Tagore Technology

TA9310E + 2xTS8441L

20W CW 0.5 – 4.0 GHz GaN Power Transistor+30W CW GaN Broadband RF Switch

Application Note: TA9310E + TS8441L EVB I

Application Note

30MHz~520MHz

28V 50mA

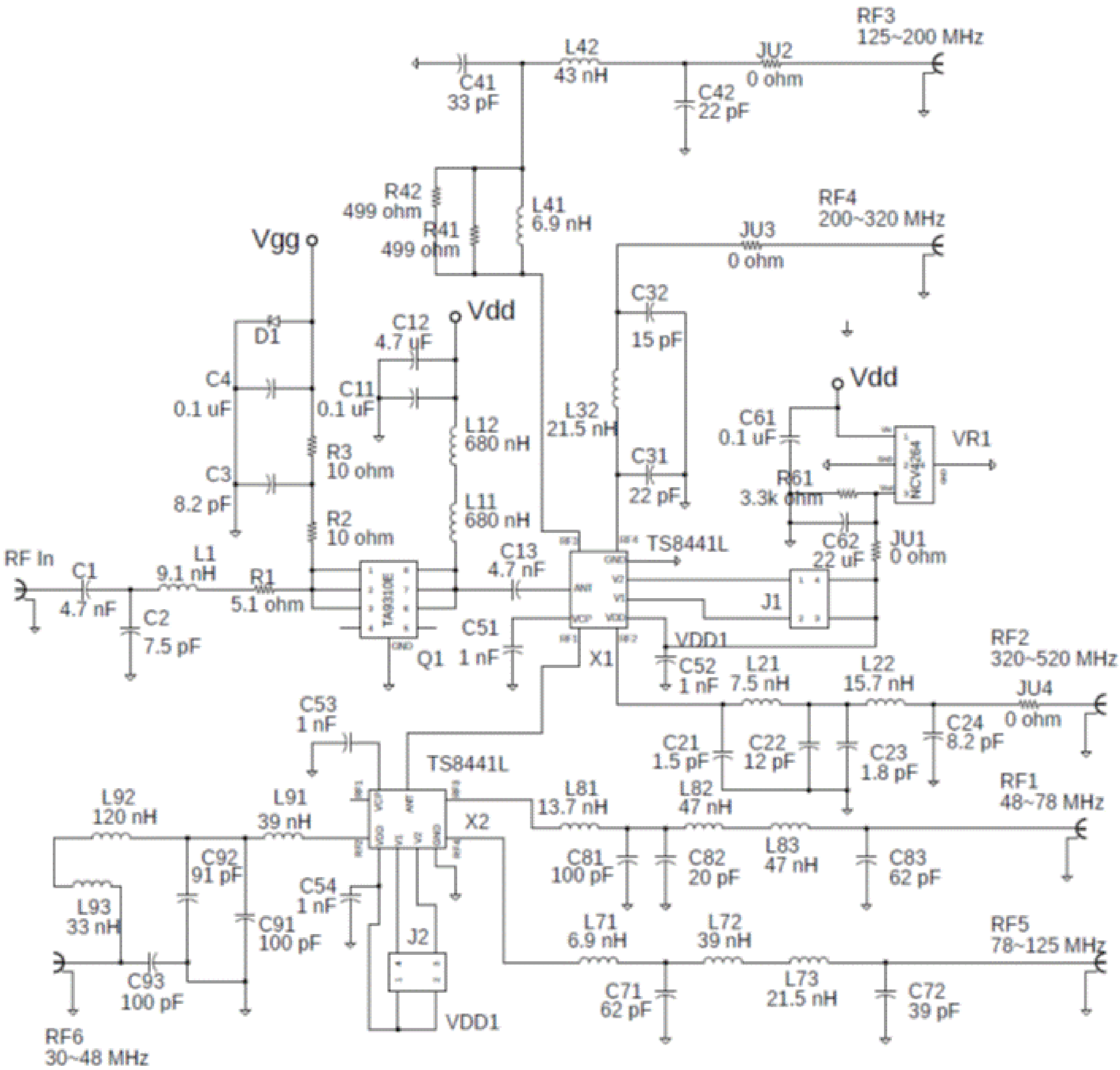
Rev-1.1

List of Contents

1. General Description

The TA9310E is a broadband GaN power transistor capable of delivering 20W CW from 500MHz to 4.0GHz frequency band. The input and output can be matched for best power and efficiency for the desired band.
The TS8441L is a symmetrical reflective Single Pole Four Throws (SP4T) switch designed for broadband, high power switching applications. Its broadband behavior from 30MHz to 4.0GHz frequencies makes the TS8441L an excellent switch for all the applications requiring low insertion loss, high isolation, and high linearity within a small package size.
This combined design makes TA9310 to be fine-tuned for each communication frequency band. In another word, it expands the fine-tuned frequency range (30MHz ~ 520MHz). The design can be applied in public safety or tactical radio system.

