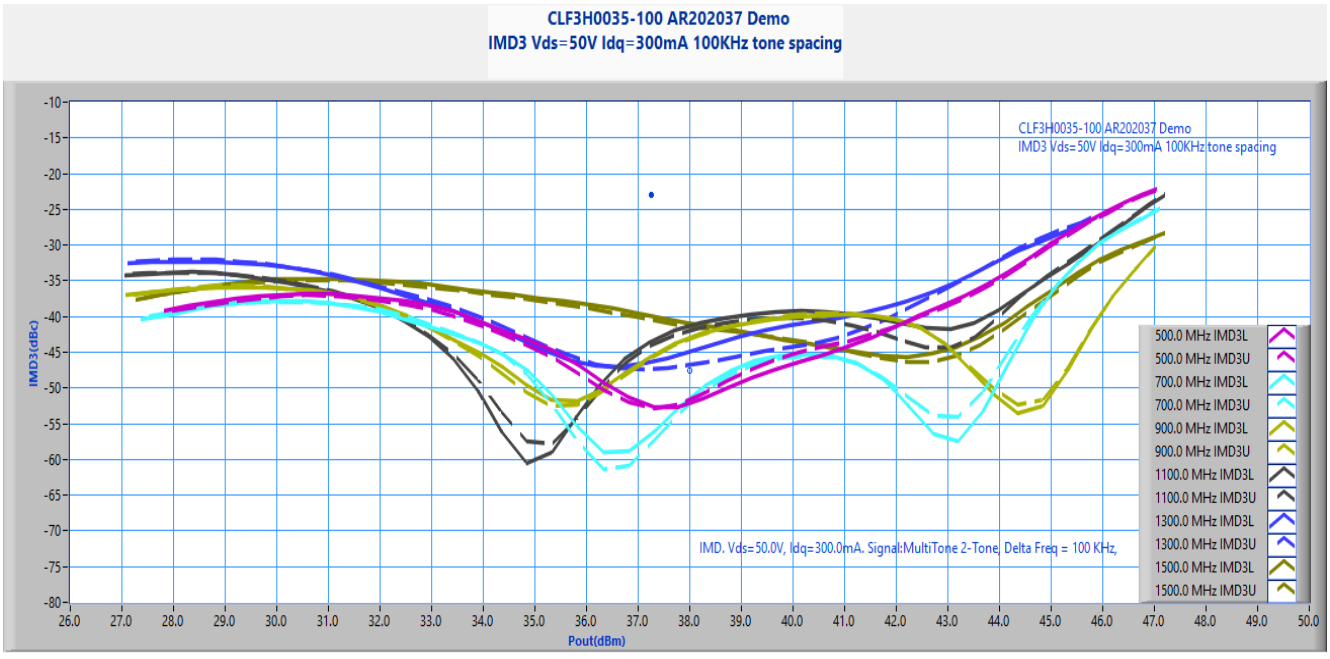


Figure 16. IMD3 vs Average Pload 500-1500MHz Vds=50V Idq=300mA.

