Build #5
DOE9_1 to DOE9_5
R9505_A (11,52 mm – 36x320 µm)

Design Review

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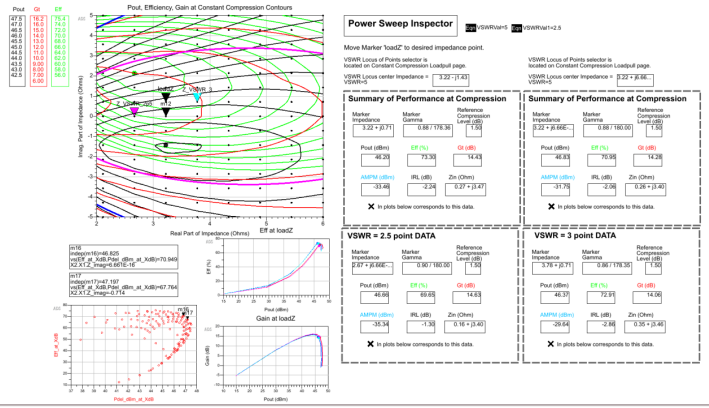
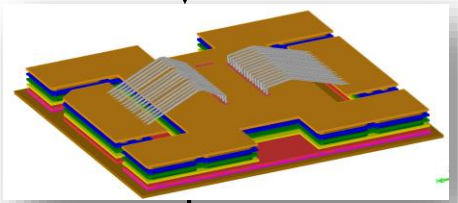
Contents

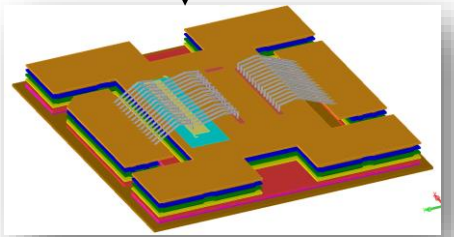
Design approach

Topology	**Line up**	Dual driver
Power calculation		Single driver
		Ppeak (dBm)
Choose biasing		Gain (dB)
Choose PX dB	**Bare-die LP**	Efficiency (%)
Choose load		VSWR 1 - 3
		Zin, ZL
Chose loadline		
Choose PX db	**Die + Laminate + BW**	Ppeak, Gain, η%
DOE BW profile		Zin, ZL
Choose Pxdb, Load line		
DOE BW profile	**Die + Laminate + MOScap + BW**	Ppeak, Gain, η%
DOE MOScap		Zin, ZL
		DOE6_3
DOE6_1	**MOScap + BW DOE**	DOE6_4
DOE6_2		DOE6_5
	Assembly Drawing	DRC

- Design selection
- Caluclate required power from peak in Doherty configuration
- Simulate
  - Bare die
  - Bare die + laminate
  - Bare die + Moscap + laminate
- Simulate DOE of MOScap + BW configuration in each case
  - Select 5 best cases as final DOE
  - DOE is also selected such that outliers & toleranes are captured
- Load Selection criteria
- Select compression point such that Pout is > 46,5 dBm
  - The die R9595_A has > 48 dBm power @ 3dB compression
  - Chosen compression point is 1.5dB where Pout > 47 dBm
- The load point is selected such that there is a good trade-off when,
  - Pout > 46,4 dBm
  - Atleast Zin > 0,4 Ohm
  - As high gain as possible
  - As high efficiency as possible







Power calculation: Asymmetric Doherty

Specification				
Project	**Frequency-Range (MHz)**	**P3dB (dBm)**	**P3dB (W)**	**PAR**
PAM 2.0+	3400 - 3800	47,4	54,95	8,4
		Pavg (dBm)	**Pavg (W)**	
		39	7,94	

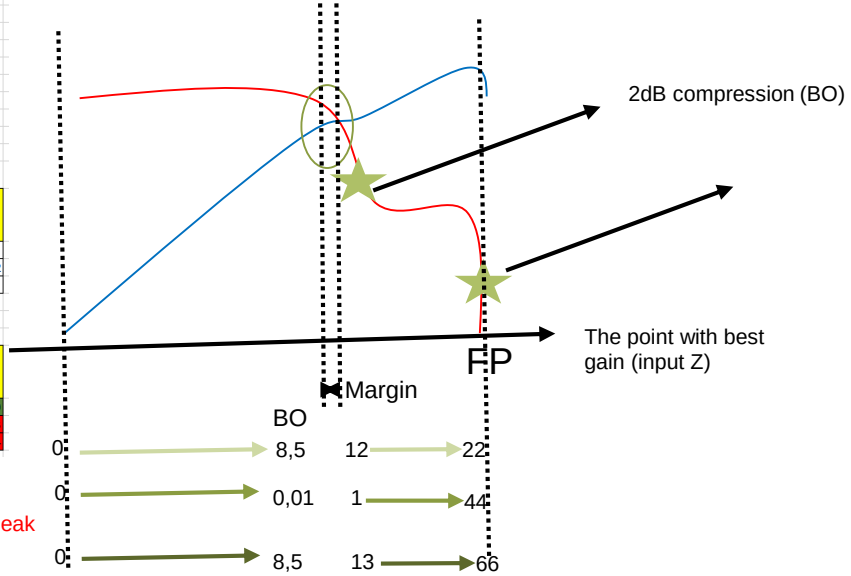
Doherty Topology	**Remark**	**Ratio**	**Main (W)**	**Peak (W)**
2-way asymmetric	To maximize efficiency	2	18,32	36,64

Estimation including loss

	Required power (W)	**Required power (dBm)**	**Loss (dBm)**	**Total required power (dBm)**	**Total required power (W)**	**Ratio**	**Total power (W)**	**Total power (dBm)**
Main	18,32	42,63	0,8	43,43	22,02			
						3,01	**66,07**	**48,2**
Peak	36,64	45,64	0,8	46,44	44,05			

	Total output power (dBm)	**PAR**	**Power @ MXE (dBm)**	**Margin (dB)**	**Power @ MXE (dB**	**Power @ MXE (W)**	**MXP (W)**	**MXP(dBm)**
	48,2	8,4					66,07	48,20
Main			39,8	1,00	40,80	12,02	22,02	43,43
Peak			Peak_start_ideal		Peak_start	0,01	44,05	46,44

Required power from peak

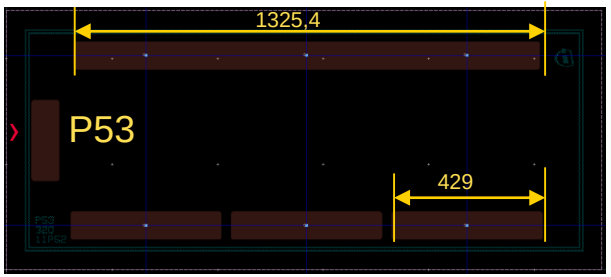


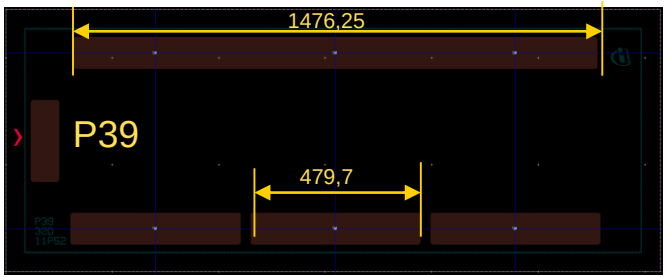
- Maximize Gain
  - Main section gain as high as possible while maintaining Power @ MXE
  - Peak section gain as high as possible while maintaining MXP

Build tracking: starting point

- Minipack build tracking

5	DOE9_1		11.52 (36*320um)	P39	R9505A	P53 :R9505A can be used as well in case of shortage of die. Need to check the quanities of P39 and P53 to decide after
5	DOE9_2		11.52 (36*320um)	P39	R9505A	
5	DOE9_3		11.52 (36*320um)	P39	R9505A	
5	DOE9_4		11.52 (36*320um)	P39	R9505A	
5	DOE9_5		11.52 (36*320um)	P39	R9505A	



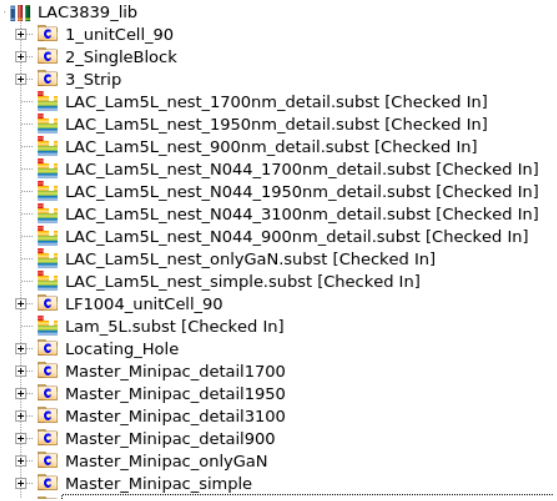


RFP_tech_product catalog -PL55 (Active GaN die)

sequence	Tech	basetype	Chip label	basetype_chip	short description (periphery_finger length_pitch)	reticle kind	D9 released basetype	Die X (um)	Die Y (um)	die area	aspect ratio	Gate Pheriphery (mm)	# Gate tabs	Gate Tab Distance (um)	Gate Width / Finger Length (um)	Gate-source pitch [µm]	Gate-drain pitch [µm]
67	RFGaN-C1	R9505A	P39	R9505A_P39	11,52_320_41,25	shared	-	1844	736	1,36	2,51	11,52	4	80	320	43,2	41,3
81	RFGaN-C1	R9505A	P53	R9505A_P53	11,52_320_32,8	shared	-	1692	736	1,25	2,30	11,52	4	80	320	43,2	32,8

Design on laminate DOE6

- Laminate library:LAC3839_lib

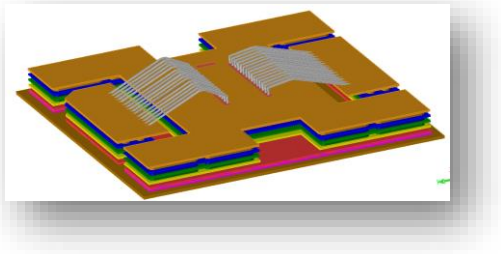


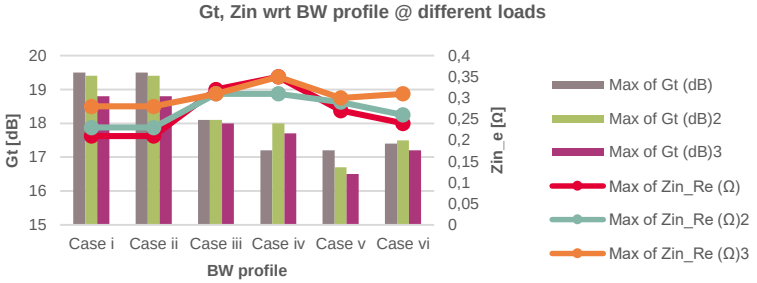
	GaN	MOSCap
Design	Die_GaN_v0_lib	IC_LD8C_lib
Assembly drawing	Central_v0_lib	

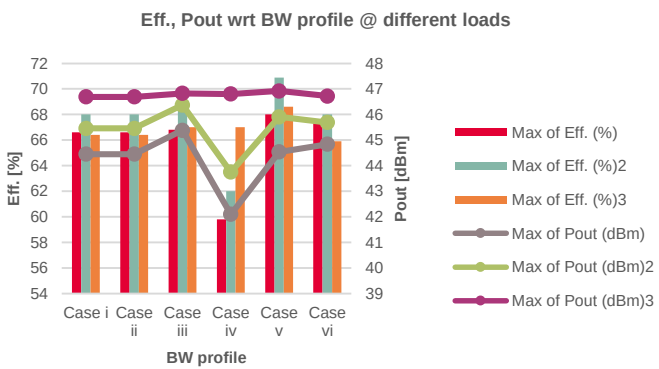
DOE9_1 : Laminate, Bond Wire selection (based on DOE6_1)

	Input – Gate Bondwire						Output – Drain Bondwire				
Sl. No.	No. of wires	No. of sets	Length	Height	Pitch	Sl.No.	No. of wires	No. of sets	Length	Height	Pitch
a	5	3	1070	150	85	A	17	1	1070	150	75
b	5	3	1070	250	85	B	15	1	1070	150	89
c	4	3	1070	250	107	C	15	1	1070	250	89
						D	12	1	1070	250	110

- Selection based on BW profile simulation from a similar die (12 mm die)
- Total 6 BW configuration cases has been simulated
- Case iii has been chosen. Selection criteria @ P1.5 dB
  - Pout > 46,6 dBm
  - Zin (> 0,3 Ω) & Gain (> 17,5 dB)
  - Good eff. (> 67%)







	BW profile		Max. performace @ P1.5dB			Z_load_1						Z_load_2						Z_load_3						
DOE variant	Input_BW	Output_BW	MXP (dBm)	MXE (%)	MXG (dB)	Zin_Re (Ω)	Zin_imag (Ω)	Pout (dBm)	Eff. (%)	Gt (dB)	IRL (dB)	Zin_Re (Ω)	ZL (Ω)	Pout (dBm)	Eff. (%)	Gt (dB)	IRL (dB)	Zin_Re (Ω)	Z_L (Ω)	Pout (dBm)	Eff. (%)	Gt (dB)	IRL (dB)	
Case i	a	A	47,50	68,90	23,20	0,32	2,80	44,05	63,00	17,90	-5,30	0,25	3,1 + j 0,3	45,49	64,50	18,50	-4,30	0,28	3,4 - j 0,3	46,74	67,00	18,10	-5,00	
Case ii	a	B	47,20	68,80	25,30	0,21	2,80	44,45	66,60	19,50	-4,20	0,23	2,9 + j 0,8	45,46	68,00	19,40	-4,90	0,28	3,4 - j 0,3	46,69	66,40	18,80	-6,40	
Case iii	b	B	47,50	69,20	22,90	0,32	3,50	45,38	66,80	18,10	-5,40	0,31	3,4 + j 0,24	46,37	68,40	18,10	-5,40	0,31	3,4 - j 0,3	46,83	67,00	18,00	-5,40	
Case iv	c	B	47,40	68,80	22,60	0,35	3,70	42,10	59,80	17,20	-4,80	0,31	3,1 + j 1,3	43,75	62,00	18,00	-4,50	0,35	3,6 - j 0,3	46,80	67,00	17,70	-5,90	
Case v	a	C	47,40	71,00	20,60	0,34	2,80	44,52	69,50	16,80	-5,30	0,31	2,9 + j 0,8	45,28	70,80	16,90	-4,70	0,30	3,4 - j 0,8	46,92	68,60	16,50	-3,60	
Case vi	a	D	47,2	68,7	21,1	0,3	2,8	44,32	67,7	17,3	-3,3	0,31	3,4 + j 0,3	45,1	68	17,5	-3,6	0,31	3,6 - j 1,4	46,67	65,7	17,6	-4,4	