2. TA9310E+TS8441L EVB-I Board Details



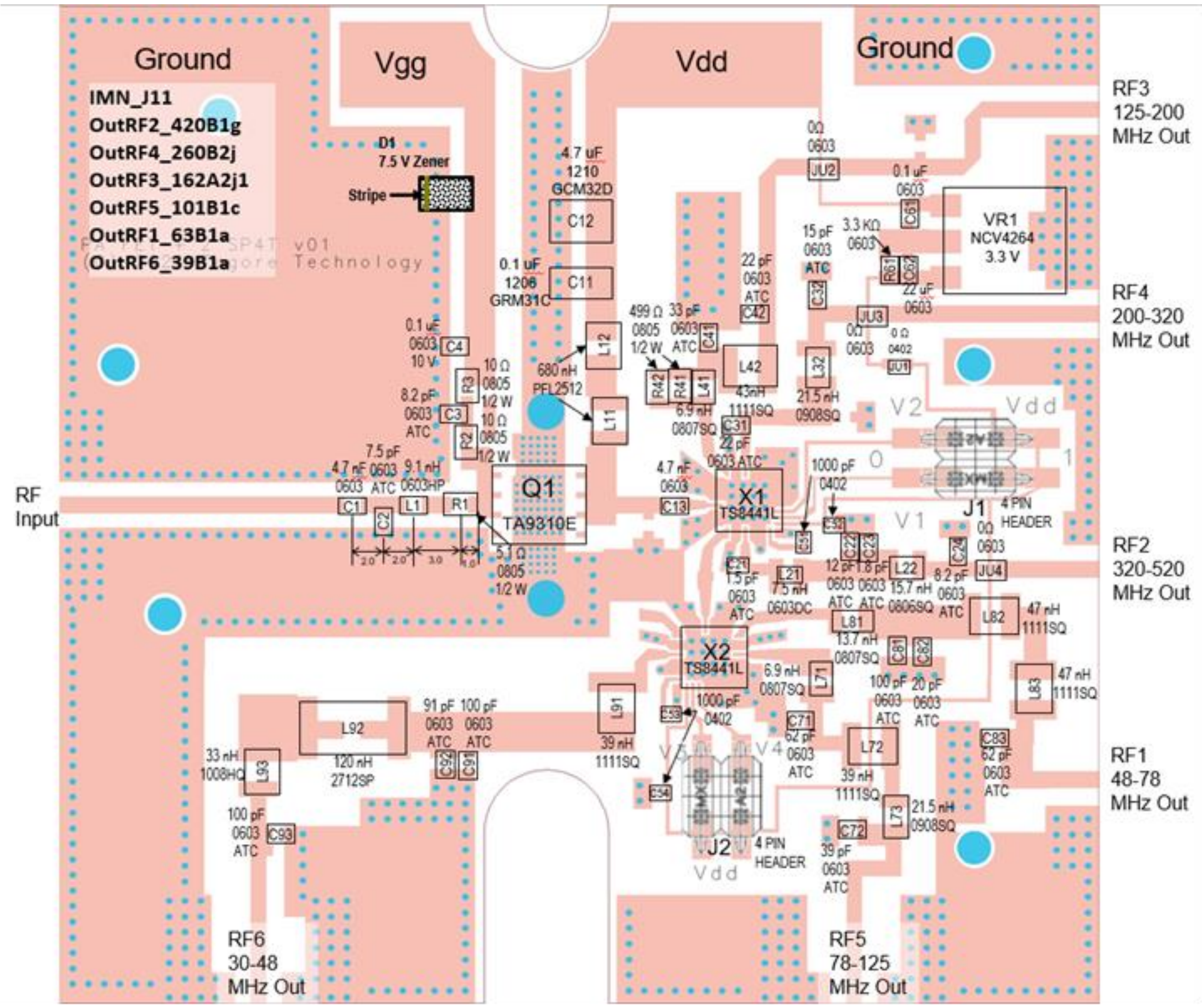


Figure 2.1 TA9310E + TS8441L EVB-I 30MHz ~ 520MHz Schematic and EVB Layout

3. TA9310E+TS8441L EVB-I Bill of Material

Part Label	Part Description	Vendor Name	Vendor Part Number
C1, C13	4.7 nF 5% 50V 0603	Murata	GRM1885C1H472JA01D
C2	7.5 pF 5% 250V 0603	AVX	600S7R5JT250XT
L1	9.1 nH 5% 0603	Coil craft	0603HP-9N1XJ
R1	5.1 ohm 5% 0805 1/2 W	Panasonic	ERJ-6DQJ5R1V
R2, R3	10 ohm 5% 0805 1/2 W	Panasonic	ERJ-P06J100V
C3	8.2 ±0.25 pF 250V 0603	AVX	600S8R2JT250XT
C4	0.1uF 20% 10V 0603	AVX	0603ZC104K4T2A
D1	7.5V Zener	On-Semiconductor	MMSZ5236BT1G
Q1	PA device	Tagore Technology	TA9310D
X1, X2	SP4T Switch	Tagore Technology	TS8441L
C51, C52, C53, C54	1nF 20% 100V 0402	Murata	GCM155R72A102KA37D
VR1	3.3V Regulator	On-Semiconductor	NCV4264-2CST33T3G
R61	3.3k ohm 5% 0603	Vishay	CRCW06033K30JNEB
C61	0.1uF 10% 100V 0603	Murata	GCM188R72A104KA64D
C62	22uF 20% 6.3V 0603	Murata	GRM188R60J226ME0D
JU1	0 ohm 0402	Vishay	CRCW04020000Z0E
J1, J2	4 Pin Header	Molex	15-91-2040
L11, L12	680 nH 20% 1008	Coil craft	PFL2512-681ME
C11	0.1uF 5% 50V 1206	Murata	GRM31C5C1H104JA01L
