Motorola Model: XT2209-1
FCC ID: IHDT56AA6

Power Density Simulation Report

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1. Table of Contents

2. Simulation Approach for MPE

This section details the approach taken to identify the worst-case beams and beam pairs for each mm-wave antenna array module for evaluation planes around the device.

2.1. General Approach

The concept of beamforming adds an additional dimension to the test matrix, effectively increasing the number of the exposure test cases to be checked, by a factor equal to the number of beams that the device can form. This makes it impractical to measure every beam in every measurement plane. Because the mm-wave power density measurement is time-consuming per beam and measurement plane, it is necessary to identify a-priori the worst-case beams for each measurement condition (plane) via simulation, so that these beams can then be measured to characterize the worst-case power density of the device.

The Ansys HFSS simulation tool (2021 R2) was used for the simulation of near-field power density for this process.

2.2. Finding Worst-Case Near-Field Results

This process consists of two parts:

1. Finding worst-case surface(s) for each beam, per antenna group and per antenna module in the middle channel of each band for determining worst-case housing influence.
2. Finding worst-case PD value for all three channels of each band for each beam and beam pair, per antenna group and per antenna module for determining the scaling factor for input power limit.

For part 1, only a few measurement planes are considered. The details of selection criteria are as described in a later section. At each x-y-z location on any of the selected measurement planes which are near to a mm-wave module, the simulated PD for each beam from that module is assessed in the middle channel of each band. The worst case of all of these PD results in a worst measurement plane is then identified, and that module and beam configuration is selected for the measurement of PD on the measurement plane in question.

For part 2, only the identified worst-case surfaces are considered as the evaluation planes. At each x-y-z location on any of the selected measurement planes which are near to a mm-wave module, the simulated PD for each beam and beam pair from that module is assessed for all three channels of each band. The worst cases of all these PD results for each individual beam and beam pair are then identified, and that PD value is then compared to the PD design target for determining the scaling factor for input power limit as described in RF Exposure Part 0 Report.

For single beams (single-polarization beam generated by transmission from a single Antenna Group, AG0 or AG1 in a module), the PD is simulated directly from the phase weights applied by the modem. For dual beams (beam pairs, i.e. a dual-polarization beam pair generated by transmission from both Antenna Groups in a module), a conservative uncertainty factor was applied based on simulated PD recalculated for every possible group phase relationship between the two beams, to conservatively cover the worst possible combination of relative phase between the two beams (worst-case addition of the fields).

The four evaluation planes are named as follows: (as illustrated in KDB Inquiry which approved by FCC)

For front module: (located in the front pod)

■ S1 = back, test separation: 2mm.

■ S2 = front, test separation: proximity sensor trigger distance D-1mm.

For rear module: (located in the rear pod)

■ S3 = inner, test separation: 2mm.

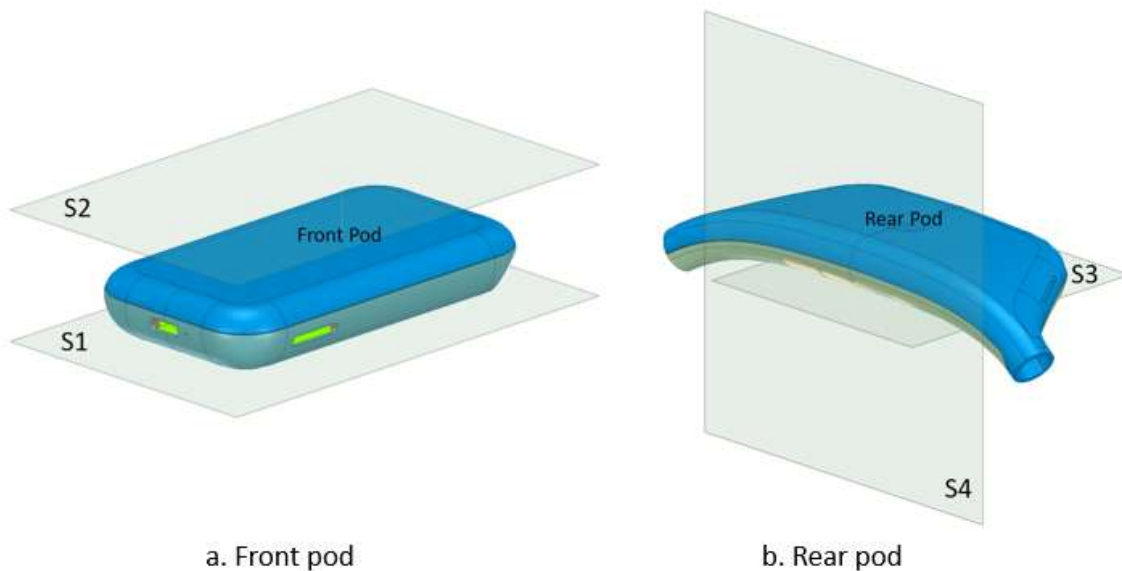■ S4 = long edge, test separation: 2mm.

a. Front pod   b. Rear pod

Figure 2.2-1 Identification of the four evaluation planes: a. Front pod; b. Rear pod.

2.3.   Simulation Tool

2.3.1. Tool Description

For the mm-wave power density simulations, the commercially-available ANSYS Electromagnetics suite version 2021 R2 (HFSS) is used. The ANSYS HFSS tool is used in the industry for simulating 3D, full-wave electromagnetic fields. Motorola uses this EM simulation tool for mm-wave problems due to its established accuracy, advanced solver, and high-performance computing technology capabilities for doing accurate and rapid   characterization   of   high-frequency   components.

2.3.2. Solver Description

HFSS' solver employs the Finite Element Method, which operates in the frequency domain. The HFSS simulation employed a direct solver with first order basis functions.

