

Build #7
DOE13_1 to DOE13_5
R9505_A (6.4 mm – 20x320 μm)

Design Review

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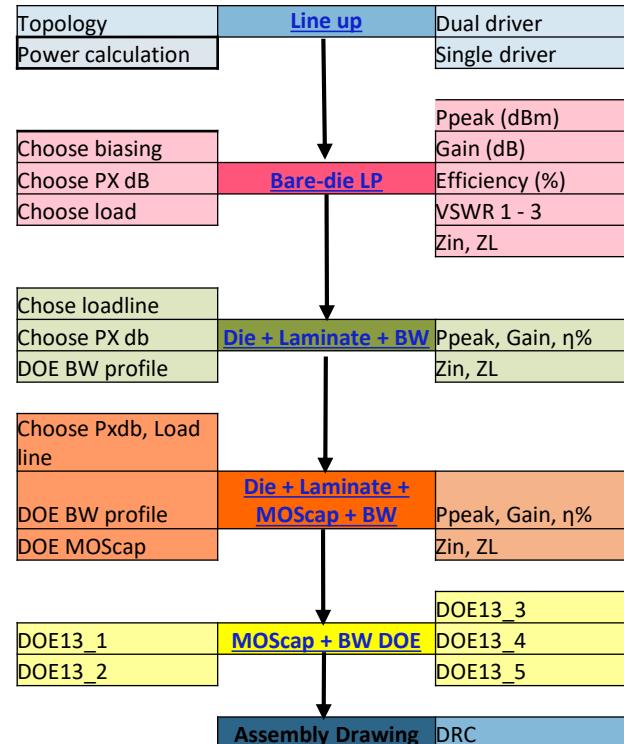
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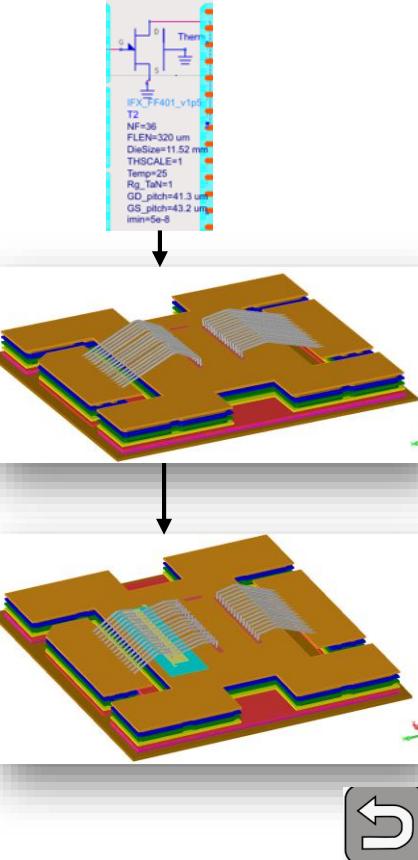
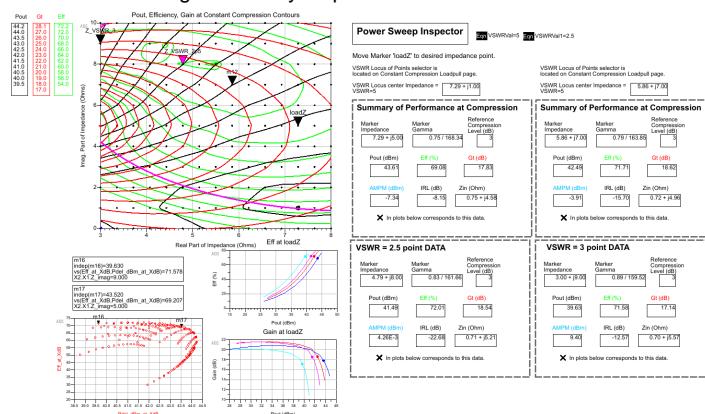
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Design approach



Design selection

- Calculate required power from main 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 & tolerances are captured
- Load Selection criteria
 - Select compression point such that Pout is > 43.3 dBm
 - The die R9505_A (6.4 mm) has > 45 dBm power @ 3dB compression
 - Chosen **compression point** is 2dB where Pout > 44 dBm
 - The load point is selected such that there is a good trade-off when,
 - Pout > 43.34 dBm
 - Atleast Zin > 0.4 Ohm
 - As high gain as possible
 - As high efficiency as possible



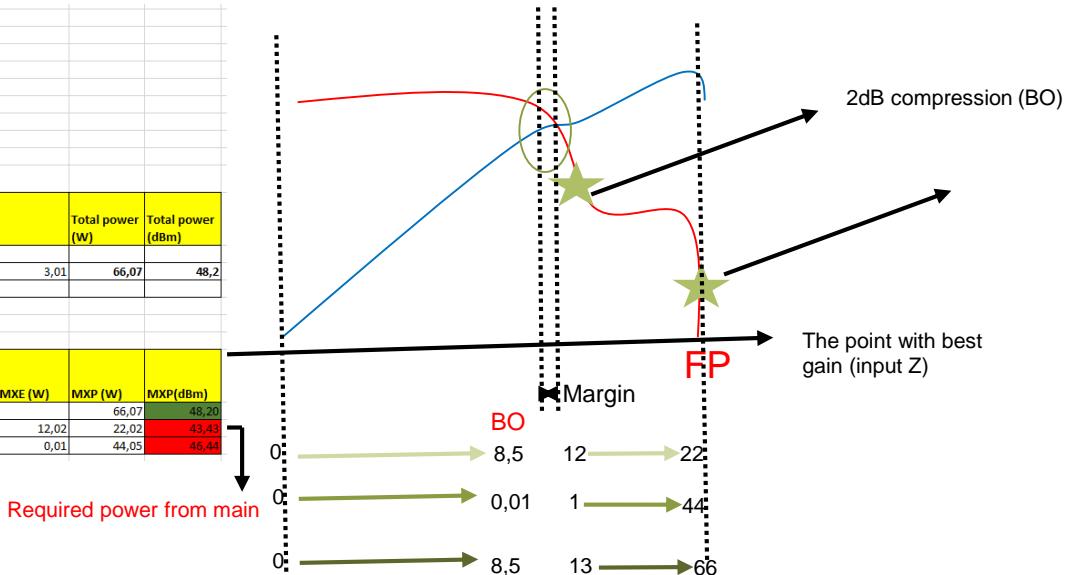
Power calculation: Asymmetric Doherty

| Specification | | P3dB (MHz) | P3dB (W) | PAR |
|---------------|-----------------------|-------------|------------|-------|
| Project | Frequency-Range [MHz] | 3400 - 3800 | 47,4 | 54,95 |
| | | | Pavg (dBm) | PAR |
| | | | 39 | 8,4 |
| | | | Pavg (W) | |
| | | | 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 | | | |
| Peak | | 36,64 | 45,64 | 0,8 | 46,44 | 44,05 | | 3,01 | 66,07 |

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



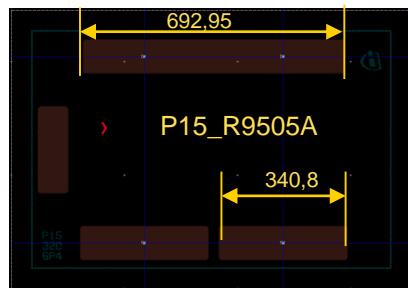
- › Maximize Gain
 - › Main section gain as high as possible while maintaining Power @ MXE
 - › Peak section gain as high as possible while maintaining MXP

Build tracking: starting point

Minipack build tracking



| | | | | | | | | |
|---|-------------|---|---------|-----------------|-----|--------|------|-----|
| 7 | LAC3839_lib | 7 | DOE13_1 | 6.40 (20*320um) | P15 | R9505A | 1060 | 736 |
| 7 | LAC3839_lib | 7 | DOE13_2 | 6.40 (20*320um) | P15 | R9505A | 1060 | 736 |
| 7 | LAC3839_lib | 7 | DOE13_3 | 6.40 (20*320um) | P15 | R9505A | 1060 | 736 |
| 7 | LAC3839_lib | 7 | DOE13_4 | 6.40 (20*320um) | P15 | R9505A | 1060 | 736 |
| 7 | LAC3839_lib | 7 | DOE13_5 | 6.40 (20*320um) | P15 | R9505A | 1060 | 736 |



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 Periphery (mm) | # Gate tabs | Gate Tab Distance (um) | Gate Width / Finger Length (um) | Gate-source pitch [um] | Gate-drain pitch [um] | gate fingers | # Gate Pad Tub | Gate Pad Size (PG opening in Y over pad) | Drain Pad Size (PG opening in Y over pad) | Thermal Resistance (K.mm/W) | # of gate R sections activated | # of gate R sections unactivated | Series Gate Resistor/finger [Ohm] |
|----------|----------|----------|------------|---------------|---|--------------|----------------------|------------|------------|----------|--------------|---------------------|-------------|------------------------|---------------------------------|------------------------|-----------------------|--------------|----------------|--|---|-----------------------------|--------------------------------|----------------------------------|-----------------------------------|
| 43 | RFGaN-C1 | R9505A | P15 | R9505A_P15 | 6.4_320_30.35 | shared | - | 1060 | 736 | 0,78 | 1,44 | 6,4 | 4 | 80 | 320 | 43,2 | 30,4 | 20 | 2 | | | 45,37 | | | |



Design on laminate DOE_13

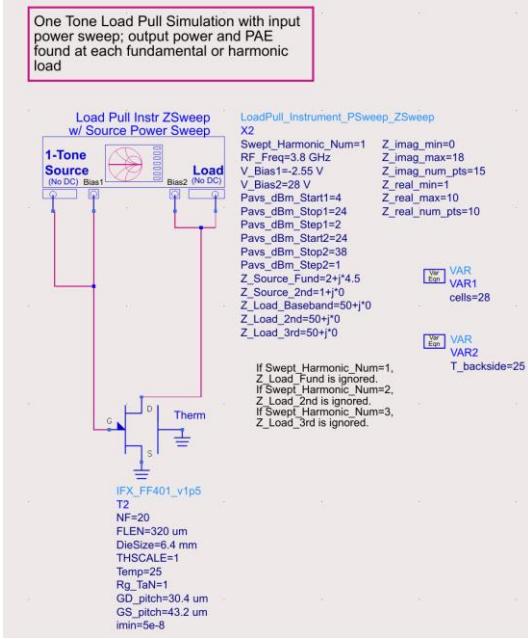
› Laminate library:LAC3839_lib

- LAC3839_lib
- ⊕ C 1_unitCell_90
- ⊕ C 2_SingleBlock
- ⊕ C 3_Strip
 - LAC_Lam5L_nest_1700nm_detail.subst [Checked In]
 - LAC_Lam5L_nest_1950nm_detail.subst [Checked In]
 - LAC_Lam5L_nest_900nm_detail.subst [Checked In]
 - LAC_Lam5L_nest_N044_1700nm_detail.subst [Checked In]
 - LAC_Lam5L_nest_N044_1950nm_detail.subst [Checked In]
 - LAC_Lam5L_nest_N044_3100nm_detail.subst [Checked In]
 - LAC_Lam5L_nest_N044_900nm_detail.subst [Checked In]
 - LAC_Lam5L_nest_onlyGaN.subst [Checked In]
 - LAC_Lam5L_nest_simple.subst [Checked In]
- ⊕ C LF1004_unitCell_90
 - Lam_5L.subst [Checked In]
- ⊕ C Locating_Hole
- ⊕ C Master_Minipac_detail1700
- ⊕ C Master_Minipac_detail1950
- ⊕ C Master_Minipac_detail3100
- ⊕ C Master_Minipac_detail900
- ⊕ C Master_Minipac_onlyGaN
- ⊕ C Master_Minipac_simple

| | GaN | MOSCap |
|------------------|----------------|----------------|
| Design | Die_GaN_v0_lib | IC_LD8C_lib |
| Assembly drawing | | Central_v0_lib |



Bare die GaN Load-pull: P15_R9505_A (20 x 320 um)

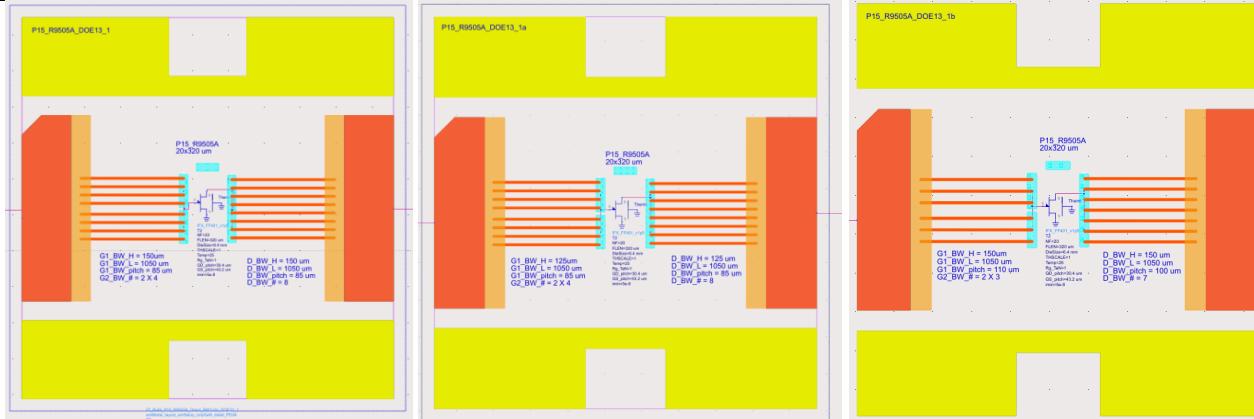
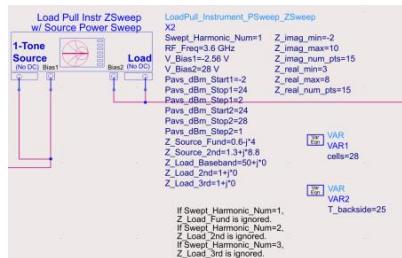


| Detailed_EM_P15_R9505A | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) | | | | | | Performance @ Full power (43.3 dBm) | | | | | |
|------------------------|-------------------------|----------|---------|-----------------------------------|------------|------------|----------|---------|----------|-------------------------------------|-------------|------------|----------|---------|----------|
| | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) |
| 3.4 | 44.2 | 27.8 | 73.6 | 0.4 - j 3.2 | 7 + j 12.9 | 41.72 | 73.7 | 19.6 | -2.3 | 0.2 - j 4.3 | 6 + j 7.7 | 44.09 | 67 | 20.4 | -1.7 |
| 3.6 | 44.3 | 23.8 | 73.9 | 0.6 - j 3.1 | 8 + j 12.9 | 41.77 | 73.5 | 18.1 | -3.5 | 0.3 - j 4.0 | 6.0 + j 7.7 | 44.18 | 68.6 | 19.5 | -2.2 |
| 3.8 | 44.5 | 20.7 | 74.4 | 0.4 - j 2.8 | 6 + j 12.9 | 41.42 | 74.5 | 17.5 | -2.1 | 0.1 - j 3.5 | 5.0 + j 9.0 | 43.67 | 70.7 | 18.9 | -0.8 |

DOE13_1 : Laminate, Bond Wire selection



- Total 3 BW configuration cases has been simulated
- DOE_1a has been chosen. Selection criteria @ P1.5 dB
 - Pout > 43.3 dBm
 - Zin (> 0.5 Ω) & Gain (> 16.0 dB)
 - Good eff. (> 67%)



| Detailed_EM_P15_R9505A | | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) | | | | | | Performance @ Full power (43.3 dBm) | | | | | |
|------------------------|----------------|-------------------------|----------|---------|-----------------------------------|-------------|------------|----------|---------|----------|-------------------------------------|-------------|------------|----------|---------|----------|
| DOE | BW_profile | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) |
| DOE_13_1 | BW_Direct_1o2o | 43.6 | 34 | 70.5 | 0.8 + j 4.4 | 4.1 + j 8.3 | 40.32 | 70.5 | 18.4 | -10.5 | 0.5 + j 3.4 | 6.6 + j 3.2 | 43.38 | 65.6 | 20.5 | -6.0 |
| DOE_13_1a | BW_Direct_1o2o | 43.6 | 30.4 | 70.8 | 0.5 + j 4.2 | 3.6 + j 8 | 40.12 | 70.7 | 20.2 | -16.5 | 0.5 + j 3.1 | 6.9 + j 3 | 43.55 | 64.6 | 18.9 | -3.4 |
| DOE_13_1b | BW_Direct_1o2o | 43.9 | 22.8 | 70.6 | 0.9 + j 4.9 | 4 + j 8.6 | 40.02 | 68.7 | 18.2 | -20 | 0.6 + j 4.0 | 6.9 + j 4 | 43.4 | 68.6 | 19.2 | -5.9 |

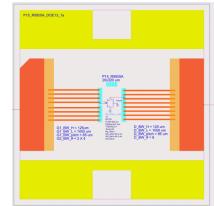
Selected variant DOE_13_1a

Harmonic termination impact

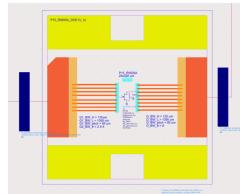
| Detailed_EM_P15 R9505A @ 3.6 GHz | | | Max. performance @ P2dB | | Performance @ Back_off (39.5 dBm) | | | | | Performance @ Full power (43.3 dBm) | | | | | |
|--|-----------|----------|-------------------------|-------------|-----------------------------------|------------|----------|---------|----------|-------------------------------------|-------------|------------|----------|---------|----------|
| Load termination | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) |
| No harmonic terminations | 43.9 | 24.2 | 65.4 | 0.8 + j 4.3 | 4.6 + j 7.6 | 39.71 | 60.8 | 18.2 | -7.1 | 0.5 + j 3.2 | 6.2 + j 1.8 | 43.5 | 63.2 | 20.8 | -10.0 |
| | | | | | | | | | | | | | | | |
| I1_term + O1_short + O2_short | 43.4 | 26.4 | 71.7 | 0.6 + j 4.3 | 4.6 + j 7.6 | 40.68 | 71.7 | 18.6 | -6.3 | 0.4 + j 3.2 | 6.2 + j 1.8 | 43.48 | 62.8 | 21.7 | -7.4 |

- › Harmonic termination has an impact on MXE and the efficiency at Back-off.
- › Slight difference in power as well.

Impact of step (Analysis on Bare die + Moscap)



| Detailed_EM_P15_R 9505A P_2dB | | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) | | | | | | Performance @ Full power (43.3 dBm) | | | | | |
|---|----------------|-------------------------|-------------|---------|-----------------------------------|-------------|------------|----------|---------|----------|-------------------------------------|-------------|------------|----------|---------|----------|
| | | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) |
| DOE | BW_profile | | | | | | | | | | | | | | | |
| DOE_13_1 | BW_Direct_1o2o | 43.6 | 34 | 70.5 | 0.8 + j 4.4 | 4.1 + j 8.3 | 40.32 | 70.5 | 18.4 | -10.5 | 0.5 + j 3.4 | 6.6 + j 3.2 | 43.38 | 65.6 | 20.5 | -6.0 |
| DOE_13_1a | BW_Direct_1o2o | 43.6 | 30.4 | 70.8 | 0.5 + j 4.2 | 3.6 + j 8 | 40.12 | 70.7 | 20.2 | -16.5 | 0.5 + j 3.1 | 6.9 + j 3 | 43.55 | 64.6 | 18.9 | -3.4 |
| DOE_13_1b | BW_Direct_1o2o | 43.9 | 22.8 | 70.6 | 0.9 + j 4.9 | 4 + j 8.6 | 40.02 | 68.7 | 18.2 | -20 | 0.6 + j 4.0 | 6.9 + j 4 | 43.4 | 68.6 | 19.2 | -5.9 |



| Detailed_EM_P15_R 9505A + step P_2dB | | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) (Zs_2fo = 4 - j 70 Ohm, ZL_2f0, ZL_3fo short) | | | | | | Performance @ Full power (43.3 dBm) (Zs_2fo = 4 - j 70 Ohm, ZL_2f0, ZL_3fo short) | | | | | |
|--|----------------|-------------------------|-------------|---------|--|-------------|------------|----------|---------|----------|--|-------------|------------|----------|---------|----------|
| | | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) |
| DOE | BW_profile | | | | | | | | | | | | | | | |
| DOE_13_1 | BW_Direct_1o2o | 43.5 | 18.3 | 65 | 1.6 + j 7.9 | 3.6 + j 3.7 | 40.43 | 63.5 | 15.8 | -11.7 | 1.2 + j 6.7 | 4.2 - j 1.6 | 43.37 | 59.4 | 16.8 | -15.3 |
| DOE_13_1a | BW_Direct_1o2o | 43.3 | 18.6 | 64.7 | 1.4 + j 7.6 | 3.1 + j 2.7 | 40.29 | 62.5 | 16.3 | -13.6 | 1.3 + j 6.4 | 4.7 - j 1.6 | 43.35 | 58.4 | 16.5 | -12.1 |
| DOE_13_1b | BW_Direct_1o2o | 43.4 | 17.5 | 64.8 | 1.8 + j 8.6 | 3.1 + j 2.7 | 39.61 | 61.4 | 15.2 | -7.4 | 1.2 + j 7.3 | 3.6 - j 1.6 | 43.24 | 58.5 | 16.6 | -15.7 |

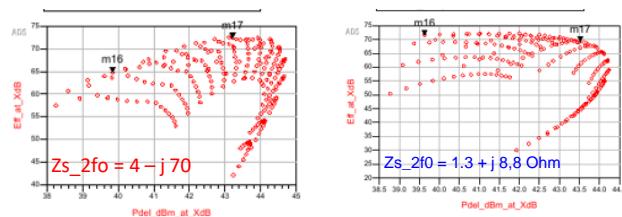
› Simulations are done with preliminary EM model of the step. The step EM model needs to be validated

Harmonic termination analysis (Die + Moscap + minipac)

($Z_s \cdot 2f_0 = 4 - j 70$ vs $Z_s \cdot 2f_0 = 1.3 + j 8.8$)

| Detailed_EM_P15_R9505A | P_2dB | Moscap | | | | | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) ($Z_s \cdot 2f_0 = 4 - j 70$; $Z_L \cdot 2f_0, Z_L \cdot 3f_0 = 1$ Ohm) | | | | | | | Performance @ Full power (43.3 dBm) ($Z_s \cdot 2f_0 = 4 - j 70$; $Z_L \cdot 2f_0, Z_L \cdot 3f_0 = 1$ Ohm) | | | | | | |
|------------------------|-------------|------------|------|----------|----------------------|----------------------|-------------------------|-----------|----------|--|-----------|---------|------------|----------|---------|-----------|--|---------|------------|----------|---------|----------|--|
| | | BW_profile | Name | Index | RF top plate (X x Y) | Oxide thickness (μm) | Value (pF) | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | |
| DOE_13 | BW_profile | N9500B_std | | 1010x337 | 1700 | 7.05 | 44.6 | 20.8 | 72.5 | 1.1+j 5.2 | 3.4+j 8.6 | 39.61 | 64.0 | 17.2 | -16.2 | 1.0+j 4.5 | 6.2+j 5.7 | 43.64 | 70.0 | 17.0 | -13.1 | | |
| DOE_13_2 | BW_3o_4o_5o | N9500B_V5 | | 1010x270 | 900 | 10.19 | 45.0 | 21.1 | 73.9 | 0.9+j 5.2 | 3.4+j 8.6 | 40.1 | 67.2 | 17.5 | -16.4 | 0.8+j 4.6 | 5.9+j 6.4 | 43.59 | 73.4 | 17.4 | -13.2 | | |
| DOE_13_3 | BW_3o_4o_5o | N9500B_V5 | | 1010x270 | 900 | 10.19 | 44.8 | 21.0 | 73.4 | 0.8+j 4.5 | 3.0+j 8.6 | 39.42 | 64.6 | 17.7 | -15.7 | 0.5+j 4.2 | 4.8+j 5.7 | 43.46 | 72.8 | 18.4 | -11.0 | | |
| DOE_13_4 | BW_6o_7o_5o | N9501B_V1 | | 1466x328 | 1300 | 12.83 | 44.9 | 21.8 | 73.3 | 0.7+j 4.8 | 3.0+j 8.6 | 39.53 | 65.4 | 17.7 | -3.4 | 0.5+j 4.3 | 4.8+j 5.7 | 43.45 | 72.7 | 18.7 | -11.9 | | |
| DOE_13_5 | BW_6o_7o_5o | N9501B_V1 | | | | | | | | | | | | | | | | | | | | | |

| Detailed_EM_P15_R9505A | P_2dB | Moscap | | | | | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) ($Z_s \cdot 2f_0 = 1.3 + j 8.8$ Ohm; $Z_L \cdot 2f_0, Z_L \cdot 3f_0 = 1$ Ohm) | | | | | | | Performance @ Full power (43.3 dBm) ($Z_s \cdot 2f_0 = 1.3 + j 8.8$ Ohm; $Z_L \cdot 2f_0, Z_L \cdot 3f_0 = 1$ Ohm) | | | | | | |
|------------------------|----------------|------------|------|------------|----------------------|----------------------|-------------------------|-----------|----------|--|-----------|---------|------------|----------|---------|-----------|--|---------|------------|----------|---------|----------|--|
| | | BW profile | Name | Index | RF top plate (X x Y) | Oxide thickness (μm) | Value (pF) | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | |
| DOE_13_1 | BW_Direct_1o2o | | | | | | | 43.6 | 30.4 | 70.8 | 0.5+j 4.2 | 3.6+j 8 | 40.12 | 70.7 | 20.2 | -16.5 | 0.5+j 3.1 | 6.9+j 3 | 43.55 | 64.6 | 18.9 | -3.4 | |
| DOE_13_2 | BW_3o_4o_5o | N9500B_V4 | | 1010 x 283 | 1700 | 5.92 | 44.5 | 19.4 | 72.3 | 1.4+j 5.3 | 4.1+j 8.6 | 39.68 | 71.8 | 15.9 | -13.7 | 0.7+j 4.5 | 4.1+j 3.6 | 43.6 | 70.2 | 17.5 | -8.9 | | |
| DOE_13_3 | BW_3o_4o_5o | N9500B_Std | | 1010 x 337 | 1700 | 7.05 => 7.11 | 44.2 | 28.1 | 72.2 | 0.7+j 5.6 | 3+j 9 | 39.63 | 71.6 | 17.1 | -12.6 | 0.8+j 4.6 | 7.3+j 5 | 43.61 | 69.1 | 17.8 | -8.2 | | |
| DOE_13_4 | BW_6o_7o_5o | N9500B_Std | | 1010 x 337 | 1700 | 7.05 => 7.11 | 43.9 | 20.3 | 66.6 | 1.5+j 4.6 | 4.4+j 8.6 | 39.4 | 67.6 | 15.7 | -10.4 | 0.6+j 4.0 | 3.7+j 3.6 | 43.53 | 69.4 | 17.6 | -8.8 | | |
| DOE_13_5 | BW_3o_4o_5o | N9500B_V5 | | 1010x270 | 900 | 10.19 => 10.27 | 44.8 | 20.6 | 73.6 | 1+j 5.2 | 3.4+j 8.6 | 39.92 | 66.1 | 17.3 | -18.2 | 0.8+j 4.6 | 5.5+j 6.4 | 43.38 | 73.2 | 17.4 | -14.3 | | |