C12	4.7 uF 10% 100V 1210	Murata	GCM32DC72A475KE02L
C21	1.5 ±0.1 pF 250V 0603	ATC	600S1R5BT250XT
L21	7.5 nH 2% 0603	Coil craft	0603DC-7N5XG
C22	12 pF 2% 250V 0603	ATC	600S120GT250XT
C23	1.8 ±0.1 pF 250V 0603	ATC	600S1R8BT250XT
L22	15.7 nH 2% 0806	Coil craft	0806SQ-16NG
C24	8.2 ±0.25 pF 250V 0603	ATC	600S8R2JT250XT
JU2, JU3, JU4	0 ohm 0603	Vishay	CRCW06030000Z0E
C31, C42	22pF 2% 250V 0603	ATC	600S220GT250XT
L32, L73	21.5 nH 2% 0806	Coil craft	0806SQ-22NG
C32	15 pF 2% 250V 0603	ATC	600S150GT250XT
L41, L71	6.9 nH 2% 0807	Coil craft	0807SQ-6N9G
R41, R42	499 ohm 1% 0805 1/2 W	Panasonic	ERJ-P06F4990V
C41	33 pF 2% 250V 0603	ATC	600S330GT250XT
L42	43 nH 2% 1111	Coil craft	1111SQ-43NG
C71, C83	62 pF 2% 250V 0603	ATC	600S620GT250XT
L72, L91	39 nH 2% 1111	Coil craft	1111SQ-39NG
C72	39 pF 2% 250V 0603	ATC	600S390GT250XT
L81	13.7 nH 2% 0807	Coil craft	0807SQ-14NG
C81, C91, C93	100 pF 2% 250V 0603	ATC	600S101GT250XT
C82	20 pF 2% 250V 0603	ATC	600S200GT250XT
L82, L83	47 nH 2% 1111	Coil craft	1111SQ-47NG
C92	91 pF 2% 250V 0603	ATC	600S910GT250XT
L92	120 nH 2% 2712	Coil craft	2712SP-121G4E
L93	33 nH 2% 1008	Coil craft	1008HQ-33NXG