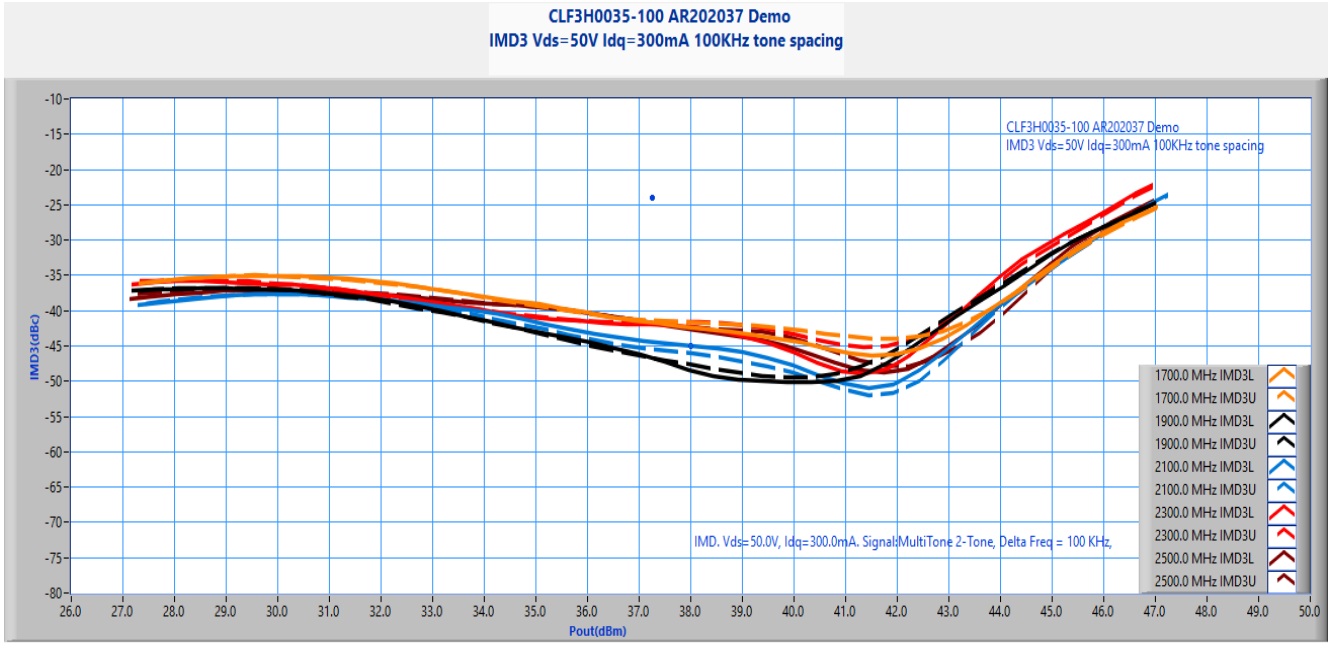


Figure 17. IMD3 vs Average Pload 1700-2500MHz Vds=50V Idq=300mA.