Selected $Z_s \cdot 2f_0 = 1.3 + j 8.8$ Ohm

Selected DOE13 variants: detailed EM simulation

| Detailed_EM_P 15_R9505A | P_2dB | Moscap | | | | | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) (Zs_2f0 = 1.3 + j 8.8 Ohm; ZL_2fo, ZL_3fo = 0 Ohm) | | | | | | Performance @ Full power (43.3 dBm) (Zs_2f0 = 1.3 + j 8.8 Ohm; ZL_2fo, ZL_3fo = 0 Ohm) | | | | | | | |
|----------------------------|----------------|------------|------------|------------|-------|----------------------|-------------------------|------------|-----------|---|---------|-------------|-------------|------------|----------|---|----------|-------------|-------------|------------|----------|---------|----------|
| | | DOE | BW profile | Name | Index | RF top plate (X x Y) | Oxide thickness (µm) | Value (pF) | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) |
| DOE_13_1 | BW_Direct_1o2o | | | | | | | | 43.6 | 30.4 | 70.8 | 0.5 + j 4.2 | 3.6 + j 8 | 40.12 | 70.7 | 20.2 | -16.5 | 0.5 + j 3.1 | 6.9 + j 3 | 43.55 | 64.6 | 18.9 | -3.4 |
| DOE_13_2 | BW_3o_4o_5o | N9500B_V4 | | 1010 x 283 | | 1700 | 5.92 | | 44.5 | 19.4 | 72.3 | 1.4 + j 5.3 | 4.1 + j 8.6 | 39.68 | 71.8 | 15.9 | -13.7 | 0.7 + j 4.5 | 4.1 + j 3.6 | 43.6 | 70.2 | 17.5 | -8.9 |
| DOE_13_3 | BW_3o_4o_5o | N9500B_Std | | 1010 x 337 | | 1700 | 7.05 => 7.11 | | 44.2 | 28.1 | 72.2 | 0.7 + j 5.6 | 3 + j 9 | 39.63 | 71.6 | 17.1 | -12.6 | 0.8 + j 4.6 | 7.3 + j 5 | 43.61 | 69.1 | 17.8 | -8.2 |
| DOE_13_4 | BW_6o_7o_5o | N9500B_Std | | 1010 x 337 | | 1700 | 7.05 => 7.11 | | 43.9 | 20.3 | 66.6 | 1.5 + j 4.6 | 4.4 + j 8.6 | 39.4 | 67.6 | 15.7 | -10.4 | 0.6 + j 4.0 | 3.7 + j 3.6 | 43.53 | 69.4 | 17.6 | -8.8 |
| DOE_13_5 | BW_3o_4o_5o | N9500B_V5 | | 1010x270 | | 900 | 10.19 => 10.27 | | 44.8 | 20.6 | 73.6 | 1 + j 5.2 | 3.4 + j 8.6 | 39.92 | 66.1 | 17.3 | -18.2 | 0.8 + j 4.6 | 5.5 + j 6.4 | 43.38 | 73.2 | 17.4 | -14.3 |



ADS cells and symbols

- P15_R9505A_Direct_BW1o2o_DOE13_1**
 - emModel_layout_emSetup_onlyGaN_detail_PD3A** [Checked In]
 - emSetup_onlyGaN_detail_PD3A** [Checked In]
 - layout** [Checked In]
 - layout_assy** [Checked In]
 - schematic** [Checked In]
 - symbol** [Checked In]

- P15_R9505_A_5pF92_N9500B_V4_BW3o4o5o_DOE13_2**
 - emModel_layout_detail_5pF92_emSetup_detail_1700_PD3A** [Checked In]
 - emSetup_detail_1750_PD3A** [Checked In]
 - layout_assy_detail_5pF92** [Checked In]
 - layout_detail_5pF92** [Checked In]
 - schematic** [Checked In]
 - symbol_detail** [Checked In]

- P15_R9505_A_N9500B_st_7pF05_BW3o4o5o_DOE13_3**
 - emModel_layout_detail_7p05pF_emSetup_detail_1700_PD3A** [Checked In]
 - emSetup_detail_1700_PD3A** [Checked In]
 - layout_detail_7p05pF** [Checked In]
 - layout_detail_7p05pF_assy** [Checked In]
 - schematic** [Checked In]
 - symbol_detail** [Checked In]

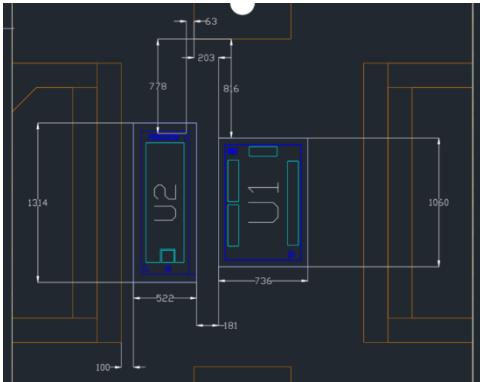
- P15_R9505_A_N9500B_st_7pF05_BW6o7o5o_DOE13_4**
 - emModel_layout_detail_7p05pF_emSetup_detail_1700_PD3A** [Not Controlled]
 - emSetup_detail_1700_PD3A** [Not Controlled]
 - layout_detail_7p05pF** [Checked In]
 - layout_detail_assy_7p05pF** [Checked In]
 - schematic** [Checked In]
 - symbol_detail** [Checked In]

- P15_R9505_A_N9500B_V5_10pF19_BW3o4o5o_DOE13_5**
 - emModel_layout_detail_10p19pF_emSetup_detail_900_PD3A** [Checked In]
 - emSetup_detail_900_PD3A** [Checked In]
 - layout_detail_10p19pF** [Checked In]
 - layout_detail_10p19pF_assy** [Checked In]
 - schematic** [Checked In]
 - symbol_detail** [Checked In]



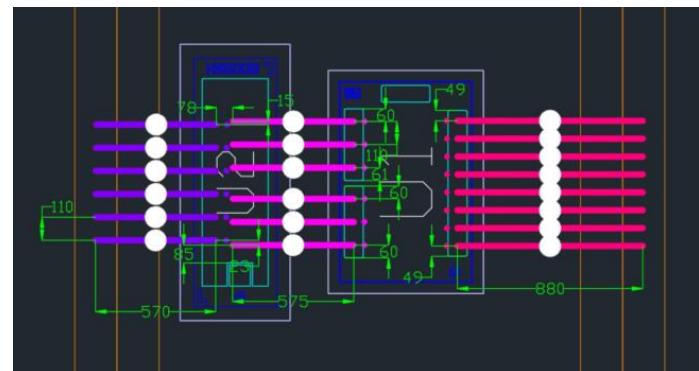
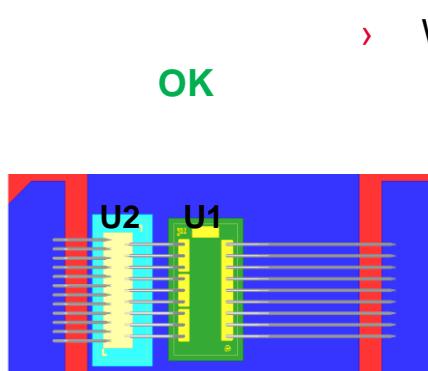
Assembly design rule review (No design rule violations)

DA



ok

WE



| DoE | Run | Substrate | | U2 (moscap) | | | | | | U1 (GaN) | | | | | | Net/gross units | Assy Drawing link | | |
|-----|-----|------------------|--------|-------------|--|--------------------------------|-----|------------|----|----------|------------|--------------|---|-----|------------|-----------------|---|-------|--|
| | | Supplier: ACCESS | Die ID | Wafer ID | Wafer map | Die Size Z=85um | | Coordinate | | Die ID | Wafer ID | Wafer map | Die Size Z=71um | | Coordinate | | | | |
| | | Strip | Block | X | Y | X | Y | X | Y | X | Y | X | X | Y | X | Y | | | |
| 13 | 1 | 1 | 1 | N9500B_V4 | RU105508.03 wfr#20 (low loss substrate) | MAP_RU105508.20_R_U105508.28 | 522 | 1314 | 63 | 780 | R9505A P15 | RU030518 #07 | no map -> shared reticle picking FEBES: K22- 19358-RG | 736 | 1060 | 32 | 820 | 20/30 | LAC3839.lib_P15_R9505_A_5pF92_N9500B_V4_BW3o4o5o_DOE13_3.dwg |
| 13 | 2 | 1 | 2 | N9500B_Std | RU105508.02 wfr#19 (low loss substrate) | VWMAP_RU105508_R_U105508.35_RE | 522 | 1314 | 63 | 778 | | | | 203 | 816 | 20/30 | LAC3839.lib_P15_R9505_A_N9500B_st_7pF05_BW3o4o5o_DOE13_2.dwg | | |
| 13 | 3 | 1 | 3 | N9500B_Std | RU105508.02 wfr#19 (low loss substrate) | VWMAP_RU105508_R_U105508.35_RE | 522 | 1314 | 63 | 778 | | | | 203 | 816 | 20/30 | LAC3839.lib_P15_R9505_A_N9500B_st_7pF05_BW3o4o5o_DOE13_3.dwg | | |
| 13 | 4 | 2 | 1 | N9500B_Std | RU105508.02 wfr#19 (low loss substrate) | VWMAP_RU105508_R_U105508.35_RE | 522 | 1314 | 63 | 773 | | | | 203 | 816 | 20/30 | LAC3839.lib_P15_R9505_A_N9500B_st_7pF05_BW6o7o5o_DOE13_4.dwg | | |
| 13 | 5 | 2 | 2 | N9500B_V5 | RU105508.04 wfr#21 (low loss substrate) | VWMAP_RU105508.01_RU105508.53 | 522 | 1314 | 63 | 808 | | | | 203 | 816 | 20/30 | LAC3839.lib_P15_R9505_A_N9500B_V5_10pF15_BW3o4o5o_DOE13_5.dwg | | |

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

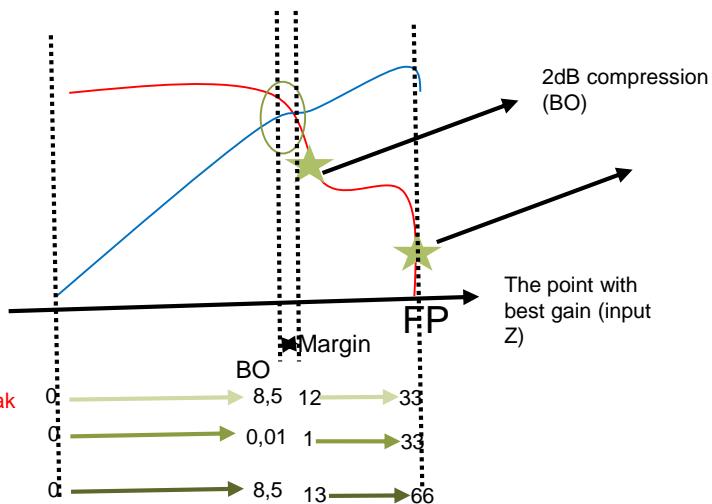
| Doherty Topology | Remark | Ratio | Main (W) | Peak (W) |
|------------------|-------------|-------|----------|----------|
| Symmetric | Maximize BW | 1 | 27,48 | 27,48 |

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 | | 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) |
|------|--------------------|-----|-------------------|-------------|-------------------|-----------------|---------|-----------|
| Main | 48,2 | 8,4 | 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



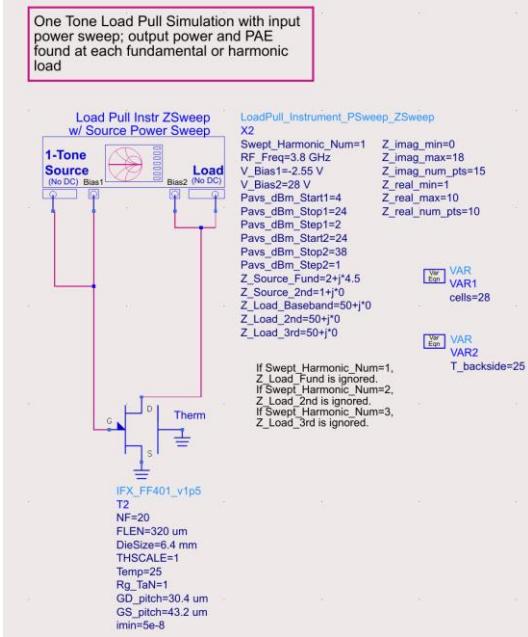
Maximize Gain

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

Simulation Results



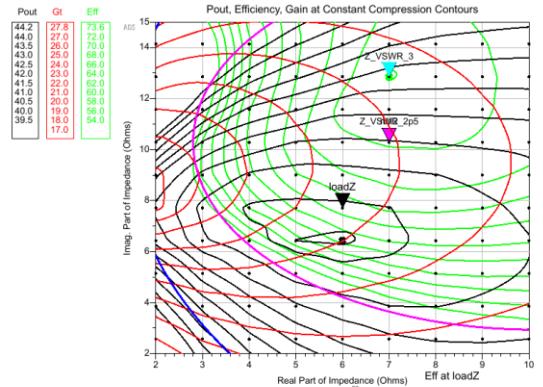
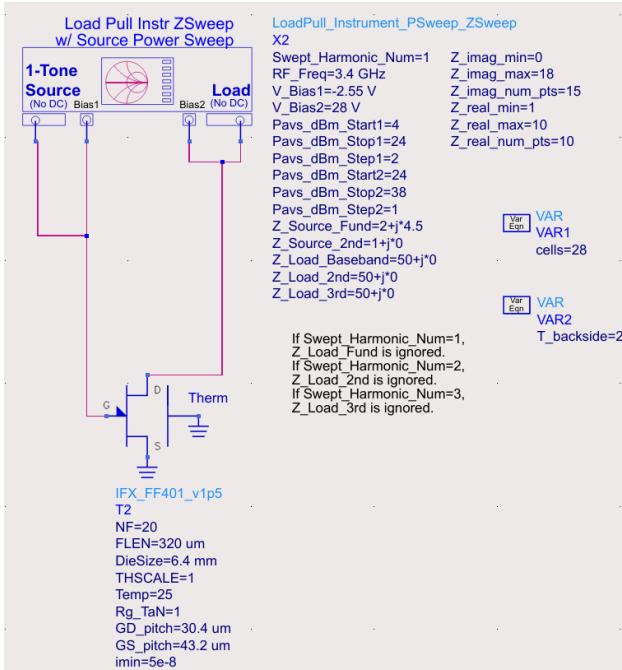
Bare die GaN Load-pull: P15_R9505_A (20 x 320 um)



| Detailed_EM_P15_R9505A | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) | | | | | | Performance @ Full power (43.3 dBm) | | | | | |
|------------------------|-------------------------|----------|---------|-----------------------------------|------------|------------|----------|---------|----------|-------------------------------------|-------------|------------|----------|---------|----------|
| | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) |
| 3.4 | 44.2 | 27.8 | 73.6 | 0.4 - j 3.2 | 7 + j 12.9 | 41.72 | 73.7 | 19.6 | -2.3 | 0.2 - j 4.3 | 6 + j 7.7 | 44.09 | 67 | 20.4 | -1.7 |
| 3.6 | 44.3 | 23.8 | 73.9 | 0.6 - j 3.1 | 8 + j 12.9 | 41.77 | 73.5 | 18.1 | -3.5 | 0.3 - j 4.0 | 6.0 + j 7.7 | 44.18 | 68.6 | 19.5 | -2.2 |
| 3.8 | 44.5 | 20.7 | 74.4 | 0.4 - j 2.8 | 6 + j 12.9 | 41.42 | 74.5 | 17.5 | -2.1 | 0.1 - j 3.5 | 5.0 + j 9.0 | 43.67 | 70.7 | 18.9 | -0.8 |



LP summary 6,4 mm die @ 3.4 GHz



Power Sweep Inspector

VSWRVal=5 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 = $6.00 + j6.43$

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $6.00 + j7.71$ | $0.79 / 162.21$ | 2 |
| Pout (dBm) | Eff (%) | GT (dB) |
| 44.09 | 67.00 | 20.44 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| 2.57 | -1.68 | $0.20 - j4.27$ |

X In plots below corresponds to this data.

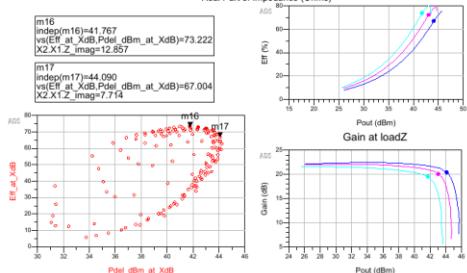
VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = $7.00 + j10.43$

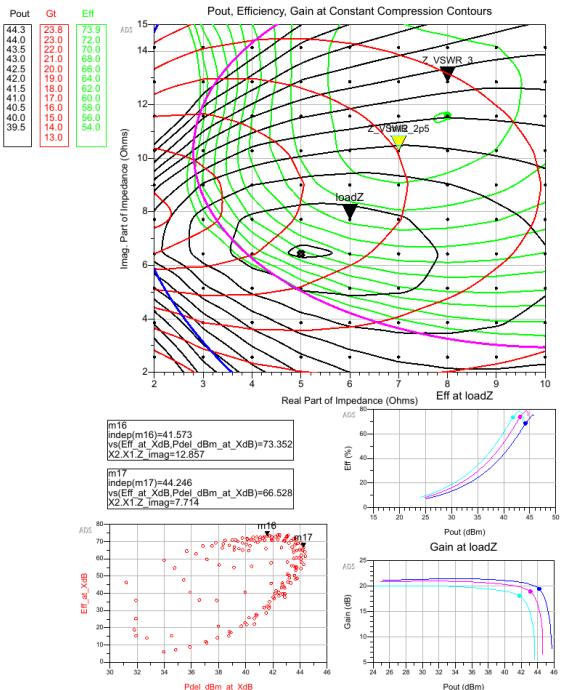
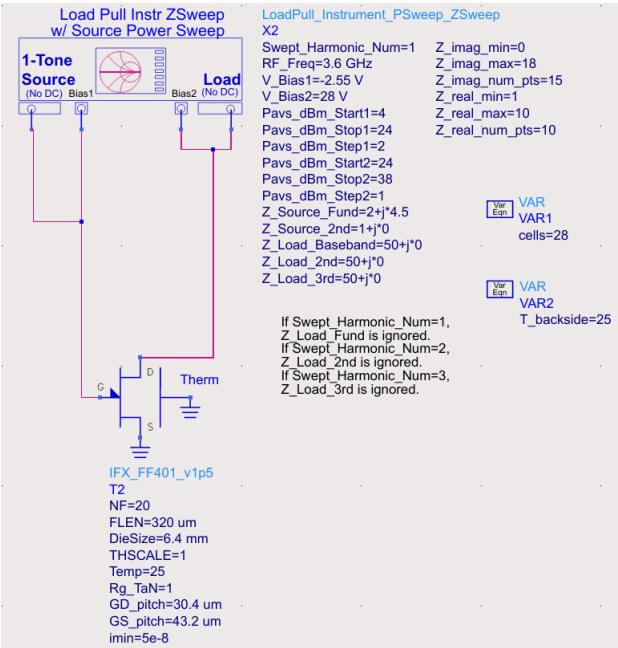
Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $7.00 + j10.29$ | $0.76 / 156.32$ | 2 |
| Pout (dBm) | Eff (%) | GT (dB) |
| 43.03 | 72.23 | 20.09 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -1.14 | -2.42 | $0.32 - j3.68$ |

X In plots below corresponds to this data.



LP summary 6,4 mm die @ 3.6 GHz



Power Sweep Inspector

Move Marker 'loadZ' to desired impedance point.

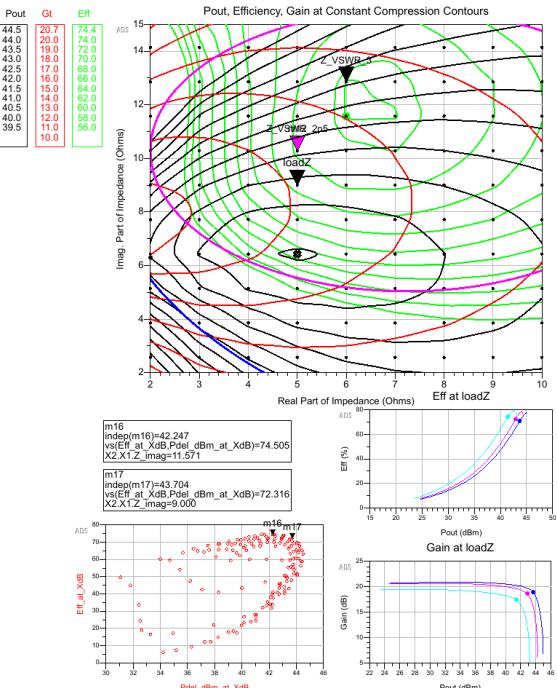
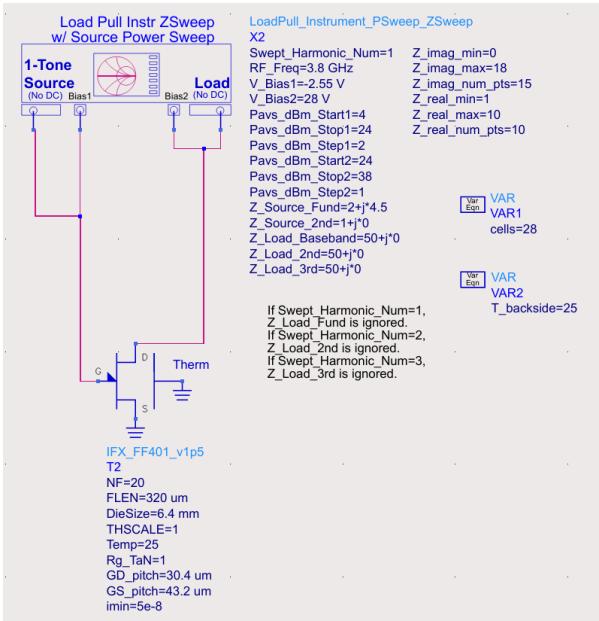
VSWR Locus of Points selector is located on Constant Compression Loadpull page.