DOE9_simulated performance: MOScap (4) X (4) BW profile (with detailed EM model)

Detailed_EM_P39_R9505A	P_1.5dB	Moscap					Max. performace @ P1.5dB			Performance_@ optimum ZL for Peak (Vgs = -3,1V)						
DOE	BW_profile	Name	Index	RF top plate (X x Y)	Oxide thickness (µm)	Value (pF)	MXP (dBm)	MXG (dB)	MXE (%)	Zin_Re (Ω)	Zin_imag (Ω)	Z_L (Ω)	Pout (dBm)	Eff. (%)	Gt (dB)	IRL (dB)
DOE9_1	BW_Direct_1i2i						47,1	23	70,2	0,5	7,5	3,8 + j 0,7	46,59	67,9	17,6	-7,1
DOE9_2	BW_3i_4i_5i	N9501B_V5	6	1466x244	1950	6,58	46,9	18,8	76,8	0,4	2,5	3,2 - j 0,7	46,65	70,3	16	-5,2
DOE9_3	BW_3i_4i_5i	N9501B_V8	19	1466x207	1300	8,09 --> 8,19	46,8	18,3	78,5	0,4	2,5	3,2 - j 0,7	46,6	71,1	15,5	-5,9
DOE9_4	BW_6i_4i_7i	N9501B_V8	19	1466x207	1300	8,09 --> 8,19	46,8	18	78,8	0,4	2,8	3,2 + j 0,7	46,65	70,9	15,5	-5,8
DOE9_5	BW_6i_4i_7i	N9501B_V4	18	1466x261	1300	10,22 --> 10,3	46,8	17,5	80,2	0,5	2,8	3,2 + j0,7	46,55	71,4	14,9	-6,8

Detailed_EM_P39_R9505A	P_1.5dB	Moscap					Max. performace @ P1.5dB			Performance_@ optimum ZL for Peak (Vgs = -4V)						
DOE	BW_profile	Name	Index	RF top plate (X x Y)	Oxide thickness (µm)	Value (pF)	MXP (dBm)	MXG (dB)	MXE (%)	Zin_Re (Ω)	Zin_imag (Ω)	Z_L (Ω)	Pout (dBm)	Eff. (%)	Gt (dB)	IRL (dB)
DOE9_1	BW_Direct_1i2i						47,5	16,2	75,4	0,27	3,5	3,2 + j 0,7	46,2	73,3	14,4	-2,2
DOE9_2	BW_3i_4i_5i	N9501B_V5	6	1466x244	1950	6,58	47,2	17	79,4	0,35	2,3	3,2 + j 0,7	46,3	75,5	14,2	-5,1
DOE9_3	BW_3i_4i_5i	N9501B_V8	19	1466x207	1300	8,09 --> 8,19	47,1	16,8	80,6	0,4	2,3	3,2 - j 0,7	46,71	72,7	13,6	-5,4
DOE9_4	BW_6i_4i_7i	N9501B_V8	19	1466x207	1300	8,09 --> 8,19	47,1	17,1	80,9	0,4	2,7	3,2 + j 0,7	46,36	76,3	13,9	-5,9
DOE9_5	BW_6i_4i_7i	N9501B_V4	18	1466x261	1300	10,22 --> 10,3	47	16,2	82,3	0,43	2,6	3,2 + j 0,7	46,71	73	13,3	-6,5

Detailed_EM_P39_R9505A	P_1.5dB	Moscap					Max. performace @ P1.5dB			Performance_@ optimum ZL for Peak (Vgs = -5V)						
DOE	BW_profile	Name	Index	RF top plate (X x Y)	Oxide thickness (µm)	Value (pF)	MXP (dBm)	MXG (dB)	MXE (%)	Zin_Re (Ω)	Zin_imag (Ω)	Z_L (Ω)	Pout (dBm)	Eff. (%)	Gt (dB)	IRL (dB)
DOE9_1	BW_Direct_1i2i						47,8	13,8	75,7	0,34	3,2	3,8 + j 0,7	46,63	73,3	12,1	-2,6
DOE9_2	BW_3i_4i_5i	N9501B_V5	6	1466x244	1950	6,58	47,6	13,8	78,7	0,33	2,2	3,8 + j 0,7	46,57	75,2	12	-4,5
DOE9_3	BW_3i_4i_5i	N9501B_V8	19	1466x207	1300	8,09 --> 8,19	47,5	13,5	79,5	0,32	2,2	3,8 - j 0,6	46,81	73,8	11,8	-4,5
DOE9_4	BW_6i_4i_7i	N9501B_V8	19	1466x207	1300	8,09 --> 8,19										
DOE9_5	BW_6i_4i_7i	N9501B_V4	18	1466x261	1300	10,22 --> 10,3	47,4	14	81,5	0,35	2,5	3,8 + j 0,7	46,5	76,7	11,8	-5,2

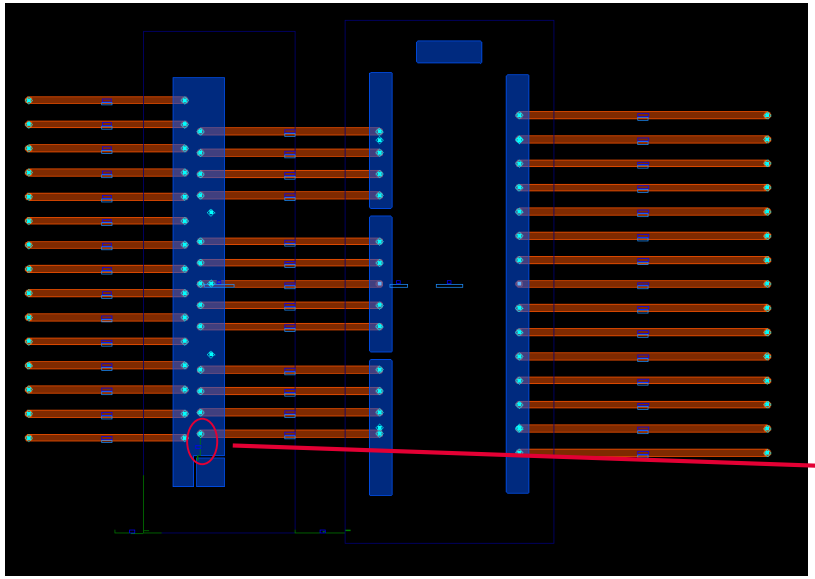
Selected DOE9 variants: detailed EM simulation P39 vs P53

Detailed_EM_P39_R9505A	P_1.5dB	Moscap					Max. performace @ P1.5dB			Performance_@ optimum ZL for Peak (Vgs = -3,1V)						
DOE	BW_profile	Name	Index	RF top plate (X x Y)	Oxide thickness (µm)	Value (pF)	MXP (dBm)	MXG (dB)	MXE (%)	Zin_Re (Ω)	Zin_imag (Ω)	Z_L (Ω)	Pout (dBm)	Eff. (%)	Gt (dB)	IRL (dB)
DOE9_1	BW_Direct_1i2i						47,1	23	70,2	0,5	7,5	3,8 + j 0,7	46,59	67,9	17,6	-7,1
DOE9_2	BW_3i_4i_5i	N9501B_V5	6	1466x244	1950	6,58	46,9	18,8	76,8	0,4	2,5	3,2 - j 0,7	46,65	70,3	16	-5,2
DOE9_3	BW_3i_4i_5i	N9501B_V8	19	1466x207	1300	8,09 --> 8,19	46,8	18,3	78,5	0,4	2,5	3,2 - j 0,7	46,6	71,1	15,5	-5,9
DOE9_4	BW_6i_4i_7i	N9501B_V8	19	1466x207	1300	8,09 --> 8,19	46,8	18	78,8	0,4	2,8	3,2 + j 0,7	46,65	70,9	15,5	-5,8
DOE9_5	BW_6i_4i_7i	N9501B_V4	18	1466x261	1300	10,22 --> 10,3	46,8	17,5	80,2	0,5	2,8	3,2 + j0,7	46,55	71,4	14,9	-6,8

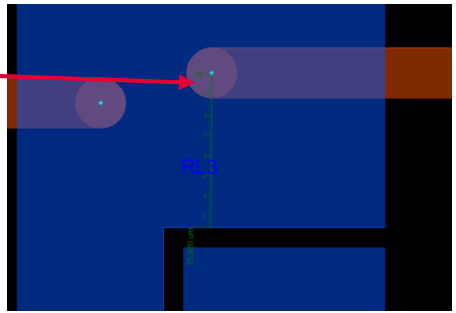
Detailed_EM_P53_R9505A	P_1.5dB	Moscap					Max. performace @ P1.5dB			Performance_@ optimum ZL for Peak (Vgs = -3,1V)						
DOE	BW_profile	Name	Index	RF top plate (X x Y)	Oxide thickness (µm)	Value (pF)	MXP (dBm)	MXG (dB)	MXE (%)	Zin_Re (Ω)	Zin_imag (Ω)	Z_L (Ω)	Pout (dBm)	Eff. (%)	Gt (dB)	IRL (dB)
DOE9_1	BW_Direct_1i2i						47,1	23,4	70,8	0,5	7,4	3,8 + j 0,6	46,25	69,5	17,6	-7,5
DOE9_2	BW_3i_4i_5i	N9501B_V5	6	1466x244	1950	6,58	46,9	18,8	77,8	0,44	2,6	3,8 - j 0,7	46,53	72,2	15,7	-6,7
DOE9_3	BW_3i_4i_5i	N9501B_V8	19	1466x207	1300	8,09 --> 8,19	46,9	18,4	80,2	0,53	2,6	3,8 - j 0,7	46,42	73,3	15,2	-8,2
DOE9_4	BW_6i_4i_7i	N9501B_V8	19	1466x207	1300	8,09 --> 8,19	46,8	17,8	79,3	0,46	2,8	3,2 + j 0,7	46,6	70,9	15,4	-6,5
DOE9_5	BW_6i_4i_7i	N9501B_V4	18	1466x261	1300	10,22 --> 10,3	46,7	17,2	80,9	0,57	2,8	3,2 + j 0,7	46,48	71,4	14,7	-8,1

Design rule violations

› 1 design rule violations: waiver needed



› DR (>80 um) -- > 76 um



ADS cells and symbols

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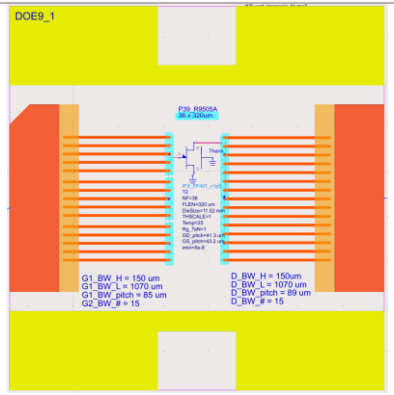
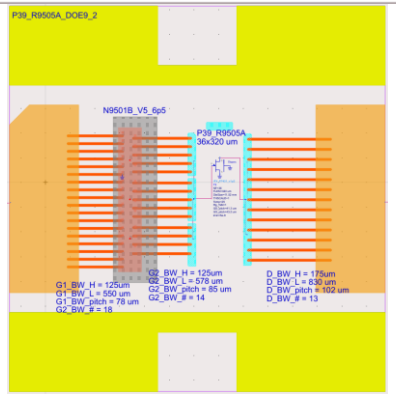
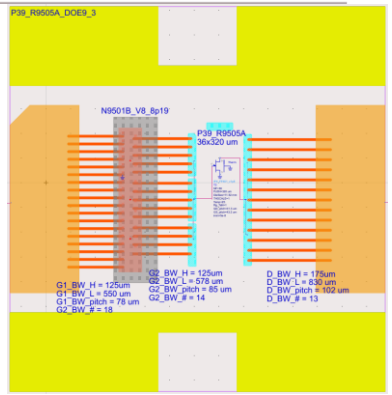
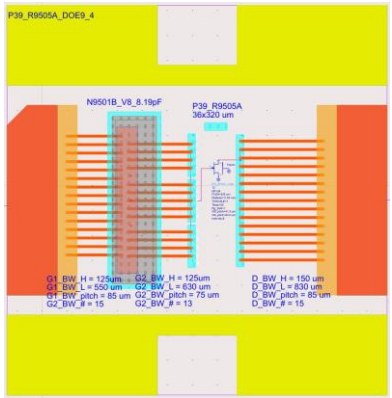
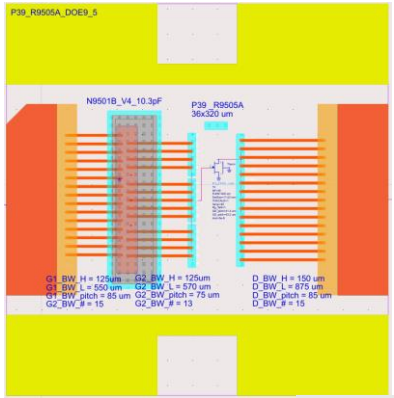










Acknowledgements

- Theepak ShoundraBalan: Design related discussions, design review, troubleshooting and debugging.
- Fillippo Panzalo: EM layouts of Moscaps, GaN dies, Assembly drawing generation and review, EM simulation support.
- Jorge Texeira: Assembly design rule guidelines, drawing review, build planning, coordination and documentation.
- Shamsafar Alireza: Design review, design target discussions and guidelines.
- De Astis Giuseppe: Design follow up, design environment & logistic coordination

Part of your life. Part of tomorrow.