Table 3.1 TA9310E + TS8441L EVB-I BOM

4. TA9310E + TS8441L EVB-I Assembled Board Picture

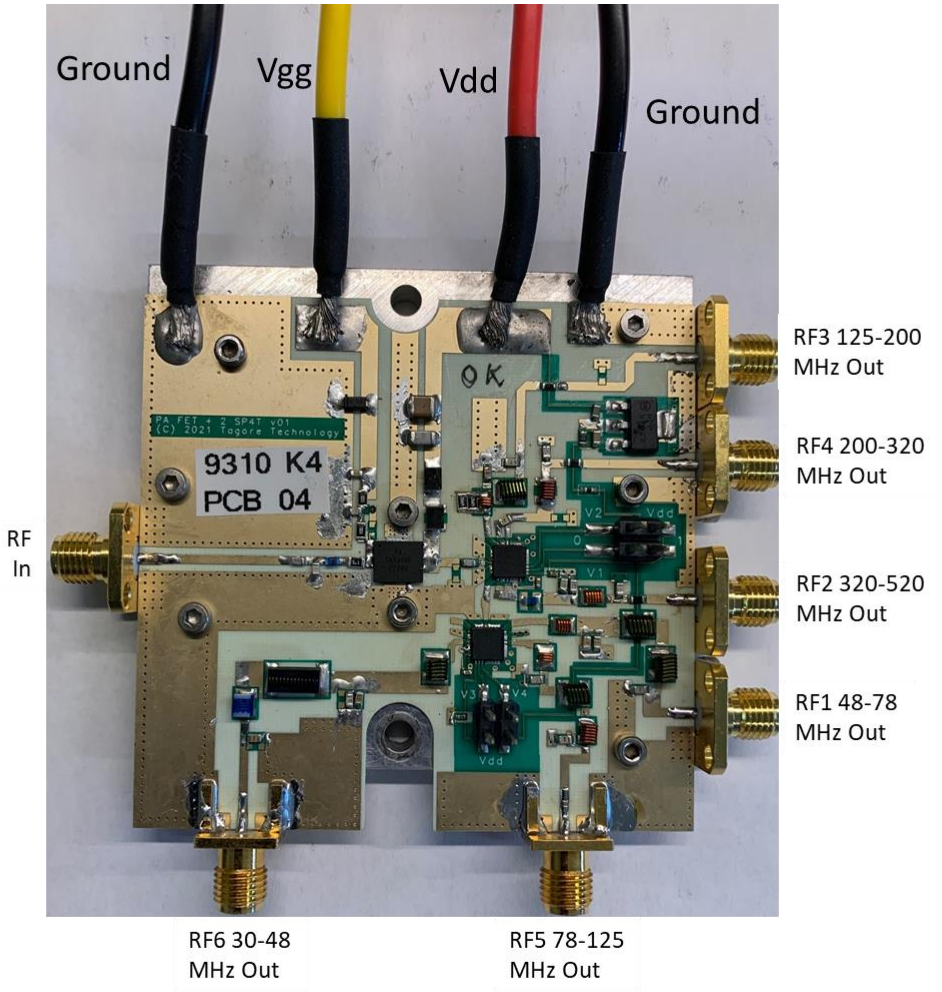


Figure 4.1 TA9310E + TS8441L EVB-I Assembled Board Picture

5. TA9310E +TS8441L EVB-I RF Output & Frequency Band Selection

RF output / frequency selection is done by either placing jumper plugs across certain pins of J1 and J2 or applying voltages to these pins. The board as supplied is setup to use jumpers, since it has an on-board 3.3 V regulator to provide the switch bias voltage (Vdd). An external switch matrix could also be used in place of the jumper plugs.
To use an external supply for switch bias and band selection, it is first necessary to remove JU1, shown in the yellow box on Figure 5.1. Switch bias must be in the range of 2.7 – 5.0 V and is applied to the outermost pin's pf J1 and J2 (i.e., the pins closest to the board edge). Band selection is then made by selectively applying switch bias voltage to selected pins marked V1…V4 in Figure 5.1.
The jumper / voltage settings for each band are shown in Table 5.1