VSWR Locus center Impedance = $5.00 + j6.43$
VSWR=5

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

VSWR Locus center Impedance = $7.00 + j10.29$
VSWR=5

LP summary 6,4 mm die @ 3.8 GHz



Power Sweep Inspector

Eqn VSWRVal=5 Eqn VSWRVal=2.5

Move Marker "loadZ" to desired impedance point.

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

VSWR=5

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

VSWR=5

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 5.00 + j9.00 | 0.82 / 159.40 | 2 |
| Pout (dBm) | 43.67 | Eff (%) 70.72 Gt (dB) 18.92 |
| AMPM (dBm) | -2.21 | IRL (dB) 0.12 - j3.48 |
| | -0.84 | Zin (Ohm) |

✗ In plots below corresponds to this data.

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 5.00 + j10.29 | 0.82 / 156.53 | 2 |
| Pout (dBm) | 42.89 | Eff (%) 72.38 Gt (dB) 18.67 |
| AMPM (dBm) | -3.40 | IRL (dB) 0.14 - j3.18 |
| | -0.84 | Zin (Ohm) |

✗ In plots below corresponds to this data.

VSWR = 2.5 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 5.00 + j10.29 | 0.82 / 156.53 | 2 |
| Pout (dBm) | 42.89 | Eff (%) 72.38 Gt (dB) 18.67 |
| AMPM (dBm) | -3.40 | IRL (dB) 0.14 - j3.18 |
| | -0.84 | Zin (Ohm) |

✗ In plots below corresponds to this data.

VSWR = 3 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 6.00 + j12.86 | 0.80 / 150.78 | 2 |
| Pout (dBm) | 41.42 | Eff (%) 74.48 Gt (dB) 17.51 |
| AMPM (dBm) | -1.03 | IRL (dB) 0.43 - j2.77 |
| | -2.12 | Zin (Ohm) |

✗ In plots below corresponds to this data.

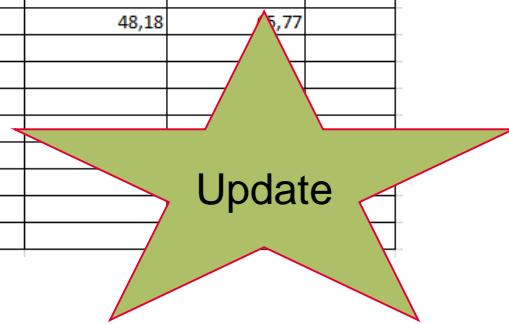


Power scaling (based on simulation)

| Available dies | Device geometry (mm) | 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 | 5,77 |
| 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 for
- › P1.5 dB, P3dB

Update



Simulation flow

1. LP die + minipac
2. Select impedances (Z_s , Z_L @ f_0 , f_1 & f_2)
3. Use impedances to do source harmonic phase sweep
4. Select Z_s @ $2f_0$
5. Put it back in LP simulation schematic
6. Select the impedances from LP simulation
- ~~7. Use the impedances to do load harmonic phase sweep~~
8. Select Z_L @ $2f_0$
9. Iterate steps from 1 to 8 to get to final impedances
10. Final LP with final Z_s , Z_L and finalized harmonic terminations.

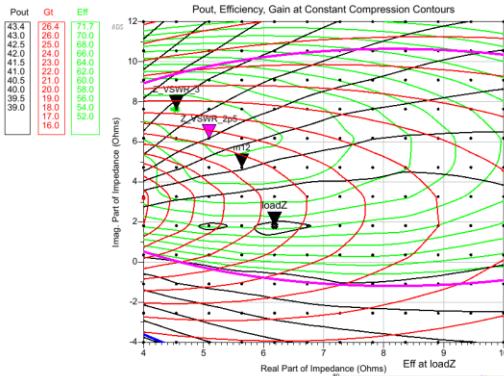
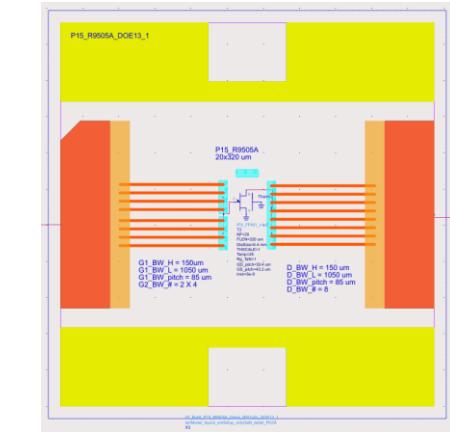


DOE_13_1 Analysis with/without harmonic termination

| Detailed_EM_P15 _R9505A @ 3.6 GHz | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) | | | | | | Performance @ Full power (43.3 dBm) | | | | |
|--|-------------------------|----------|---------|-----------------------------------|-------------|------------|----------|---------|----------|-------------------------------------|-------------|------------|----------|---------|
| | | | | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) |
| Load termination | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) |
| <u>No harmonic terminations</u> | 43.9 | 24.2 | 65.4 | 0.8 + j 4.3 | 4.6 + j 7.6 | 39.71 | 60.8 | 18.2 | -7.1 | 0.5 + j 3.2 | 6.2 + j 1.8 | 43.5 | 63.2 | 20.8 |
| | | | | | | | | | | | | | | |
| <u>I1_term + O1_short + O2_short</u> | 43.4 | 26.4 | 71.7 | 0.6 + j 4.3 | 4.6 + j 7.6 | 40.68 | 71.7 | 18.6 | -6.3 | 0.4 + j 3.2 | 6.2 + j 1.8 | 43.48 | 62.8 | 21.7 |
| | | | | | | | | | | | | | | |



P15_R9505A_BW1o2o_DOE13_1 With harmonic termination/short



Power Sweep Inspector

Marker VSWRVal=5 Marker 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 = $6.18 + j1.82$

Summary of Performance at Compression

Marker Impedance $6.18 + j1.82$ Marker Gamma $0.78 / 175.77$ Reference Compression Level (dB) 2

Pout (dBm) 43.48 Eff (%) 62.79 Gr (dB) 21.66

AMPM (dBm) -7.20 IRL (dB) -7.38 Zin (Ohm) $0.37 + j3.21$

✖ In plots below corresponds to this data.

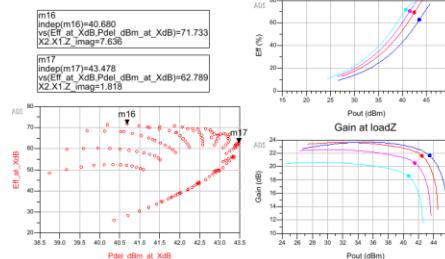
Summary of Performance at Compression

Marker Impedance $5.64 + j4.73$ Marker Gamma $0.80 / 169.06$ Reference Compression Level (dB) 2

Pout (dBm) 42.44 Eff (%) 69.23 Gr (dB) 21.61

AMPM (dBm) -6.05 IRL (dB) -8.48 Zin (Ohm) $0.41 + j3.74$

✖ In plots below corresponds to this data.



VSWR = 2.5 point DATA

Marker Impedance $5.09 + j6.18$ Marker Gamma $0.82 / 165.76$ Reference Compression Level (dB) 4

Pout (dBm) 41.50 Eff (%) 70.37 Gr (dB) 20.52

AMPM (dBm) -6.29 IRL (dB) -6.99 Zin (Ohm) $0.47 + j4.02$

✖ In plots below corresponds to this data.

VSWR = 3 point DATA

Marker Impedance $4.55 + j7.64$ Marker Gamma $0.84 / 162.49$ Reference Compression Level (dB) 2

Pout (dBm) 40.68 Eff (%) 71.73 Gr (dB) 18.60

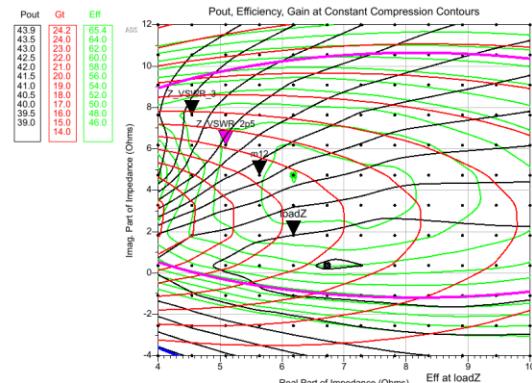
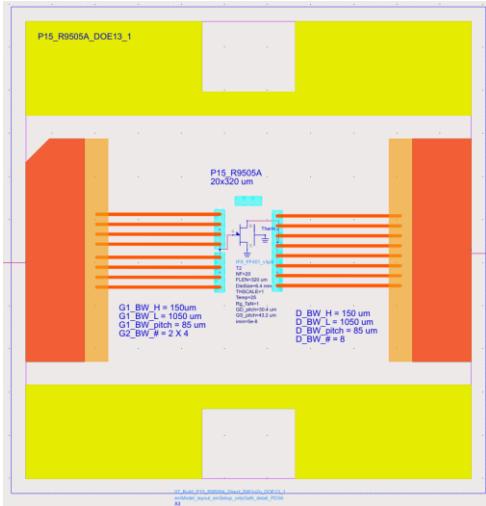
AMPM (dBm) -3.46 IRL (dB) -6.29 Zin (Ohm) $0.63 + j4.27$

✖ In plots below corresponds to this data.

- › F1_in_term
- › F1_out_short
- › F2_out_short



P15_R9505A_BW1o2o_DOE13_1 Without harmonic termination/short



Power Sweep Inspector

Move Marker "loadZ" to desired impedance point.

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

VSWR center Impedance = $6.73 + j0.36$

VSWR=5

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

VSWR center Impedance = $5.64 + j4.73$

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $6.18 + j1.82$ | $0.78 / 175.77$ | 2 |

Pout (dBm) 43.50, Eff (%) 63.24, GI (dB) 20.81

AMPM (dBm) -10.94, IRL (dB) -10.03, Zin (Ohm) 0.50 + j3.22

X In plots below corresponds to this data.

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $5.64 + j4.73$ | $0.80 / 169.06$ | 2 |

Pout (dBm) 41.79, Eff (%) 63.92, GI (dB) 20.72

AMPM (dBm) -11.83, IRL (dB) -12.02, Zin (Ohm) 0.57 + j3.77

X In plots below corresponds to this data.

VSWR = 2.5 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $5.09 + j6.18$ | $0.82 / 165.76$ | 2 |

Pout (dBm) 40.60, Eff (%) 62.31, GI (dB) 19.85

AMPM (dBm) -9.05, IRL (dB) -8.73, Zin (Ohm) 0.64 + j4.04

X In plots below corresponds to this data.

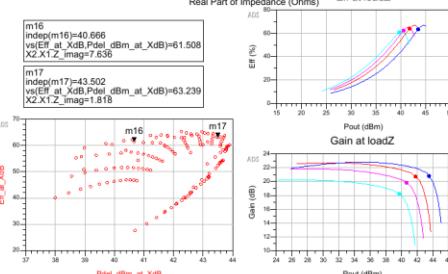
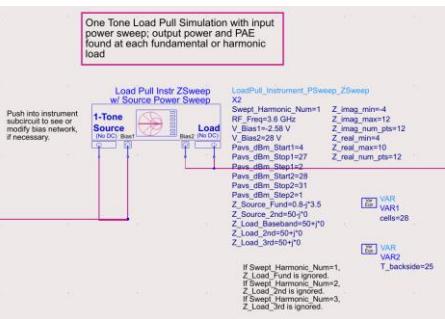
VSWR = 3 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $4.55 + j7.64$ | $0.84 / 162.49$ | 2 |

Pout (dBm) 39.71, Eff (%) 60.78, GI (dB) 18.21

AMPM (dBm) -5.12, IRL (dB) -7.09, Zin (Ohm) 0.77 + j4.27

X In plots below corresponds to this data.



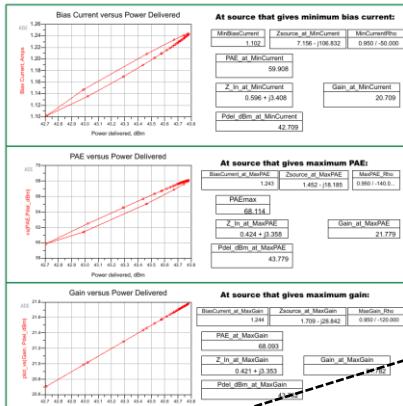
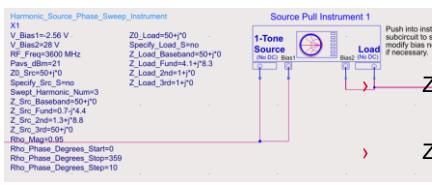
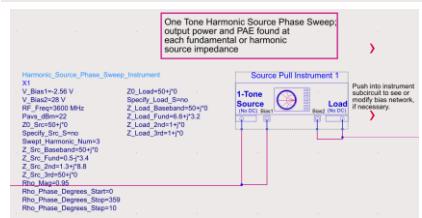
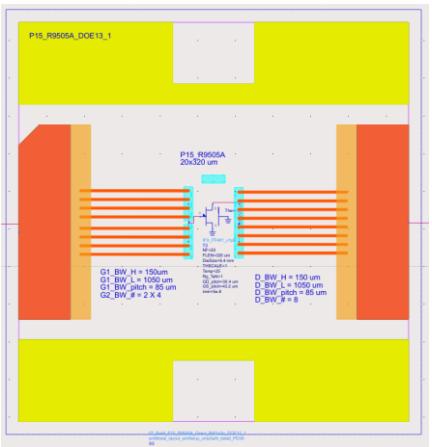
DOE_13_1

Harmonic termination optimization & performance analysis

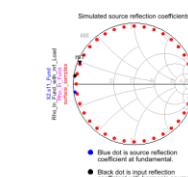
| Detailed_EM_P15_R 950SA | | P_2dB | Max. performance @ P2dB | | | Performance_@ Back_off (39.5 dBm) | | | | | Performance_@ Full power (43.3 dBm) | | | | | | |
|----------------------------|----------------|-------|-------------------------|-------------|---------|-----------------------------------|-------------|------------|----------|---------|-------------------------------------|-------------|-------------|------------|----------|---------|----------|
| DOE | BW_profile | | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) |
| DOE_13_1 | BW_Direct_1o2o | | 43.6 | 34 | 70.5 | 0.8 + j 4.4 | 4.1 + j 8.3 | 40.32 | 70.5 | 18.4 | -10.5 | 0.5 + j 3.4 | 6.6 + j 3.2 | 43.38 | 65.6 | 20.5 | -6.0 |
| DOE_13_1a | BW_Direct_1o2o | | 43.6 | 30.4 | 70.8 | 0.5 + j 4.2 | 3.6 + j 8 | 40.12 | 70.7 | 20.2 | -16.5 | 0.5 + j 3.1 | 6.9 + j 3 | 43.55 | 64.6 | 18.9 | -3.4 |
| DOE_13_1b | BW_Direct_1o2o | | 43.9 | 22.8 | 70.6 | 0.9 + j 4.9 | 4 + j 8.6 | 40.02 | 68.7 | 18.2 | -20 | 0.6 + j 4.0 | 6.9 + j 4 | 43.4 | 68.6 | 19.2 | -5.9 |



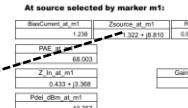
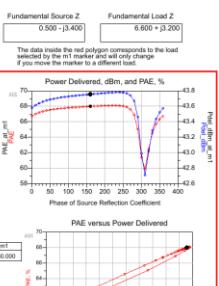
DOE_13_1: Harmonic termination @ Zs 2f0 phase sweep



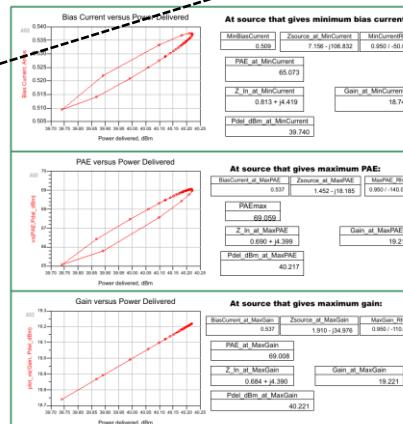
Bias 1 Voltage = -2.560
Bias 2 Voltage = 28.000
Fundamental RF Frequency = 3600000000.000
Swept Source Harmonic Number = 3.000
Available Source Power = 22.000 dBm



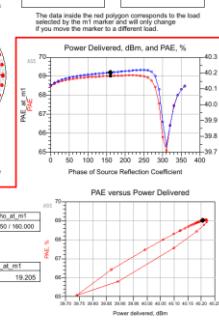
Data Display: HB1 Tone Source Harmonic Phase Sweep
Dataset: Date/Time: Jun 19, 2022 01:42:02 PM
Dataset: HB1 Tone Source Harmonic Phase Sweep LP



Data Display: HB1 Tone Source Harmonic Phase Sweep
Dataset: Date/Time: Jun 19, 2022 01:42:02 PM
Dataset: HB1 Tone Source Harmonic Phase Sweep LP

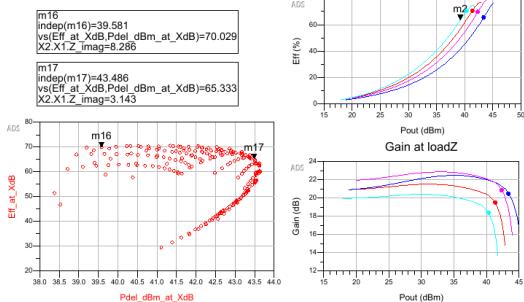
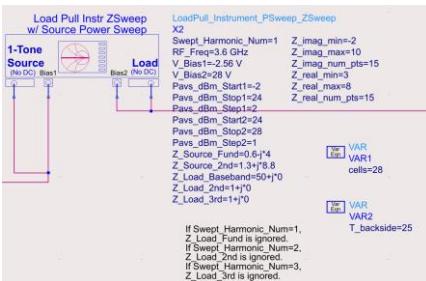
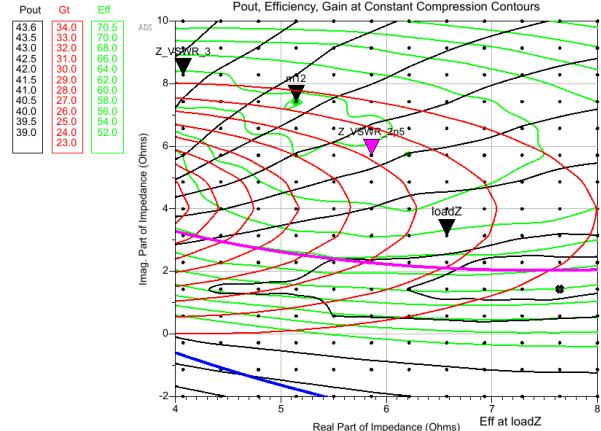
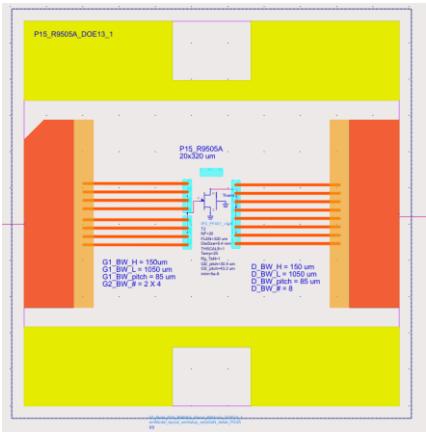


Bias 1 Voltage = -2.560
Bias 2 Voltage = 28.000
Fundamental RF Frequency = 3600000000.000
Swept Source Harmonic Number = 3.000
Available Source Power = 21.000 dBm



DOE13_1 LP with harmonic termination

P2dB



- › Z_{s2f0} terminated with $1.3 + j 8.8$
- › Z_{L2f0}, Z_{L3f0} shorted

Power Sweep Inspector

Eqr VSWRVal=5 Eqr VSWRVal=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 = $7.64 + j1.43$
VSWR=5

VSWR Locus of Points selector is located on Constant Compression Loadpull page.
VSWR Locus center Impedance = $5.14 + j7.43$
VSWR=5

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $6.57 + j3.14$ | 0.77 / 172.68 | 2 |
| Pout (dBm) | Eff (%) | Gt (dB) |
| 43.38 | 65.62 | 20.49 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -2.50 | -5.99 | $0.46 + j3.40$ |

✖ In plots below corresponds to this data.

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $5.14 + j7.43$ | 0.82 / 162.92 | 2 |
| Pout (dBm) | Eff (%) | Gt (dB) |
| 41.34 | 70.60 | 19.52 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -1.59 | -17.48 | $0.69 + j4.15$ |

✖ In plots below corresponds to this data.

VSWR = 2.5 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $5.86 + j5.71$ | 0.79 / 166.78 | 2 |
| Pout (dBm) | Eff (%) | Gt (dB) |
| 42.31 | 69.72 | 20.88 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -2.08 | -17.41 | $0.55 + j3.85$ |

✖ In plots below corresponds to this data.

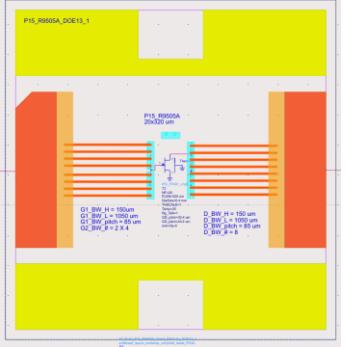
VSWR = 3 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $4.07 + j8.29$ | 0.85 / 161.06 | 2 |
| Pout (dBm) | Eff (%) | Gt (dB) |
| 40.32 | 70.50 | 18.41 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| 4.87 | -10.46 | $0.74 + j4.40$ |

✖ In plots below corresponds to this data.

m2
indep(m2)=39.226
plot_vs(Eff[m_idx_oc3.re_idx_oc3::]Pdel_dBm[m_idx_oc3.re_idx_oc3::])=63.707

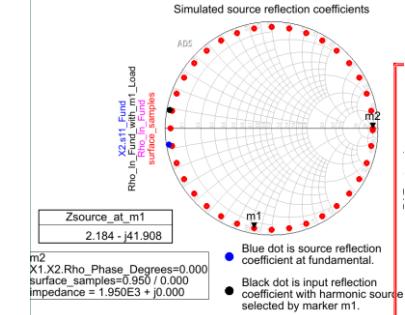
DOE13_1 (Die + minipac with Source harmonic phase sweep)



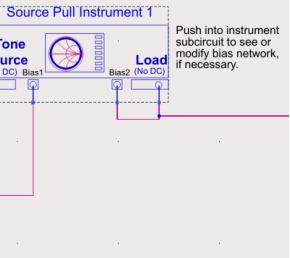
Harmonic_Source_Phase_Sweep_Instrument

```
X1
V_Bias1=2.56 V
V_Bias2=28 V
RF_Freq=3600 MHz
Pavs_dBm=21
Z0_Src=50+j0
Specify_Src_S=no
Swept_Harmonic_Number=3
Z_src_Baseband=50+j0
Z_src_Bandwidth=50+j0
Z_src_Fund=4+j8.3
Z_src_2nd=1.3+j8.8
Z_src_3rd=50+j0
Rho_Mag=0.95
Rho_Phase_Degrees_Start=0
Rho_Phase_Degrees_Stop=359
Rho_Phase_Degrees_Step=10
```

Z0_Load=50+j0
Specify_Load_S=no
Z_Load_Baseband=50+j0
Z_Load_Fund=4+j8.3
Z_Load_2nd=1+j0
Z_Load_3rd=1+j0

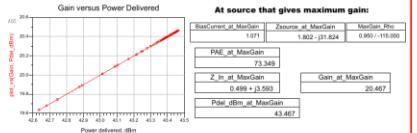
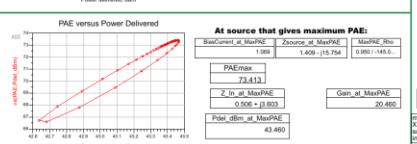
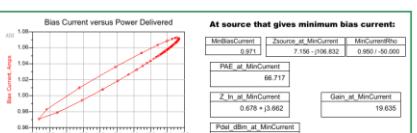
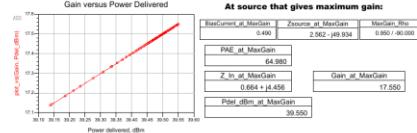
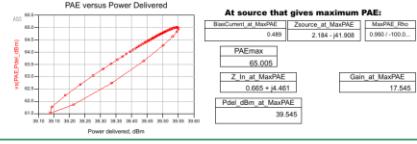
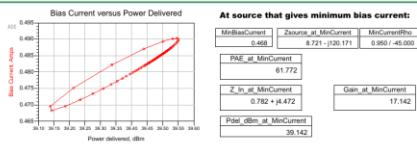


- Avoid Zs_2f0 termination in between m1 & m2
- Phase rotation from 250 deg to 360 deg



- Zin selected for Zs_2f0_phase sweep = 0.6 + j 3.9 (VSWR 2.5 @ P2 dB)
- Zs_2f0_termination = 1.3 + j 8.8

- ZL selected for Zs_2f0_phase sweep for MXE @ 39 dBm = 4.1 + j 8.3
- ZL selected for Zs_2f0_phase sweep for MXP @ P2dB = 6.6 + j 3.2

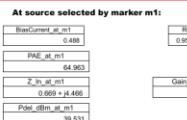
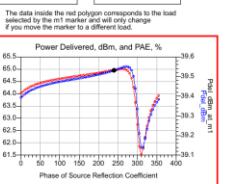


Bias 1 Voltage = -2.560
Bias 2 Voltage = 28.000
Fundamental RF Frequency = 3600000000.000
Swept Source Harmonic Number = 3.000
Available Source Power = 22.000 dBm

Data Display: HB1Tone_Source_Harmonic_Phase_Sweep
Dataset Date/Time: Jun 20, 2022 02:11:22 PM
Dataset: 07_Build_DOE13_1.HB1Tone_Source_Harmonic_Phase_Sweep

Fundamental Source Z
0.500 - j3.500

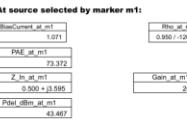
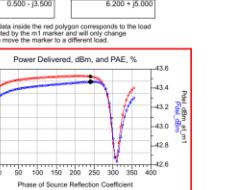
Fundamental Load Z
4.100 + j8.300



Data Display: HB1Tone_Source_Harmonic_Phase_Sweep
Dataset Date/Time: Jun 20, 2022 02:11:22 PM
Dataset: 07_Build_DOE13_1.HB1Tone_Source_Harmonic_Phase_Sweep

Fundamental Source Z
0.500 - j3.500

Fundamental Load Z
6.200 + j5.000

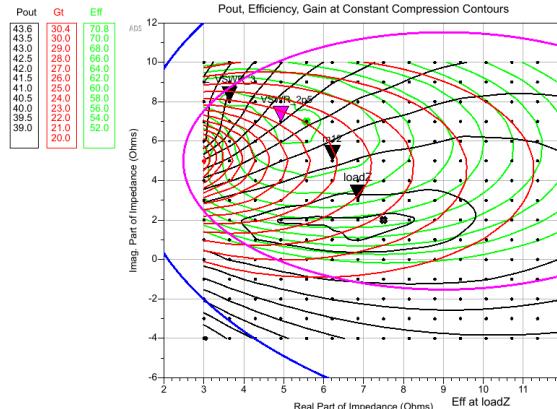
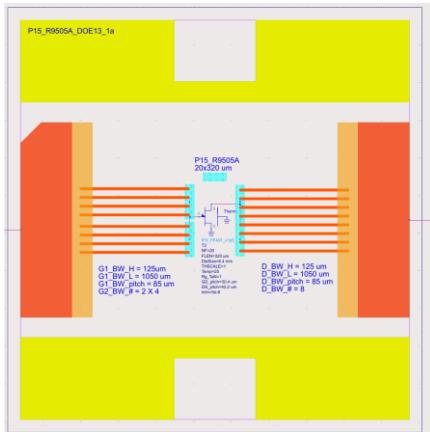


DOE_13_1a



DOE13_1a LP with harmonic termination

P2dB



Power Sweep Inspector

Eqn_VSWRVal=5 Eqn_VSWRVal=2.5

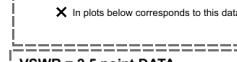
Move Marker "loadZ" to desired impedance point.