2.3.3. Convergence criteria and power density calculations

HFSS uses a volume air box containing the simulated area to calculate the EM fields. The box is truncated by an Absorbing Boundary Condition. The simulation uses the adaptive mesh technique to meet the exit criteria of delta S < 0.02. The delta S is the change in the magnitude of the S-parameters between two consecutive passes; if the magnitude and phase of all S-parameters change by an amount less than the Maximum-Delta-S-per-Pass value from one iteration to the next, the adaptive analysis stops. Otherwise, the mesh is refined in higher energy areas, according to proprietary Ansys algorithms, and an additional solution pass is taken. An example of a fully refined mesh through one cross-section of the device is shown in the figure below.
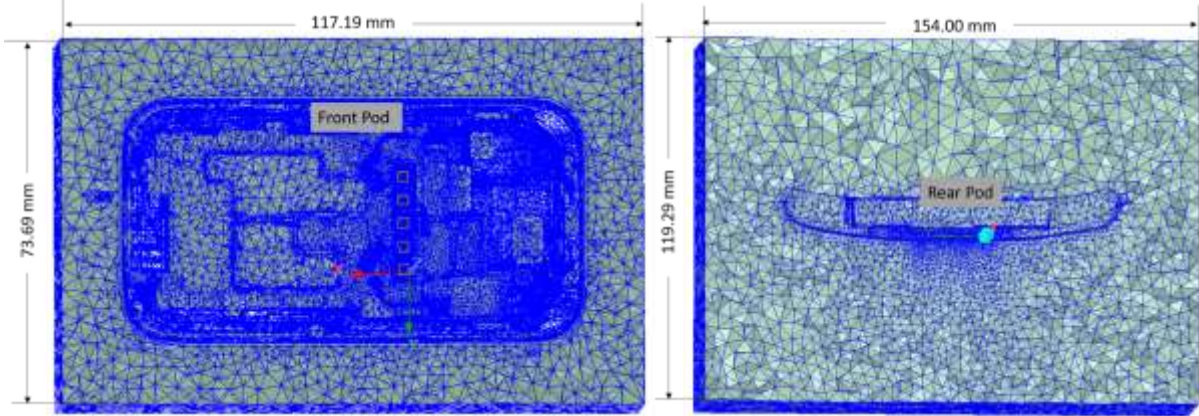
Figure 2.3.3-1: The HFSS mesh in a model of the device. After finding the simulated electric and magnetic (E and H) fields, the Poynting vector is calculated based on "peak" (i.e. non-RMS) field values in a grid with a 1 mm step, on the appropriate measurement planes as defined in previous sections. The Poynting vector at each spatial point is readily available in HFSS through the "Field Calculator" navigation option. The magnitude of the real part of the Poynting vector (all X, Y, Z components) at each spatial point i.e. the point power density is exported from HFSS to do the averaging. The spatially averaged power density at each point on a given surface is then calculated by taking the average of the point power density over a 4 square cm area. Thus the total power density (all X, Y, Z components) through any given surface is used to calculate the averaged power density.

Hence the spatially averaged power density on a given surface is calculated as the surface integral of the Poynting vector over a 4 square cm averaging area A:

$$P_{av} = \frac{1}{2A} \int_A \left| Re(\vec{E} \times \vec{H}^*) \right| \cdot dS$$

Note that E and H are the complex field vectors, and the calculation thus leads to the total power density average.

2.3.4. 3D Models Used in the Simulations

The 3D model simulated consists of the full CAD model of the mobile device that includes all of the significant structure such as PCB, metal frame, battery, cables and legacy antennas as well as mmWave antenna modules called front module and rear module. Front module is placed in the front pod, facing the front surface and Rear module is placed in the rear pod, facing the outer surface (opposite of the inner surface). A view of the 3D model variant used in each of the various module simulations is shown in the figures 2.3.4-1 to 2.3.4-2.

Both Front and Rear modules consist of 10 ports for source excitation, for 1 x 5 patch antenna array. In the 10 antenna ports for each patch antenna array, 5 ports are divided into V polarization feeding and the other 5 ports are divided into H polarization feeding. V and H polarizations here represent 2 polarizations that are orthogonal to each other.

After the 3D full wave electromagnetic simulation of the modeling structure is finished, the magnitude and phase information can be loaded for each port by using the "Edit Sources" function in ANSYS Electromagnetics suite (HFSS). Figure 2.3.4-3 shows an example of antenna port excitations.
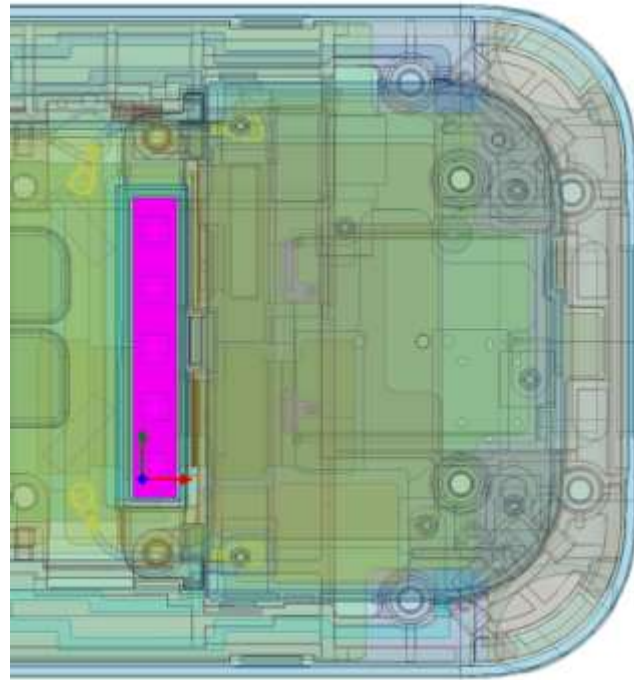
Figure 2.3.4-1: 3D model used for Module 0 (Front module), the antenna array is highlighted
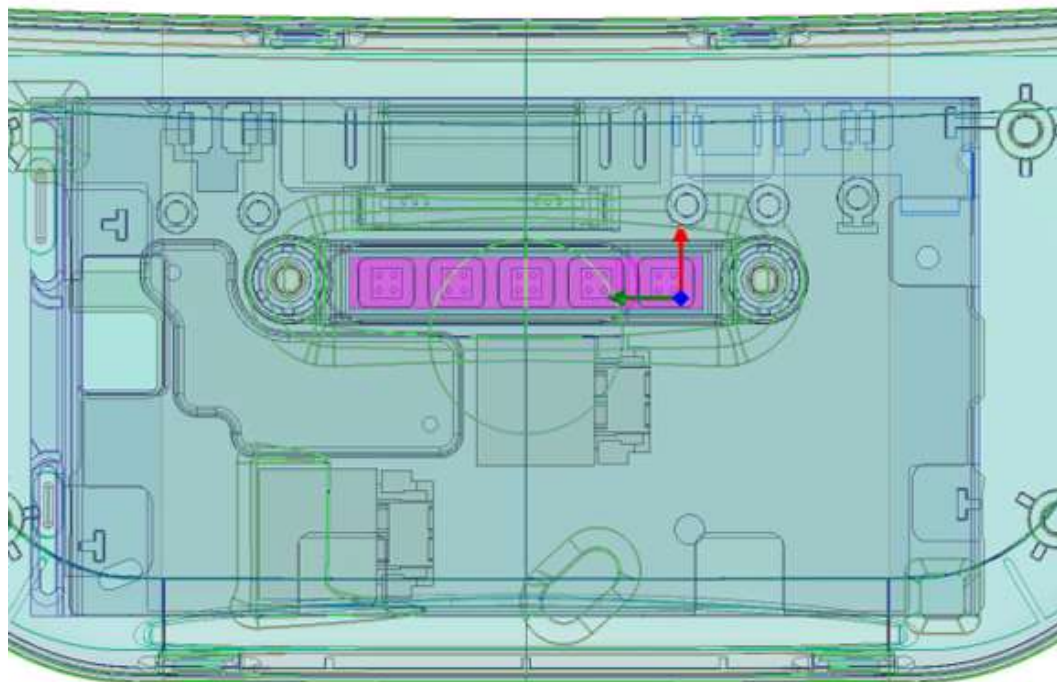
Figure 2.3.4-2: 3D model used for Module 1 (Rear module), the antenna array is highlighted
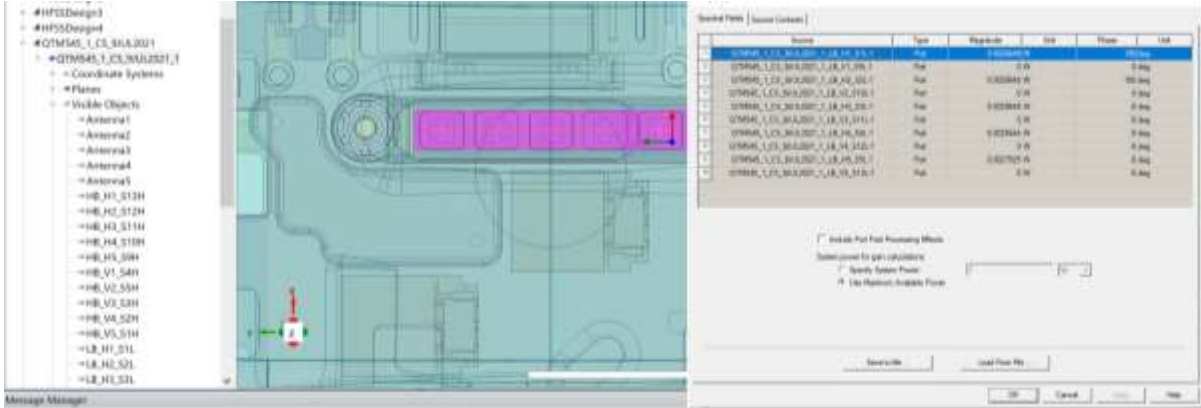
Figure 2.3.4-3: An example of port excitations in HFSS for Rear module.