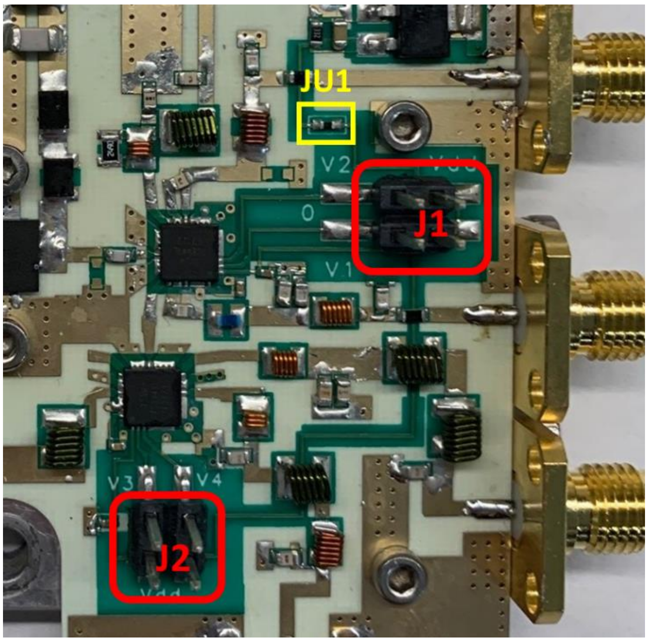


Figure 5.1 TA9310E + TS8441L EVB-I Assembled board Picture.

		Pin Voltages				Jumper Settings			
Freq. MHz	Port	V1	V2	V3	V4	V1	V2	V3	V4
320-520	RF2	3.3V	0V	0V	0V	Short	Open	Open	Open
200-320	RF4	3.3V	3.3V	0V	0V	Short	Short	Open	Open
125-200	RF3	0V	3.3V	0V	0V	Open	Short	Open	Open
78-125	RF5	0V	0V	3.3V	3.3V	Open	Open	Short	Short
48-78	RF1	0V	0V	0V	3.3V	Open	Open	Open	Short
30-48	RF6	0V	0V	3.3V	0V	Open	Open	Short	Open

Table 5.1. Band Selection Table

6. TA9310E + TS8441L EVB-I Biasing Sequence

Turn ON Device	Turn OFF Device
1. Connect selected output port to 50 Ω load. 2. Apply -5.5 V to Vgg terminal. 3. Connect power supply to Vdd terminal. 4. Start at 0.00 volts, then SLOWLY increase to **+ 28 V.** 5. Monitor Vdd supply current (Id), stop increasing Vdd if Id exceeds 20 mA. 6. SLOWLY raise Vgg (toward zero volts) until Id = **50 mA** (Vgg should be between **-2.5 V to -3.2V**) 7. Apply RF drive to RF input port.	1. Remove RF drive from RF input port. 2. Decrease Vdd to zero volts. 3. Return Vgg to -5.5 V setting.

Table 6.1 TA9310E + TS8441L EVB-I Bias and Sequencing

7. TA9310E + TS8441L EVB-I Board Measurement Summary

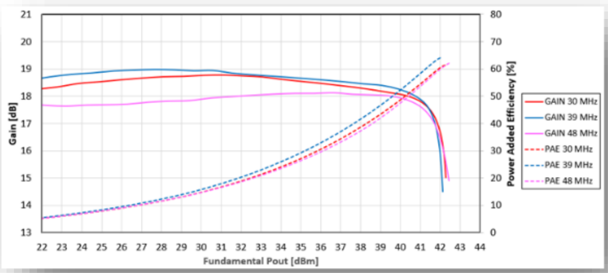
Frequency (MHz)	Psat(dBm)	PAE%@Psat	Second Harmonic[dBc]	Third Harmonic[dBc]
30-48	42-42.2	62-65	-15 to -30	-35 to -65
48-78	42-42.5	58-65	-15 to -30	-35 to -65
78-125	42	60-70	-15 to -30	-36 to -65
125-200	42-42.1	65-75	-15 to -28	-36 to -55
200-320	42.2-42.7	55-66	-15 to -30	-33 to -65
320-520	42.2-43	59-68	-15 to -30	-32 to -65

Table 7.1 TA9310E + TS8441L EVB-I 32V 100mA Electrical Characteristics Summary

8. TA9310E + TS8441L EVB-I Test Results

8.1. Gain & PAE vs Pout, IRL &Pdiss Vs Pout and H2-H3 dBc Vs Pout@ 28V 50mA.

30-48MHz Band



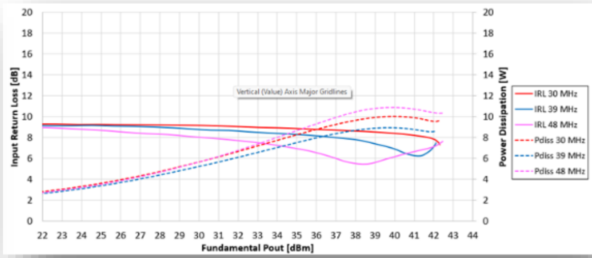


Figure 8.1.1 Gain, PAE v/s Pout Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=30mA