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

VSWR Locus center Impedance = $7.50 + j2.00$
VSWR=5

Summary of Performance at Compression

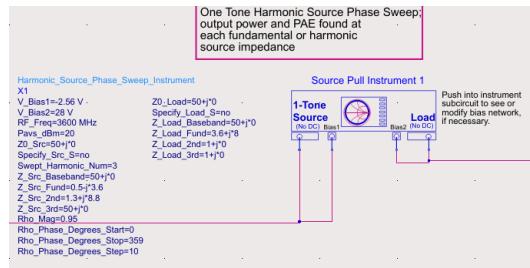
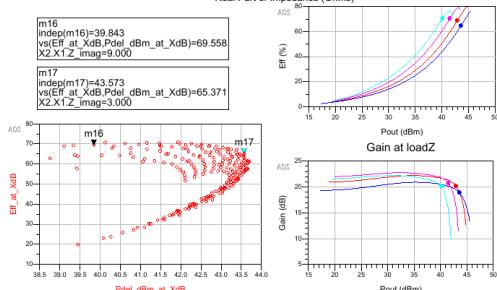
| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $6.86 + j3.00$ | $0.76 / 173.00$ | 2 |
| Pout (dBm) | Eff (%) | Gt (dB) |
| 43.55 | 64.57 | 18.90 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -0.50 | -3.44 | $0.47 + j3.04$ |



VSWR = 3 point DATA

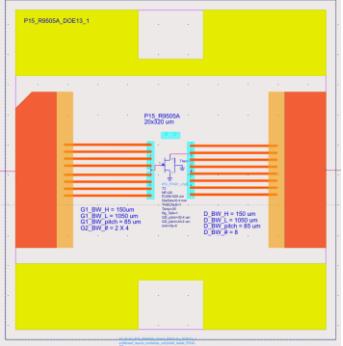
| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $3.64 + j8.00$ | $0.87 / 161.73$ | 2 |
| Pout (dBm) | Eff (%) | Gt (dB) |
| 40.12 | 70.73 | 20.18 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| 6.34 | -16.52 | $0.54 + j4.16$ |

VSWR = 3 point DATA

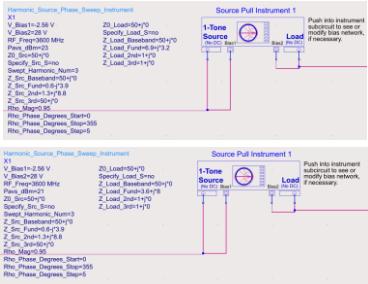


- › $Z_s 2f_0$ terminated with $1.3 + j 8.8$
- › $Z_L 2f_0, Z_L 3f_0$ shorted

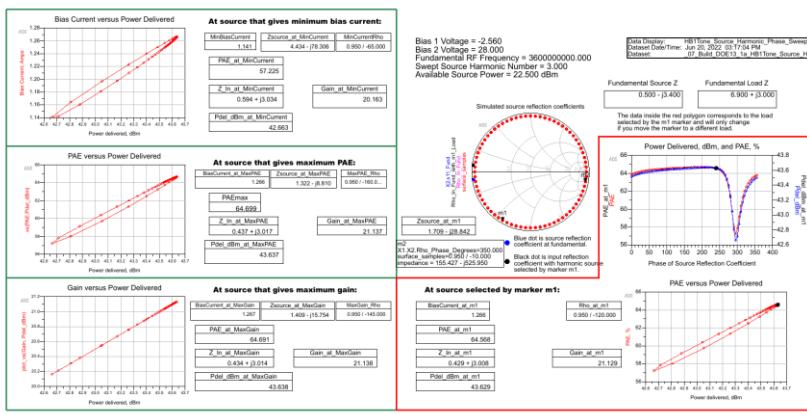
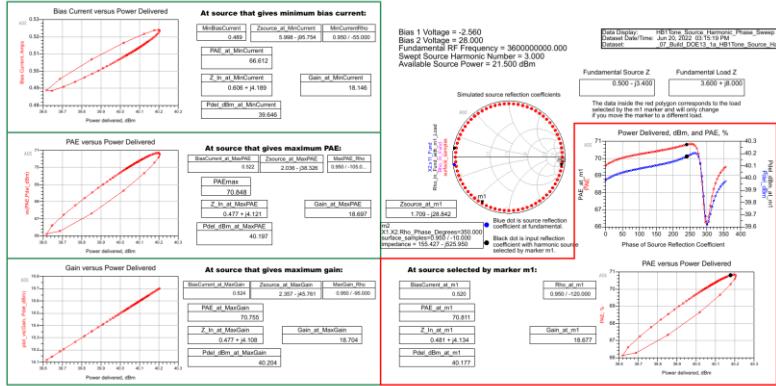
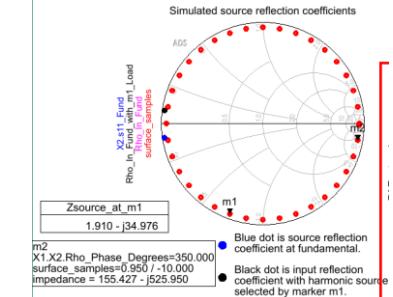
DOE13_1a (Die + minipac with Source harmonic phase sweep)



Avoid Z_s_{2f0} termination in between m1 & m2
Phase rotation from 250 deg to 360 deg



- › Z_{in} selected for $Z_{s_2f0_phase\ sweep} = 0.6 + j 3.9$ (VSWR 2.5 @ P2 dB)
 - › $Z_{s_2f0_termination} = 1.3 + j 8.8$
- › ZL selected for $Z_{s_2f0_phase\ sweep}$ for MXE @ 39 dBm = $3.6 + j 8.0$
- › ZL selected for $Z_{s_2f0_phase\ sweep}$ for MXP @ $P2dB = 6.9 + j 4.0$

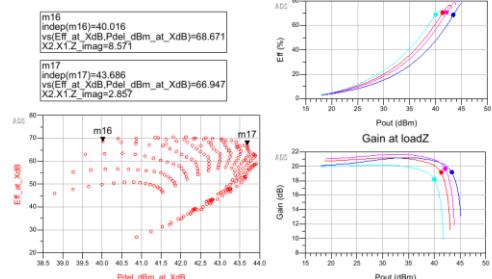
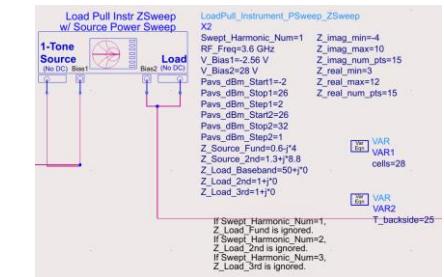
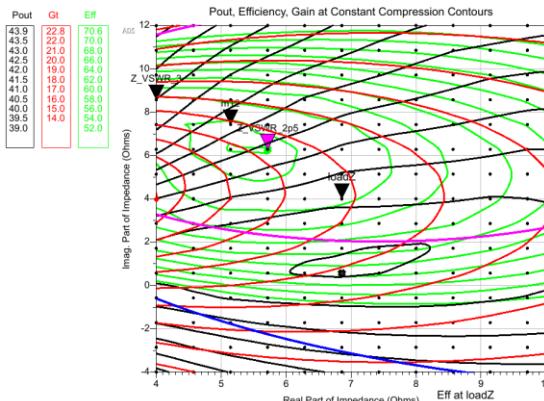
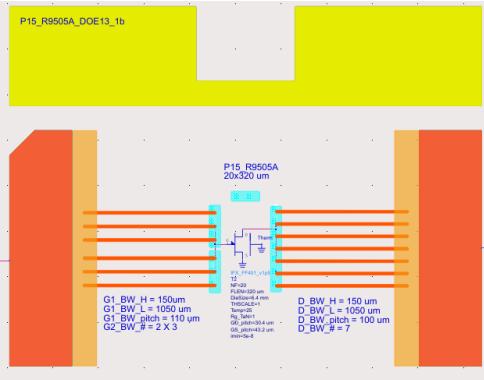


DOE_13_1b



DOE13_1b LP with harmonic termination

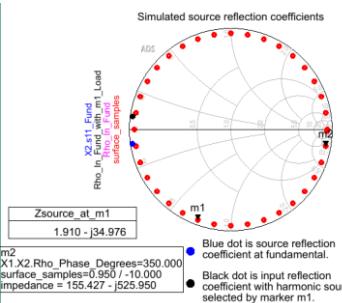
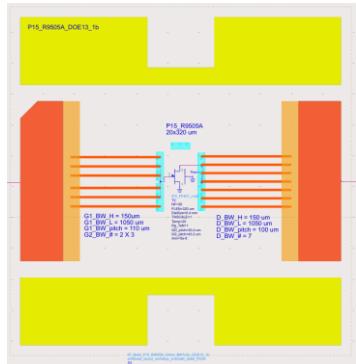
P2dB



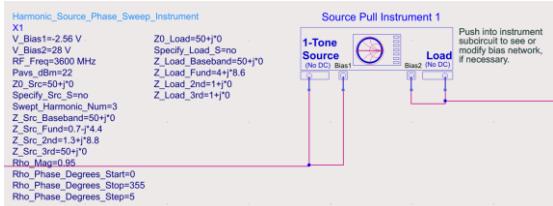
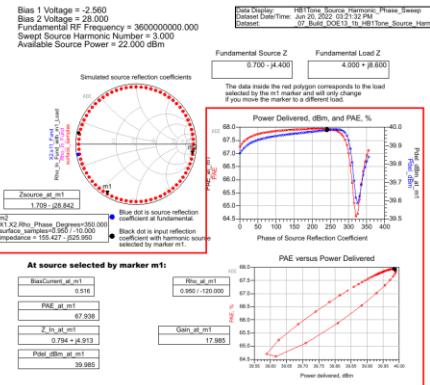
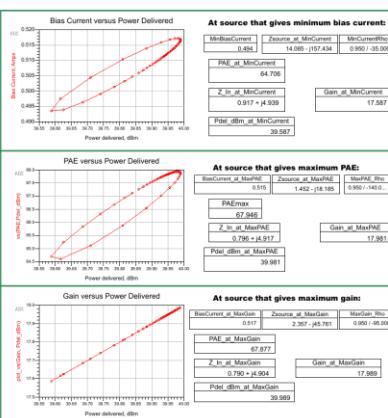
- › Zs_2fo terminated with 1,3 + j 8,8
 - › ZL_2f0, ZL_3f0 shorted



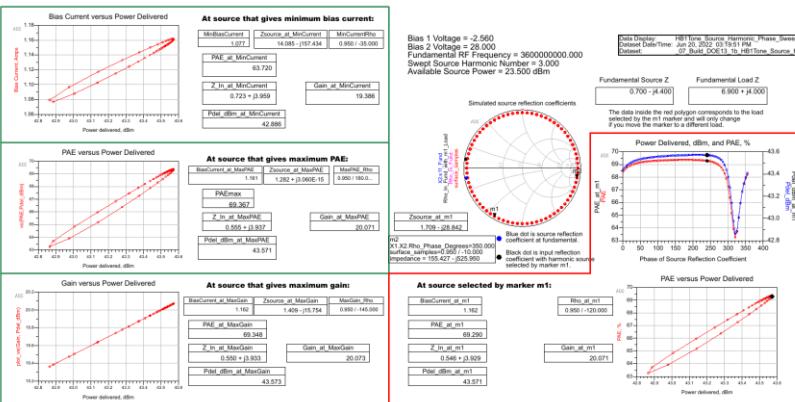
DOE13_1b (Die + minipac with Source harmonic phase sweep)



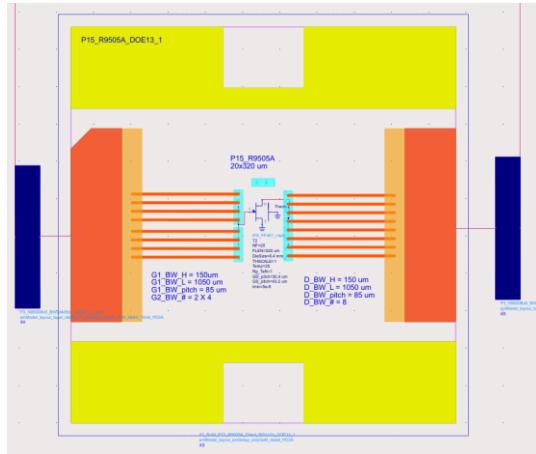
Avoid Zs_2f0 termination in between m1 & m2
 ▷ Phase rotation from 250 deg to 360 deg



- ▷ Zin selected for Zs_2f0_phase sweep = 0,7 + j 4,4 (VSWR 2.5 @ P2 dB)
 - ▷ Zs_2f0_termination = 1,3 + j 8,6
- ▷ ZL selected for Zs_2f0_phase sweep for MXE @ 39 dBm = 4,0 + j 8,6
- ▷ ZL selected for Zs_2f0_phase sweep for MXP @ P2dB = 6,9 + j 4



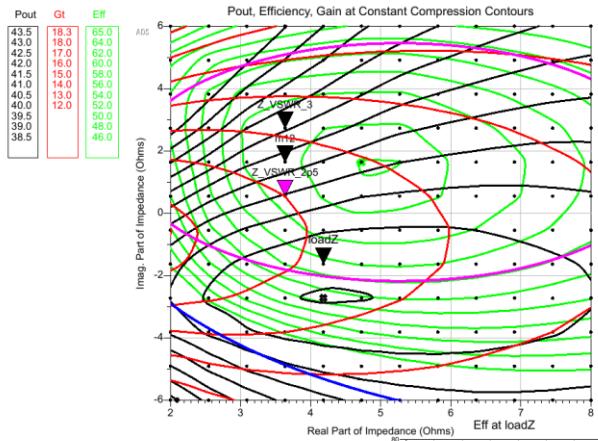
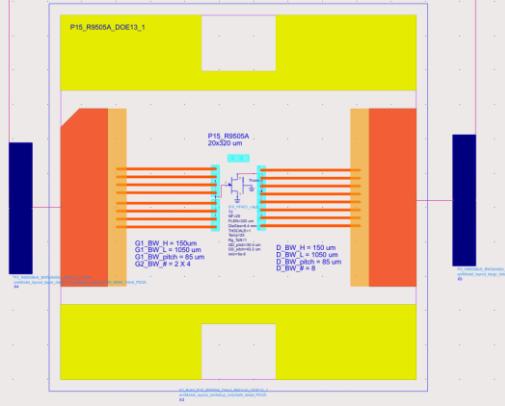
With step (Bare die + mini-pac)



$Z_s \text{ } 2\text{fo} = 4 - j \text{ } 70 \text{ Ohm}$
 $Z_L \text{ } 2\text{fo}, Z_L \text{ } 3\text{fo short}$

| Detailed_EM_P15_R 9505A + step | P_2dB | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) ($Z_s \text{ } 2\text{fo} = 4 - j \text{ } 70 \text{ Ohm}, Z_L \text{ } 2\text{fo}, Z_L \text{ } 3\text{fo short}$) | | | | | | Performance @ Full power (43.3 dBm) ($Z_s \text{ } 2\text{fo} = 4 - j \text{ } 70 \text{ Ohm}, Z_L \text{ } 2\text{fo}, Z_L \text{ } 3\text{fo short}$) | | | | | |
|-----------------------------------|----------------|-------------------------|------|------|--|-------------|---------|---------|---------|------------|--|-------------|----------|---------|---------|------------|
| | | | | | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) |
| DOE_13_1 | BW_Direct_1o2o | 43.5 | 18.3 | 65 | 1.6 + j 7.9 | 3.6 + j 3.7 | 40.43 | 63.5 | 15.8 | -11.7 | 1.2 + j 6.7 | 4.2 - j 1.6 | 43.37 | 59.4 | 16.8 | -15.3 |
| DOE_13_1a | BW_Direct_1o2o | 43.3 | 18.6 | 64.7 | 1.4 + j 7.6 | 3.1 + j 2.7 | 40.29 | 62.5 | 16.3 | -13.6 | 1.3 + j 6.4 | 4.7 - j 1.6 | 43.35 | 58.4 | 16.5 | -12.1 |
| DOE_13_1b | BW_Direct_1o2o | 43.4 | 17.5 | 64.8 | 1.8 + j 8.6 | 3.1 + j 2.7 | 39.61 | 61.4 | 15.2 | -7.4 | 1.2 + j 7.3 | 3.6 - j 1.6 | 43.24 | 58.5 | 16.6 | -15.7 |

DOE13_1 (Die + minipac + step with Source, load harmonic termination)



Power Sweep Inspector

Eqn VSWR_val=5 Eqn VSWR_val=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 = $4.18 - j2.73$
VSWR=5

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

VSWR Locus center Impedance = $3.64 + j1.64$
VSWR=5

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|----------------|----------------------------------|
| 4.18 -j1.64 | 0.86 / -176.22 | 2 |

Pout (dBm): 43.37

Eff (%): 59.43

Gt (dB): 16.81

AMPM (dBm): -5.38

IRL (dB): -15.32

Zin (Ohm): 1.20 + j6.73

\times In plots below corresponds to this data.

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 3.64 + j1.64 | 0.86 / 176.23 | 2 |

Pout (dBm): 41.24

Eff (%): 63.79

Gt (dB): 16.51

AMPM (dBm): -7.39

IRL (dB): -13.19

Zin (Ohm): 1.42 + j7.66

\times In plots below corresponds to this data.

VSWR = 2.5 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 3.64 + j0.55 | 0.86 / 178.74 | 2 |

Pout (dBm): 42.04

Eff (%): 62.93

Gt (dB): 17.00

AMPM (dBm): -8.53

IRL (dB): -14.86

Zin (Ohm): 1.25 + j7.39

\times In plots below corresponds to this data.

VSWR = 3 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 3.64 + j2.73 | 0.86 / 173.72 | 2 |

Pout (dBm): 40.43

Eff (%): 63.52

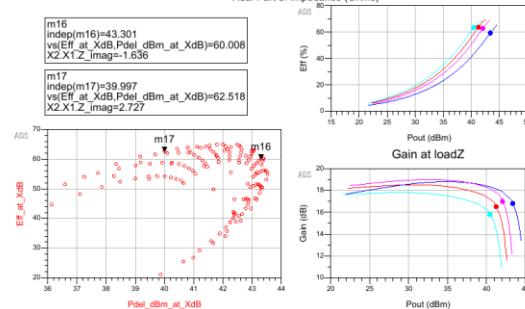
Gt (dB): 15.80

AMPM (dBm): -5.71

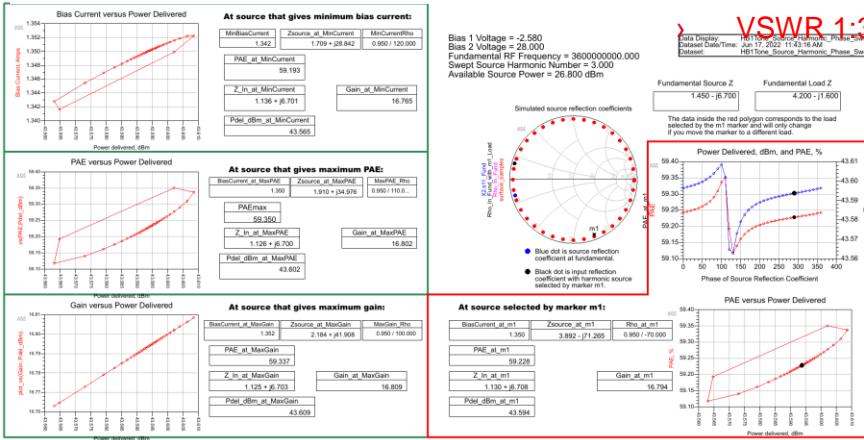
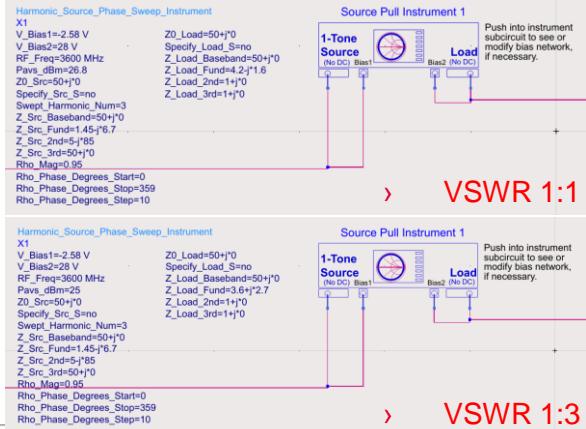
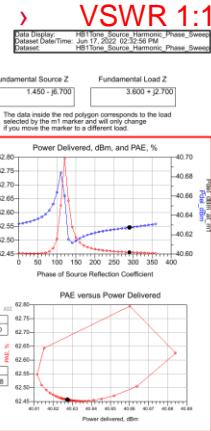
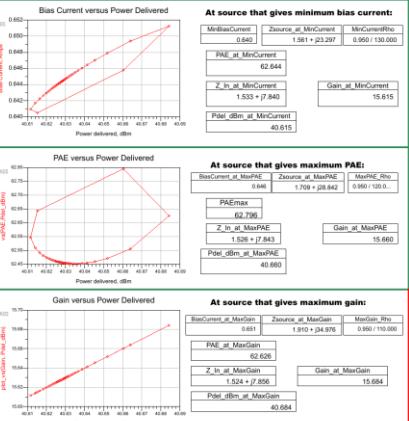
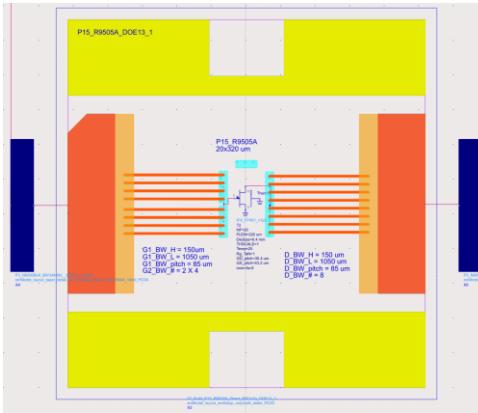
IRL (dB): -11.66

Zin (Ohm): 1.64 + j7.88

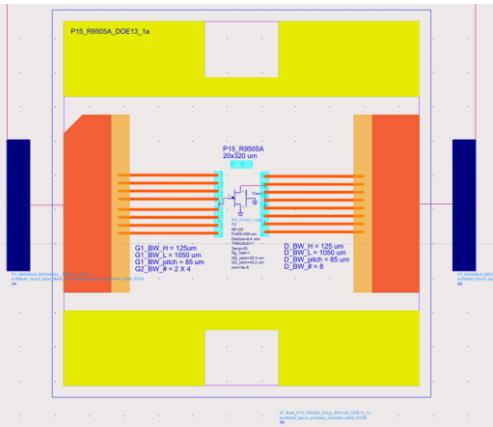
\times In plots below corresponds to this data.