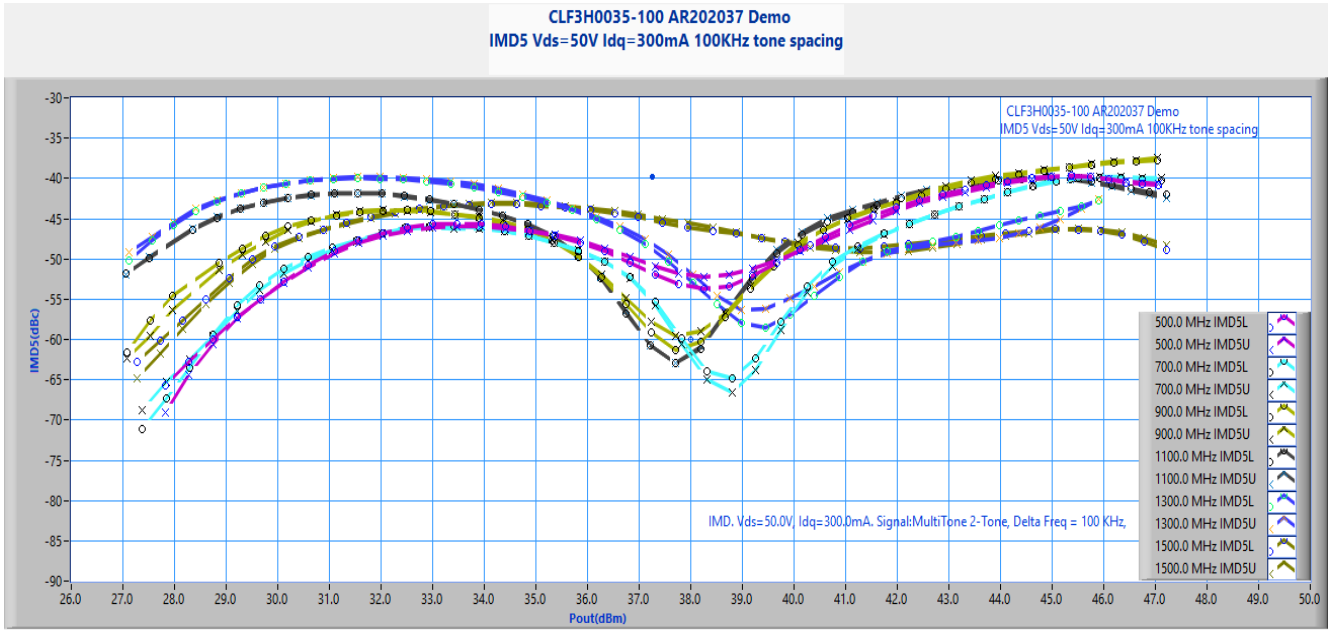


Figure 18. IMD5 vs Average Pload 500-1500MHz Vds=50V Idq=300mA.

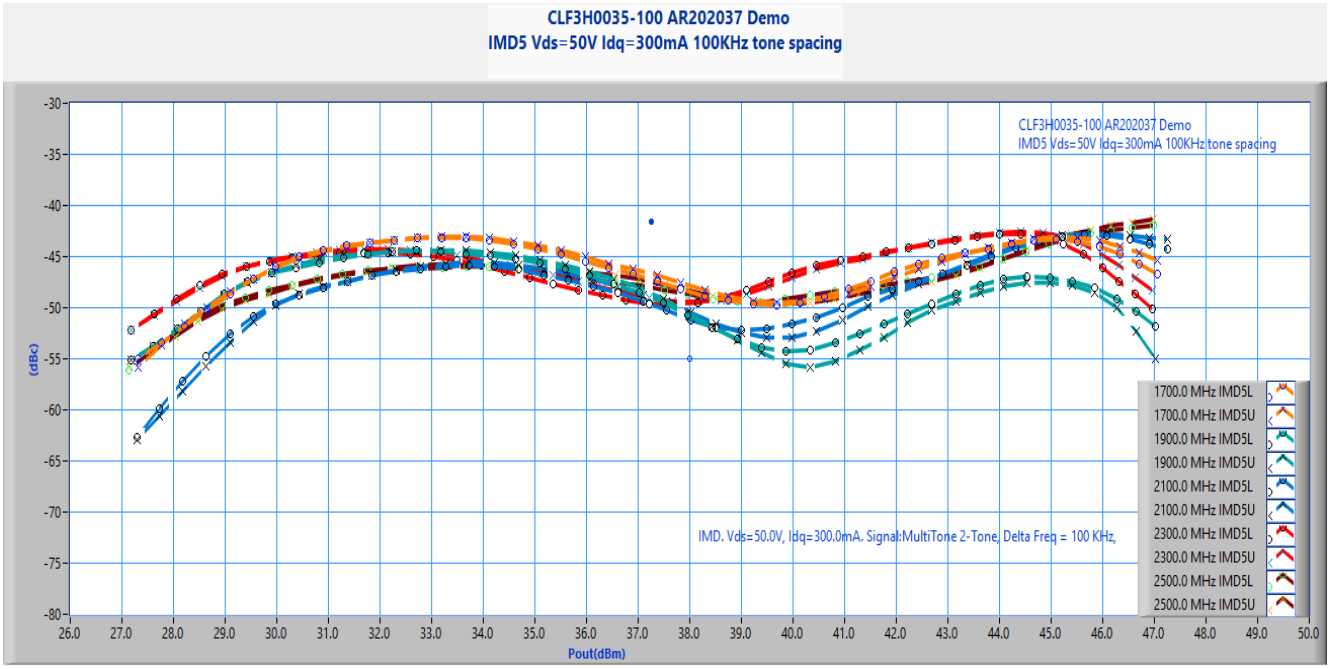
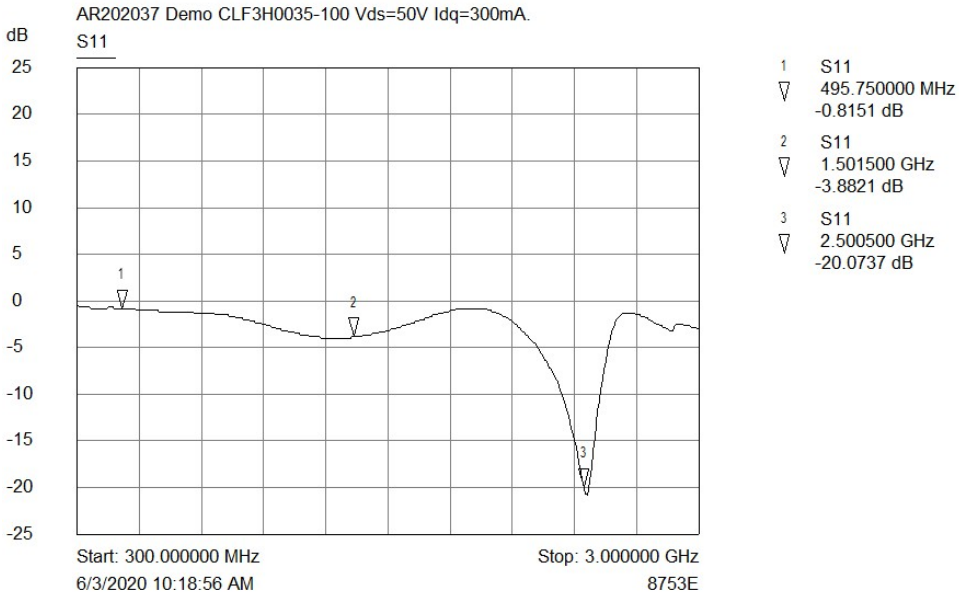