Figure 8.1.2 IRL and Pdiss v/s Pout Of TA9310E + TS8441L EVB-I, VD=32V, IDQ=30mA

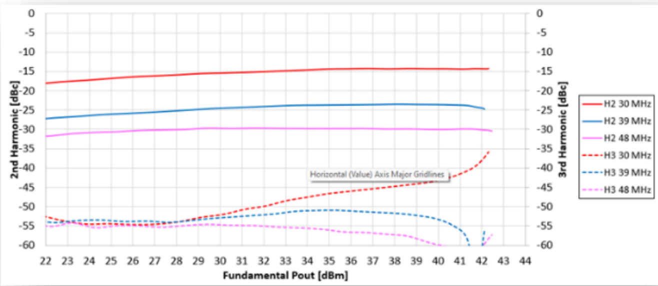
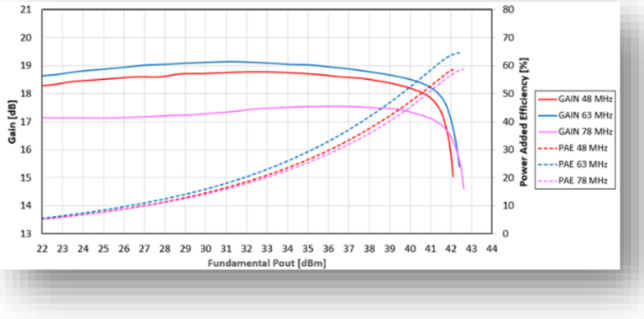


Figure 8.1.3 H2dBc and H3dBc v/s Pout Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=30mA

48-78MHz Band



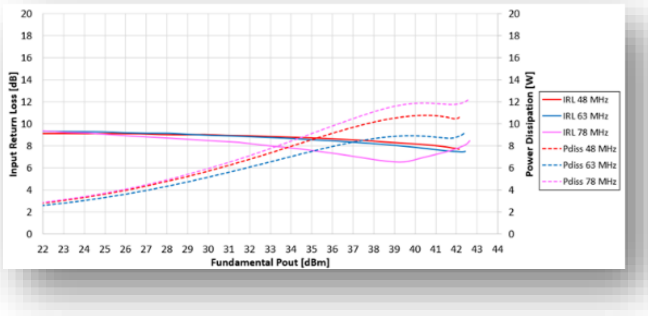


Figure 8.1.4 Gain, PAE v/s Pout Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=30mA

Figure 8.1.5 IRL and Pdiss v/s Pout Of TA9310E + TS8441L EVB-I, VD=32V, IDQ=30mA

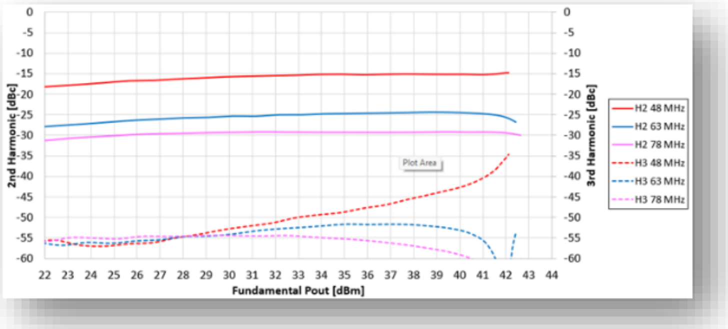
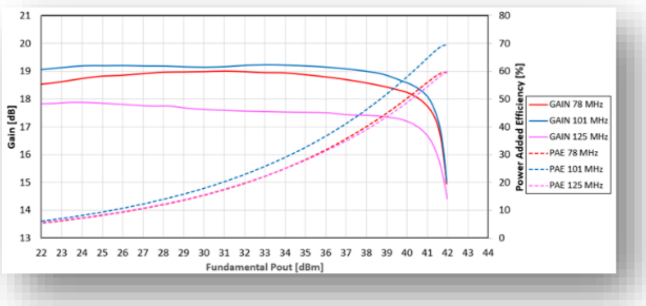