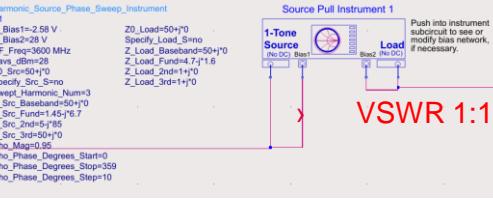
DOE13_1 (Die + minipac + step with Source harmonic phase sweep)



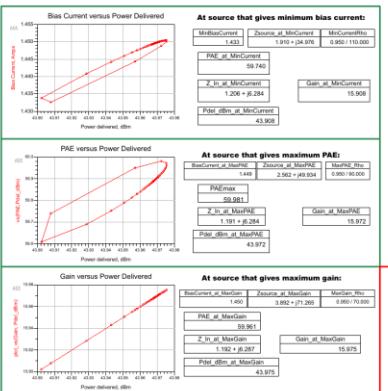
DOE13_1a (Die + minipac + step with Source harmonic phase sweep)



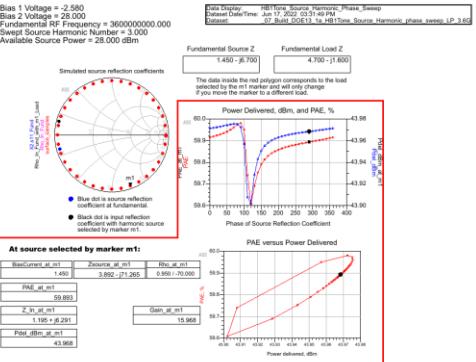
VSWR 1:1



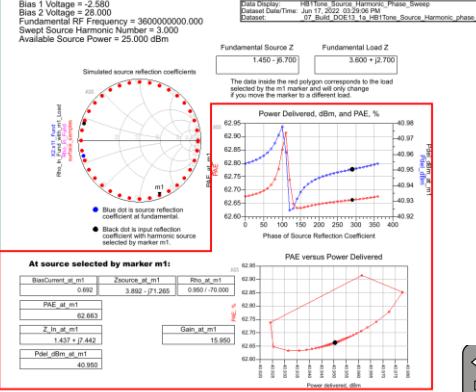
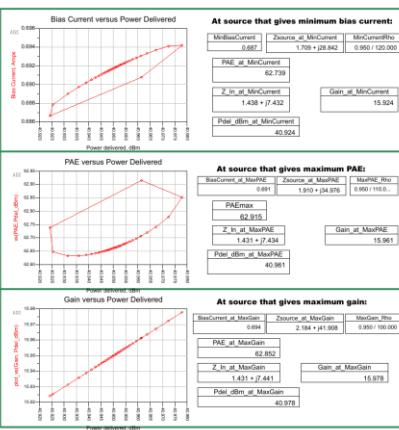
VSWR 1:3



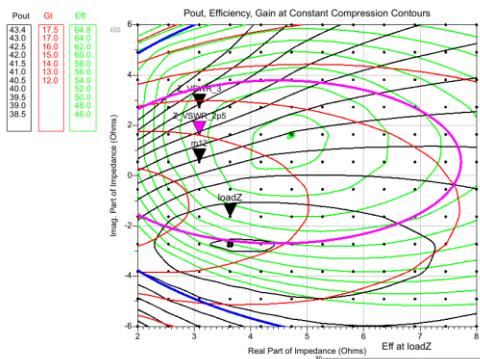
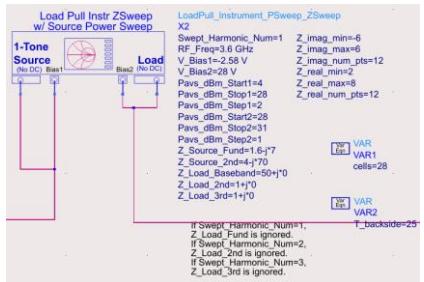
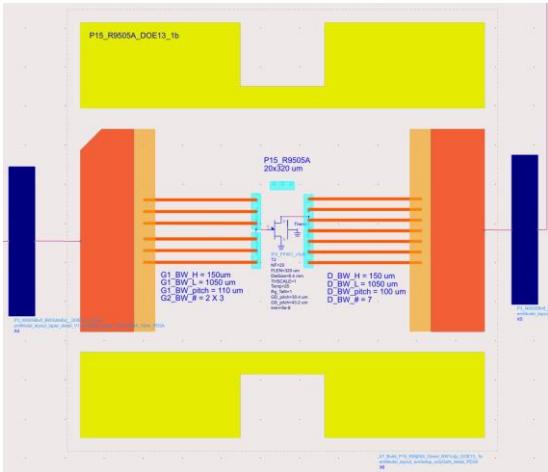
VSWR 1:1



VSWR 1:3



DOE13_1b (Die + minipac + step with Source, load harmonic termination)



Power Sweep Inspector

Move Marker loadZ to desired impedance point.

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

VSWR Locus center Impedance = 3.64 - j2.73

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 3.64 - j1.64 | 0.86 / 176.23 | 2 |
| Pout (dBm) | Eff (%) | Gr (dB) |
| 43.24 | 58.53 | 16.64 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -5.79 | -15.74 | 1.22 + j7.26 |

✗ In plots below corresponds to this data.

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

VSWR Locus center Impedance = 3.09 + j0.55

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 3.09 + j0.55 | 0.88 / 178.75 | 2 |
| Pout (dBm) | Eff (%) | Gr (dB) |
| 41.60 | 60.98 | 16.58 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -8.66 | -9.11 | 1.28 + j8.02 |

✗ In plots below corresponds to this data.

VSWR = 2.5 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 3.64 - j1.64 | 0.86 / 176.23 | 2 |
| Pout (dBm) | Eff (%) | Gr (dB) |
| 43.24 | 58.53 | 16.64 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -5.79 | -15.74 | 1.22 + j7.26 |

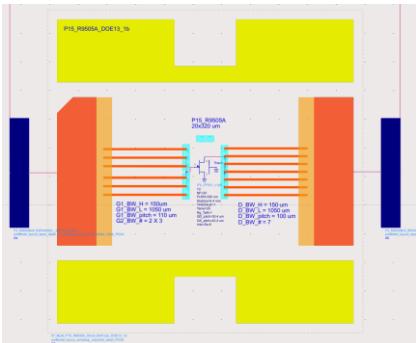
✗ In plots below corresponds to this data.

VSWR = 3 point DATA

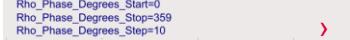
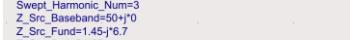
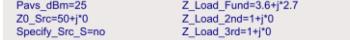
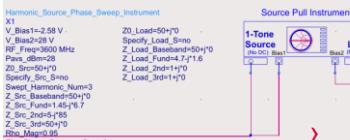
| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 3.09 + j2.73 | 0.88 / 173.73 | 2 |
| Pout (dBm) | Eff (%) | Gr (dB) |
| 40.60 | 61.65 | 15.99 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -6.91 | -8.03 | 1.49 + j8.33 |

✗ In plots below corresponds to this data.

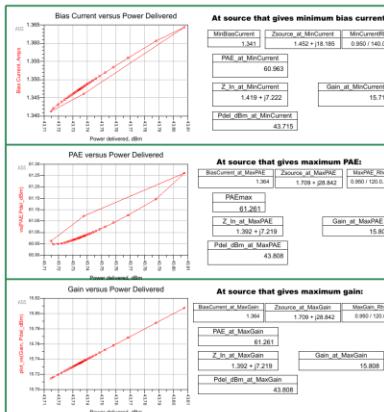
DOE13_1b (Die + minipac + step with Source harmonic phase sweep)



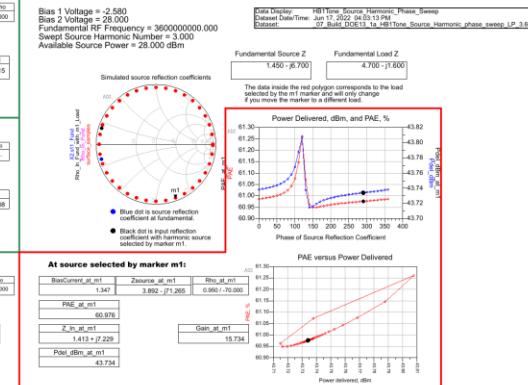
One Tone Harmonic Source Phase Sweep:
output power and PAE found at
each combination of harmonic
source impedance



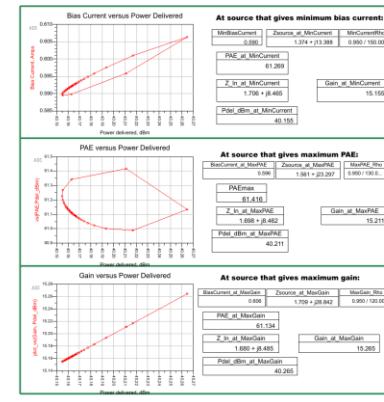
➤ VSWR 1:3



➤ VSWR 1:1



➤ VSWR 1:3



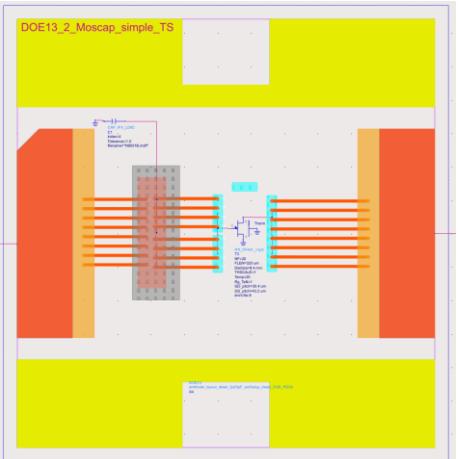
➤ VSWR 1:3

DOE_13_2 to DOE_13_5 With harmonic termination $Z_s \cdot 2f_o = 5 - j 85 \text{ Ohm}$

Minipac + BW → detailed EM simulation
Moscap → Simple EM simulation (file based)

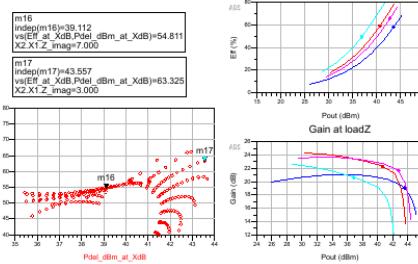
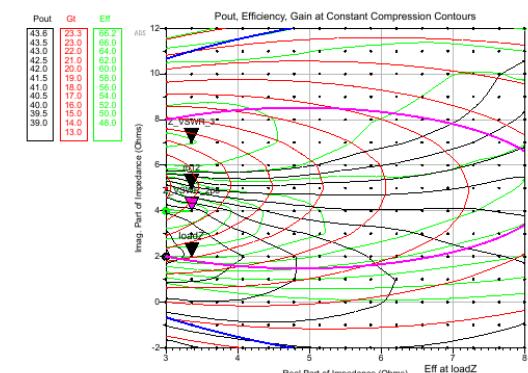
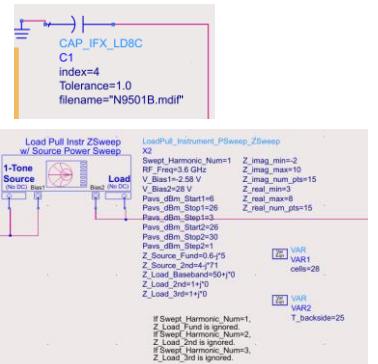
| Detailed_EM_P15 R9505A | | P_2dB | | Moscap | | | | | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) | | | | | | Performance @ Full power (43.3 dBm) | | | | | |
|---------------------------|-------------|------------|-------|----------------------|----------------------|------------|-----------|----------|-------------------------|----------|----------|-----------------------------------|----------|---------|----------|----------|----------|-------------------------------------|----------|---------|----------|--|--|
| DOE_13 | BW_profile | Name | Index | RF top plate (X x Y) | Oxide thickness (μm) | Value (pF) | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | | |
| DOE_13_4.16pF | BW_60_70_50 | N9501B_V5 | 23 | 1466x244 | 3100 | 4.16 | 43.6 | 23.3 | 66.2 | 0.4+j5.1 | 3.4+j5.0 | 40.63 | 59.5 | 22.3 | -10.6 | 0.2+j4.3 | 3.4+j2.0 | 43.5 | 58.4 | 19.1 | -1.9 | | |
| DOE_13_5.96pF | BW_60_70_50 | N9501B_Std | 4 | 1466x351 | 3100 | 5.96 | 44.9 | 23.1 | 73.6 | 1.0+j5.5 | 3.4+j9.4 | 39.65 | 64.9 | 17.1 | -18.7 | 0.8+j4.7 | 6.9+j6.9 | 43.62 | 70.7 | 17.4 | -11.1 | | |
| DOE_13_7.05pF | BW_60_70_50 | N9500B_Std | | 1010x337 | 1700 | 7.05 | 44.6 | 26.1 | 72.1 | 0.7+j5.5 | 3.4+j8.3 | 40.09 | 66.0 | 18.8 | -9.5 | 0.7+j4.7 | 6.2+j5.7 | 43.69 | 70.2 | 18.6 | -11.9 | | |
| DOE_13_8.8pF | BW_60_70_50 | N9501B_V1 | 20 | 1466x328 | 1950 | 8.8 | 44.7 | 26.7 | 72.6 | 0.6+j5.5 | 3.4+j8.3 | 40.34 | 68.1 | 19.0 | -9.2 | 0.7+j4.8 | 6.2+j6.6 | 43.41 | 71.3 | 18.6 | -15.8 | | |
| DOE_13_11.96pF | BW_60_70_50 | N9501B_V2 | 2 | 1466x304 | 1300 | 11.96 | 44.8 | 25.5 | 73.0 | 0.9+j5.3 | 3.4+j9.4 | 39.72 | 65.9 | 17.0 | -11.0 | 0.6+j4.8 | 6.6+j6.9 | 43.43 | 71.3 | 18.2 | -17.3 | | |

DOE_13_4.16pF Die + Moscap + minipac with Harmonic termination



4,16 pF

CAP_IFX_LD8C
C1
index=23
Tolerance=1.0
filename="N9501B.mdf"



Power Sweep Inspector

Eqn VSWRVal=5 Eqn VSWRVal=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 = $3.00 + j2.00$

VSWR=5

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $3.36 + j5.00$ | 0.87 / 175.40 | 2 |

| Pout (dBm) | Eff (%) | GT (dB) |
|------------|---------|---------|
| 43.50 | 58.33 | 19.08 |

| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
|------------|----------|----------------|
| -2.78 | -1.94 | $0.21 + j4.29$ |

X In plots below corresponds to this data.

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

VSWR Locus center Impedance = $3.36 + j5.00$

VSWR=5

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $3.36 + j5.00$ | 0.88 / 188.53 | 2 |

| Pout (dBm) | Eff (%) | GT (dB) |
|------------|---------|---------|
| 40.63 | 59.46 | 22.29 |

| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
|------------|----------|----------------|
| -9.77 | -10.59 | $0.40 + j5.09$ |

X In plots below corresponds to this data.

VSWR = 2.5 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $3.36 + j4.00$ | 0.87 / 170.81 | 2 |

| Pout (dBm) | Eff (%) | GT (dB) |
|------------|---------|---------|
| 42.73 | 66.07 | 21.69 |

| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
|------------|----------|----------------|
| -8.28 | -5.46 | $0.29 + j4.81$ |

X In plots below corresponds to this data.

VSWR = 3 point DATA

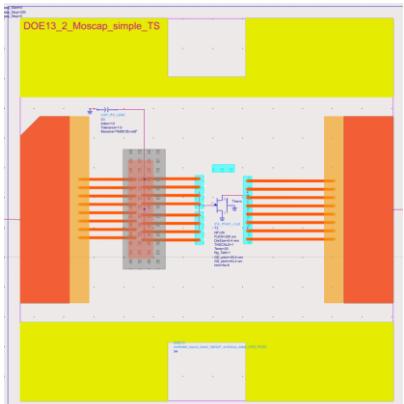
| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $3.36 + j7.00$ | 0.68 / 163.99 | 2 |

| Pout (dBm) | Eff (%) | GT (dB) |
|------------|---------|---------|
| 36.62 | 49.87 | 20.64 |

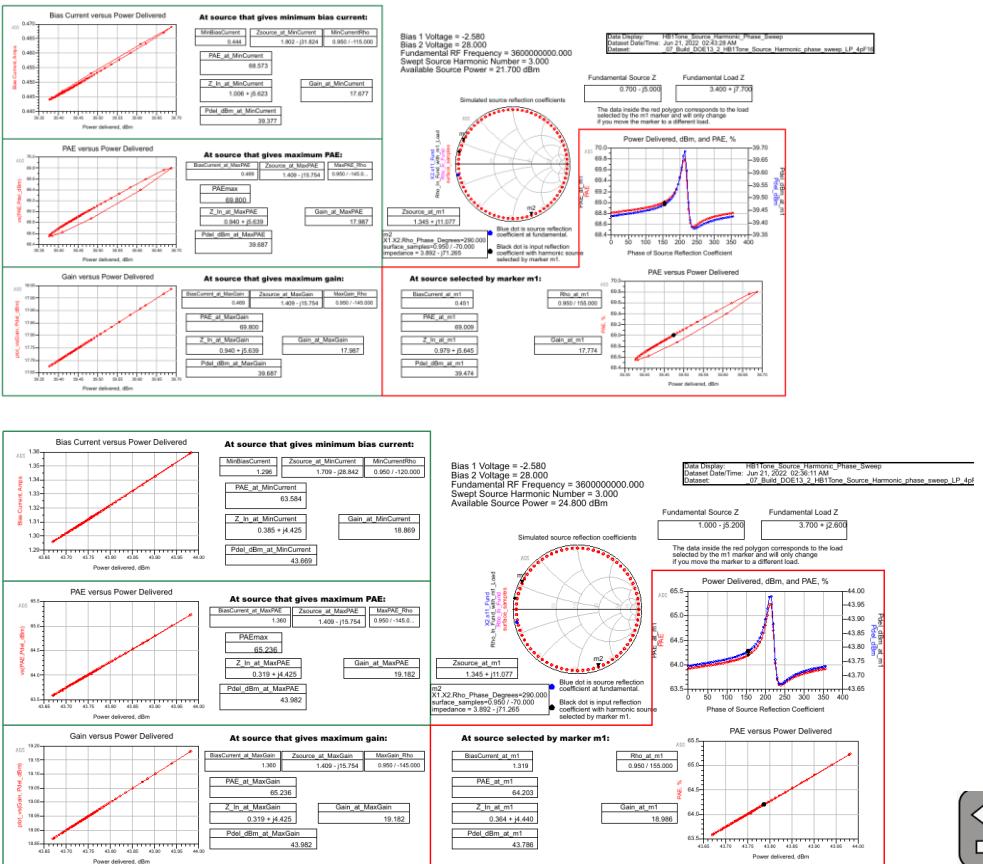
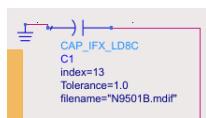
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
|------------|----------|----------------|
| -3.77 | -13.14 | $0.69 + j5.51$ |

X In plots below corresponds to this data.

DOE_13_4.16pF Die + Moscap + minipac with Source harmonic sweep

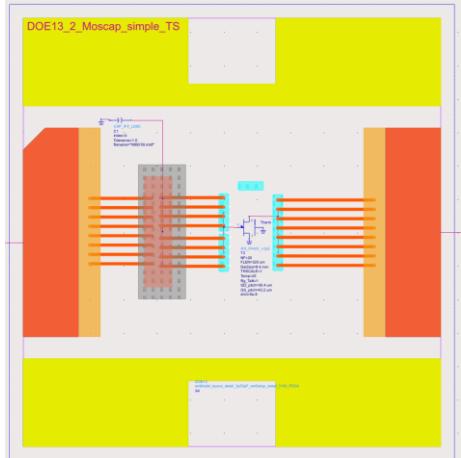


4,16 pF

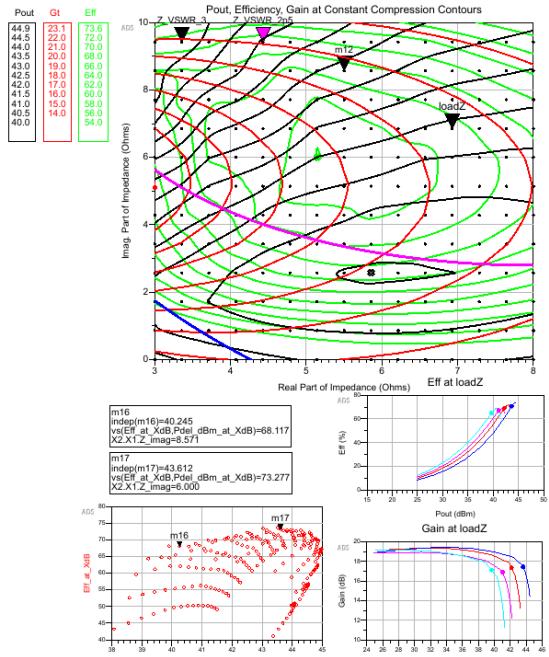
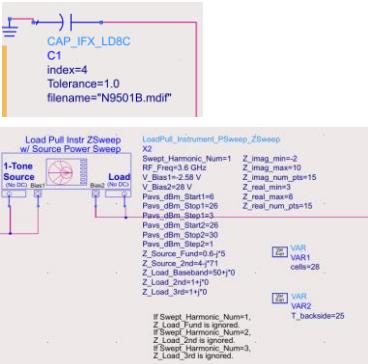


- › Z_{in} selected for $Z_{s_2f0_phase}$ sweep = $1 + j5.2$ (VSWR 2.5 @ P2 dB)
 - › $Z_{s_2f0_termination} = 5 - j85$
- › ZL selected for $Z_{s_2f0_phase}$ sweep for MXE @ 39 dBm = $3.4 + j9.4$
- › ZL selected for $Z_{s_2f0_phase}$ sweep for MXP @ $P2dB = 6.9 + j7.7$