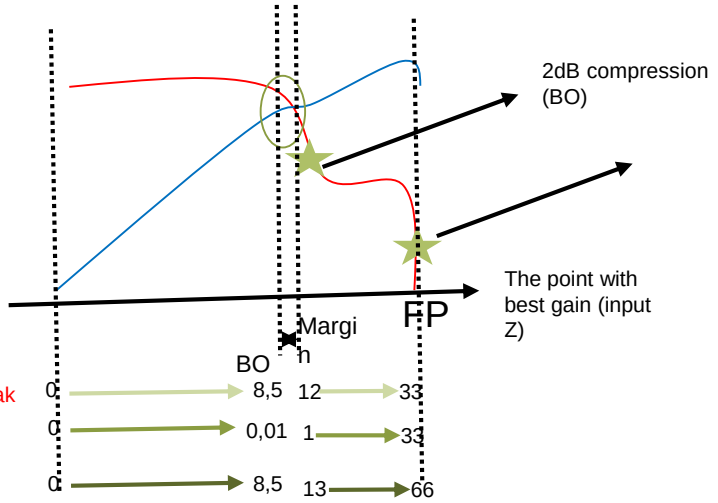
Power calculation: Hybrid Symmetric Doherty

Doherty Topology	Remark	Ratio	Main (W)	Peak (W)
Symmetric	Maximize BW	1	27,48	27,48

Estimation including loss								
	Required power (W)	Required power (dBm)	Loss (dBm)	Total required power (dBm)	Total required power (W)	Ratio	Total power (W)	Total power (dBm)
Main	27,48	44,39	0,8	45,19	33,03			
						0,00	66,07	48,2
Peak	27,48	44,39	0,8	45,19	33,03			

	Total output power	PAR	Power @ MXE (dBm)	Margin (dB)	Power @ MXE (dBm)	Power @ MXE (W)	MXP (W)	MXP (dBm)
	48,2	8,4					66,07	48,20
Main			39,8	1,00	40,80	12,02	33,03	45,19
Peak			Peak_start_ideal		Peak_start	0,01	33,03	45,19

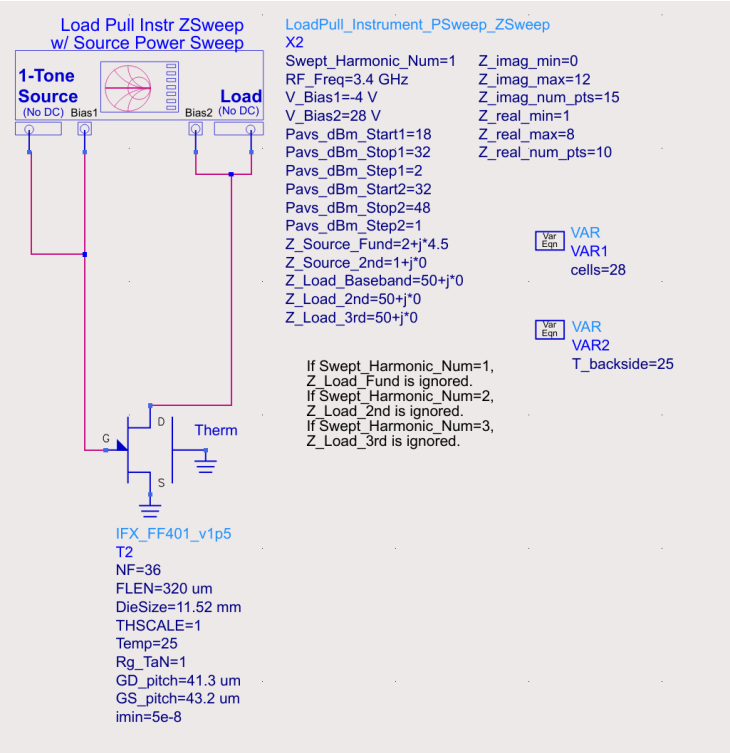
Required power from peak



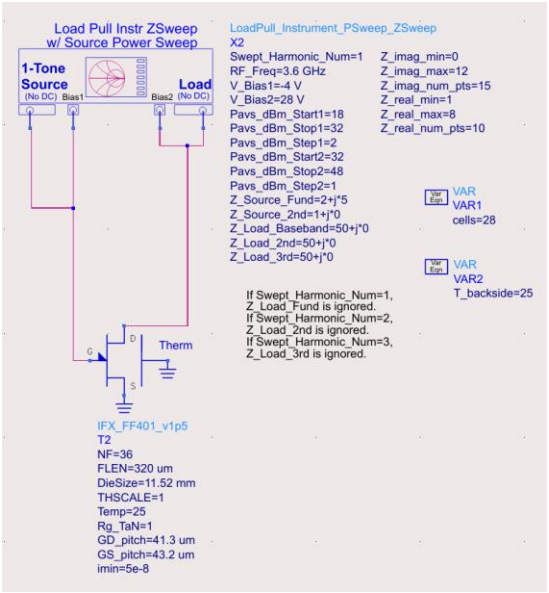
- Maximize Gain
  - Main section gain as high as possible while maintaining Power @ MXE
  - Peak section gain as high as possible while maintaining MXP

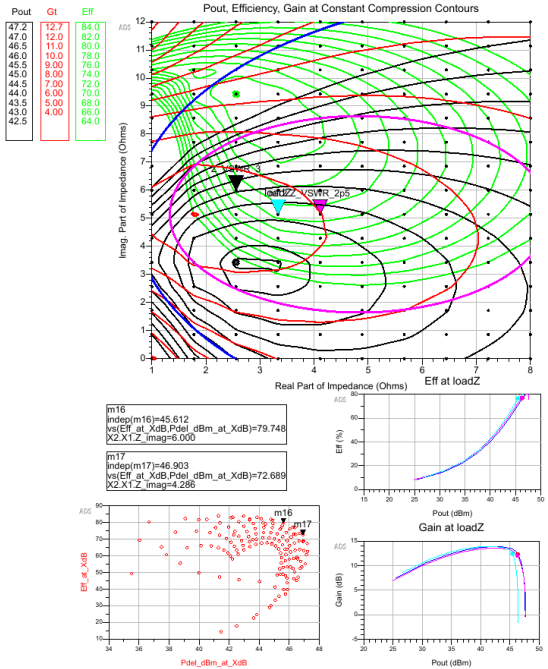
Simulation Results

Bare die GaN Load-pull: P39_R9507_A (36 x 320 um)



LP summary 2,4 mm die @ 3.6 GHz





Power Sweep Inspector

Eqn VSWRVal=5 Eqn VSWRVal1=2.5

Move Marker 'loadZ' to desired impedance point.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = 2.56 + j3.43
VSWR=5

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = 3.33 + j5.14
VSWR=5

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.33 + j5.14	0.88 / 168.20	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.37	76.86	12.33

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-33.33	-0.64	0.17 - j2.69

✕ In plots below corresponds to this data.

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.33 + j5.14	0.88 / 168.20	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.37	76.86	12.33

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-33.33	-0.64	0.17 - j2.69

✕ In plots below corresponds to this data.

VSWR = 2.5 point DATA

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
4.11 + j5.14	0.85 / 168.18	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.25	77.25	12.02

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-29.60	-1.16	0.32 - j2.67

✕ In plots below corresponds to this data.

VSWR = 3 point DATA

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
2.56 + j6.00	0.90 / 166.28	1.50

Pout (dBm)	Eff (%)	Gt (dB)
45.45	76.55	12.38

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-39.03	0.08	-0.02 - j2.58

✕ In plots below corresponds to this data.

Power scaling (based on simulation)

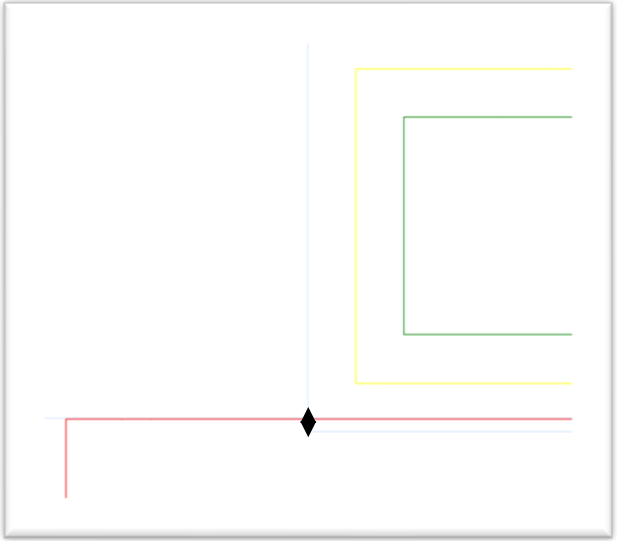
Available dies	Device geometry (mm)	Power scaling	Power scaling (W/mm)	Power deliverd (dBm)	Power deliverd (W)	
P19	5,76	(24x240um)				
P6	5,76	36x160um				
P3	4,8	30x160um	3,88	42,7	18,62	
P14	5,12	16X320um				
P76	10,1	42x240 um				
T9503A_1	12	30X400um	5,48	48,18		
P39	11,52	36x320um				
P35	10,24	32x320um				
T9507B_2	2,4	6x400um				
P47_RF	1,92	8X240um				
P13	3,84	12X320um				
P10	3,84	16X240um				
P15	6,4	20X320um				
P15	6,4	20X320um				

Update

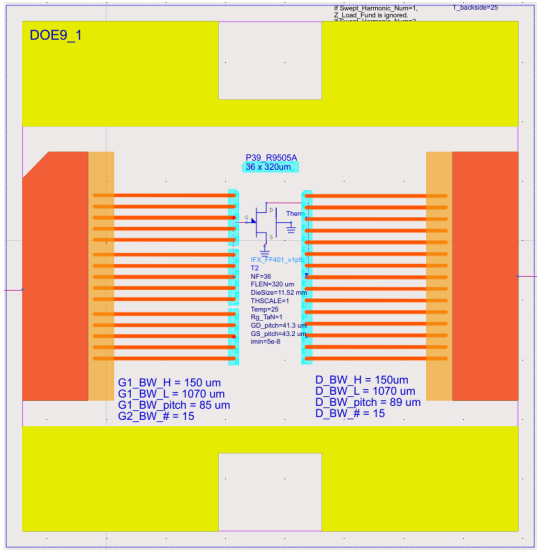
- Update for
- P1.5 dB, P3dB

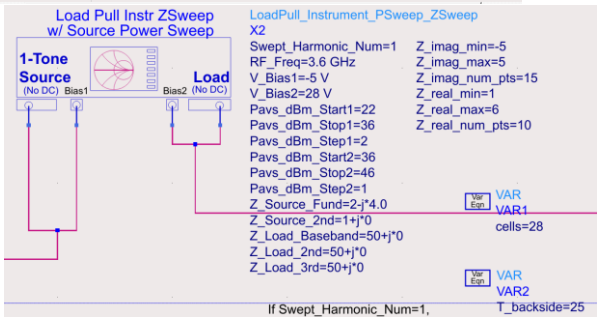
- 12 mm die has lot of power
  - 65 W worst case vs needed 45 W worst case
  - Can be made operated slightly lower than Class C enabling Main to match for more gain
- Input matching can be designed for Max gain & reasonable gain still having enough power to deliver.

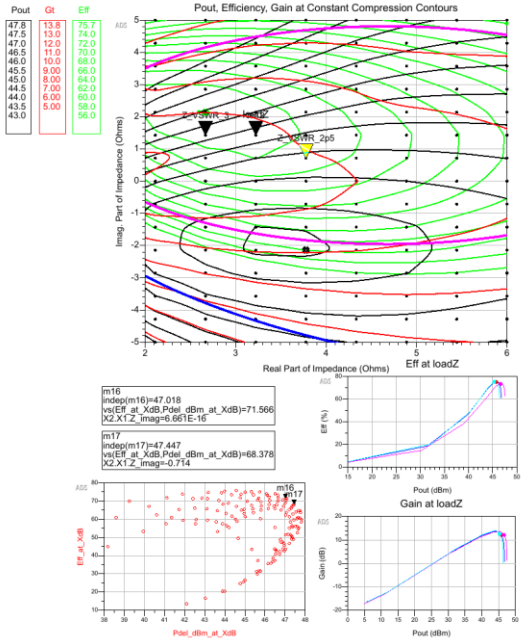
Detailed EM simulation for Selected DOE variants with



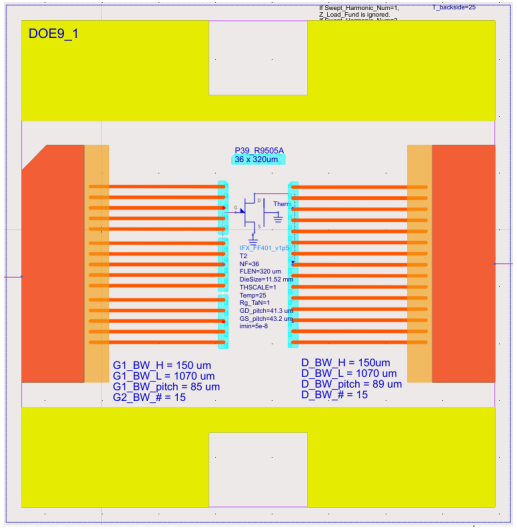
P39_R9505A_ BW1i2i _DOE9_1 (Vgs = -5V)

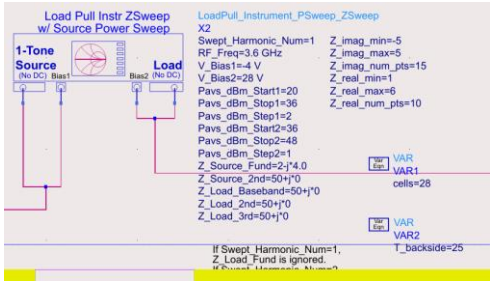




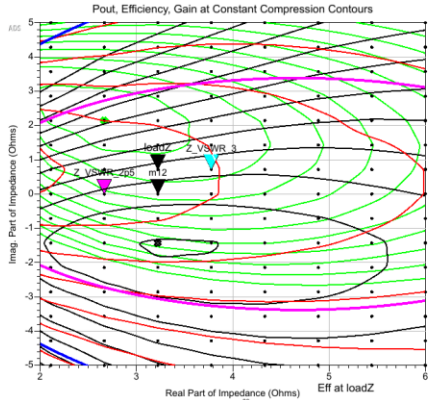


P39_R9505A_ BW1i2i _DOE9_1 (Vgs = -4V)



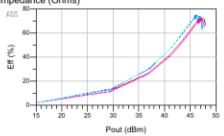


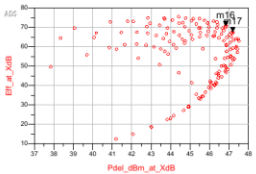
Pout	Gt	Eff
47.5	16.2	75.4
47.0	16.0	74.0
46.5	15.0	72.0
46.0	14.0	70.0
45.5	13.0	68.0
45.0	12.0	66.0
44.5	11.0	64.0
44.0	10.0	62.0
43.5	9.00	60.0
43.0	8.00	58.0
42.5	7.00	56.0
	6.00	

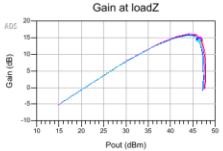


m16
indep(m16)=46.825
vs(Eff_at_XdB,Pdel_dBm_at_XdB)=70.949
X2.X1.Z_imag=6.661E-16

m17
indep(m17)=47.197
vs(Eff_at_XdB,Pdel_dBm_at_XdB)=67.764
X2.X1.Z_imag=-0.714







Power Sweep Inspector

Eqn VSWRVal=5 Eqn VSWRVal1=2.5

Move Marker 'loadZ' to desired impedance point.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 - j1.43

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 + j6.66...