Figure 8.1.6 H2dBc and H3dBc v/s Pout Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=30mA

78-125MHz Band



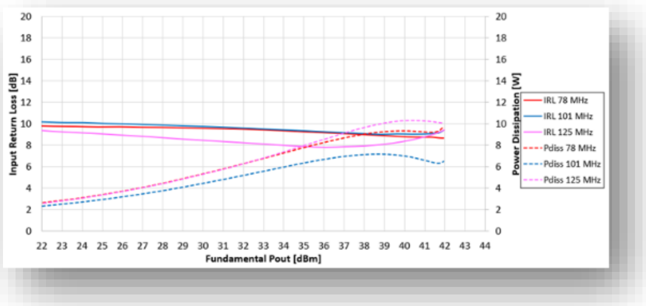


Figure 8.1.7 Gain, PAE v/s Pout Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=30mA

Figure 8.1.8 IRL and Pdiss v/s Pout Of TA9310E + TS8441L EVB-I, VD=32V, IDQ=30mA

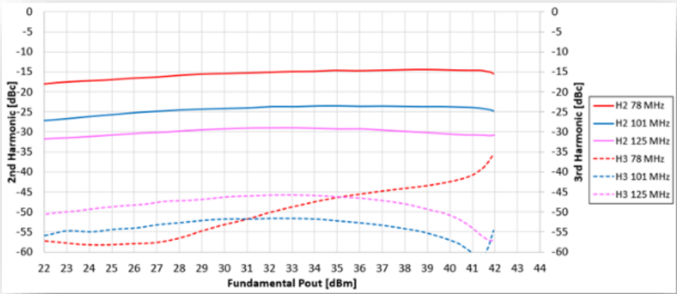


Figure 8.1.9 H2dBc and H3dBc v/s Pout
Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=30mA

125-200MHz Band

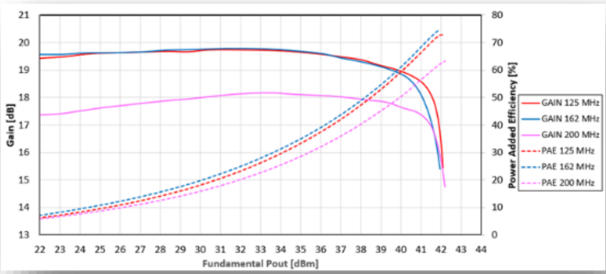


Figure 8.1.10 Gain, PAE v/s Pout
Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=50mA

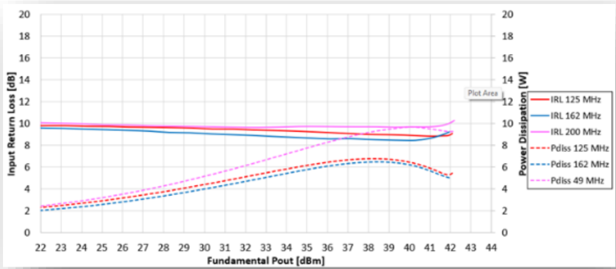


Figure 8.1.11 IRL and Pdiss v/s Pout
Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=50mA

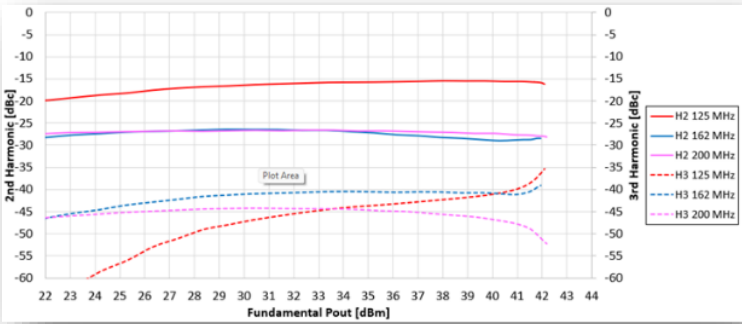


Figure 8.1.12 H2dBc and H3dBc v/s Pout
Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=50mA