2.3.5. PD evaluation planes

Due to the location of the mmW module and the antenna array orientation relative to the surface of the device, the following surfaces are included for PD calculation as illustrated in KDB Inquiry which approved by FCC when using Equation below:

$$\text{For Front module: } PD = max\{PD_{s1}, PD_{s2}, \}$$

$$\text{For Rear module: } PD = max\{PD_{s3}, PD_{s4}, \}$$

Where $PD_{s1}, PD_{s2}, PD_{s3}, PD_{s4}$, are the highest PD on surface S1, S2, S3, and S4 of the devices, respectively.

Table 1 shows the PD evaluation planes for each mmWave antenna module. For the front module case, only S1 and S2 are included in PD evaluation planes.

Similarly, for the rear module case, the PD evaluation can be conducted on the S3 and S4 surfaces only.

Table 1. PD evaluation planes

(O for included X for not-included)	Back	Front	Inner	Long edge
	S1	S2	S3	S4
Front module	O	O	X	X
Rear module	X	X	O	O

Perform EM simulation to characterize PD at low, mid, and high channels for each supported band. We soon realized that the evaluation planes can be further reduced, as shown in Table 2.

Table 2. PD evaluation planes

(O for included	Back	Front	Inner	Long edge

7

X for not-included)	S1	S2	S3	S4
Front Module	X	O	X	X
Rear Module	X	X	X	O

2.3.6. Simulated verification (Spatial-averaged power density)

As mentioned in the previous section, the Poynting vector ($\vec{S}$) can be obtained through cross product of an electric field ($\vec{E}$) and complex conjugate of a magnetic field ($\vec{H}$). The real term of the Poynting vector can be described as the point power density or peak power density. Using the point power density, the spatial-averaged power density can be obtained by the integral of a 4 square cm area at 1 mm intervals of the point power density result. Figure 2.3.6-1 shows examples of the distribution of point power density and the averaged power density.

2.3.7. Simulated and Measured Results

In this section, the simulated power density distribution and measured power density distributions are compared to each mmWave antenna. The input powers per each active port are listed below for both Simulation and Measurement validation and power density characterization. For Simulation, these values were entered directly into the HFSS model. For measurements, using FTM, the phone was configured to set the active port power to these powers in CW modulation.

Table 3 Input power for simulations and measurements

Band	Antenna	Input Power (dBm) SISO	Input Power (dBm) MIMO
n261	Front Module	6	6
	Rear Module	6	6
n260	Front Module	6	6
	Rear Module	6	6

PD evaluations were performed based on simulation for all the beams on all determined surfaces of the device. The beams that corresponds to the worst PD for each antenna group for each antenna module for both bands with their corresponding worst surfaces are listed in below table:

Table 4 Worst case beams for each antenna group for each antenna module identified through HFSS simulations

Band	Antenna	Beam ID	Surface

Band			
n261	Front Module	40	Front
		168	Front
	Rear Module	36	Long edge
		164	Long edge
n260	Front Module	30	Front
		158	Front
	Rear Module	36	Long edge
		164	Long edge

2.3.7.1 Comparison between simulated and measured Results

The below simulation at measurement results were performed at a test separation distance of 2 mm for the Long edge surface and a test separation distance of proximity sensor trigger distance D-1mm for the Front surface and 28GHz/38.5GHz. The input.power.limit was determined based on the results below from the RF Exposure Part 0 Report.

Table 5 Comparison between simulated and measured results

Band	Antenna	Beam ID	Surface	Channel	4 cm^2 avg. PD (W/m^2)	
					Meas.	Sim.
n261	Front Module	40	Front	Mid	7.89	13.96
		168	Front	Mid	6.65	13.93
	Rear Module	36	Long edge	Mid	2.54	5.27
		164	Long edge	Mid	2.53	4.81
n260	Front Module	30	Front	Mid	4.76	10.11
		158	Front	Mid	5.32	11.39

| | | 36 | Long edge | Mid | 1.84 | 2.93 |
| Rear Module | | 164 | Long edge | Mid | 1.24 | 4.58 |

Based on comparison of power density distributions, simulated power density and measured power density have a good correlation. The discrepancy in amplitude between simulated 4cm^2 averaged power density and measured 4cm^2 averaged power density is considered as housing influence and used in determining input power limit for each beam for RF exposure compliance (see RF Exposure Part 0 Report).

Figure 2.3.7.1-1 to Figure 2.3.7.1-8 show the comparison of the simulated PD distribution and the measured PD distribution. Since this correlation is only for PD distribution correlation, only Point PD distributions are used for comparison.