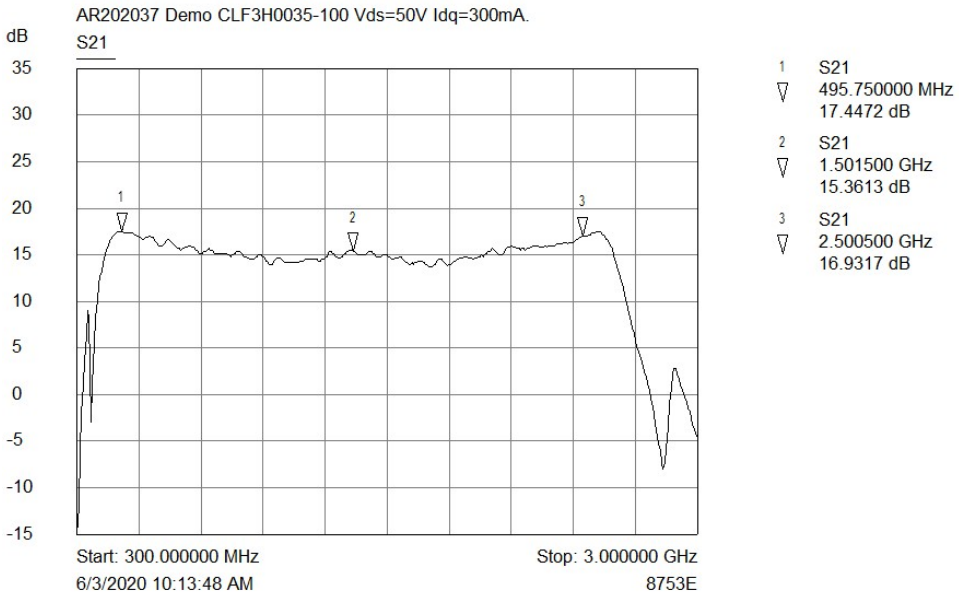
Figure 19. IMD5 vs Average Pload 1700-2500MHz Vds=50V Idq=300mA.

8.2 Small Signal Data of CLF3H0035-100 AR202037 Demo circuit



S11 Pin=+13dBm.

Vds=50V Idq=300mA.



S21 Pin=+13dBm.

Vds=50V Idq=300mA.

Figure 20. S11 and S21 Small Signal response. Pin=+15dBm. Vds=50V Idq=300mA.