DOE_13_5.96pF Die + Moscap + minipac with Harmonic termination

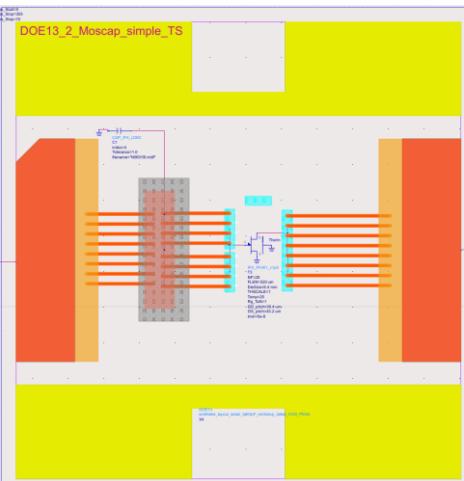


5.96 pF

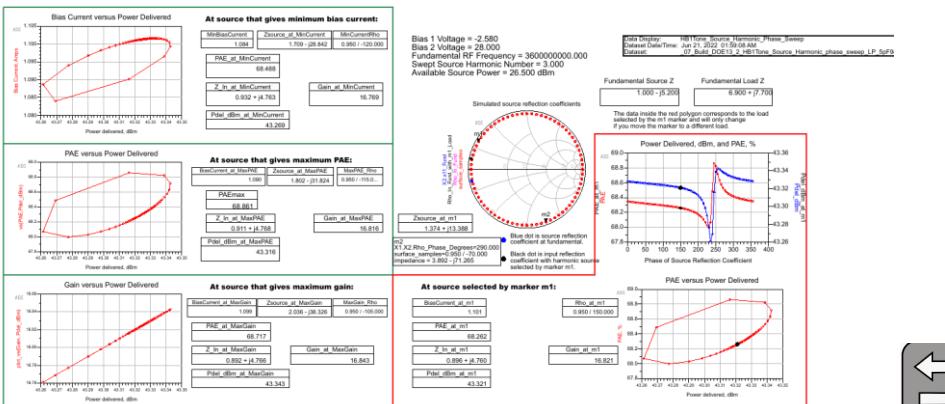
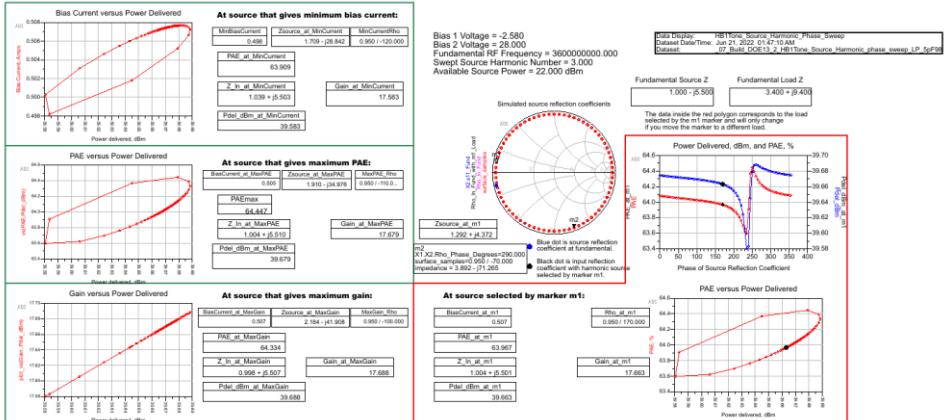


- Zs_2fo terminated with $5 - j 85$
- ZL_2f0, ZL_3f0 shorted

DOE_13_5.96pF Die + Moscap + minipac with Source harmonic sweep

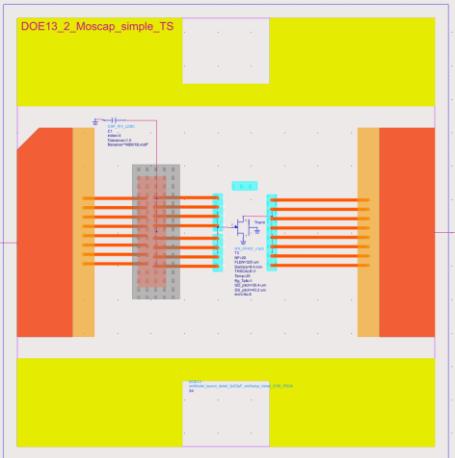


5,96 pF

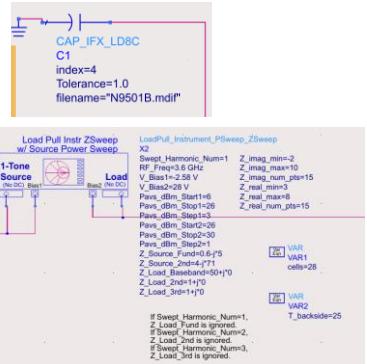
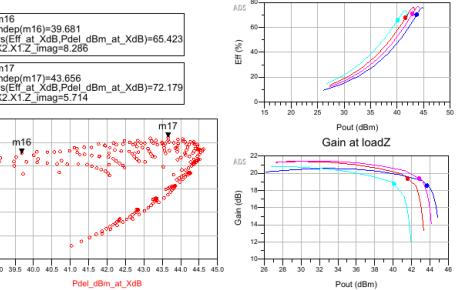
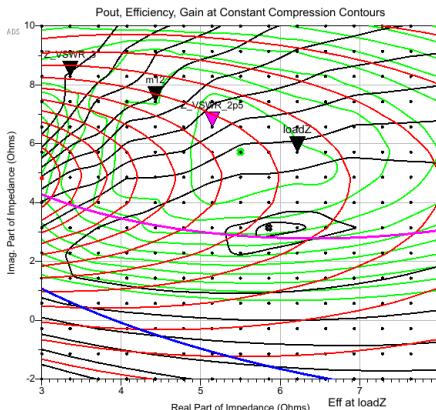


- › Zin selected for Zs_2f0_phase sweep =1 + 5.2 (VSWR 2.5 @ P2 dB)
 - › Zs_2f0_termination = 5 - j 85
- › ZL selected for Zs_2f0_phase sweep for MXE @ 39 dBm = 3,4 + j 9,4
- › ZL selected for Zs_2f0_phase sweep for MXP @ P2dB = 6,9 + j 7,7

DOE_13_7.03pF Die + Moscap + minipac with Harmonic termination



| Pout | Gt | Eff |
|------|------|------|
| 44.5 | 29.1 | 72.1 |
| 44.0 | 28.0 | 71.0 |
| 43.5 | 24.0 | 68.0 |
| 43.0 | 23.0 | 66.0 |
| 42.5 | 22.0 | 64.0 |
| 42.0 | 20.0 | 62.0 |
| 41.5 | 19.0 | 60.0 |
| 41.0 | 18.0 | 58.0 |
| 40.5 | 17.0 | 56.0 |
| 40.0 | 16.0 | 54.0 |
| 39.5 | 15.0 | 52.0 |



- › Zs_2f0 terminated with $4 - j 7$
- › ZL_2f0, ZL_3f0 shorted

Power Sweep Inspector

VSWRval=5 Eqr VSWRval1=2.5

Move Marker "loadZ" to desired impedance point.

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

VSWR Loc center Impedance = $5.86 + j3.14$

VSWR=5

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

VSWR Loc center Impedance = $4.43 + j7.43$

VSWR=5

Summary of Performance at Compression

Marker Impedance

Marker Gamma

Reference Compression Level (dB)

Pout (dBm)

Eff (%)

Gt (dB)

AMPM (dBm)

IRL (dB)

Zin (Ohm)

X In plots below corresponds to this data.

Summary of Performance at Compression

Marker Impedance

Marker Gamma

Reference Compression Level (dB)

Pout (dBm)

Eff (%)

Gt (dB)

AMPM (dBm)

IRL (dB)

Zin (Ohm)

X In plots below corresponds to this data.

VSWR = 2.5 point DATA

Marker Impedance

Marker Gamma

Reference Compression Level (dB)

Pout (dBm)

Eff (%)

Gt (dB)

AMPM (dBm)

IRL (dB)

Zin (Ohm)

X In plots below corresponds to this data.

VSWR = 3 point DATA

Marker Impedance

Marker Gamma

Reference Compression Level (dB)

Pout (dBm)

Eff (%)

Gt (dB)

AMPM (dBm)

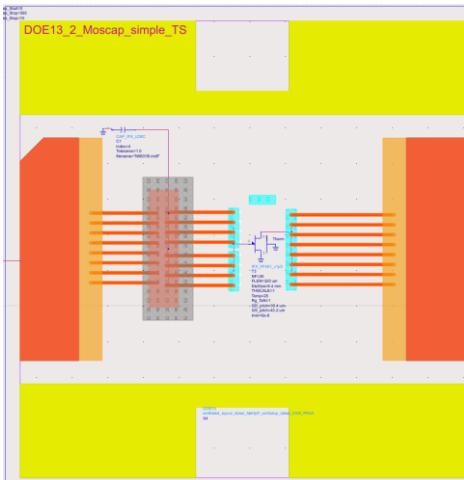
IRL (dB)

Zin (Ohm)

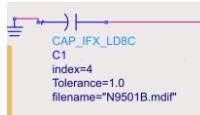
X In plots below corresponds to this data.



DOE_13_7.03pF Die + Moscap + minipac with Source harmonic sweep



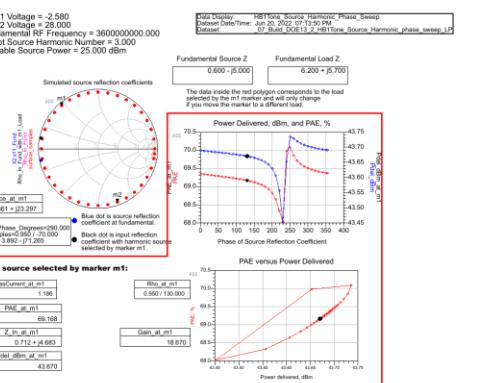
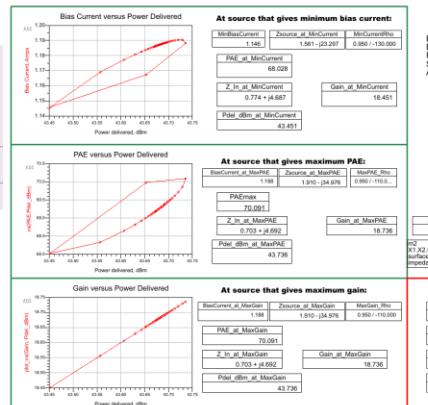
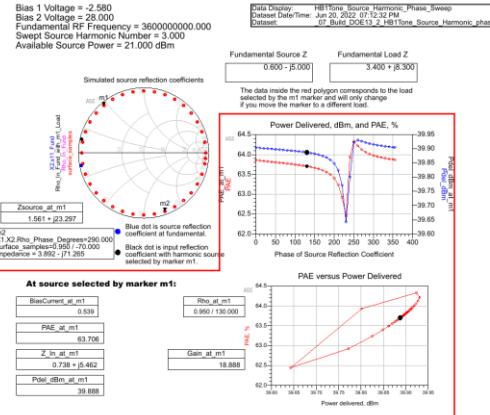
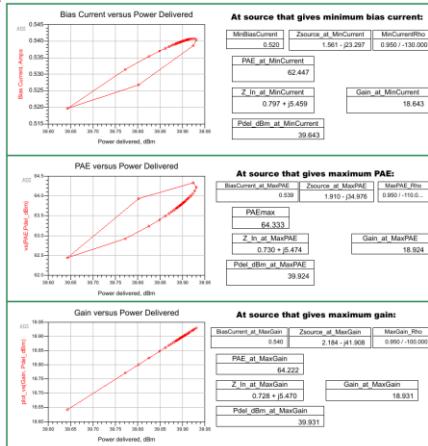
› 7,03 pF



```

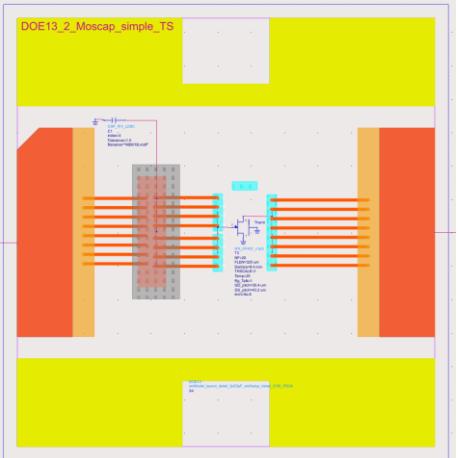
Harmonic_Source_Phase_Sweep
X1
V_Bias1=2.58 V
V_Bias2=28 V
RF_Freq=3600 MHz
Pavg_dBm=21
Z0_Src=50+j0
Specify_Src_Sinc
Swept_Harmonic_Num=3
Z_src_Bandwidth=50+j0
Z_src_Fund=0.6-j5
Z_src_2ndHar=j71
Z_src_3rdHar=j504-95
Rho_Mag=0.95
Rho_Phase_Degrees_Start=0
Rho_Phase_Degrees_Stop=355
Rho_Phase_Degrees_Step=10

```

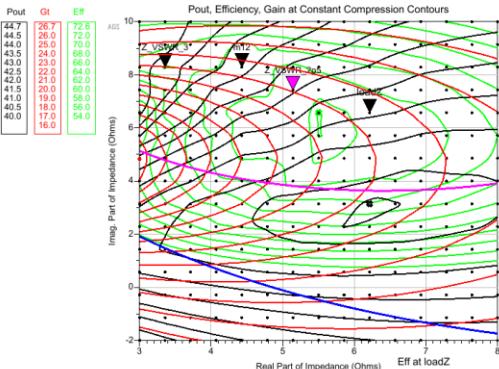


- › Zin selected for Zs_2f0_phase sweep = 0,6 + 5 (VSWR 2.5 @ P2 dB)
 - › Zs_2f0_termination = 4 - j 71
 - › ZL selected for Zs_2f0_phase sweep for MXE @ 39 dBm = 3,4 + j 8,3
 - › ZL selected for Zs_2f0_phase sweep for MXP @ P2dB = 6,2 + j 5,7

DOE_13_8.8pF Die + Moscap + minipac with Harmonic termination



→ 8,8 pF



Power Sweep Inspector

VSWRval5 VSWRval1=2.5

Move Marker loadZ to desired impedance point.

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

VSWR center Impedance = $6.21 + j3.14$

Summary of Performance at Compression

Marker Impedance $6.21 + j6.57$ Marker Gamma $0.78 / 164.80$ Reference Compression Level (dB) 2

Pout (dBm) 43.41 Eff (%) 71.27 Gt (dB) 18.55

AMPM (dBm) IRL (dB) Zin (Ohm) -4.96 -15.89 $0.68 + j4.80$

× In plots below corresponds to this data.

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

VSWR center Impedance = $4.43 + j6.29$

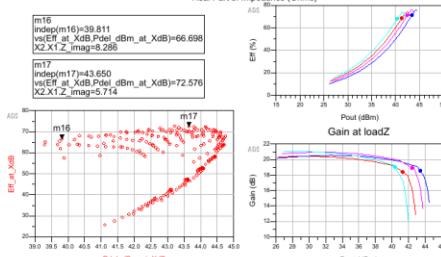
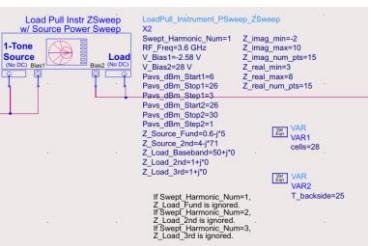
Summary of Performance at Compression

Marker Impedance $4.43 + j8.29$ Marker Gamma $0.84 / 161.04$ Reference Compression Level (dB) 2

Pout (dBm) 41.28 Eff (%) 68.54 Gt (dB) 18.39

AMPM (dBm) IRL (dB) Zin (Ohm) -1.69 -14.48 $0.77 + j5.20$

× In plots below corresponds to this data.



VSWR = 2.5 point DATA

Marker Impedance $5.14 + j7.43$ Marker Gamma $0.82 / 162.92$ Reference Compression Level (dB) 2

Pout (dBm) 42.44 Eff (%) 71.14 Gt (dB) 18.92

AMPM (dBm) IRL (dB) Zin (Ohm) -3.95 -23.38 $0.68 + j5.02$

× In plots below corresponds to this data.

VSWR = 3 point DATA

Marker Impedance $3.36 + j8.29$ Marker Gamma $0.88 / 161.10$ Reference Compression Level (dB) 2

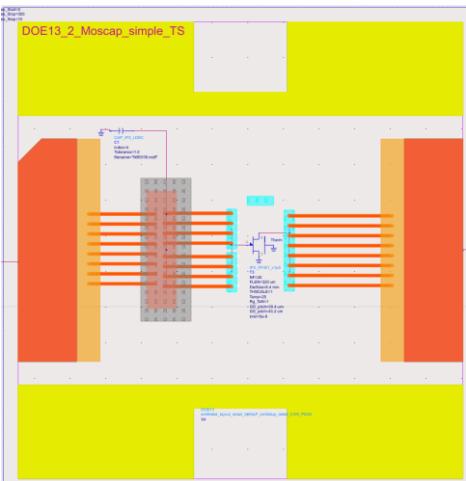
Pout (dBm) 40.34 Eff (%) 68.07 Gt (dB) 19.03

AMPM (dBm) IRL (dB) Zin (Ohm) -0.83 -9.20 $0.63 + j5.46$

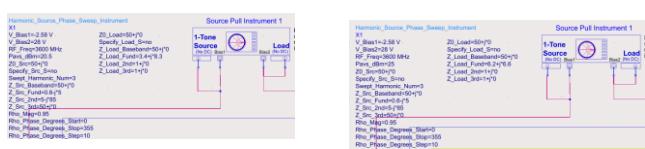
× In plots below corresponds to this data.

- › Zs_2fo terminated with $4 - j 71$
- › ZL_2f0, ZL_3f0 shorted

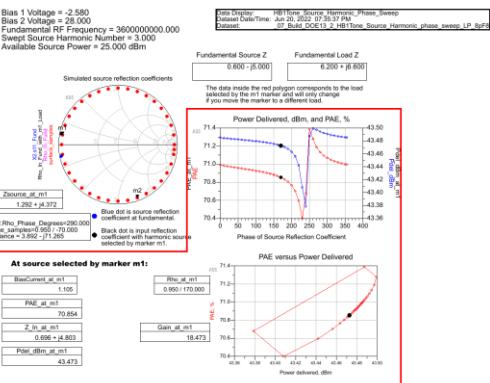
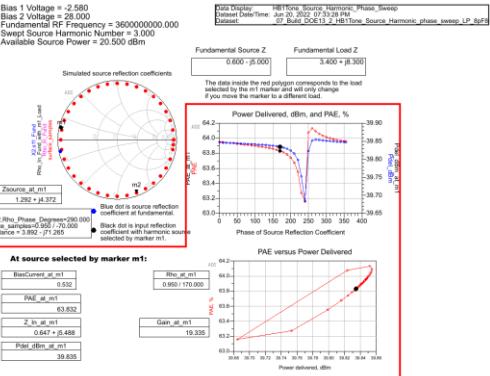
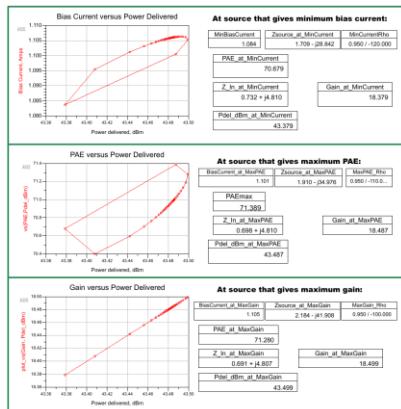
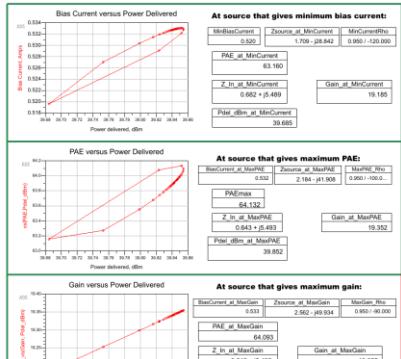
DOE_13_8.8pF Die + Moscap + minipac with Source harmonic sweep



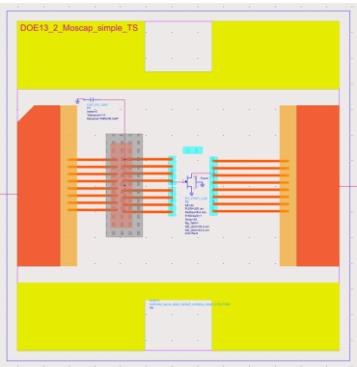
8,8 pF



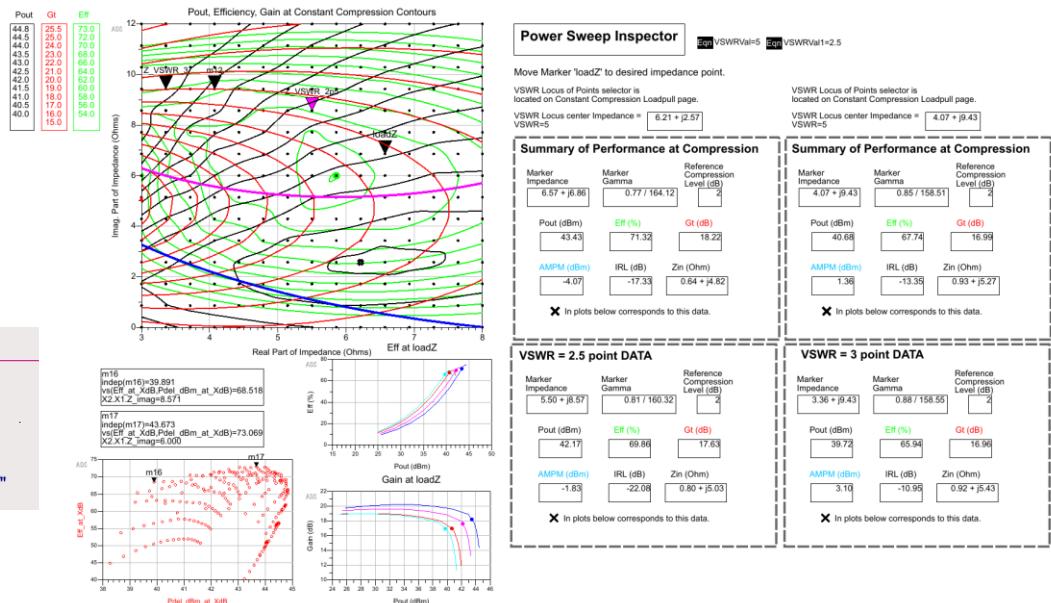
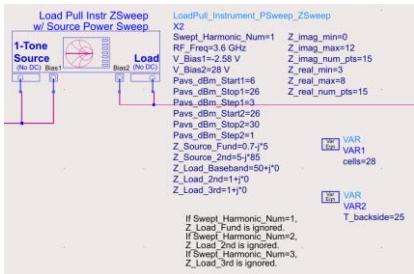
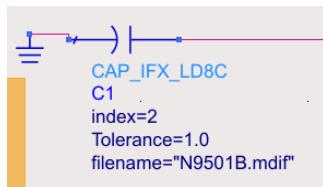
- › Zin selected for Zs_2f0_phase sweep = 0.6 + j 5 (VSWR 2.5 @ P2 dB)
 - › Zs_2f0_termination = 5 - j 85
- › ZL selected for Zs_2f0_phase sweep for MXE @ 39 dBm = 3,4 + j 8,3
- › ZL selected for Zs_2f0_phase sweep for MXP @ P2dB = 6,2 + j 6,6



DOE_13_11.96pF Die + Moscap + minipac with Harmonic termination

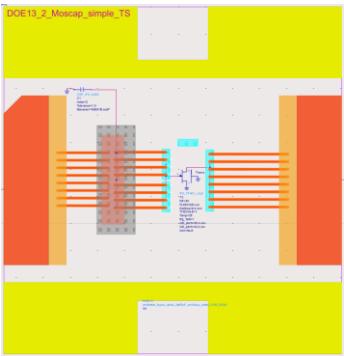


› 11,96 pF



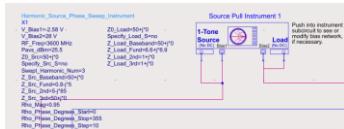
- › Z_{s_2f0} terminated with $5 - j 85$
- › Z_{L_2f0}, Z_{L_3f0} shorted