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 + j0.71	0.88 / 178.36	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.20	73.30	14.43

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-33.46	-2.24	0.27 + j3.47

✕ In plots below corresponds to this data.

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 + j6.66E-...	0.88 / 180.00	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.83	70.95	14.28

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-31.75	-2.06	0.26 + j3.40

✕ In plots below corresponds to this data.

VSWR = 2.5 point DATA

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
2.67 + j6.66E-...	0.90 / 180.00	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.66	69.65	14.63

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-35.34	-1.30	0.16 + j3.40

✕ In plots below corresponds to this data.

VSWR = 3 point DATA

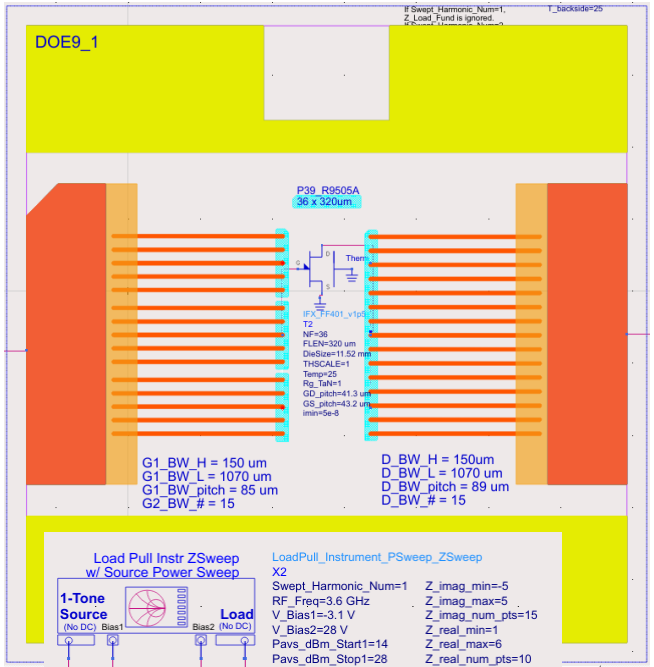
Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 + j0.71	0.86 / 178.35	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.37	72.91	14.06

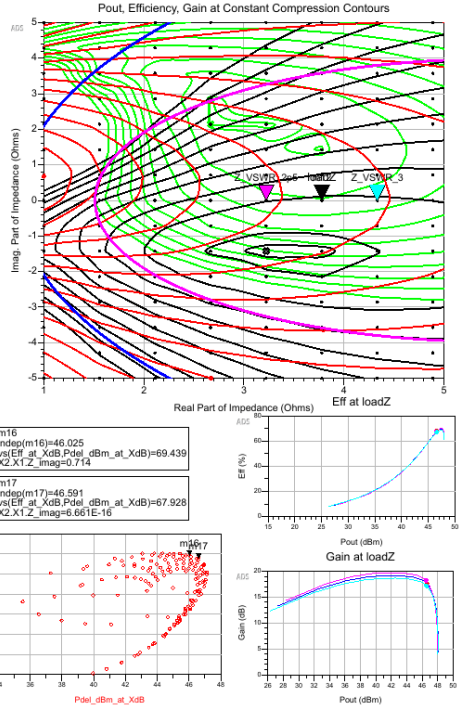
AMPM (dBm)	IRL (dB)	Zin (Ohm)
-29.64	-2.86	0.35 + j3.46

✕ In plots below corresponds to this data.

P39_R9505A_ BW1i2i _DOE9_1



Pout	Gt	Eff
47.1	23.0	70.2
47.0	22.0	70.0
46.5	21.0	68.0
46.0	20.0	66.0
45.5	19.0	64.0
45.0	18.0	62.0
44.5	17.0	60.0
44.0	16.0	58.0
43.5	15.0	56.0
43.0	14.0	54.0
42.5	13.0	52.0
	12.0	



Power Sweep Inspector

Eqn VSWRVal=5 Eqn VSWRVal1=2.5

Move Marker 'loadZ' to desired impedance point.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 - j1.43

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.78 + j6.66...

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 + j6.66E-...	0.86 / 180.00	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.59	67.93	17.60

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-46.50	-7.06	0.50 + j7.52

✕ In plots below corresponds to this data.

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 + j6.66E-...	0.86 / 180.00	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.59	67.93	17.60

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-46.50	-7.06	0.50 + j7.52

✕ In plots below corresponds to this data.

VSWR = 2.5 point DATA

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 + j6.66E-...	0.88 / 180.00	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.48	67.54	18.17

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-48.52	-5.47	0.40 + j7.52

✕ In plots below corresponds to this data.

VSWR = 3 point DATA

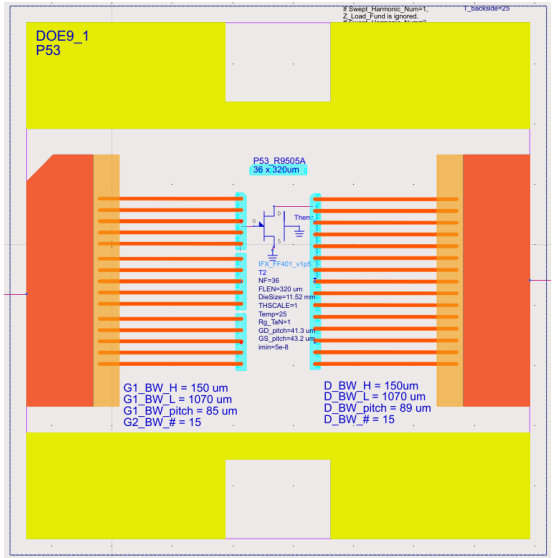
Marker Impedance	Marker Gamma	Reference Compression Level (dB)
4.33 + j6.66E-...	0.84 / 180.00	1.50

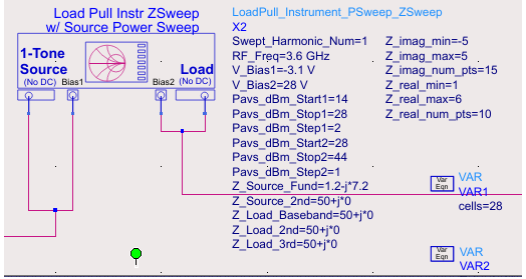
Pout (dBm)	Eff (%)	Gt (dB)
46.57	67.03	17.11

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-44.39	-8.46	0.59 + j7.52

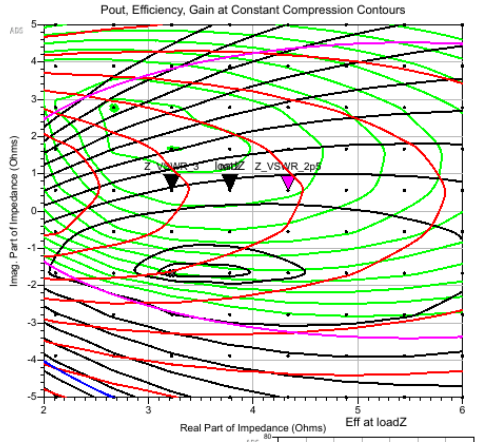
✕ In plots below corresponds to this data.

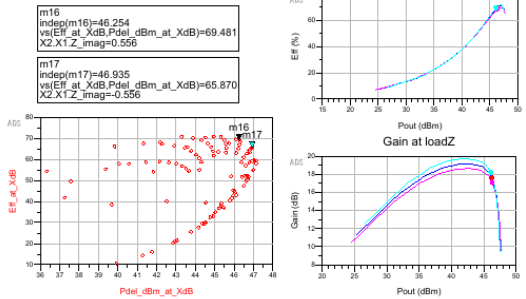
P53_R9505A_ BW1i2i _DOE9_1





Pout	Gt	Eff
47.1	23.4	70.8
47.0	23.0	70.0
46.5	22.0	68.0
46.0	21.0	66.0
45.5	20.0	64.0
45.0	19.0	62.0
44.5	18.0	60.0
44.0	17.0	58.0
43.5	16.0	56.0
43.0	15.0	54.0
42.5	14.0	52.0





Power Sweep Inspector

Eqn VSWRVal=5 Eqn VSWRVal1=2.5

Move Marker 'loadZ' to desired impedance point.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 - j1.67

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 + j0.56	0.86 / 178.72	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.25	69.48	17.61

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-49.68	-7.48	0.50 + j7.35

✕ In plots below corresponds to this data.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.78 + j0.56

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 + j0.56	0.86 / 178.72	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.25	69.48	17.61

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-49.68	-7.48	0.50 + j7.35

✕ In plots below corresponds to this data.

VSWR = 2.5 point DATA

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
4.33 + j0.56	0.84 / 178.72	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.30	68.54	17.14

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-46.74	-9.02	0.58 + j7.33

✕ In plots below corresponds to this data.

VSWR = 3 point DATA

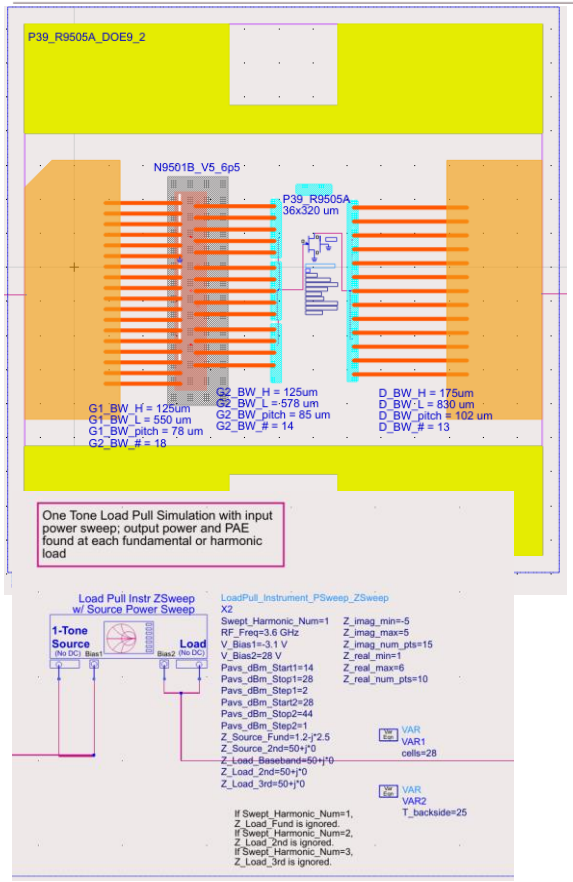
Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 + j0.56	0.88 / 178.72	1.50

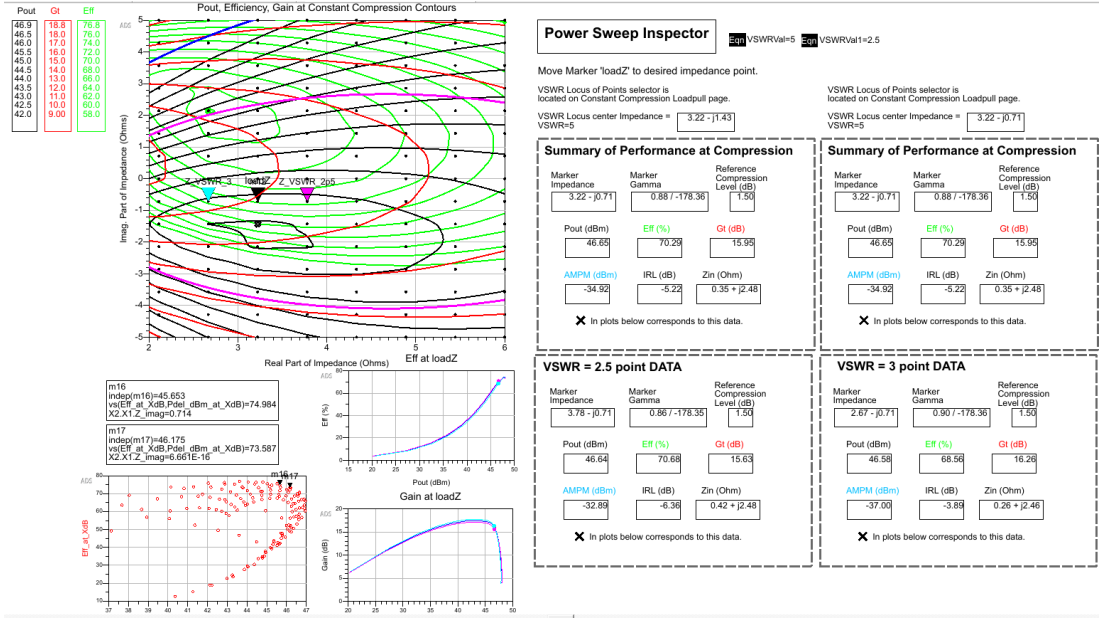
Pout (dBm)	Eff (%)	Gt (dB)
46.08	69.45	18.21

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-52.74	-5.82	0.40 + j7.36

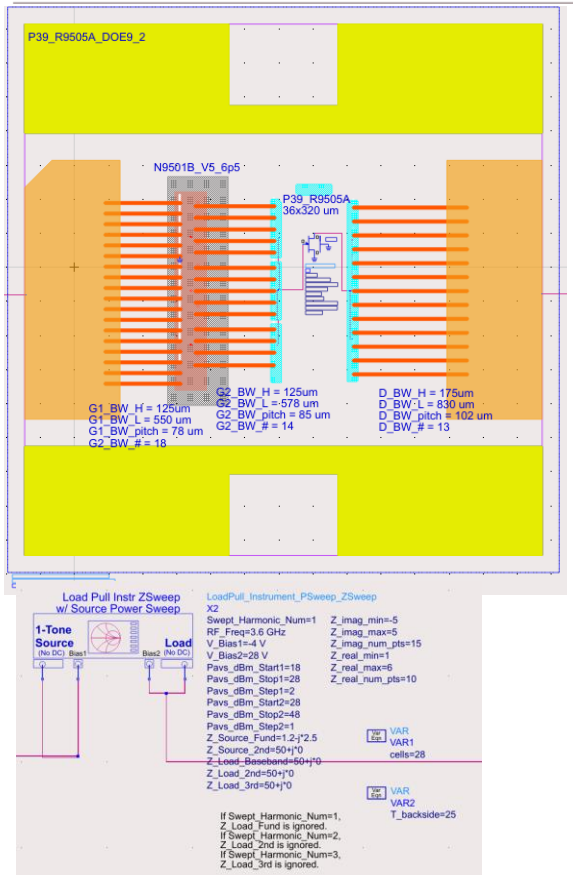
✕ In plots below corresponds to this data.