Figure 2.3.7.1-1 Measured (left) and Simulated (right) peak power density distributions for the worst case found in the Front surface measurement plane for n261 (**Front module, beam 40, Front surface**)

Figure 2.3.7.1-2 Measured (left) and Simulated (right) peak power density distributions for the worst case found in the Front surface measurement plane for n261 (**Front module, beam 168, Front surface**)
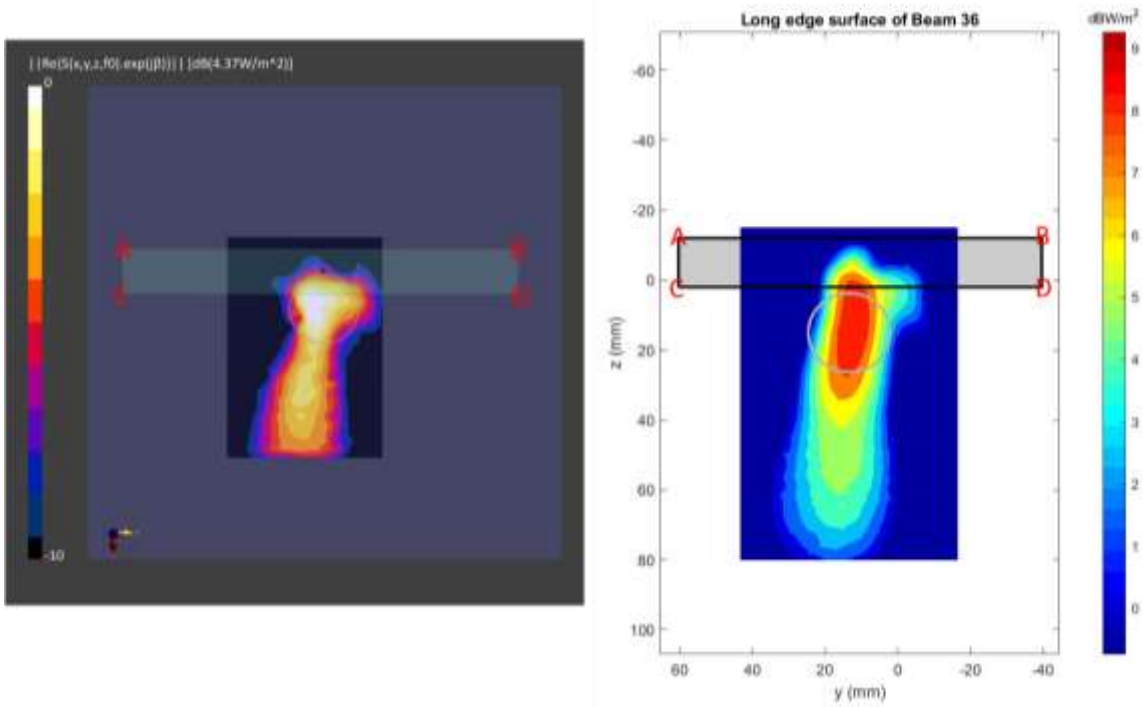
Figure 2.3.7.1-3 Measured (left) and Simulated (right) peak power density distributions for the worst case found in the Long edge surface measurement plane for n261 (**Rear module, beam 36, Long edge surface**)
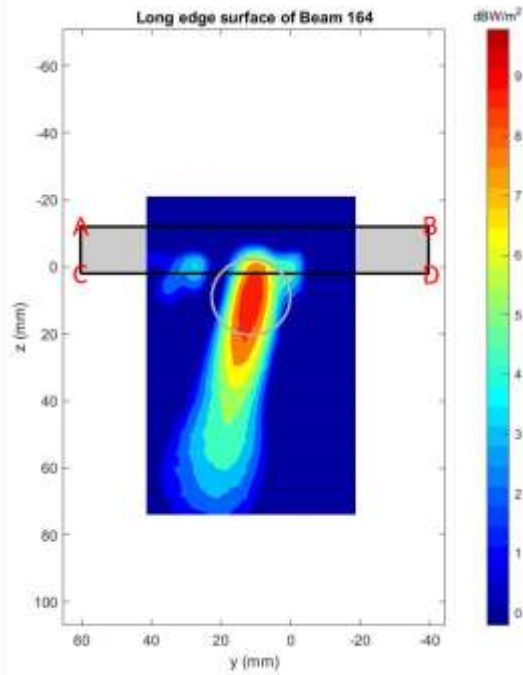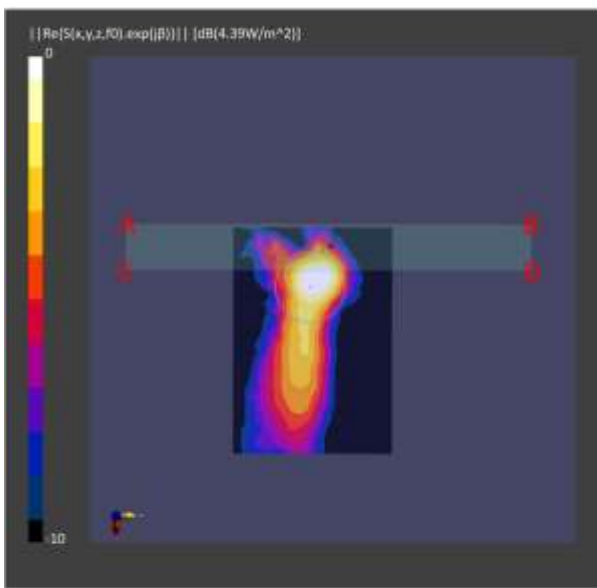
Figure 2.3.7.1-4 Measured (left) and Simulated (right) peak power density distributions for the worst case found in the Long edge surface measurement plane for n261 (**Rear module, beam 164, Long edge surface**)
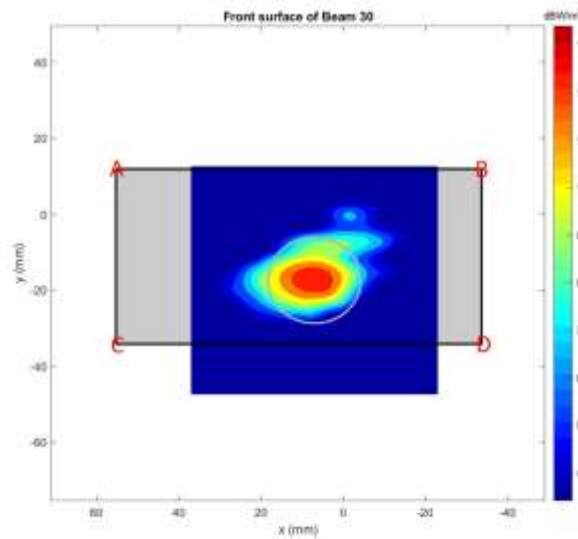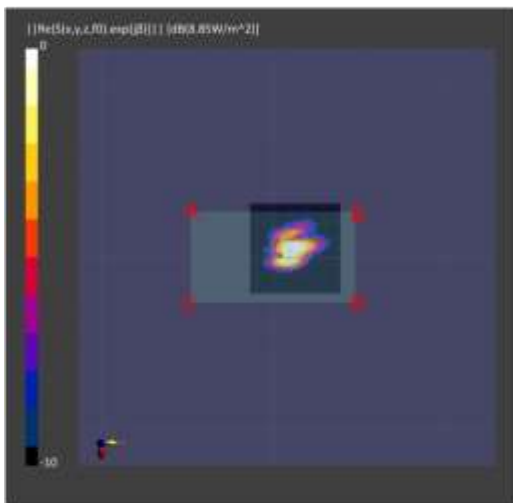