9 Hardware

9.1 Input PCB Layout

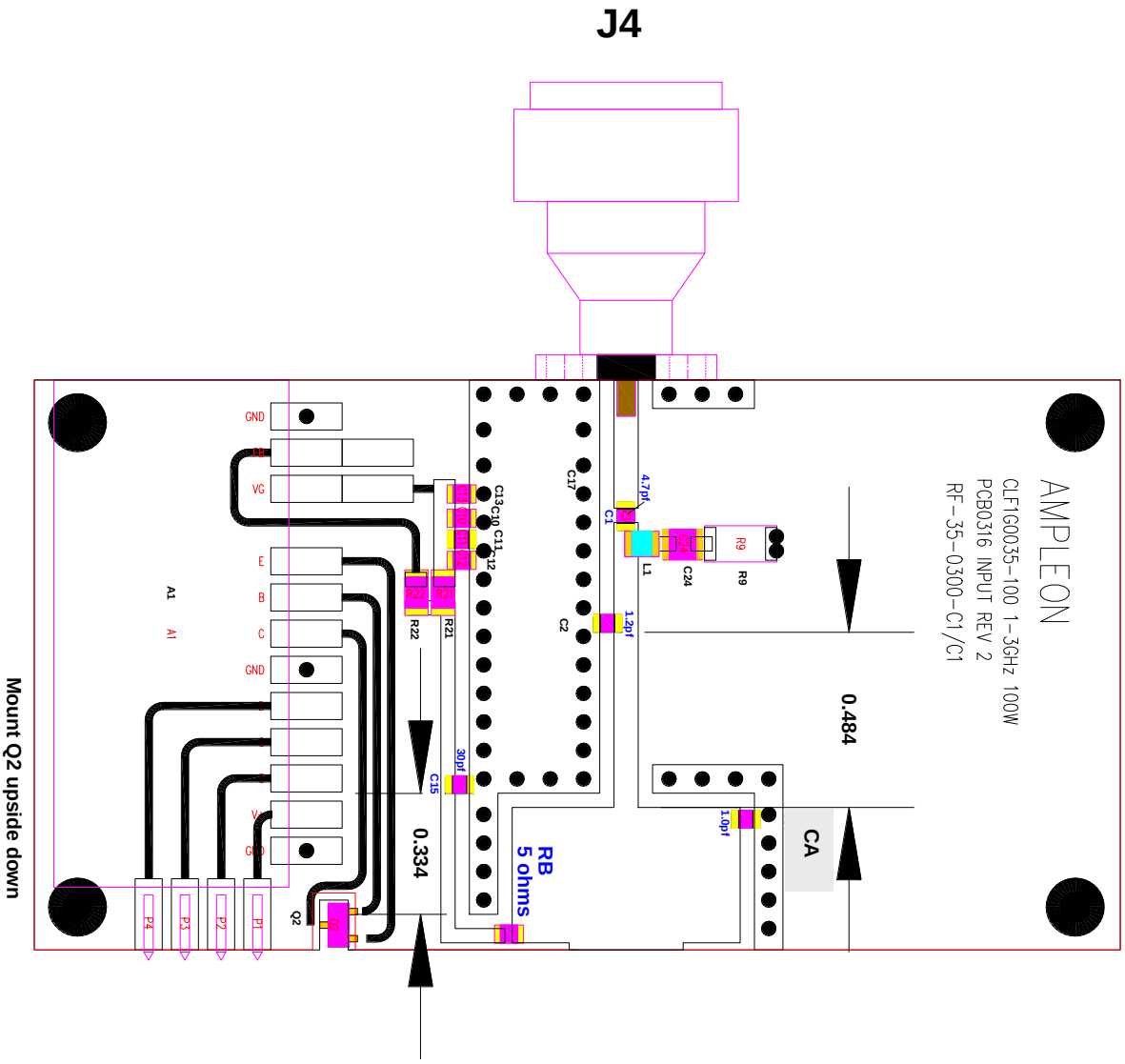


Figure 21. Input PCB Layout with reference designators, added components, and PCB cuts.