DOE_13_11.96pF Die + Moscap + minipac with Source harmonic sweep

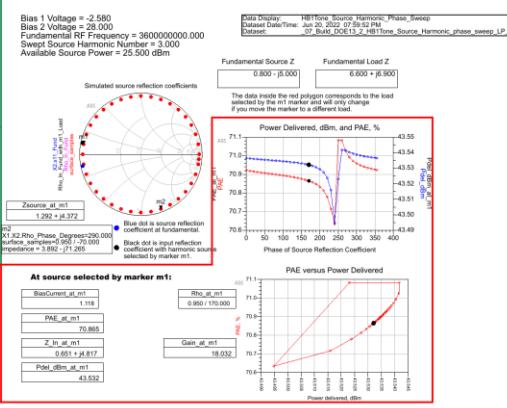
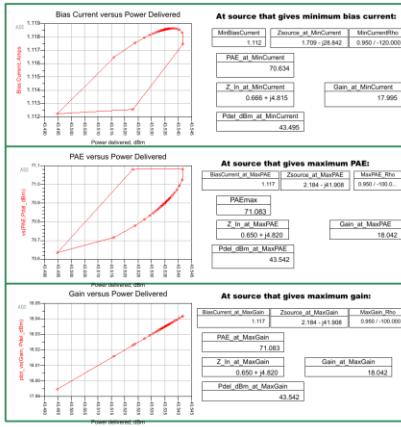
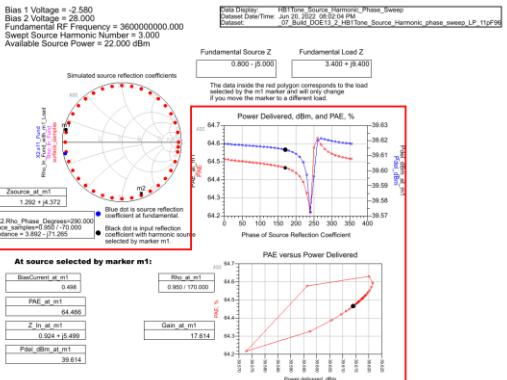
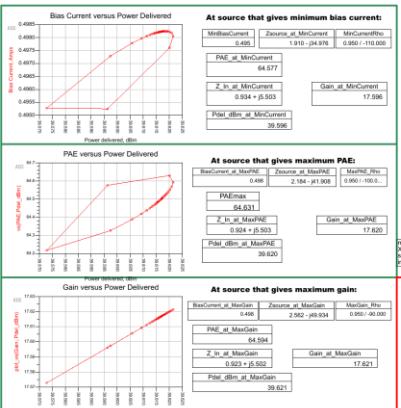



CAP_IFX_LD8C
C1
index=20
Tolerance=1.0
filename="N9501B.mdif"

› 11,96 pF



- › Zin selected for Zs_2f0_phase sweep = 0,8 + j 5 (VSWR 2,5 @ P2 dB)
 - › Zs_2f0_termination = 5 - j 85
 - › ZL selected for Zs_2f0_phase sweep for MXE @ 39 dBm = 3,4 + j 9,4
 - › ZL selected for Zs_2f0_phase sweep for MXP @ P2dB = 6,6 + j 6,9



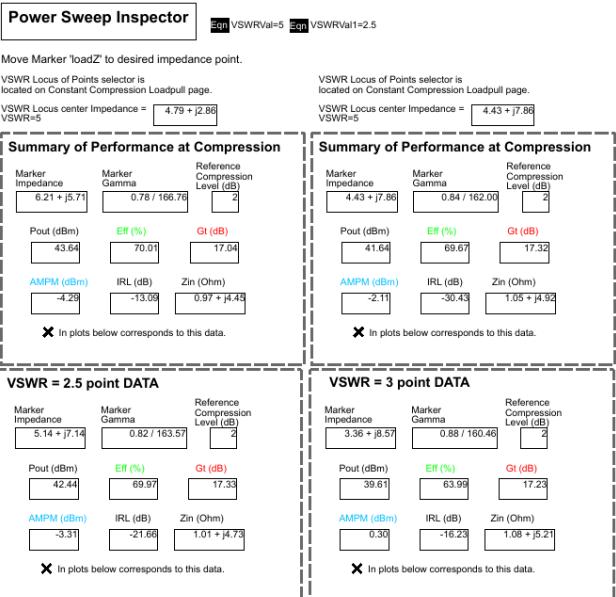
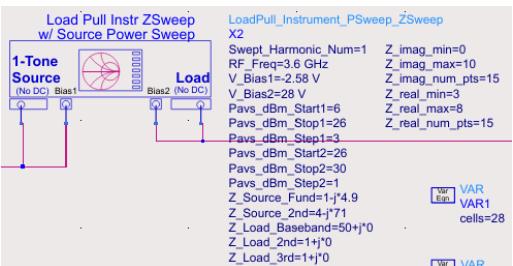
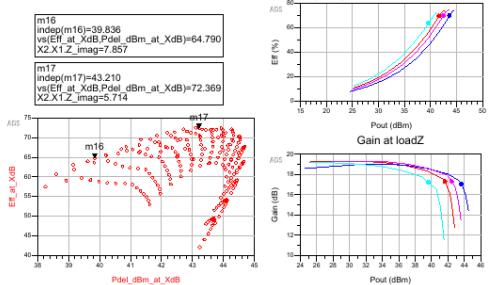
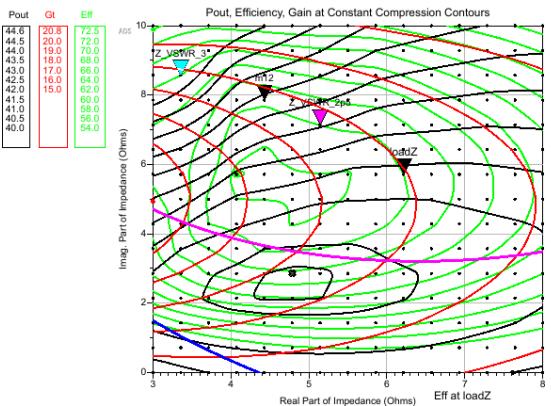
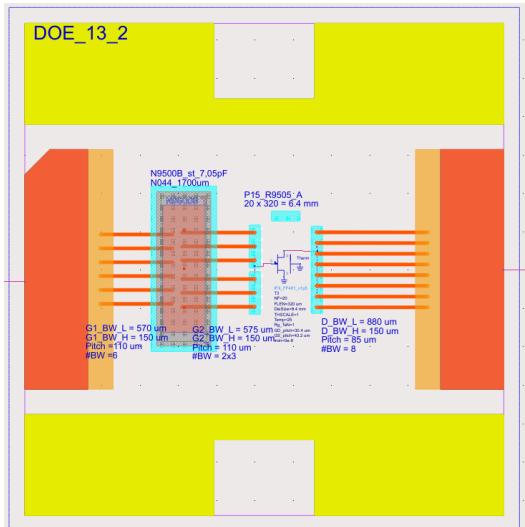
Detail EM simulation_initial

$Z_s \text{ } 2f_0 = 4 - j \text{ } 70 \text{ Ohm}$

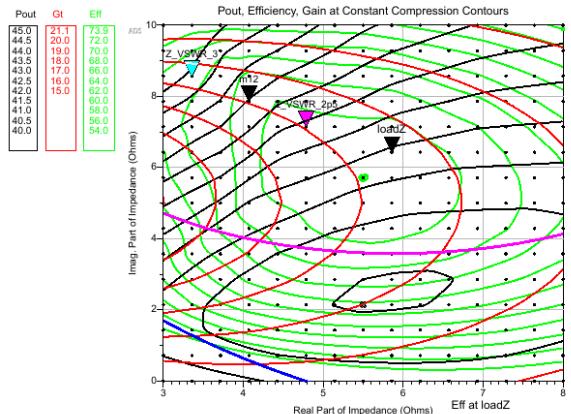
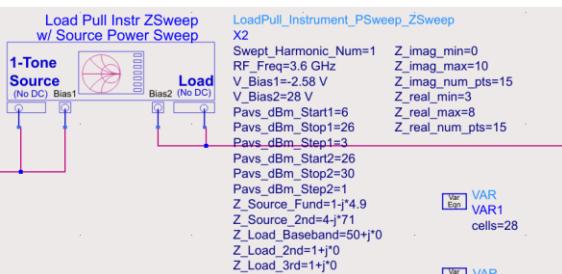
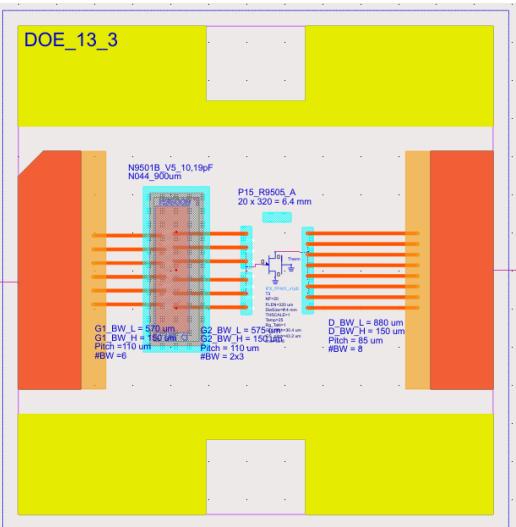
$Z_L \text{ } 2f_0, Z_L \text{ } 3f_0$ shorted

| Detailed_EM_P15 R9505A | P_2dB | Moscap | | | | | | Max. performance @ P2dB | | Performance @ Back_off (39.5 dBm) ($Z_s \text{ } 2f_0 = 4 - j \text{ } 70; Z_L \text{ } 2f_0, Z_L \text{ } 3f_0$ shorted) | | | | | | Performance @ Full power (43.3 dBm) ($Z_s \text{ } 2f_0 = 4 - j \text{ } 70; Z_L \text{ } 2f_0, Z_L \text{ } 3f_0$ shorted) | | | | | | | |
|---------------------------|-------------|------------|-------|----------------------|--------------------------------------|------------|------|-------------------------|------|---|-------------|---------|------------------|------------------|---------------|---|------------|----------|------------------|------------------|------------|----------|---------|
| | | | | | | | | | | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) |
| DOE_13 | BW_profile | Name | Index | RF top plate (X x Y) | Oxide thickness (μm) | Value (pF) | | | | | | | | | | | | | | | | | |
| DOE_13_2 | BW_3o_4o_5o | N9500B_std | | 1010x337 | 1700 | 7.05 | 44.6 | 20.8 | 72.5 | 1.1 +j 5.2 | 3.4 +j 8.6 | 39.61 | 64.0 | 17.2 | -16.2 | 1.0 +j 4.5 | 6.2 +j 5.7 | 43.64 | 70.0 | 17.0 | -13.1 | | |
| DOE_13_3 | BW_3o_4o_5o | N9500B_V5 | | 1010x270 | 900 | 10.19 | 45.0 | 21.1 | 73.9 | 0.9 +j 5.2 | 3.4 +j 8.6 | 40.1 | 67.2 | 17.5 | -16.4 | 0.8 +j 4.6 | 5.9 +j 6.4 | 43.59 | 73.4 | 17.4 | -13.2 | | |
| DOE_13_4 | BW_6o_7o_5o | N9500B_V5 | | 1010x270 | 900 | 10.19 | 44.8 | 21.0 | 73.4 | 0.8 +j 4.5 | 3.0 +j 8.6 | 39.42 | 64.6 | 17.7 | -15.7 | 0.5 +j 4.2 | 4.8 +j 5.7 | 43.46 | 72.8 | 18.4 | -11.0 | | |
| DOE_13_5 | BW_6o_7o_5o | N9501B_V1 | | 1466x328 | 1300 | 12.83 | 44.9 | 21.8 | 73.3 | 0.7 +j 4.8 | 3.0 +j 8.6 | 39.53 | 65.4 | 17.7 | -3.4 | 0.5 +j 4.3 | 4.8 +j 5.7 | 43.45 | 72.7 | 18.7 | -11.9 | | |

P15_R9505_A_N9500B_st_BW_3o4o5o_DOE_13_2



P15_R9505_A_N9500B_V5_10pF19_BW_3o4o5o_DOE_13_3



Power Sweep Inspector

VSWRVal=5 VSWRVal=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 = $5.50 + j2.14$

VSWR=5

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

VSWR Locus center Impedance = $4.07 + j7.89$

VSWR=5

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $5.86 + j6.43$ | $0.79 / 163.15$ | 2 |
| Pout (dBm) | Eff (%) | Gr (dB) |
| 43.59 | 73.42 | 17.44 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -4.08 | -13.20 | $0.75 + j4.66$ |

X In plots below corresponds to this data.

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $4.07 + j7.86$ | $0.85 / 162.02$ | 2 |
| Pout (dBm) | Eff (%) | Gr (dB) |
| 41.54 | 71.09 | 17.54 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -2.68 | -17.77 | $0.78 + j4.98$ |

X In plots below corresponds to this data.

VSWR = 2.5 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $4.79 + j7.14$ | $0.83 / 163.59$ | 2 |
| Pout (dBm) | Eff (%) | Gr (dB) |
| 42.61 | 72.80 | 17.95 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -4.10 | -15.56 | $0.73 + j4.80$ |

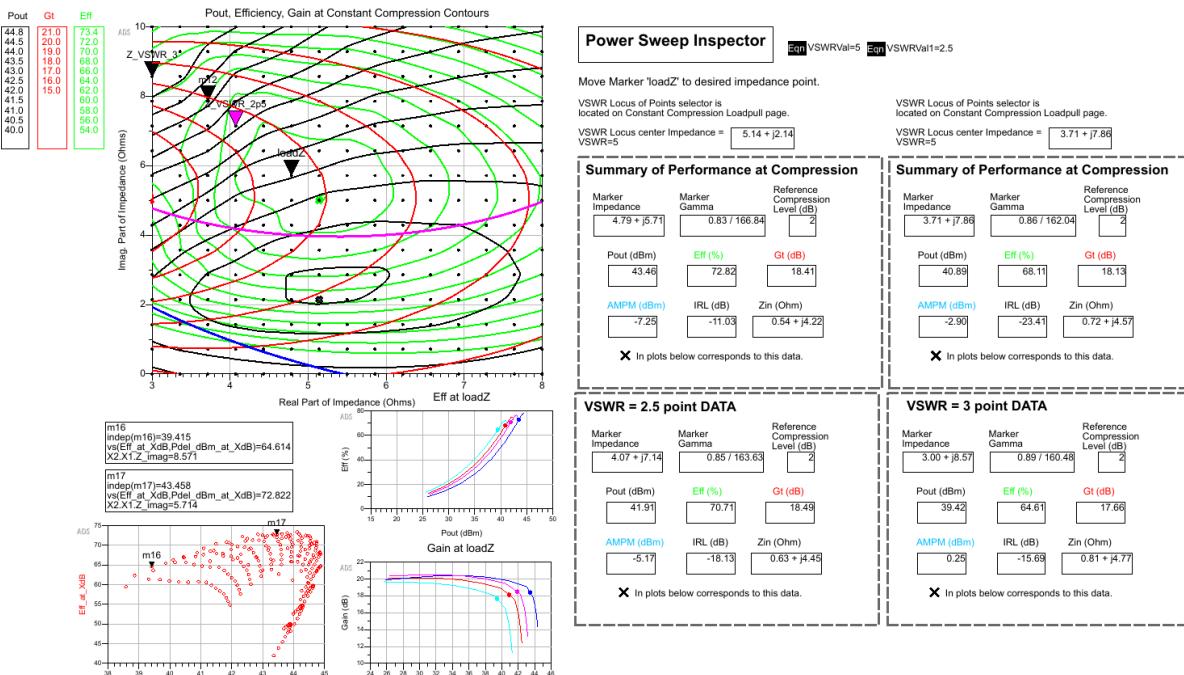
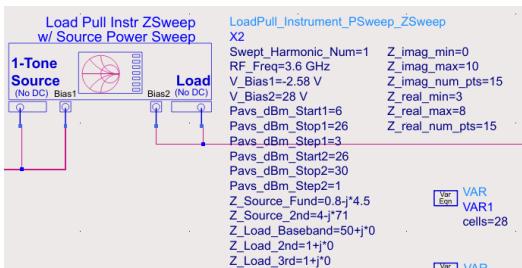
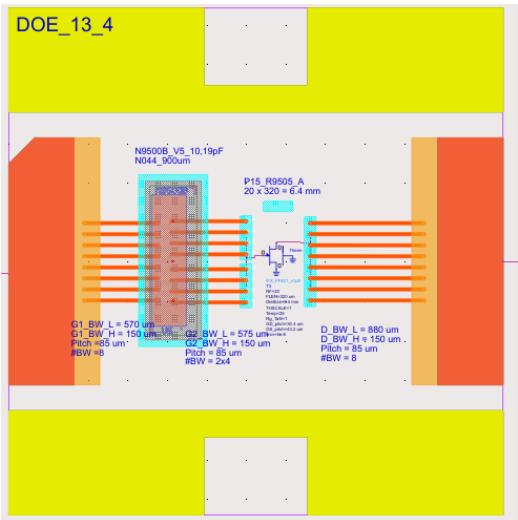
X In plots below corresponds to this data.

VSWR = 3 point DATA

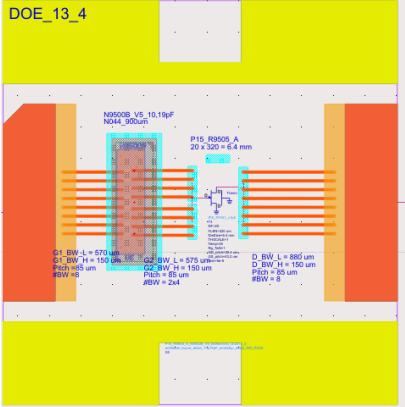
| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $3.36 + j8.57$ | $0.88 / 160.46$ | 2 |
| Pout (dBm) | Eff (%) | Gr (dB) |
| 40.10 | 67.18 | 17.51 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| 0.02 | -16.40 | $0.88 + j5.17$ |

X In plots below corresponds to this data.

P15_R9505_A_N9500B_V5_10pF19_BW_607o5o_DOE_13_4



DOE_13_4 Source harmonic phase sweep



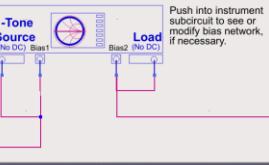
Harmonic_Source_Phase_Sweep_Instrument

X1
 V_Bias1=2.58 V
 V_Bias2=28 V
 RF_Freq=3600 MHz
 Pavs_dBm=26
 ZD_Src=50+j0
 Specify_Src_S=0
 Swept_Harmonic_Num=3
 Z_Src_Baseband=50+j0
 Z_Src_Fund=4.81+j5.7
 Z_Src_2nd=4+j70
 Z_Src_3rd=50+j0
 Rho_Mag=0.95
 Rho_Phase_Degrees_Start=0
 Rho_Phase_Degrees_Stop=355
 Rho_Phase_Degrees_Step=5

Harmonic_Source_Phase_Sweep_Instrument

X1
 V_Bias1=2.58 V
 V_Bias2=28 V
 RF_Freq=3600 MHz
 Pavs_dBm=26
 ZD_Src=50+j0
 Specify_Src_S=0
 Swept_Harmonic_Num=3
 Z_Src_Baseband=50+j0
 Z_Src_Fund=4.81+j5.7
 Z_Src_2nd=4+j70
 Z_Src_3rd=50+j0
 Rho_Mag=0.95
 Rho_Phase_Degrees_Start=0
 Rho_Phase_Degrees_Stop=355
 Rho_Phase_Degrees_Step=5

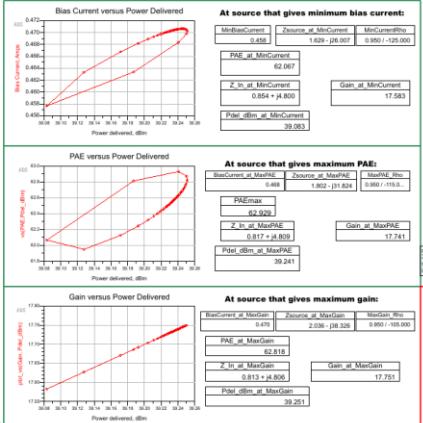
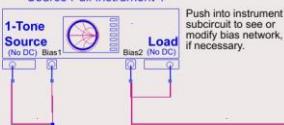
Source Pull Instrument 1



Harmonic_Source_Phase_Sweep_Instrument

X1
 V_Bias1=2.58 V
 V_Bias2=28 V
 RF_Freq=3600 MHz
 Pavs_dBm=26
 ZD_Src=50+j0
 Specify_Src_S=0
 Swept_Harmonic_Num=3
 Z_Src_Baseband=50+j0
 Z_Src_Fund=4.81+j5.7
 Z_Src_2nd=4+j70
 Z_Src_3rd=50+j0
 Rho_Mag=0.95
 Rho_Phase_Degrees_Start=0
 Rho_Phase_Degrees_Stop=355
 Rho_Phase_Degrees_Step=5

Source Pull Instrument 1

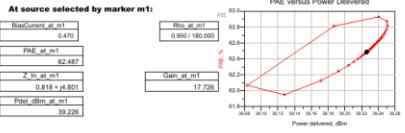
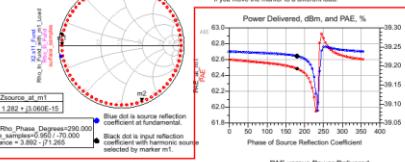


Date Monday Jun 22, 2020 01:43:57 AM
 Dataset: 07 Build DOE13_4 HBTone.Source Harmonic
 Project: HBTone

Fundamental Source Z
 $0.600 \times j5.500$

Fundamental Load Z
 $2.000 \times j9.600$

The data inside the red polygon corresponds to the load selected by the m1 marker and will change if you move the marker to a different load.

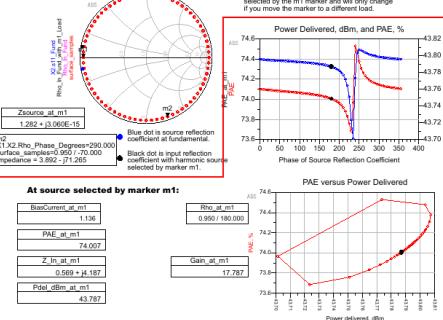


Date Monday Jun 22, 2020 01:43:58 AM
 Dataset: 07 Build DOE13_4 HBTone.Source Harmonic
 Project: HBTone

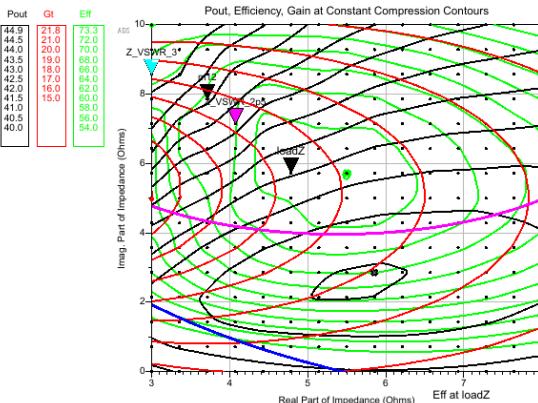
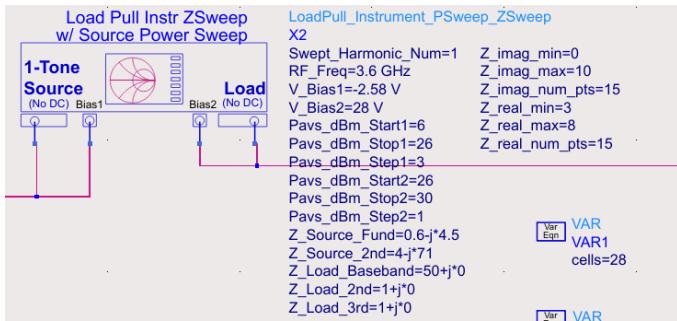
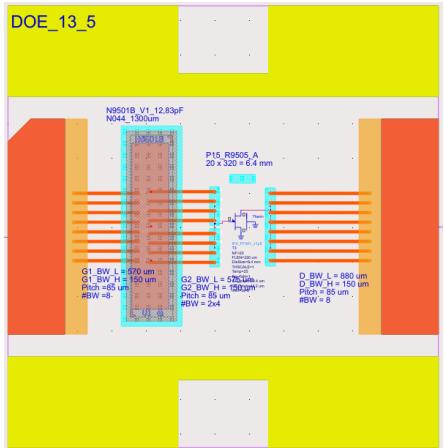
Fundamental Source Z
 $0.600 \times j5.500$

Fundamental Load Z
 $4.800 \times j5.700$

The data inside the red polygon corresponds to the load selected by the m1 marker and will change if you move the marker to a different load.



P15_R9505_A_N9501B_V1_12pF83_BW_607050_DOE_13_5



Power Sweep Inspector

VSWRVal=5 VSWRVal=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 = 5.86 + j2.86
 VSWR=5

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 4.79 + j5.71 | 0.83 / 166.84 | 2 |
| Pout (dBm) | Eff (%) | Gt (dB) |
| 43.49 | 72.74 | 18.70 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -8.04 | -11.92 | 0.45 + j4.27 |

✗ in plots below corresponds to this data.

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

VSWR Locus center Impedance = 3.71 + j7.86
 VSWR=5

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 3.71 + j7.86 | 0.86 / 162.04 | 2 |
| Pout (dBm) | Eff (%) | Gt (dB) |
| 40.89 | 68.14 | 18.35 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -3.21 | -23.76 | 0.62 + j4.58 |

✗ in plots below corresponds to this data.