Figure 2.3.7.1-5 Measured (left) and Simulated (right) peak power density distributions for the worst case found in the Front surface measurement plane for n260 (**Front module, beam 30, Front surface**)
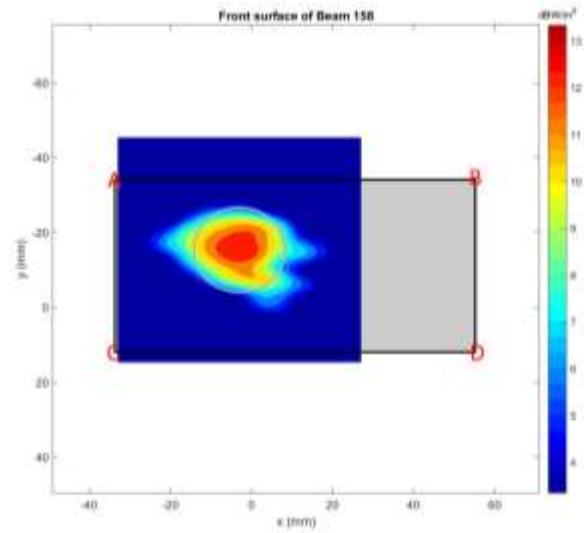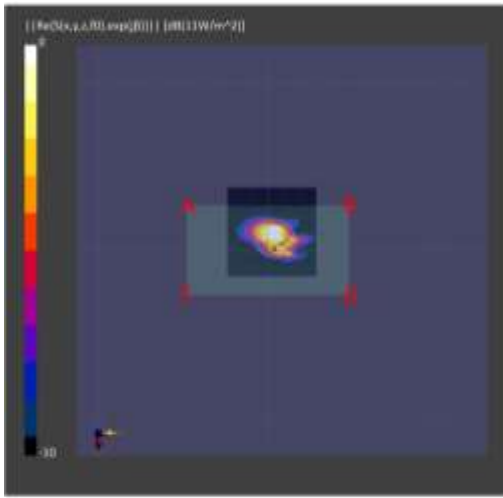
Figure 2.3.7.1-6 Measured (left) and Simulated (right) peak power density distributions for the worst case found in the Front surface measurement plane for n260 (**Front module, beam 158, Front surface**)
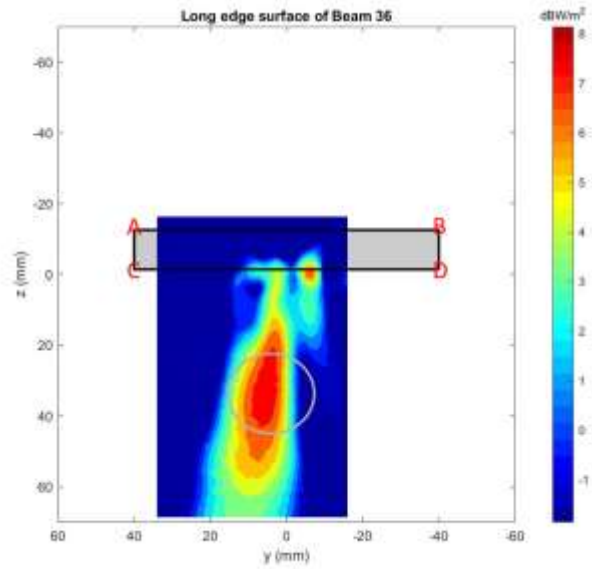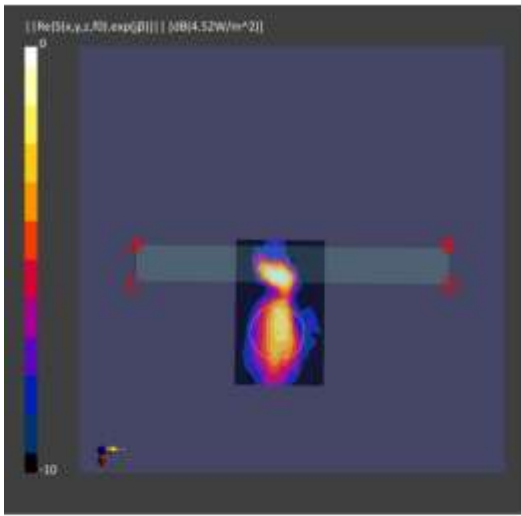
Figure 2.3.7.1-7 Measured (left) and Simulated (right) peak power density distributions for the worst case found in the Long edge surface measurement plane for n260 (**Rear module, beam 36, Long edge surface**)
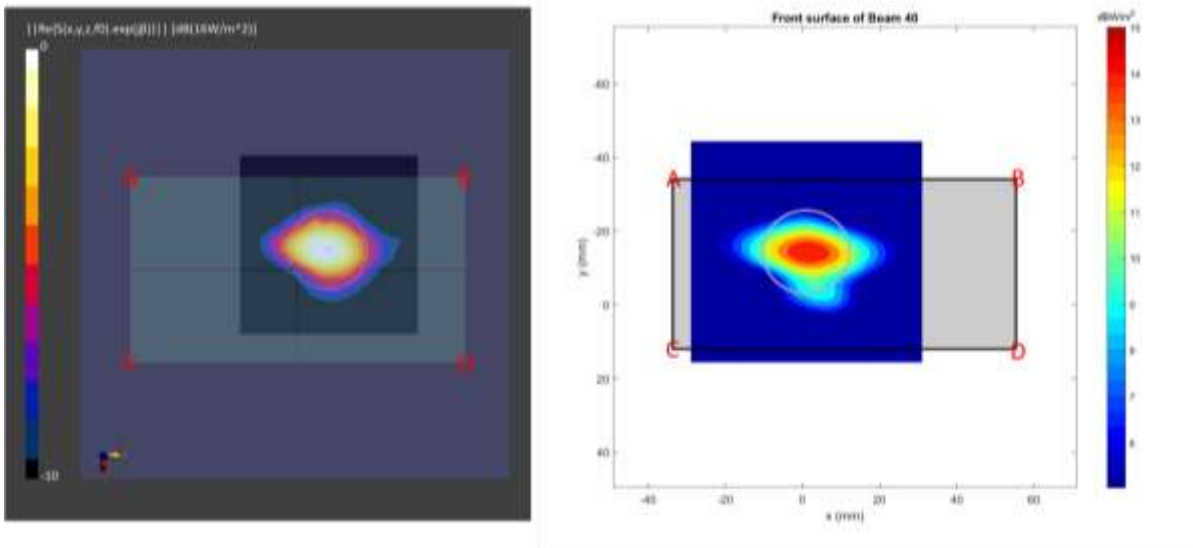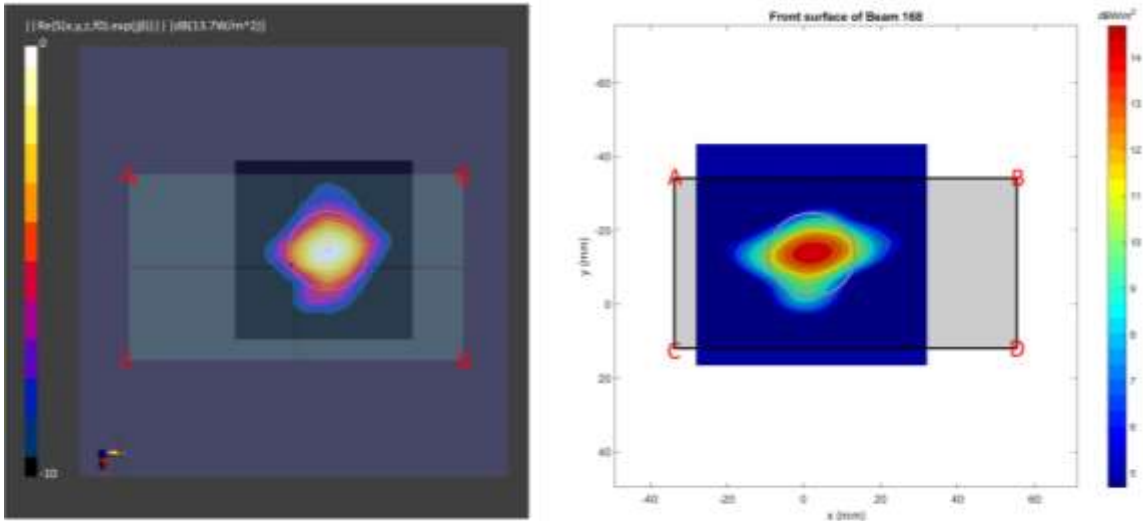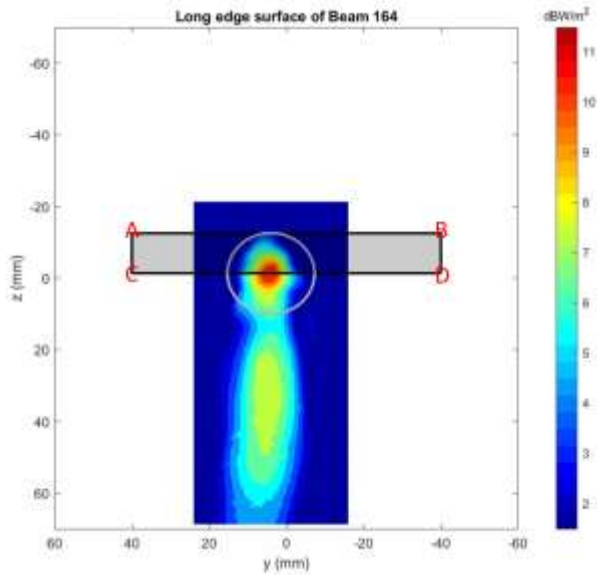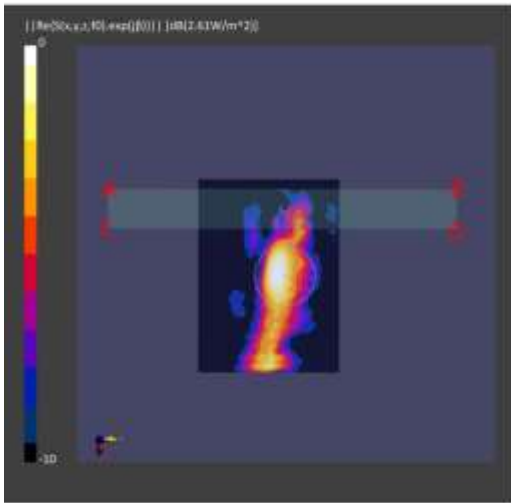
Figure 2.3.7.1-8 Measured (left) and Simulated (right) peak power density distributions for the worst case found in the Long edge surface measurement plane for n260 (**Rear module, beam 164, Long edge surface**)