200-320MHz Band

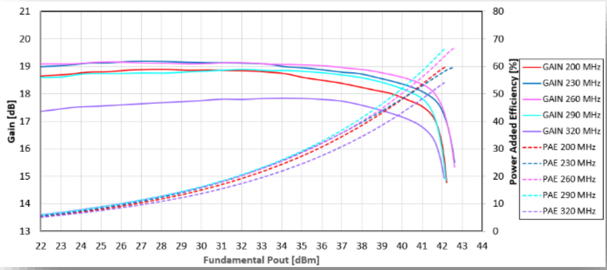


Figure 8.1.13 Gain, PAE v/s Pout Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=50mA

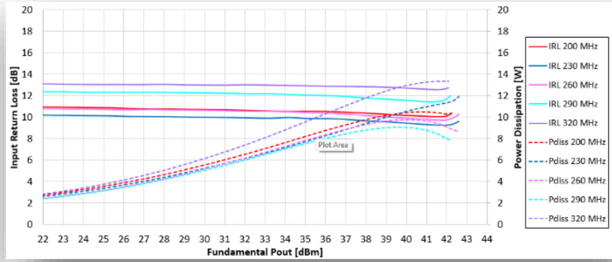


Figure 8.1.14 IRL and Pdiss v/s Pout Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=50mA

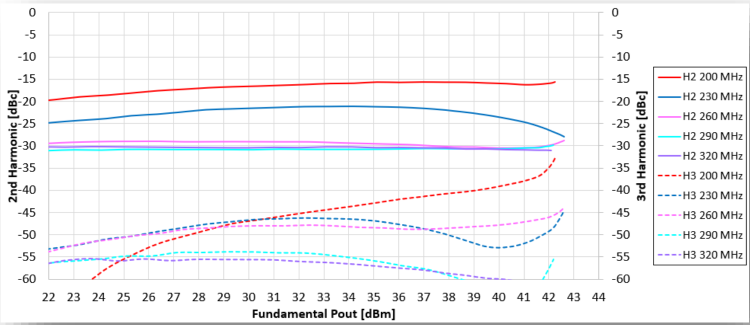


Figure 8.1.15 H2dBc and H3dBc v/s Pout Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=50mA

320-520MHz Band

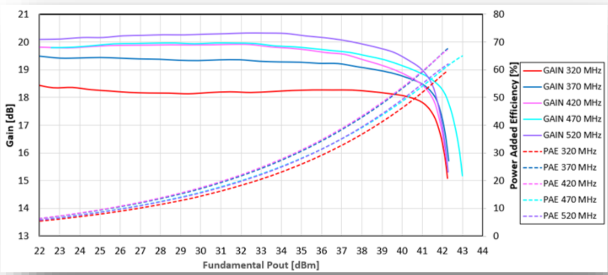


Figure 8.1.16 Gain, PAE v/s Pout Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=50mA

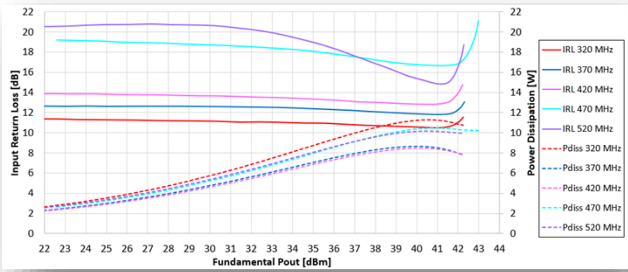


Figure 8.1.17 IRL and Pdiss v/s Pout Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=50mA

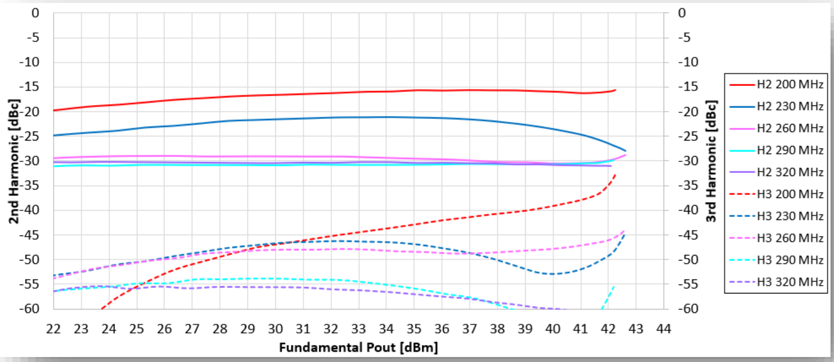


Figure 8.1.18 H2dBc and H3dBc v/s Pout
Of TA9310E + TS8441L EVB-I, VD=28V, IDQ=50mA

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