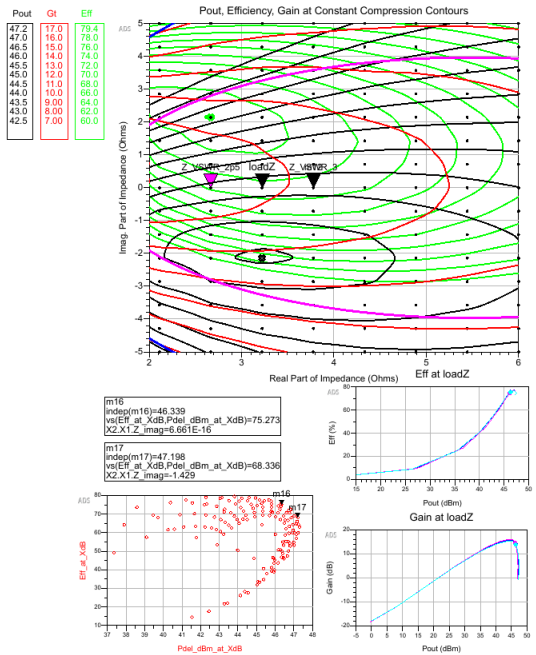
P39_R9505A_N9501B_V5_ BW3i4i5i _DOE9_2

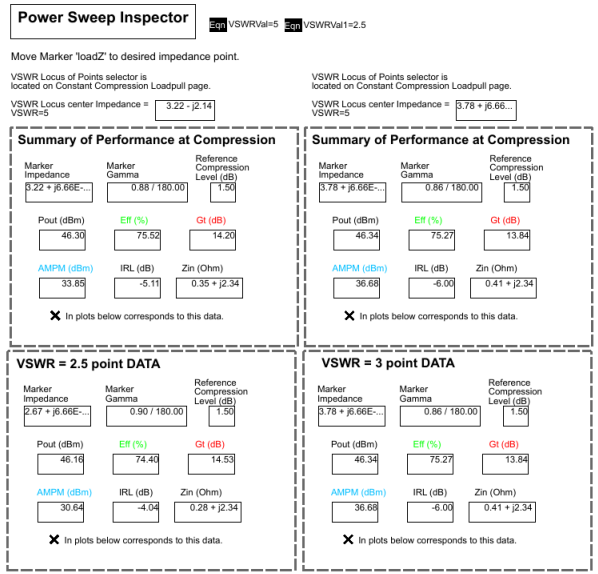




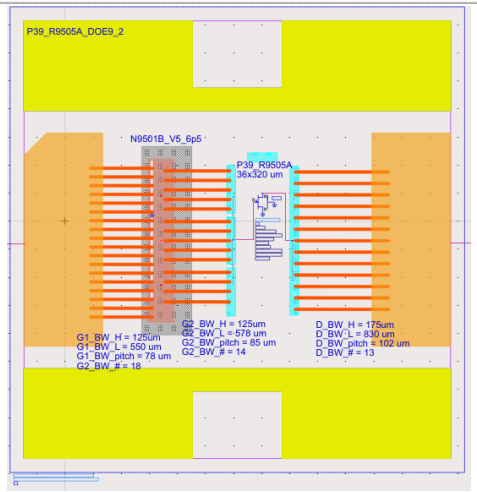
P39_R9505A_N9501B_V5_ BW3i4i5i _DOE9_2 (Vgs = -4V)

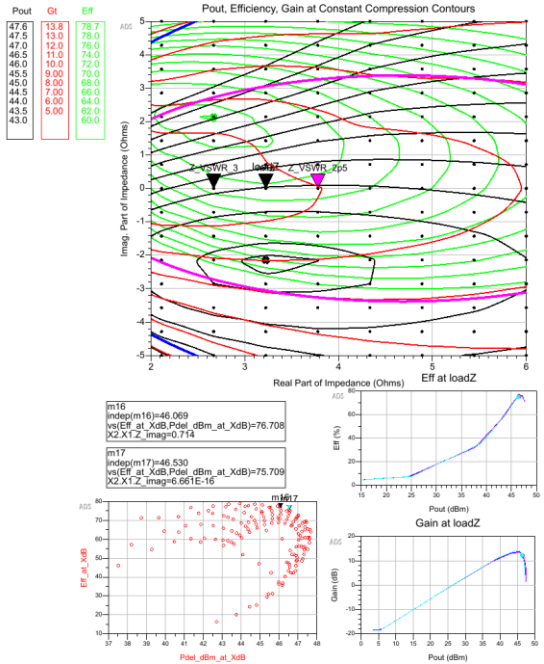


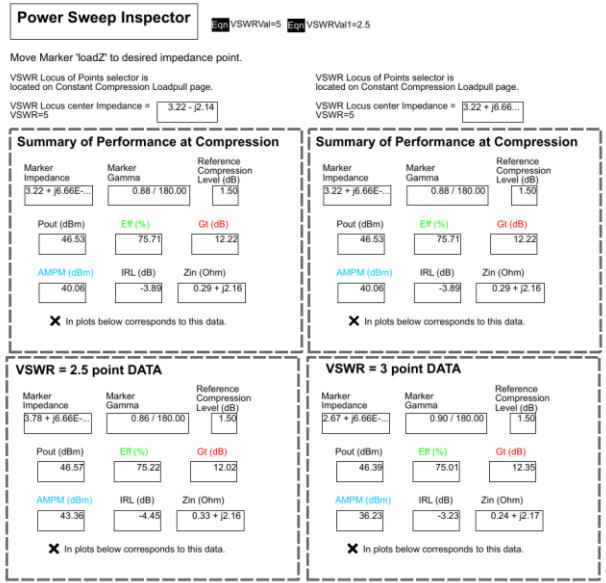


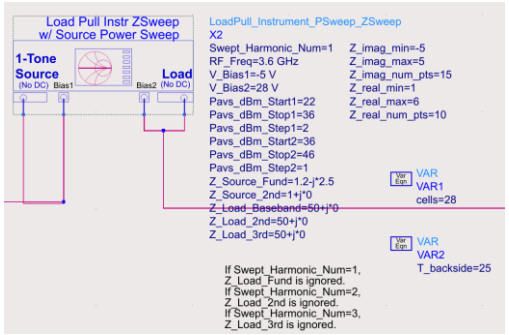


P39_R9505A_N9501B_V5_ BW3i4i5i _DOE9_2 (Vgs = -5V)

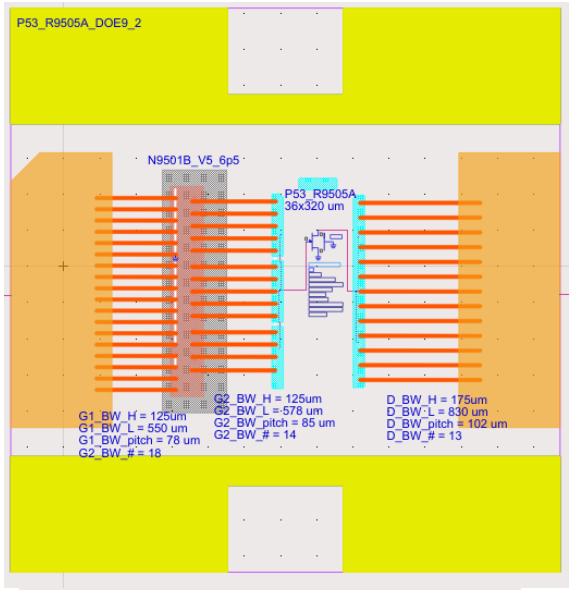


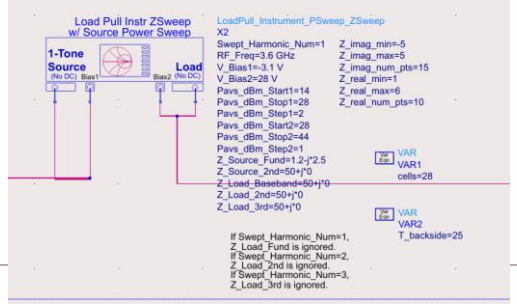


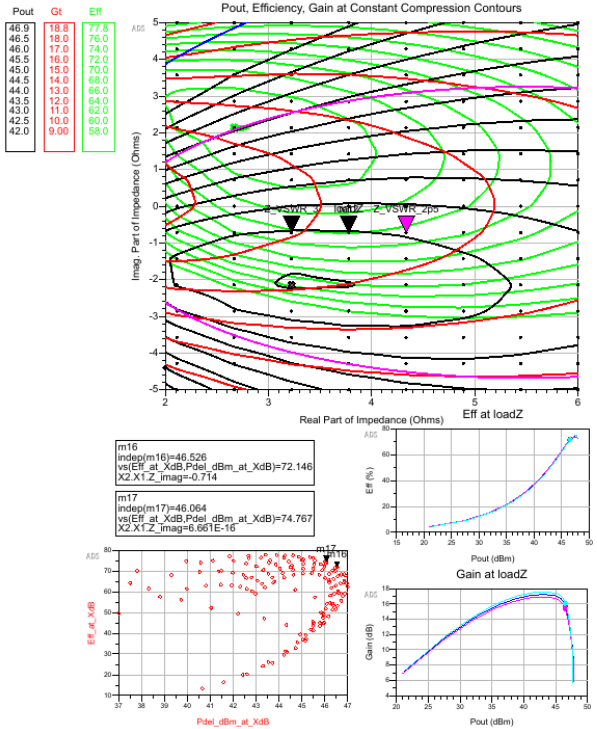


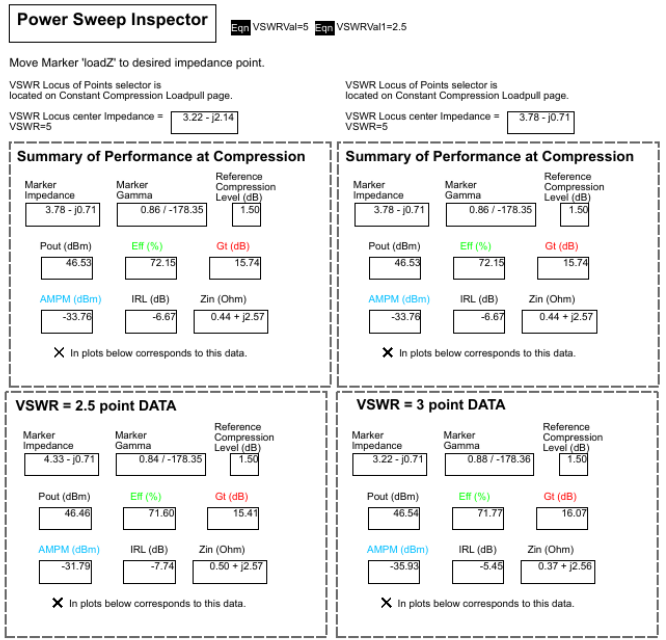


P53_R9505A_N9501B_V5_ BW3i4i5i _DOE9_2

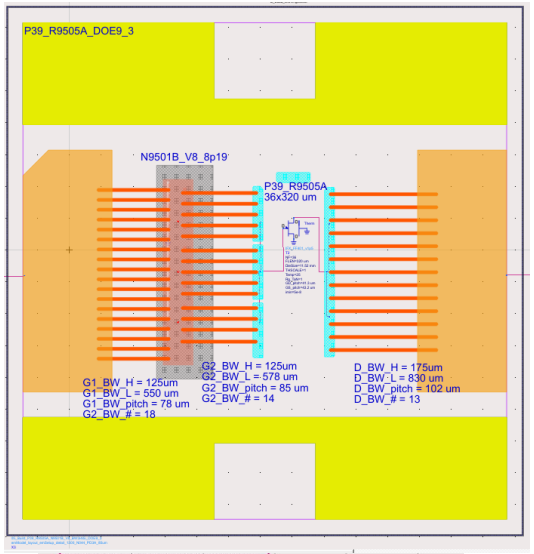


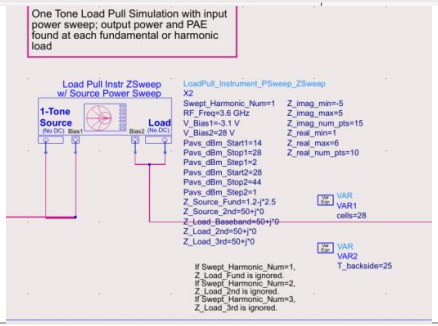




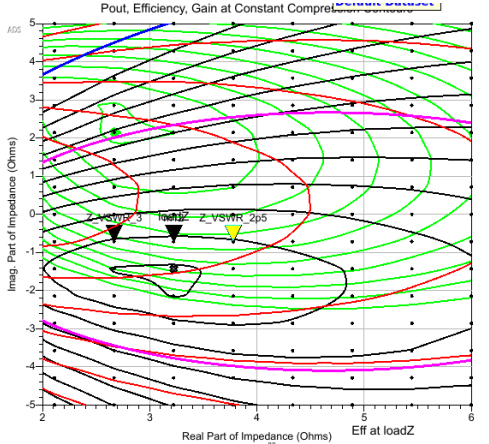


P39_R9505A_N9501B_V8_ BW3i4i5i _DOE9_3



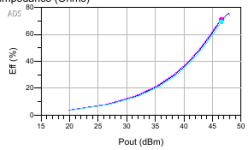


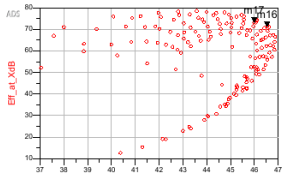
Pout	Gt	Eff
46.8	18.3	78.5
46.5	18.0	78.0
46.0	17.0	76.0
45.5	16.0	74.0
45.0	15.0	72.0
44.5	14.0	70.0
44.0	13.0	68.0
43.5	12.0	66.0
43.0	11.0	64.0
42.5	10.0	62.0
42.0	9.00	60.0



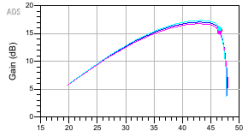
m16
indep(m16)=46.533
vs(Eff_at_XdB,Pdel_dBm_at_XdB)=71.290
X2.X1.Z_imag=-0.714

m17
indep(m17)=45.986
vs(Eff_at_XdB,Pdel_dBm_at_XdB)=73.218
X2.X1.Z_imag=6.661E-16





Gain at loadZ



Power Sweep Inspector

Eqn VSWRVal=5 Eqn VSWRVal1=2.5

Move Marker 'loadZ' to desired impedance point.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 - j1.43

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 - j0.71

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 - j0.71	0.88 / -178.36	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.60	71.12	15.54

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-33.59	-5.89	0.39 + j2.51

✕ In plots below corresponds to this data.