2.3.8. Simulation Results

This section shows the PD simulation results of both the front module and the rear module at 28GHz and 38.5GHz for each evaluation plane in Table 2.

The relative phase between beam pairs is not controlled in the chipset design. Therefore, the relative phase between each beam pair was considered mathematically to identify the worst case conditions. A conservative uncertainty factor was applied to the PD design target based on simulated PD recalculated for every group phase relationship between the two beams sweeping from 0° to 360° at a 5° step interval. The below MIMO results represent MIMO simulation results for 0° relative phase between the beam pairs. The worst-case simulated PD determined from the tables in this section were used for conservativeness in input.power.limit determination in RF Exposure Part 0 Report.

2.3.8.1 Front Module

Table 6&7 show the PD simulation evaluation of the Front module at 28GHz/38.5GHz for the corresponding evaluation planes specified in Table 2.

Table 6 PD of Front module (28GHz – n261)

Beam ID 1	Beam ID 2	Antenna Module	4cm2 Average Total PD (W/m^2)			Surface
			low channel	mid channel	high channel	
1		0	1.7	1.7	1.7	S2
3		0	1.5	1.6	1.6	S2
5		0	1.5	1.5	1.5	S2
7		0	1.5	1.6	1.7	S2

14

9		0	1.5	1.6	1.7	S2
14		0	3.7	3.6	3.6	S2
15		0	5.1	5.2	5.2	S2
16		0	4.3	4.5	4.7	S2
17		0	3.9	3.9	3.8	S2
21		0	3.8	3.9	4.0	S2
22		0	5.0	5.2	5.2	S2
23		0	4.3	4.4	4.4	S2
29		0	7.4	7.4	7.4	S2
30		0	11.7	11.9	11.8	S2
31		0	12.4	13.1	13.6	S2
32		0	13.5	14.0	14.3	S2
33		0	11.4	11.6	11.8	S2
38		0	9.2	9.1	9.1	S2
39		0	12.4	12.9	13.2	S2
40		0	13.2	14.0	14.3	S2
41		0	14.1	14.4	14.3	S2
	129	0	1.6	1.6	1.7	S2
	131	0	1.5	1.5	1.5	S2
	133	0	1.7	1.7	1.7	S2
	135	0	1.7	1.8	1.8	S2
	137	0	1.6	1.7	1.7	S2
	142	0	3.6	3.9	4.0	S2
	143	0	5.1	5.1	5.1	S2
	144	0	4.9	5.0	4.9	S2
	145	0	3.6	3.7	3.8	S2
	149	0	3.9	3.7	3.8	S2
	150	0	5.5	5.6	5.6	S2
	151	0	4.1	4.2	4.2	S2
	157	0	9.8	10.0	10.6	S2
	158	0	15.0	15.2	15.1	S2