VSWR = 2.5 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 4.07 + j7.14 | 0.85 / 163.63 | 2 |
| Pout (dBm) | Eff (%) | Gt (dB) |
| 41.79 | 69.89 | 18.79 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -5.70 | -23.48 | 0.54 + j4.48 |

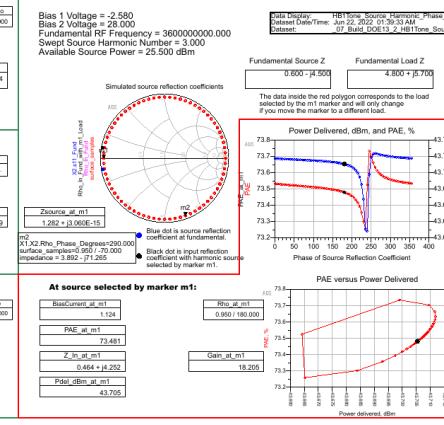
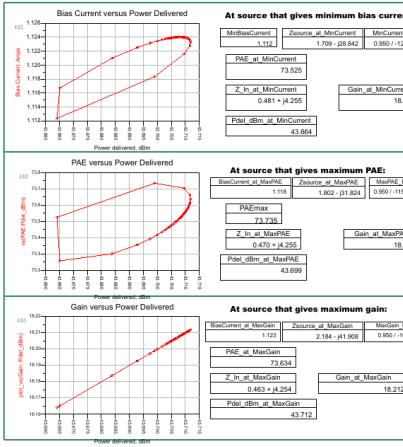
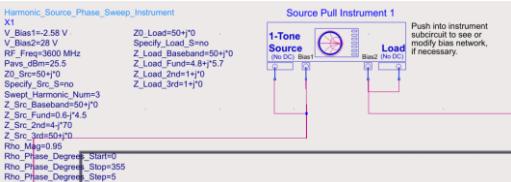
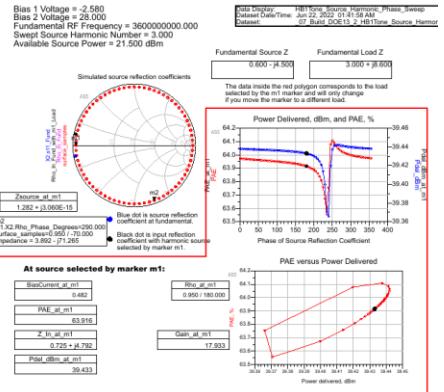
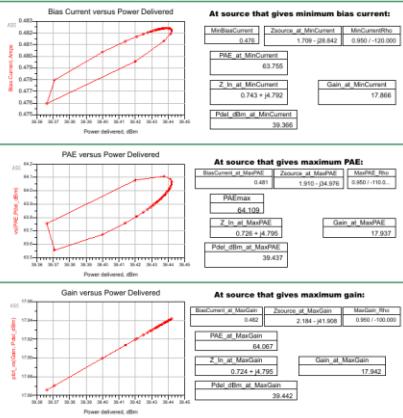
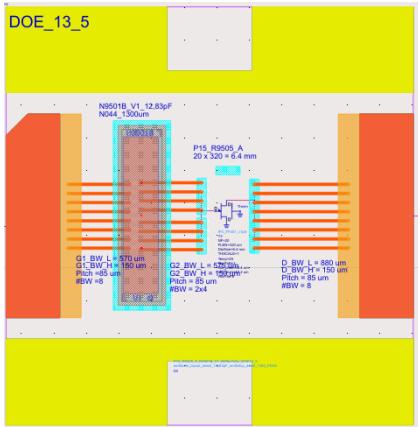
✗ in plots below corresponds to this data.

VSWR = 3 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| 3.00 + j8.51 | 0.89 / 160.48 | 2 |
| Pout (dBm) | Eff (%) | Gt (dB) |
| 39.53 | 65.38 | 17.74 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| 0.36 | -13.43 | 0.71 + j4.76 |

✗ in plots below corresponds to this data.

DOE_13_5 Source harmonic phase sweep



2020-04-20

restricted

Detail EM simulation_final

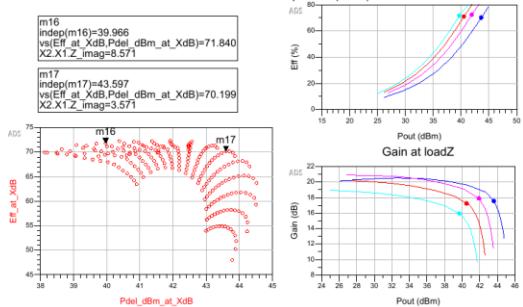
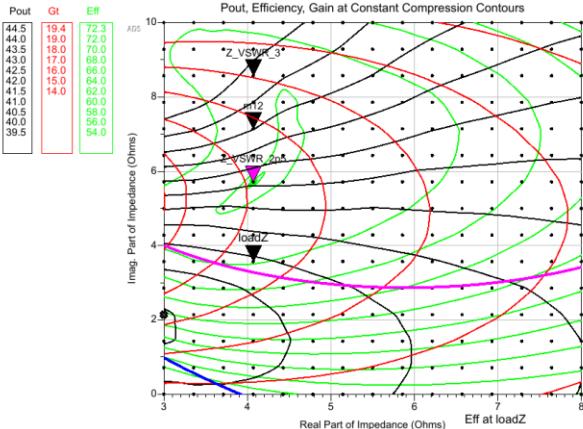
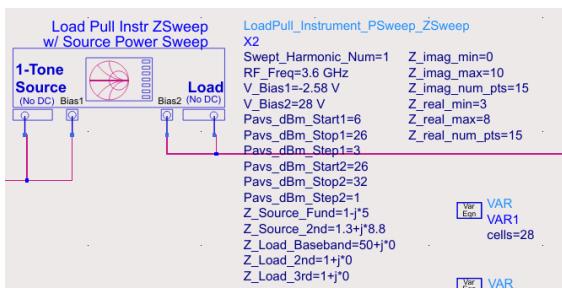
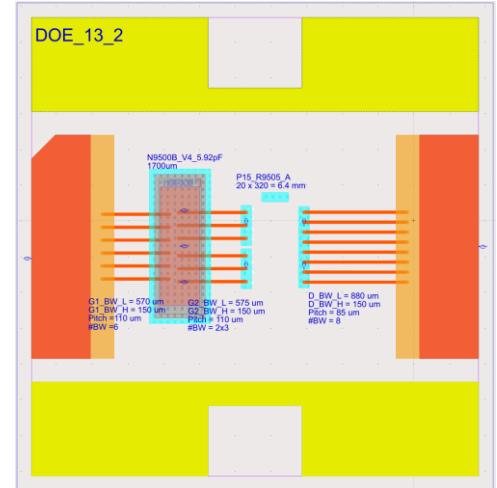
$Z_s_2f0 = 1.3 + j 8,8 \text{ Ohm}$

| Detailed_EM_P1 15_R9505A | P_2dB | Moscap | | | | | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) | | | | | | Performance @ Full power (43.3 dBm) | | | | | |
|-----------------------------|----------------|------------|-------|----------------------|----------------------|----------------|-------------------------|----------|---------|--|-------------|------------|----------|---------|----------|--|-------------|------------|----------|---------|----------|
| | | | | | | | | | | (Zs_2f0 = 1.3 + j 8.8 Ohm; ZL_2fo, ZL_3fo = 0 Ohm) | | | | | | (Zs_2f0 = 1.3 + j 8.8 Ohm; ZL_2fo, ZL_3fo = 0 Ohm) | | | | | |
| DOE | BW_profile | Name | Index | RF top plate (X x Y) | Oxide thickness (µm) | Value (pF) | MXP (dBm) | MXG (dB) | MXE (%) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) | Zin (Ω) | Z_L (Ω) | Pout (dBm) | Eff. (%) | Gt (dB) | IRL (dB) |
| DOE_13_1 | BW_Direct_1o2o | | | 1010 x 283 | 1700 | 5.92 | 44.5 | 19.4 | 72.3 | 1.4 + j 5.3 | 4.1 + j 8.6 | 39.68 | 71.8 | 15.9 | -13.7 | 0.7 + j 4.5 | 4.1 + j 3.6 | 43.6 | 70.2 | 17.5 | -8.9 |
| DOE_13_2 | BW_3o_4o_5o | N9500B_V4 | | 1010 x 337 | 1700 | 7.05 => 7.11 | 44.2 | 28.1 | 72.2 | 0.7 + j 5.6 | 3 + j 9 | 39.63 | 71.6 | 17.1 | -12.6 | 0.8 + j 4.6 | 7.3 + j 5 | 43.61 | 69.1 | 17.8 | -8.2 |
| DOE_13_3 | BW_3o_4o_5o | N9500B_Std | | 1010 x 337 | 1700 | 7.05 => 7.11 | 43.9 | 20.3 | 66.6 | 1.5 + j 4.6 | 4.4 + j 8.6 | 39.4 | 67.6 | 15.7 | -10.4 | 0.6 + j 4.0 | 3.7 + j 3.6 | 43.53 | 69.4 | 17.6 | -8.8 |
| DOE_13_4 | BW_6o_7o_5o | N9500B_Std | | 1010 x 337 | 1700 | 7.05 => 7.11 | 44.8 | 20.6 | 73.6 | 1 + j 5.2 | 3.4 + j 8.6 | 39.92 | 66.1 | 17.3 | -18.2 | 0.8 + j 4.6 | 5.5 + j 6.4 | 43.38 | 73.2 | 17.4 | -14.3 |
| DOE_13_5 | BW_3o_4o_5o | N9500B_V5 | | 1010x270 | 900 | 10.19 => 10.27 | 44.8 | 20.6 | 73.6 | 1 + j 5.2 | 3.4 + j 8.6 | 39.92 | 66.1 | 17.3 | -18.2 | 0.8 + j 4.6 | 5.5 + j 6.4 | 43.38 | 73.2 | 17.4 | -14.3 |

| Simple_EM_P1 5_R9505A | P_2dB | Moscap | | | | | Max. performance @ P2dB | | | Performance @ Back_off (39.5 dBm) | | | | | | Performance @ Full power (43.3 dBm) | | | | | | |
|--------------------------|-------------|-----------|-----------|------------|------------|----------------|-------------------------|------|------|--|-------------|-----------|-------|------|-------|--|-------------|-------------|------|------|-------|-------|
| | | | | | | | | | | (Zs_2f0 = 1.3 + j 8.8 Ohm; ZL_2fo, ZL_3fo = 0 Ohm) | | | | | | (Zs_2f0 = 1.3 + j 8.8 Ohm; ZL_2fo, ZL_3fo = 0 Ohm) | | | | | | |
| DOE | BW | 3o_4o_5o | N9500B_V7 | | 1010 x 253 | 1950 | 4.64 | 44.3 | 21.3 | 75.3 | 1.1 + j 5.6 | 3 + j 8.6 | 39.53 | 75.1 | 15.6 | -7.7 | 0.6 + j 4.7 | 4.1 + j 4.3 | 43.3 | 71.8 | 19.2 | -15.4 |
| DOE_13_6 | BW_3o_4o_5o | N9500B_V7 | | 1010 x 253 | 1950 | 4.64 | 44.3 | 21.3 | 75.3 | 1.1 + j 5.6 | 3 + j 8.6 | 39.53 | 75.1 | 15.6 | -7.7 | 0.6 + j 4.7 | 4.1 + j 4.3 | 43.3 | 71.8 | 19.2 | -15.4 | |
| DOE_13_7 | BW_3o_4o_5o | N9501B_V1 | | 1010 x 337 | 3100 | 5.59 | 44.5 | 19.2 | 73.2 | 1.6 + j 5.4 | 4.1 + j 9.3 | 39.5 | 71.6 | 14.9 | -11.4 | 0.7 + j 4.5 | 4.1 + j 3.6 | 43.67 | 70.5 | 17.4 | -10.3 | |
| DOE_13_8 | BW_6o_7o_5o | N9500B_V5 | | 1010x270 | 900 | 10.19 => 10.27 | 44.5 | 20.5 | 72.2 | 1.2 + j 4.6 | 3.7 + j 9.3 | 39.43 | 61.8 | 16.2 | -14.5 | 0.7 + j 4.1 | 5.5 + j 5.7 | 43.43 | 71.2 | 17.4 | -12.3 | |
| DOE_13_9 | BW_6o_7o_5o | N9501B_V1 | | 1466x328 | 1300 | 12.83 => 12.89 | 44.8 | 21.5 | 73.1 | 1 + j 4.7 | 3.4 + j 9.3 | 39.47 | 63.9 | 16.3 | -11.9 | 0.6 + j 4.2 | 5.5 + j 6.4 | 43.33 | 72.6 | 17.5 | -13.6 | |

Selected Moscap 5.92 pF, 7.11pF, 10.27 pF

P15_R9505_A_N9500B_V4_5pF92_BW_3o4o5o_DOE_13_2



Power Sweep Inspector

Move Marker 'loadZ' to desired impedance point.

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

VSWR Locus center Impedance = $3.00 + j2.14$

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $4.07 + j3.57$ | $0.85 / 171.77$ | 3 |

Pout (dBm) Eff (%) Gt (dB)

AMPM (dBm) iRL (dB) Zin (Ohm)

-5.74 -8.93 0.66 + j4.47

VSWR = 2.5 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $4.07 + j5.71$ | $0.85 / 166.88$ | 3 |

Pout (dBm) Eff (%) Gt (dB)

AMPM (dBm) iRL (dB) Zin (Ohm)

-5.21 -21.61 0.89 + j4.89

* In plots below corresponds to this data.

VSWR = 3 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|-----------------|----------------------------------|
| $4.07 + j8.57$ | $0.85 / 160.42$ | 3 |

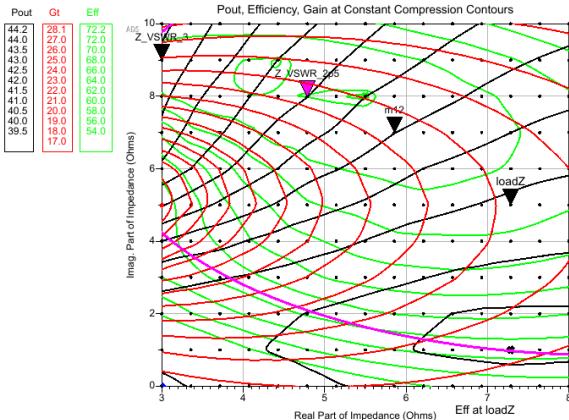
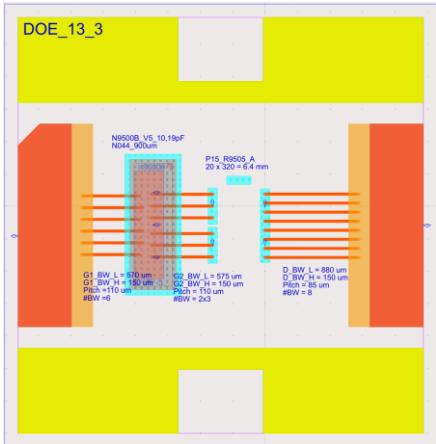
Pout (dBm) Eff (%) Gt (dB)

AMPM (dBm) iRL (dB) Zin (Ohm)

-1.94 -13.74 1.41 + j5.28

* In plots below corresponds to this data.

P15_R9505_A_N9500B_V5_7pF05_BW_3o4o5o_DOE_13_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 = $7.29 + j7.00$
VSWR=5

Summary of Performance at Compression

VSWR Locus of Points selector is located on Constant Compression Loadpull page.
VSWR Locus center Impedance = $5.86 + j7.00$
VSWR=5

Marker Impedance: $5.86 + j7.00$
Marker Gamma: $0.79 / 163.85$
Reference Compression Level (dB): 3

Pout (dBm): 42.49
Eff (%): 71.71
Gt (dB): 18.62

AMPM (dBm): -3.91
IRL (dB): -15.70
Zin (Ohm): $0.72 + j4.96$

X In plots below corresponds to this data.

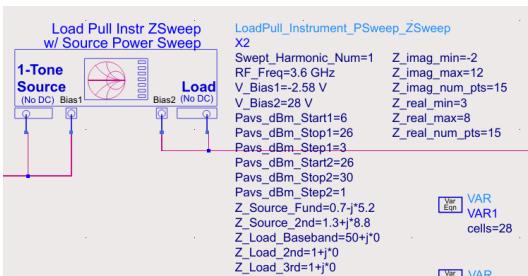
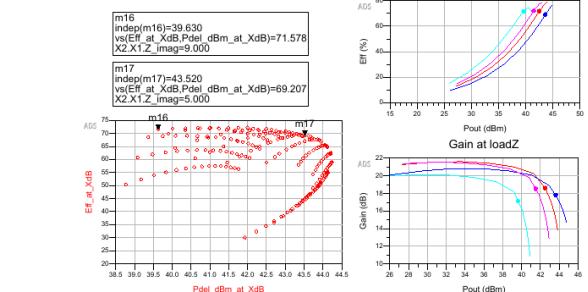
VSWR = 2.5 point DATA

Marker Impedance: $3.00 + j9.00$
Marker Gamma: $0.89 / 159.52$
Reference Compression Level (dB): 3

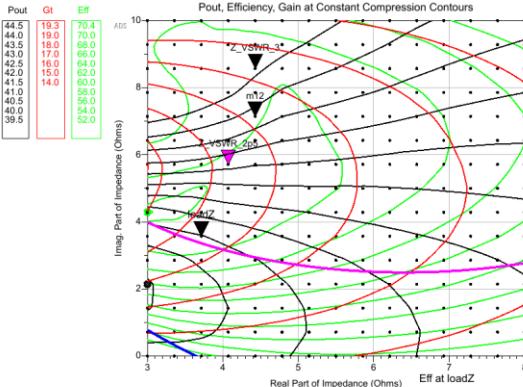
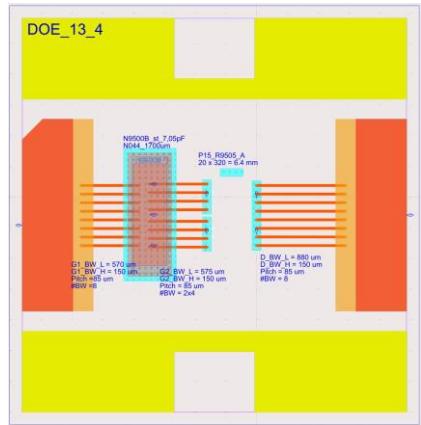
Pout (dBm): 39.63
Eff (%): 71.58
Gt (dB): 17.14

AMPM (dBm): 9.40
IRL (dB): -12.57
Zin (Ohm): $0.70 + j5.57$

X In plots below corresponds to this data.



P15_R9505_A_N9500B_V5_7pF05_BW_60705o_DOE_13_4



Power Sweep Inspector

En VSWRVal=5 Eq VSWRVal=2.5

Move Marker "loadZ" to desired impedance point.

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

VSWR center Impedance = $3.00 + j2.14$
VSWR=5

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

VSWR center Impedance = $4.43 + j7.14$
VSWR=5

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $3.71 + j3.57$ | 0.86 / 171.78 | 3 |
| Pout (dBm) | Eff (%) | GT (dB) |
| 43.53 | 69.42 | 17.58 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -9.00 | -8.84 | $0.59 + j4.01$ |

X In plots below corresponds to this data.

Summary of Performance at Compression

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $4.43 + j7.14$ | 0.84 / 163.62 | 3 |
| Pout (dBm) | Eff (%) | GT (dB) |
| 40.18 | 67.69 | 16.80 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -6.50 | -14.01 | $1.20 + j4.50$ |

X In plots below corresponds to this data.

VSWR = 2.5 point DATA

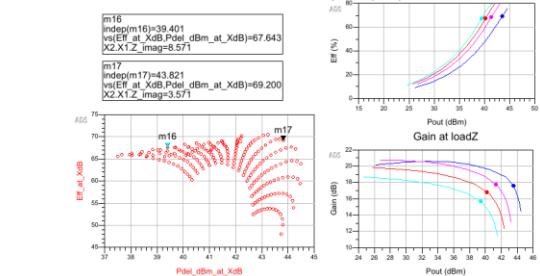
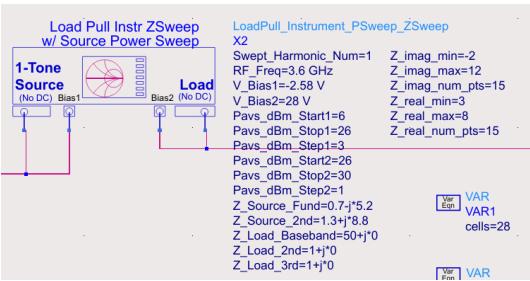
| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $4.07 + j5.71$ | 0.85 / 166.88 | 3 |
| Pout (dBm) | Eff (%) | GT (dB) |
| 41.33 | 68.63 | 17.73 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -8.65 | -19.13 | $0.92 + j4.35$ |

X In plots below corresponds to this data.

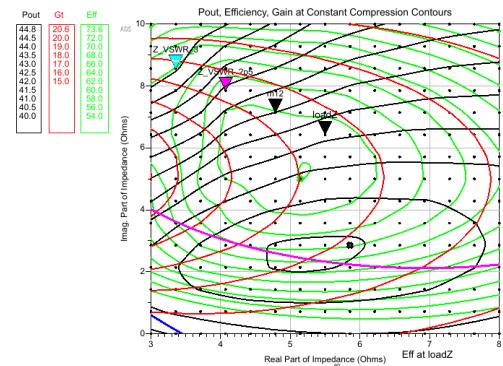
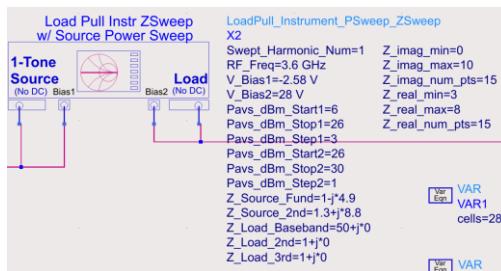
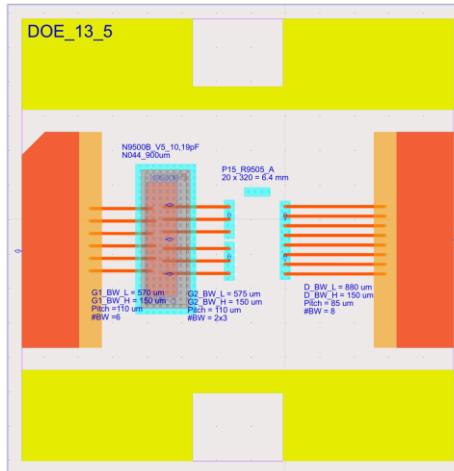
VSWR = 3 point DATA

| Marker Impedance | Marker Gamma | Reference Compression Level (dB) |
|------------------|---------------|----------------------------------|
| $4.43 + j8.57$ | 0.84 / 160.40 | 3 |
| Pout (dBm) | Eff (%) | GT (dB) |
| 39.40 | 67.64 | 15.66 |
| AMPM (dBm) | IRL (dB) | Zin (Ohm) |
| -5.11 | -10.40 | $1.48 + j4.62$ |

X In plots below corresponds to this data.



P15_R9505_A_N9500B_V5_10pF19_BW_3o4o5o_DOE_13_5



Power Sweep Inspector

VSWRVal=5 VSWRVal=1.2.5

Move Marker 'loadZ' to desired impedance point.

VSWR Locus selector is located on Constant Compression Loadpull page.

VSWR center Impedance = 5.86 + j2.88

VSWR=5

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

VSWR center Impedance = 4.79 + j7.14

VSWR=5

Summary of Performance at Compression

Marker Impedance

5.50 + j8.43

Marker Gamma

0.80 / 165.17

Reference Compression Level (dB)

2

Pout (dBm)

43.38

Eff (%)

73.21

Gt (dB)

17.42

AMPM (dBm)

-4.17

IRL (dB)

-14.31

Zin (Ohm)

0.80 + j4.62

X In plots below corresponds to this data.

Marker Impedance

4.79 + j7.14

Marker Gamma

0.83 / 163.59

Reference Compression Level (dB)

2

Pout (dBm)

42.5

Eff (%)

72.11

Gt (dB)

17.66

AMPM (dBm)

-3.84

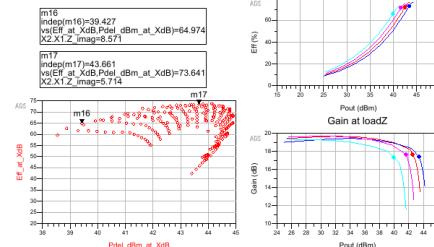
IRL (dB)

-18.19

Zin (Ohm)

0.82 + j4.77

X In plots below corresponds to this data.



VSWR = 3 point DATA

Marker Impedance

3.36 + j8.57

Marker Gamma

0.88 / 160.48

Reference Compression Level (dB)

2

Pout (dBm)

39.92

Eff (%)

66.06

Gt (dB)

17.33

AMPM (dBm)

-8.93E-3

IRL (dB)

-18.17

Zin (Ohm)

0.97 + j5.15

X In plots below corresponds to this data.



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