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 - j0.71	0.88 / -178.36	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.60	71.12	15.54

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-33.59	-5.89	0.39 + j2.51

✕ In plots below corresponds to this data.

VSWR = 2.5 point DATA

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 - j0.71	0.86 / -178.35	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.53	71.29	15.24

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-31.73	-7.06	0.46 + j2.51

✕ In plots below corresponds to this data.

VSWR = 3 point DATA

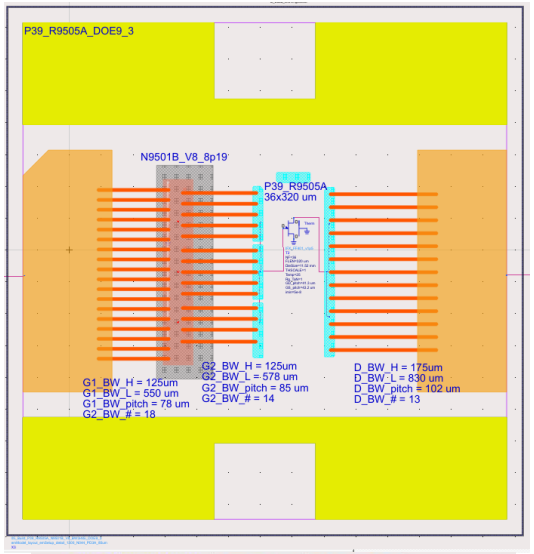
Marker Impedance	Marker Gamma	Reference Compression Level (dB)
2.67 - j0.71	0.90 / -178.36	1.50

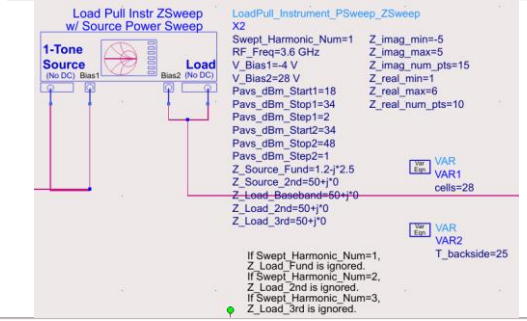
Pout (dBm)	Eff (%)	Gt (dB)
46.55	69.33	15.84

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-35.47	-4.50	0.30 + j2.50

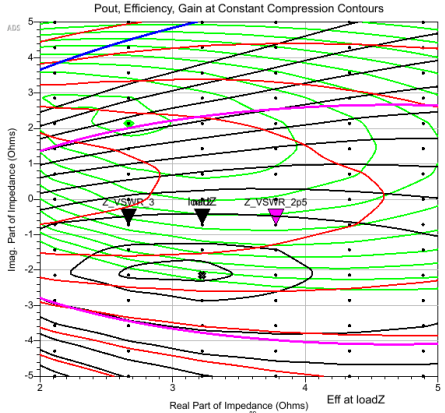
✕ In plots below corresponds to this data.

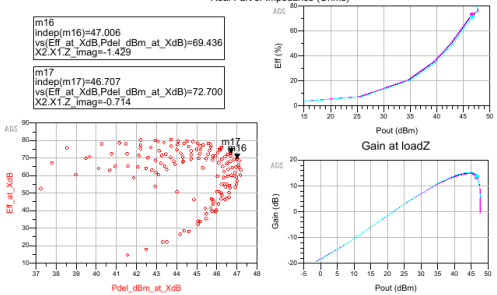
P39_R9505A_N9501B_V8_ BW3i4i5i _DOE9_3 (Vgs = -4V)





Pout	Gt	Eff
47.1	16.8	80.6
47.0	16.0	80.0
46.5	15.0	78.0
46.0	14.0	76.0
45.5	13.0	74.0
45.0	12.0	72.0
44.5	11.0	70.0
44.0	10.0	68.0
43.5	9.00	66.0
43.0	8.00	64.0
42.5	7.00	62.0
	6.00	





Power Sweep Inspector

Eqn VSWRVal=5 Eqn VSWRVal1=2.5

Move Marker 'loadZ' to desired impedance point.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 - j2.14

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 - j0.71	0.88 / -178.36	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.71	72.70	13.56

AMPM (dBm)	IRL (dB)	Zin (Ohm)
37.23	-5.41	0.37 + j2.32

✕ In plots below corresponds to this data.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 - j0.71

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 - j0.71	0.88 / -178.36	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.71	72.70	13.56

AMPM (dBm)	IRL (dB)	Zin (Ohm)
37.23	-5.41	0.37 + j2.32

✕ In plots below corresponds to this data.

VSWR = 2.5 point DATA

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 - j0.71	0.86 / -178.35	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.65	72.90	13.30

AMPM (dBm)	IRL (dB)	Zin (Ohm)
39.13	-6.31	0.43 + j2.32

✕ In plots below corresponds to this data.

VSWR = 3 point DATA

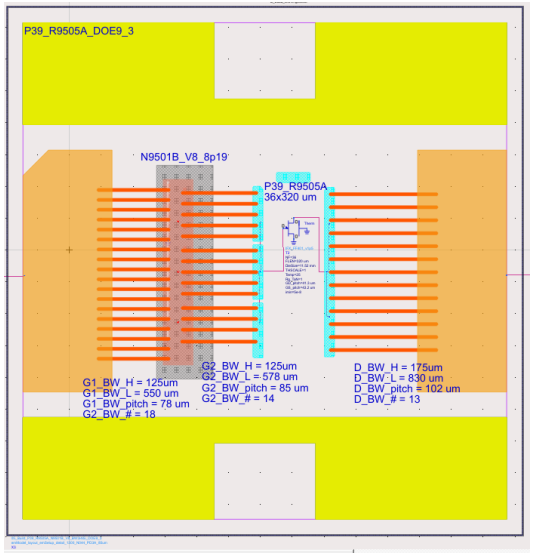
Marker Impedance	Marker Gamma	Reference Compression Level (dB)
2.67 - j0.71	0.90 / -178.36	1.50

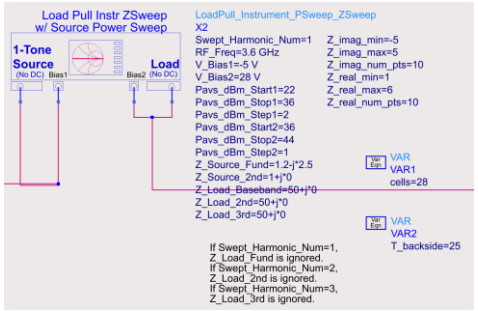
Pout (dBm)	Eff (%)	Gt (dB)
46.69	71.14	13.79

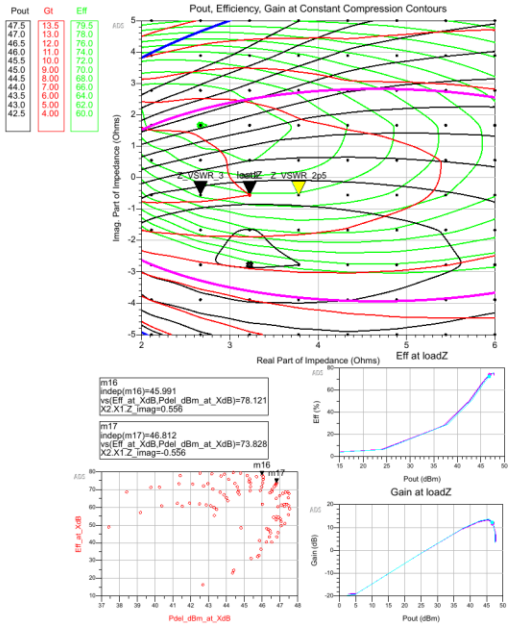
AMPM (dBm)	IRL (dB)	Zin (Ohm)
35.42	-4.31	0.30 + j2.32

✕ In plots below corresponds to this data.

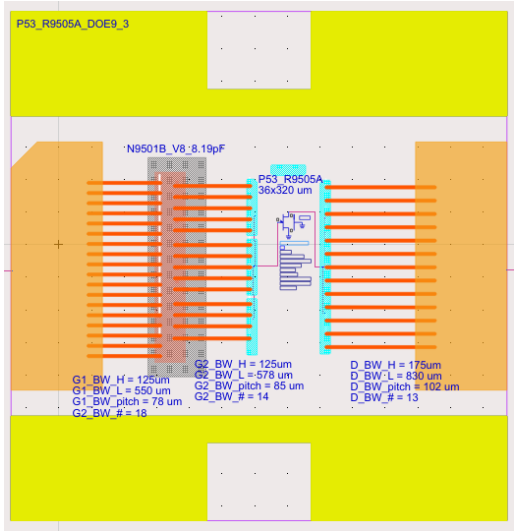
P39_R9505A_N9501B_V8_ BW3i4i5i _DOE9_3 (Vgs = -5V)

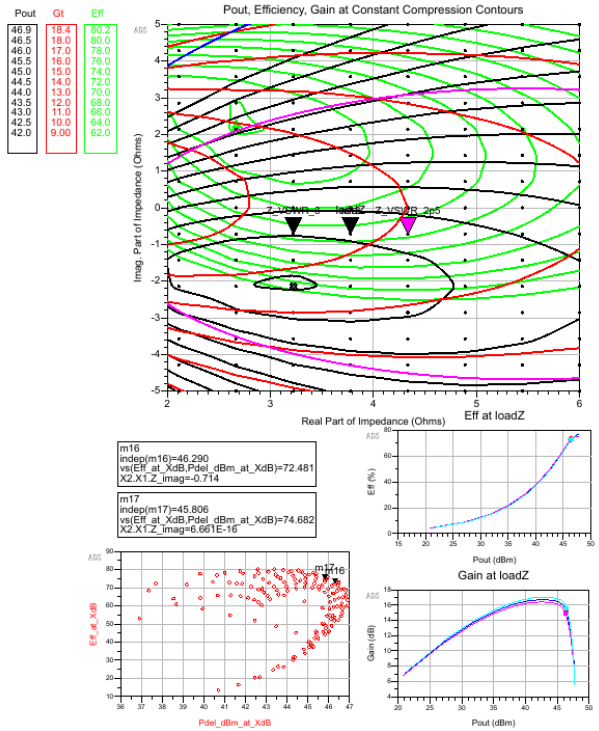


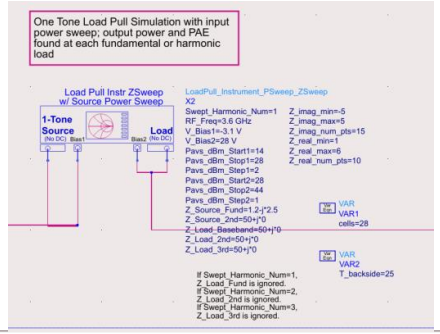




P53_R9505A_N9501B_V8_ BW3i4i5i _DOE9_3







Power Sweep Inspector

Eqn VSWRVal=5 Eqn VSWRVal1=2.5

Move Marker 'loadZ' to desired impedance point.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 - j2.14

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.78 - j0.71

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 - j0.71	0.86 / -178.35	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.42	73.25	15.22

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-32.63	-8.21	0.53 + j2.61

✕ In plots below corresponds to this data.

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 - j0.71	0.86 / -178.35	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.42	73.25	15.22

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-32.63	-8.21	0.53 + j2.61

✕ In plots below corresponds to this data.

VSWR = 2.5 point DATA

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
4.33 - j0.71	0.84 / -178.35	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.29	72.48	14.91

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-30.90	-9.45	0.60 + j2.61

✕ In plots below corresponds to this data.