	159	0	14.3	14.4	14.4	S2
	160	0	13.3	13.7	13.9	S2
	161	0	9.0	9.5	9.8	S2
	166	0	14.2	14.4	14.5	S2
	167	0	14.4	14.5	14.4	S2
	168	0	13.8	13.9	14.0	S2
	169	0	12.0	12.6	12.9	S2
1	129	0	3.1	3.1	3.2	S2
3	131	0	3.7	3.6	3.3	S2
5	133	0	3.6	3.6	3.6	S2
7	135	0	3.8	3.9	3.9	S2
9	137	0	2.8	3.1	3.3	S2
14	142	0	6.3	6.9	7.0	S2
15	143	0	11.1	11.3	11.0	S2
16	144	0	8.9	8.8	8.6	S2
17	145	0	6.0	6.3	6.4	S2
21	149	0	6.9	7.4	7.4	S2
22	150	0	9.5	9.6	9.6	S2
23	151	0	7.0	7.7	8.1	S2
29	157	0	19.4	18.1	18.5	S2
30	158	0	30.3	29.9	29.3	S2
31	159	0	29.3	30.6	31.1	S2
32	160	0	30.6	31.2	31.2	S2
33	161	0	25.4	25.6	25.0	S2
38	166	0	28.0	26.8	26.4	S2
39	167	0	28.5	29.4	29.4	S2
40	168	0	30.7	31.3	31.6	S2
41	169	0	29.3	30.0	30.1	S2

Table 7 PD of Front module (38.5GHz – n260)

| Beam ID 1 | Beam ID 2 | Antenna Module | 4cm2 Average Total PD (W/m^2) | | | Surface |
			low channel	mid channel	high channel	
1		0	1.2	1.5	1.5	S2
3		0	1.2	1.2	1.3	S2
5		0	1.8	1.7	1.6	S2
7		0	1.5	1.6	1.4	S2
9		0	1.7	1.5	1.4	S2
14		0	2.3	2.8	2.5	S2
15		0	4.7	4.6	4.0	S2
16		0	2.5	2.9	3.0	S2
17		0	1.8	2.0	1.7	S2
21		0	3.8	4.7	4.4	S2
22		0	4.0	3.9	3.2	S2
23		0	1.4	1.8	1.9	S2
29		0	7.2	8.9	7.5	S2
30		0	10.5	10.1	8.7	S2
31		0	10.8	9.9	9.0	S2
32		0	6.0	8.1	7.6	S2
33		0	5.6	7.3	6.2	S2
38		0	8.5	9.5	8.3	S2
39		0	10.9	9.6	8.2	S2
40		0	6.8	8.8	9.0	S2
41		0	4.7	5.6	5.9	S2
	129	0	1.2	1.4	1.4	S2
	131	0	1.5	1.5	1.6	S2
	133	0	1.9	1.7	1.5	S2
	135	0	1.3	1.5	1.5	S2
	137	0	1.4	1.5	1.6	S2
	142	0	3.3	4.2	4.3	S2

	143	0	3.9	4.1	4.3	S2
	144	0	2.5	2.6	2.3	S2
	145	0	2.8	2.7	2.5	S2
	149	0	3.2	2.9	2.8	S2
	150	0	3.4	4.2	4.2	S2
	151	0	1.8	2.1	2.0	S2
	157	0	6.3	8.2	8.1	S2
	158	0	11.7	11.4	10.4	S2
	159	0	10.3	8.9	7.5	S2
	160	0	6.1	7.1	6.9	S2
	161	0	6.7	8.5	8.9	S2
	166	0	9.7	10.1	9.6	S2
	167	0	11.0	9.3	8.3	S2
	168	0	6.4	8.0	7.2	S2
	169	0	4.4	5.4	5.9	S2
1	129	0	2.6	3.2	3.0	S2
3	131	0	2.7	2.9	2.9	S2
5	133	0	4.4	3.8	3.7	S2
7	135	0	3.6	3.6	3.2	S2
9	137	0	3.7	3.8	3.4	S2
14	142	0	6.3	7.2	7.5	S2
15	143	0	6.5	6.4	5.4	S2
16	144	0	5.5	6.1	5.7	S2
17	145	0	5.6	6.0	5.2	S2
21	149	0	5.7	6.1	6.2	S2
22	150	0	6.3	6.9	5.3	S2
23	151	0	3.3	3.6	4.0	S2
29	157	0	15.0	17.5	16.8	S2
30	158	0	25.4	22.4	20.5	S2
31	159	0	22.5	17.8	17.1	S2
32	160	0	10.6	12.8	12.4	S2

33	161	0	15.0	16.7	16.0	S2
38	166	0	19.1	20.2	20.1	S2
39	167	0	26.4	24.3	16.8	S2
40	168	0	10.3	13.4	13.3	S2
41	169	0	8.5	11.9	11.9	S2

2.3.8.2 Rear Module

Table 8&9 show the PD simulation evaluation of the Rear module at 28GHz/38.5GHz for the corresponding evaluation planes specified in Table 2.

Table 8 PD of Rear module (28GHz – n261)

Beam ID 1	Beam ID 2	Antenna Module	4cm2 Average Total PD (W/m^2)			Surface
			low channel	mid channel	high channel	
0		1	0.5	0.5	0.5	S4
2		1	0.6	0.5	0.5	S4
4		1	0.4	0.5	0.5	S4
6		1	0.6	0.6	0.7	S4
8		1	0.9	0.8	0.9	S4
10		1	1.0	0.9	0.9	S4
11		1	1.0	0.9	0.8	S4
12		1	1.2	1.3	1.4	S4
13		1	0.9	0.8	1.0	S4
18		1	0.7	0.6	0.6	S4
19		1	1.5	1.5	1.5	S4
20		1	0.8	1.0	1.0	S4
24		1	2.2	2.1	1.9	S4
25		1	2.7	2.8	2.7	S4
26		1	4.6	4.6	4.4	S4
27		1	3.5	3.7	3.8	S4
28		1	3.5	3.8	4.3	S4
34		1	2.4	2.4	2.2	S4