9.2 Bill of Materials Input PCB

Designator	Description	Manufacturer	Part#
Input Base Plate	1.575" X 3.000"	Jones Machine	SMI0001
Q2 MOUNT UPSIDE DOWN	Transistor, PNP 45V 100mA GP	NXP	BC857B
Q3	Transistor, N-ch MOS 80V 80A	NXP	BSMN8R2-80YS
PCB input	Taconic RF 35 30 mils thickness	Avanti	PCB0316 Input Rev 2
A1	GaN bias module v2	Ampleon	CA-167-11
C1	Capacitor, 4.7pF,250V ±0.1pF	ATC or Passive Plus	600F or 0805N
C2	Capacitor, 1.2pF,250V ±0.1pF	ATC or Passive Plus	600F or 0805N
CA	Capacitor,1.0pF, 500V ±0.1pF NP0	ATC or Passive Plus	600F or 0805N
C10	Capacitor, 10nF,50V 10% X7R 0805	10nF	Generic
C11	Capacitor, 22pF, 250V 5% NP0	ATC or Passive Plus	600F or 0805N
C12	Capacitor, 1nF,100V 5% NP0 0805	1nF	Generic
C13	Capacitor, 100nF,50V 10% X7R 0805	100nF	Generic
C15	Capacitor,30pF, 250V 5% NP0	ATC or Passive Plus	600F or 0805N
C24	Capacitor, 100pF,500V 5% NP0	ATC	100B
L1	Inductor chip inductor 15nH	Coilcraft	0805CS
RB	5 ohms	Generic	1206
R9	Resistor ,50 Ω, 5%, 2010	Generic	2010
R21	Resistor, 20 Ω,1%	Generic	1206
R22	Resistor, 10KΩ, 1%	Generic	1206
J4	Type: 23 N-50-0-16 Input N Connector	Huber+Suhner	Part #: 22641166