VSWR = 3 point DATA

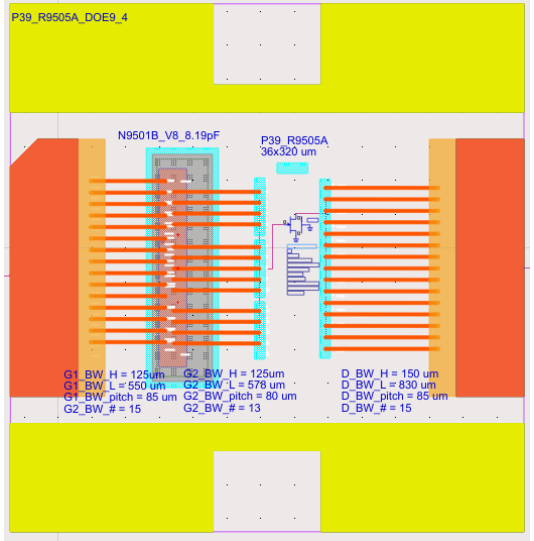
Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 - j0.71	0.88 / -178.36	1.50

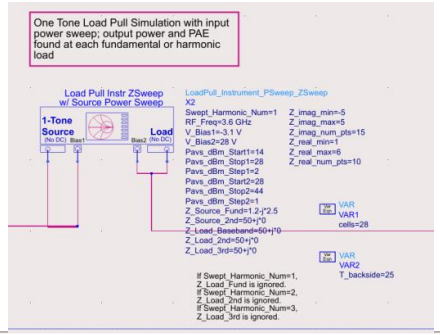
Pout (dBm)	Eff (%)	Gt (dB)
46.48	73.00	15.56

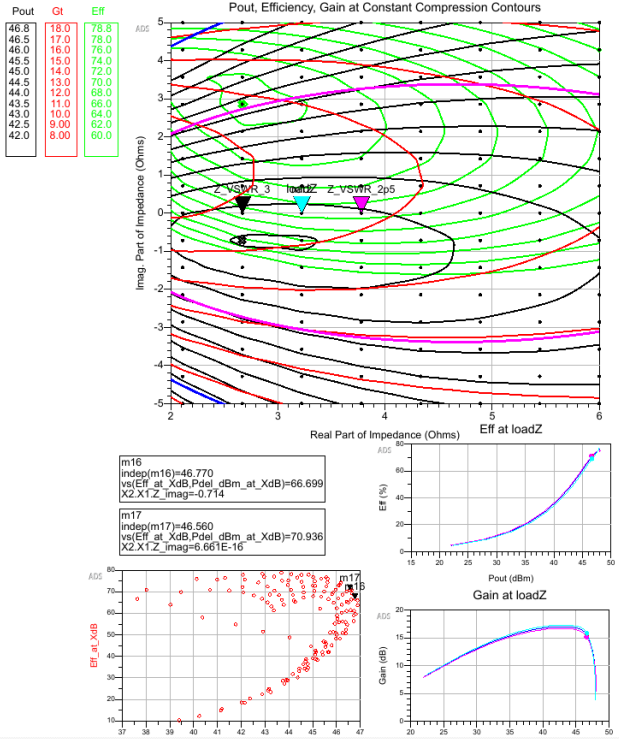
AMPM (dBm)	IRL (dB)	Zin (Ohm)
-34.49	-6.81	0.45 + j2.62

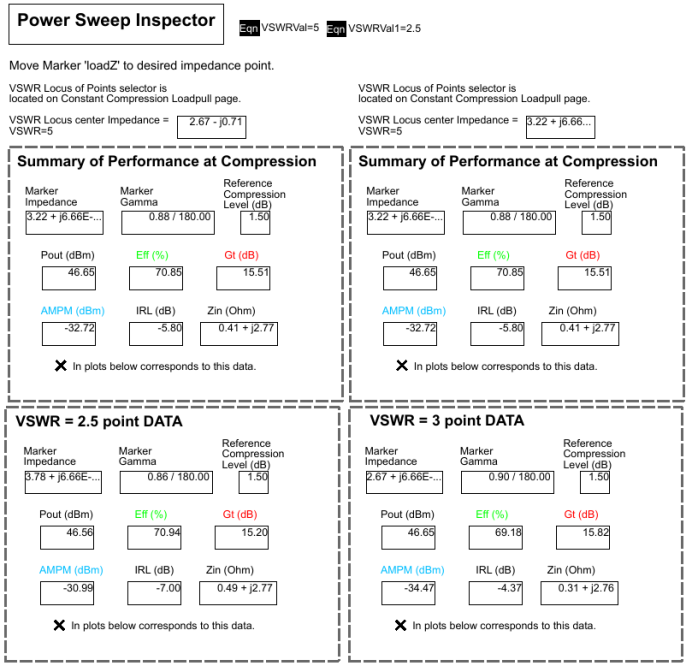
✕ In plots below corresponds to this data.

P39_R9505A_N9501B_V8_ BW6i4i7i _DOE9_4

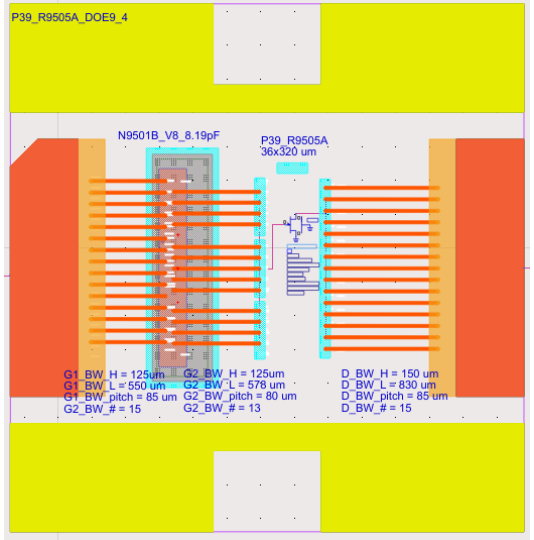


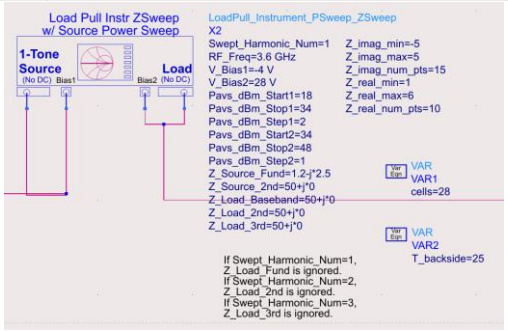


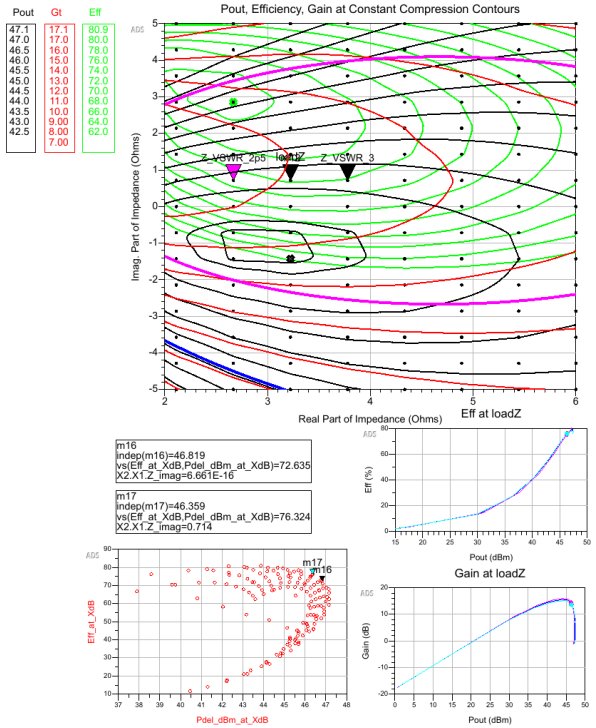


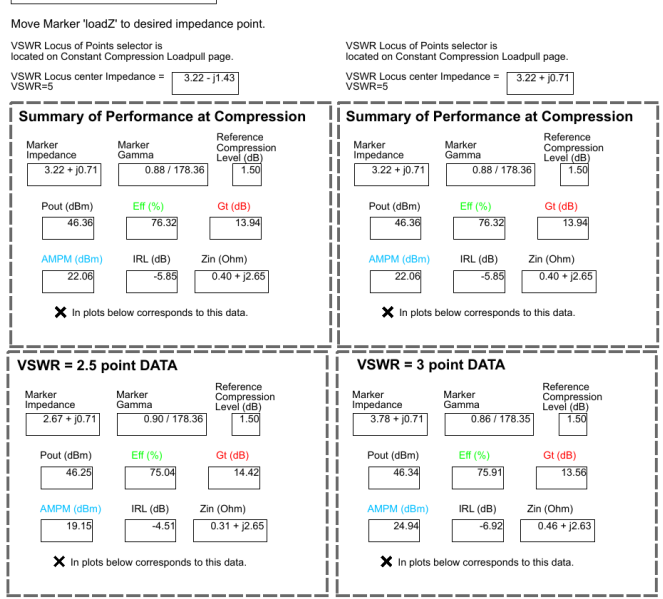


P39_R9505A_N9501B_V8_ BW6i4i7i _DOE9_4 (Vgs = -4V)

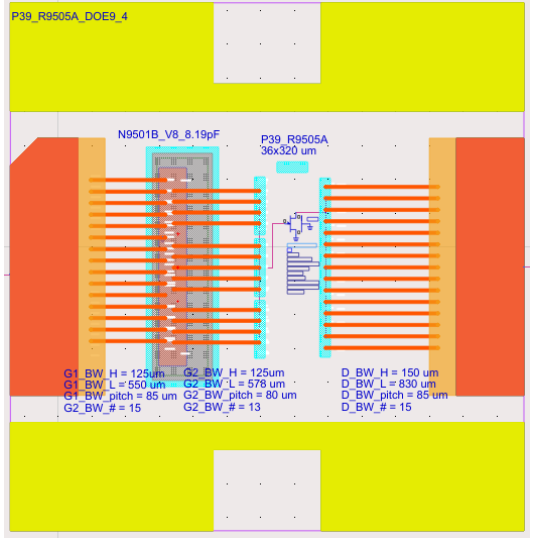


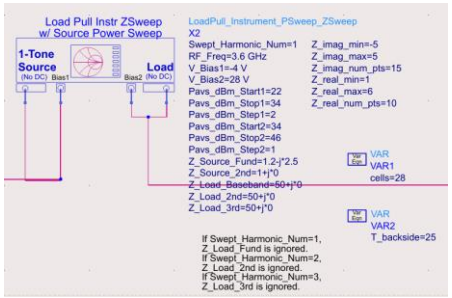




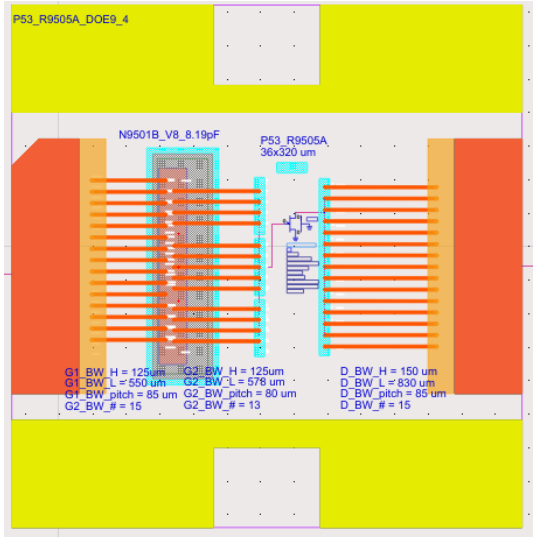


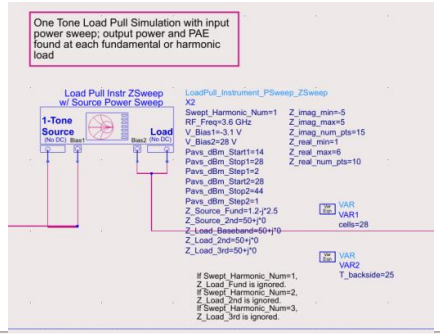
P39_R9505A_N9501B_V8_ BW6i4i7i _DOE9_4 (Vgs = -5V)

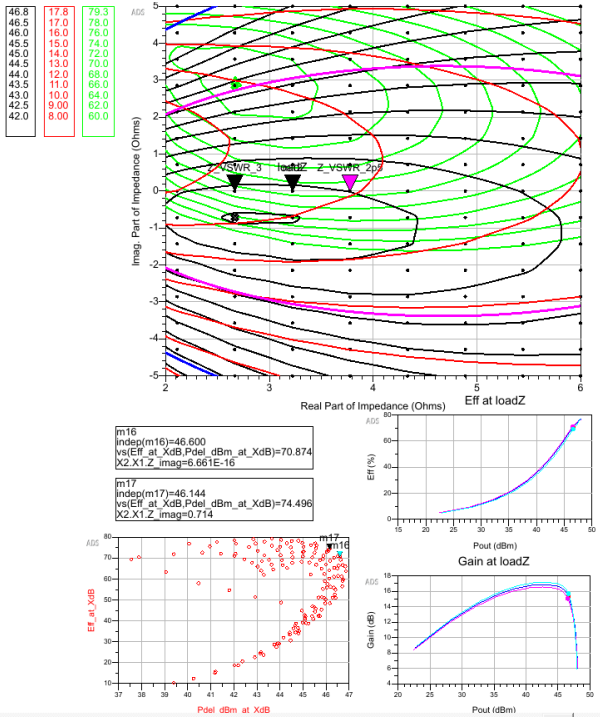


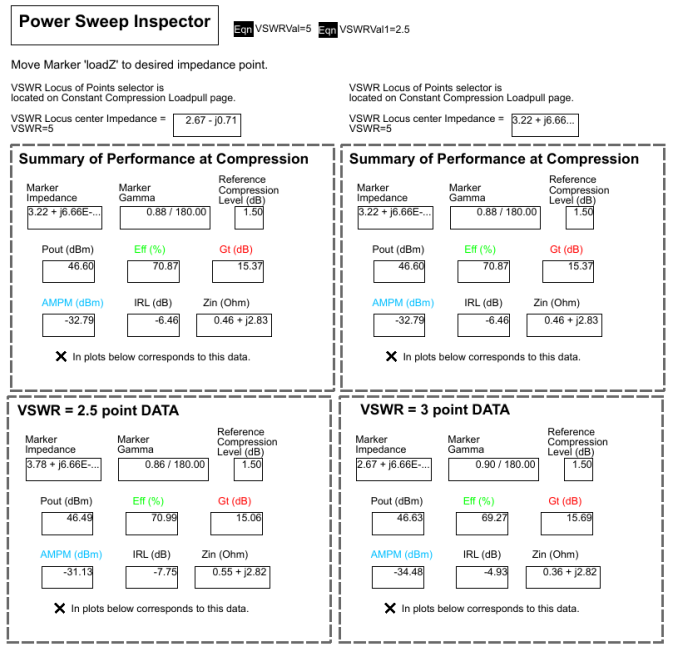


P53_R9505A_N9501B_V8_ BW6i4i7i _DOE9_4

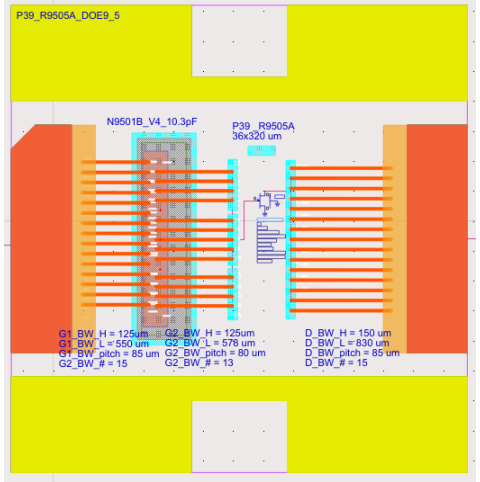


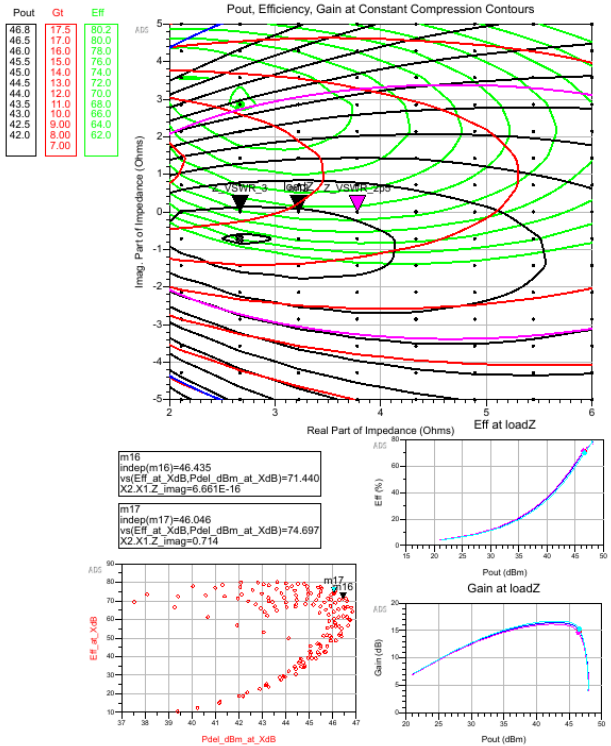


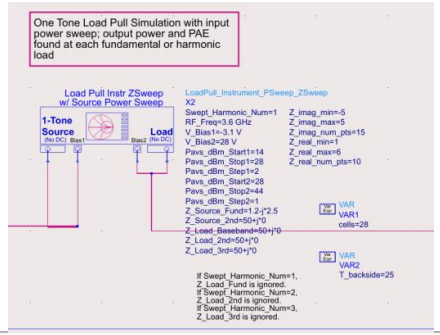




P39_R9505A_N9501B_V4_ BW6i4i7i _DOE9_5







Power Sweep Inspector

Eqn VSWRVal=5 Eqn VSWRVal1=2.5

Move Marker 'loadZ' to desired impedance point.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 2.67 - j0.71

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 + j6.66...