35		1	3.2	3.2	3.2	S4
36		1	5.2	5.3	5.2	S4
37		1	4.1	4.4	4.6	S4
	128	1	0.3	0.3	0.4	S4
	130	1	0.5	0.6	0.6	S4
	132	1	0.8	0.8	0.7	S4
	134	1	0.7	0.6	0.5	S4
	136	1	0.8	0.8	1.0	S4
	138	1	1.0	1.3	1.4	S4
	139	1	1.2	1.2	1.4	S4
	140	1	2.0	1.9	1.8	S4
	141	1	1.0	1.0	1.1	S4
	146	1	1.1	1.1	1.1	S4
	147	1	1.2	1.3	1.3	S4
	148	1	0.9	0.8	0.9	S4
	152	1	2.2	2.5	3.0	S4
	153	1	3.9	4.2	4.7	S4
	154	1	4.8	4.8	4.8	S4
	155	1	4.0	3.9	4.1	S4
	156	1	1.9	2.1	2.1	S4
	162	1	2.4	2.6	3.2	S4
	163	1	4.9	5.1	5.2	S4
	164	1	4.9	4.8	5.0	S4
	165	1	2.5	2.6	2.7	S4
0	128	1	0.7	0.8	0.8	S4
2	130	1	1.4	1.4	1.3	S4
4	132	1	1.4	1.2	1.2	S4
6	134	1	1.1	1.0	1.0	S4
8	136	1	2.2	2.2	2.6	S4
10	138	1	2.0	1.9	2.0	S4
11	139	1	2.4	2.5	2.7	S4

12		140	1	3.0	2.9	2.9	S4
13		141	1	1.4	1.5	1.5	S4
18		146	1	2.4	2.4	2.4	S4
19		147	1	2.9	3.0	2.9	S4
20		148	1	2.0	1.9	2.4	S4
24		152	1	4.0	3.8	3.8	S4
25		153	1	3.6	4.5	5.2	S4
26		154	1	10.8	10.5	10.2	S4
27		155	1	6.3	6.2	6.7	S4
28		156	1	3.8	4.1	4.2	S4
34		162	1	4.7	4.6	4.8	S4
35		163	1	7.3	7.9	8.2	S4
36		164	1	11.5	11.4	11.8	S4
37		165	1	4.5	3.8	3.8	S4

Table 9 PD of Rear module (38.5GHz – n260)

Beam ID 1	Beam ID 2	Antenna Module	4cm2 Average Total PD (W/m^2)			Surface
			low channel	mid channel	high channel	
0		1	0.5	0.4	0.3	S4
2		1	0.6	0.5	0.4	S4
4		1	0.5	0.5	0.5	S4
6		1	0.5	0.6	0.5	S4
8		1	0.4	0.5	0.5	S4
10		1	1.4	1.1	1.2	S4
11		1	1.5	1.3	0.9	S4
12		1	0.7	1.0	1.3	S4
13		1	1.5	1.3	1.5	S4
18		1	1.7	1.3	1.1	S4
19		1	1.2	1.3	1.1	S4
20		1	0.8	0.8	1.0	S4
24		1	3.6	4.0	4.6	S4

25		1	4.6	3.8	3.0	S4
26		1	2.9	3.7	2.9	S4
27		1	2.4	2.1	2.8	S4
28		1	2.9	2.8	4.2	S4
34		1	3.9	3.8	4.1	S4
35		1	3.8	3.4	2.5	S4
36		1	2.8	2.9	2.6	S4
37		1	2.5	2.5	2.5	S4
	128	1	0.5	0.6	0.8	S4
	130	1	0.6	0.7	1.0	S4
	132	1	0.7	0.8	1.0	S4
	134	1	0.5	0.5	0.9	S4
	136	1	0.4	0.4	1.1	S4
	138	1	1.1	1.3	2.3	S4
	139	1	1.3	1.6	2.4	S4
	140	1	1.8	1.4	1.9	S4
	141	1	1.1	1.1	3.0	S4
	146	1	0.9	0.9	1.8	S4
	147	1	1.4	1.4	2.2	S4
	148	1	1.5	1.4	2.4	S4
	152	1	3.8	3.8	5.6	S4
	153	1	2.8	3.4	4.9	S4
	154	1	3.1	3.3	4.0	S4
	155	1	5.1	4.9	6.2	S4
	156	1	3.8	3.6	4.7	S4
	162	1	3.7	3.9	5.4	S4
	163	1	2.7	3.0	4.5	S4
	164	1	3.9	4.58	5.1	S4
	165	1	4.7	4.1	5.1	S4
0	128	1	1.0	1.0	0.5	S4
2	130	1	1.0	1.2	0.5	S4

4	132	1	0.9	1.0	0.6	S4
6	134	1	1.2	1.1	0.4	S4
8	136	1	1.0	1.1	0.4	S4
10	138	1	3.0	2.4	1.1	S4
11	139	1	2.3	3.4	1.3	S4
12	140	1	2.7	2.6	0.9	S4
13	141	1	3.3	3.0	1.4	S4
18	146	1	2.6	2.4	1.1	S4
19	147	1	2.0	2.2	1.1	S4
20	148	1	2.5	2.8	1.2	S4
24	152	1	5.0	6.1	4.6	S4
25	153	1	4.3	4.8	3.2	S4
26	154	1	5.3	5.8	2.9	S4
27	155	1	5.8	6.2	3.1	S4
28	156	1	6.2	5.5	3.7	S4
34	162	1	4.7	5.3	4.3	S4
35	163	1	5.2	4.6	3.1	S4
36	164	1	5.8	5.9	3.0	S4
37	165	1	5.2	5.6	2.9	S4

Appendix A: PD CHAR Verification for 2nd Generation of Smart Transmit (GEN2)

The 2nd generation of Smart Transmit (GEN2) operates based on pre-defined sub6 antenna groups (AG) and mmW module groups (MG). According to Qualcomm's guideline, The PD char for GEN2 cannot be finalized until the additional verifications described in this section are performed and passed.

A.1 Verification criteria 1 (PD per beam)

The measured power density at input.power.limit agrees with simulated power density at sim.power.limit for the beams that are identified as worst case PD for the evaluation surface for each QTM module and for each bands, and the measure power density is less than PD_design_target+total uncertainty. Demonstrated in RF exposure Part 1 report.

A.2 Verification criteria 2 (Combined PD)

Per QC's guidance, for simultaneous TER analysis, the device needs to demonstrate that combined PD for these identified PD beams at each QTM's dominant surface are less than PD_design_target+total uncertainty.

In this case, as illustrated in Figure 2.2-1, the 2 QTM modules are in physically separated devices, and each QTM module has its own PD evaluation planes, unlike conventional devices where the QTM modules are collocated in the same physical device and share the same PD evaluation plane.

Since the 2 QTM modules have different RF exposure conditions, the combined PD doesn't apply here. Hence, there's no need for additional verifications for Smart Transmit Gen 2, mmWave favor mode.