9.3 Output PCB Layout

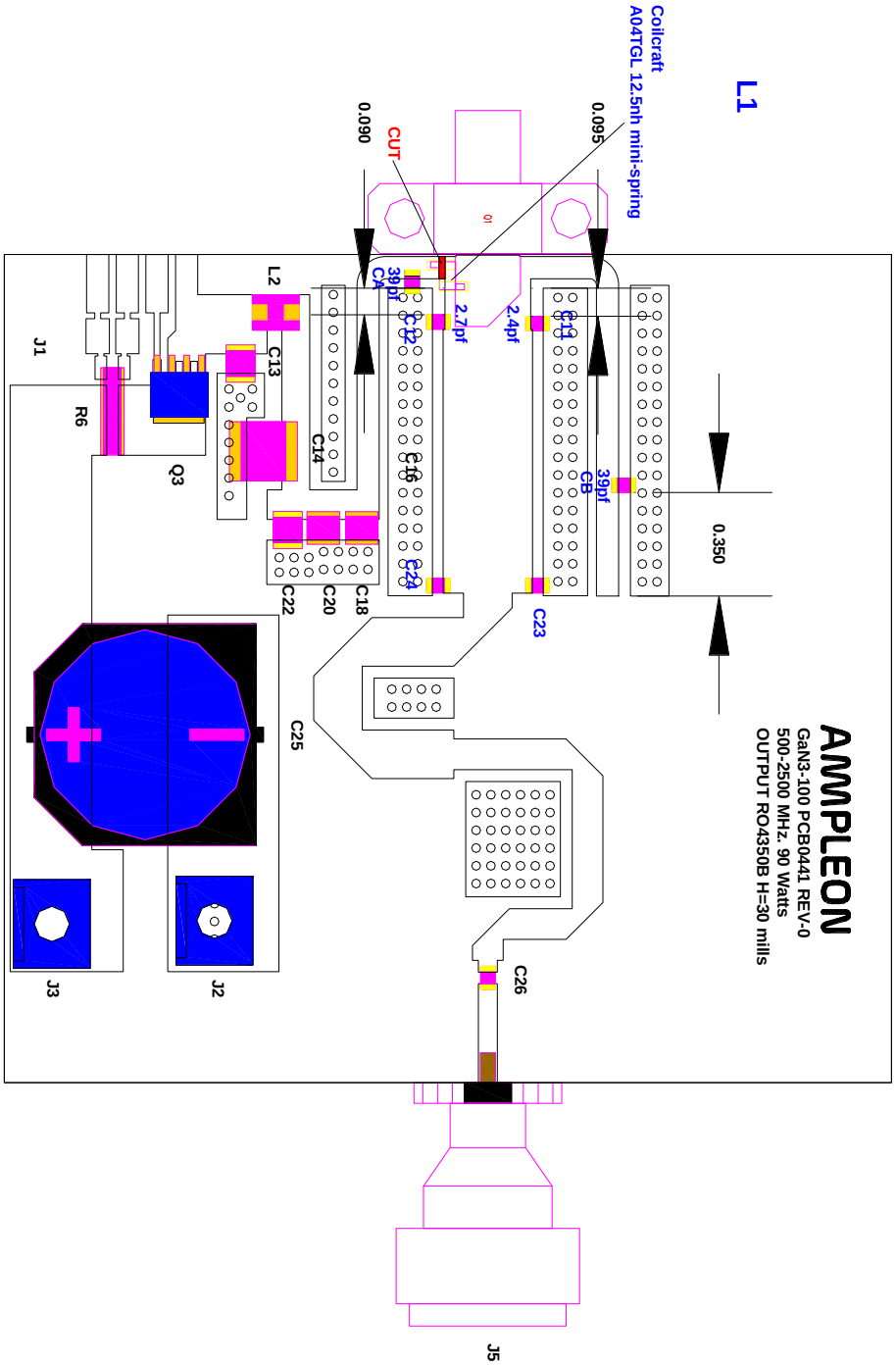


Figure 22. Output PCB Layout with reference designators, added components, and PCB cuts.

9.4 Bill of Materials Output PCB

Designator	Description	Manufacturer	Part#
PCB Output PCB	Output PCB, 30 mil thk. Rogers RO4350B 1oz.	Avanti Circuits	PCB0441 Rev.0
Output Base Plate	2.800" X 3.000"	Jones Machine	SMI0019
C11	2.4pf. 0805 case Critical Placement	ATC 600F	600F series
C12	2.7pf. 0805 case Critical Placement	ATC 600F	600F series
C13	Capacitor, 0.01uF. (10nF) 200V 5% NP0 1210	Generic	
C14	10uF. 100V, 10% X7S (2220 case)	TDK	TDK C5750X7S2A106M
CA, CB, C26	39pf. 0805 case CB Critical Placement	ATC or Passive Plus	600F series or 0805N
C18	1000pf. N1111 or ATC100B case	ATC or Passive Plus	
C20	0.1uf. ATC200B or ATC700B case	ATC	
C22	Capacitor, 1uF.100V 10% X7R 1206 case	Generic	
C23, C24	0.4pf. 0805 case	ATC or Passive Plus	600F series or 0805N
C25	220 uF. /63V		
R6	0.005-ohm, 1% (3008 case)	Susumu	RL7520WT-R005-F
Q1	LDMOS	Ampleon	CLF3H0035-100 GaN Gen3-100W
L1	12.5nh. mini-spring 4 turn	Coilcraft	Coilcraft A04TGL
L2	SM Ferrite Bead	Fair-Rite	Fair-Rite 2743019447
J1	8-pin terminal		Connects across input and output PCB
J2, J3	Spade Connector	Power Connectors	
J5	Type: 23 N-50-0-16 Input N Connector	Huber+Suhner	Part #: 22641166

9.5 PCB materials

Table 3. Board specifications

Parameter	Value
Manufacturer	Taconic (Input PCB)
Input PCB Type	RF-35-0300 PCB0366 Input REV-2
Thickness	30mil, 0.635 mm 1oz. Cu.
Layers	2, top/bottom. Bottom all copper
Manufacturer	Rogers (Output PCB)
Output PCB Type	RO4350B PCB0441 Input REV-0
Thickness	30mil, 0.635 mm 1oz. Cu.
Layers	2, top/bottom. Bottom all copper

9.6 Device markings

Table 4. Device specifics

Parameter	Value
Manufacturer	Ampleon
Device	CLF3H0035-100
Marking	WK2009-10743
Comments	Production sample

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