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 + j6.66E-...	0.88 / 180.00	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.55	71.37	14.93

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-31.58	-6.79	0.48 + j2.79

✕ In plots below corresponds to this data.

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 + j6.66E-...	0.88 / 180.00	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.55	71.37	14.93

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-31.58	-6.79	0.48 + j2.79

✕ In plots below corresponds to this data.

VSWR = 2.5 point DATA

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 + j6.66E-...	0.86 / 180.00	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.43	71.44	14.64

AMPM (dBm)	IRL (dB)	Zin (Ohm)
-30.06	-8.08	0.56 + j2.78

✕ In plots below corresponds to this data.

VSWR = 3 point DATA

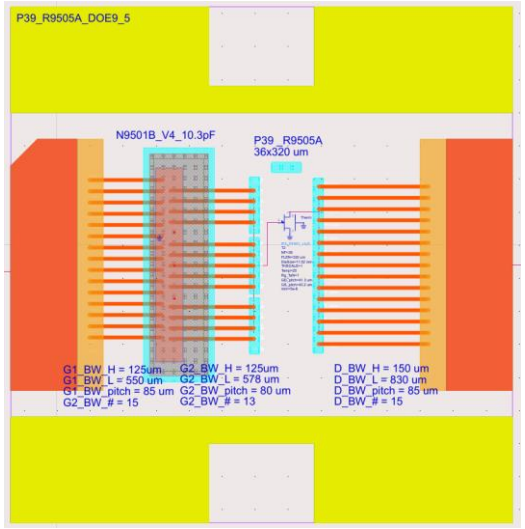
Marker Impedance	Marker Gamma	Reference Compression Level (dB)
2.67 + j6.66E-...	0.90 / 180.00	1.50

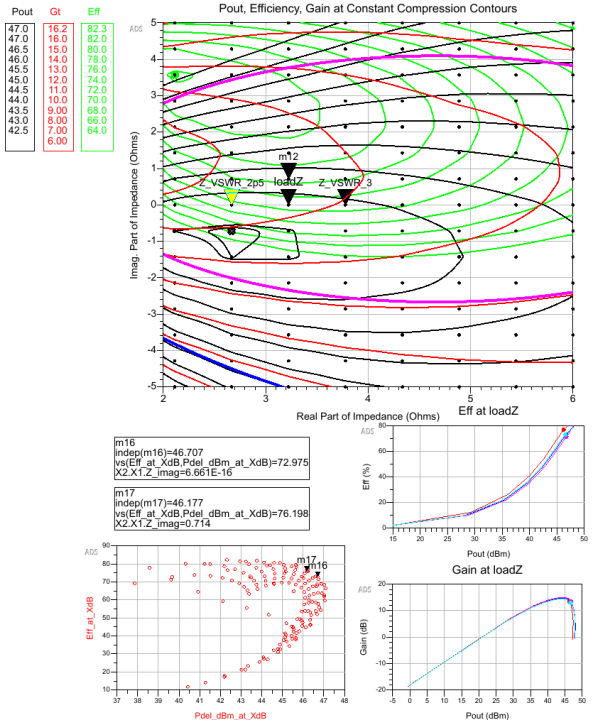
Pout (dBm)	Eff (%)	Gt (dB)
46.60	69.86	15.22

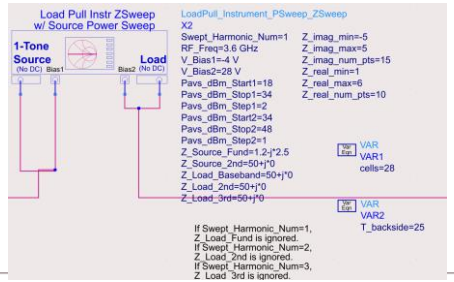
AMPM (dBm)	IRL (dB)	Zin (Ohm)
-33.02	-5.25	0.38 + j2.80

✕ In plots below corresponds to this data.

P39_R9505A_N9501B_V4_ BW6i4i7i _DOE9_5 (Vgs = -4V)







Power Sweep Inspector

Eqn VSWRVal=5 Eqn VSWRVal1=2.5

Move Marker 'loadZ' to desired impedance point.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = 2.67 - j0.71
VSWR=5

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = 3.22 + j0.71
VSWR=5

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 + j6.66E-...	0.88 / 180.00	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.71	72.98	13.25

AMPM (dBm)	IRL (dB)	Zin (Ohm)
27.62	-6.47	0.43 + j2.62

✖ In plots below corresponds to this data.

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 + j0.71	0.88 / 178.36	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.25	76.75	13.43

AMPM (dBm)	IRL (dB)	Zin (Ohm)
24.60	-6.64	0.45 + j2.69

✖ In plots below corresponds to this data.

VSWR = 2.5 point DATA

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
2.67 + j6.66E-...	0.90 / 180.00	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.75	71.45	13.52

AMPM (dBm)	IRL (dB)	Zin (Ohm)
25.98	-5.13	0.35 + j2.63

✖ In plots below corresponds to this data.

VSWR = 3 point DATA

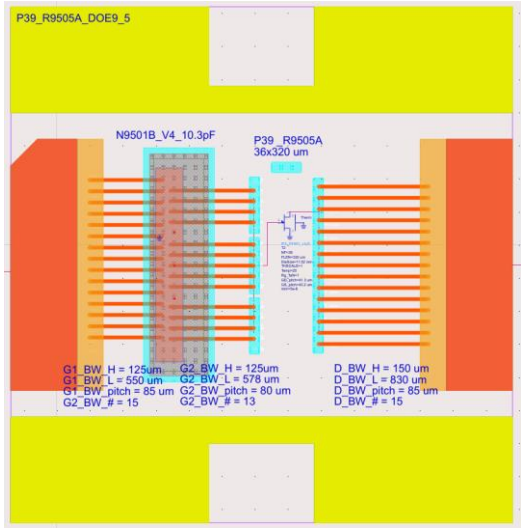
Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 + j6.66E-...	0.86 / 180.00	1.50

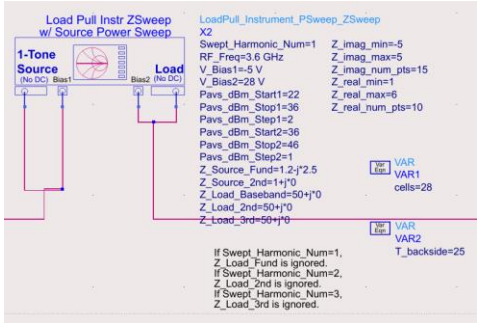
Pout (dBm)	Eff (%)	Gt (dB)
46.60	73.05	12.96

AMPM (dBm)	IRL (dB)	Zin (Ohm)
29.37	-7.58	0.50 + j2.61

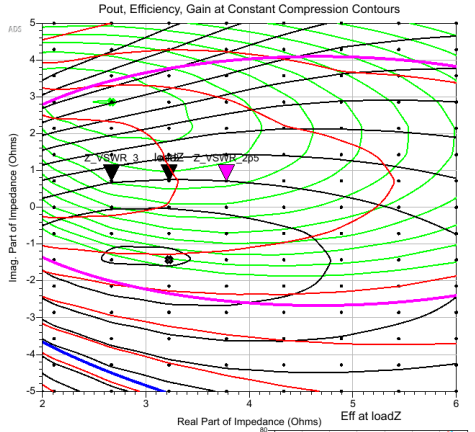
✖ In plots below corresponds to this data.

P39_R9505A_N9501B_V4_ BW6i4i7i _DOE9_5 (Vgs = -5V)



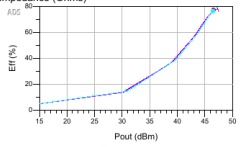


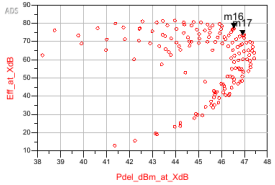
Pout	Gt	Eff
47.4	14.0	81.5
47.0	13.0	80.0
46.5	12.0	78.0
46.0	11.0	76.0
45.5	10.0	74.0
45.0	9.00	72.0
44.5	8.00	70.0
44.0	7.00	68.0
43.5	6.00	66.0
43.0	5.00	64.0
42.5	4.00	62.0



m16
indep(m16)=46.534
vs(Eff_at_XdB,Pdel_dBm_at_XdB)=77.266
X2.X1:Z_imag=0.714

m17
indep(m17)=46.911
vs(Eff_at_XdB,Pdel_dBm_at_XdB)=73.672
X2.X1:Z_imag=6.661E-16





Power Sweep Inspector

Eqn VSWRVal1=5 Eqn VSWRVal1=2.5

Move Marker 'loadZ' to desired impedance point.

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 - j1.43

VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = VSWR=5: 3.22 + j0.71

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 + j0.71	0.88 / 178.36	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.53	77.27	12.05

AMPM (dBm)	IRL (dB)	Zin (Ohm)
39.04	-4.53	0.31 + j2.55

✕ In plots below corresponds to this data.

Summary of Performance at Compression

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.22 + j0.71	0.88 / 178.36	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.53	77.27	12.05

AMPM (dBm)	IRL (dB)	Zin (Ohm)
39.04	-4.53	0.31 + j2.55

✕ In plots below corresponds to this data.

VSWR = 2.5 point DATA

Marker Impedance	Marker Gamma	Reference Compression Level (dB)
3.78 + j0.71	0.86 / 178.35	1.50

Pout (dBm)	Eff (%)	Gt (dB)
46.50	76.68	11.80

AMPM (dBm)	IRL (dB)	Zin (Ohm)
41.90	-5.24	0.35 + j2.54

✕ In plots below corresponds to this data.

VSWR = 3 point DATA

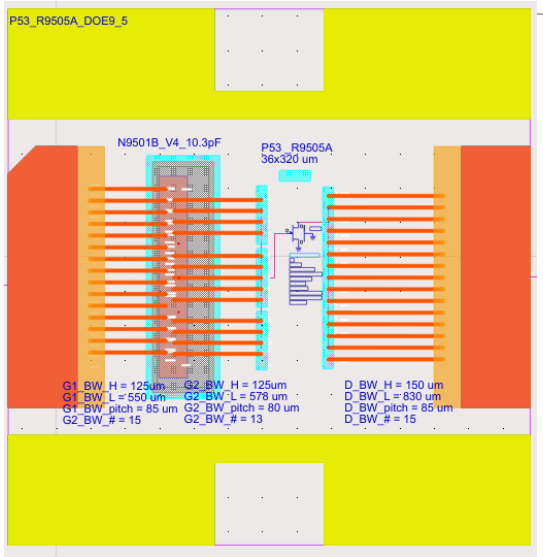
Marker Impedance	Marker Gamma	Reference Compression Level (dB)
2.67 + j0.71	0.90 / 178.36	1.50

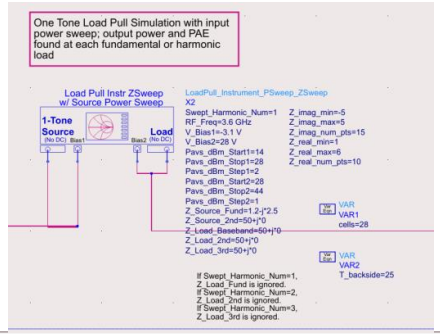
Pout (dBm)	Eff (%)	Gt (dB)
46.47	76.49	12.30

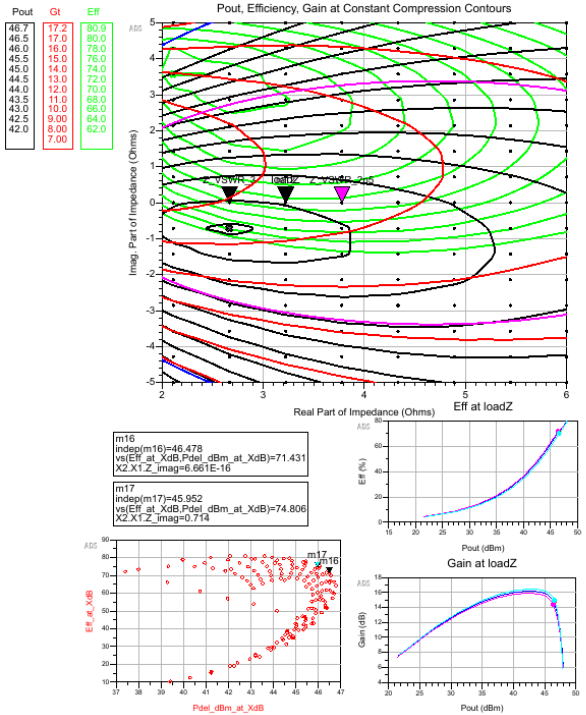
AMPM (dBm)	IRL (dB)	Zin (Ohm)
35.94	-3.68	0.25 + j2.56

✕ In plots below corresponds to this data.

P53_R9505A_N9501B_V4_ BW6i4i7i _DOE9_5







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