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Power Density Simulation Report

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1. Electromagnetic simulation method for power density

1.1 EM simulation tool

1.1.1 EM simulation tool description

The mmWave power density (PD) simulation method for calculating PD for mobile phones with mmWave antenna modules is available in ANSYS Electromagnetics suite HFSS ver. 20.2(2020 R2) is used. ANSYS HFSS is one of several commercial tools for 3D full-wave electromagnetic simulation used for antenna and RF structure design of high frequency component. ANSYS Electromagnetics suite HFSS ver. 20.2(2020 R2) is implemented based on Finite Element Method (FEM), which operates in the frequency domain.

1.1.2 Mesh and convergence criteria

ANSYS Electromagnetic suite HFSS ver. 20.2(2020 R2) uses the FEM to solve the structure for 3D EM simulations to analyze power density. The volume area containing the simulated object should be subdivided into electrically small parts called finite elements with unknown functions. To subdivide system, the adaptive mesh technique in ANSYS Electromagnetics suite HFSS ver. 20.2(2020 R2) is used. ANSYS Electromagnetics suite HFSS ver. 20.2(2020 R2) starts to refine the initial mesh based on wavelength and calculate the error to iterative process for adaptive mesh refinement. The determination parameter of the number of iteration in ANSYS Electromagnetics suite HFSS ver. 20.2(2020 R2) is defined as convergence criteria, delta S, and the iterative adaptive mesh process repeats until the delta S is met. In ANSYS Electromagnetics suite HFSS ver. 20.2(2020 R2), the accuracy of converged results depends on the delta S.

1.1.3 Time-averaged power density calculation

It is possible to get various kinds of physical quantities can be obtained after finishing 3D full-wave electromagnetic simulation. To calculate PD evaluation, two physical quantities, an electric field ($\vec{E}$) and a magnetic field ($\vec{H}$) are needed. The actual consumption power can be expressed as the real term of the time-averaged Poynting vector ($\vec{S}$) from the cross product of $\vec{E}$ and complex conjugation of $\vec{H}$ as shown below:

$$(\vec{S}) = Re \left(\frac{1}{2} \vec{E} \times \vec{H}^* \right)$$

($\vec{S}$) can be expressed as point power density based on a peak value of each spatial point on mesh grids, and obtained directly from ANSYS Electromagnetics suite HFSS ver. 20.2(2020 R2) .

From the point power density ($\vec{S}$) , the spatial-averaged power density (PD_{av}) on an evaluated area (A) can be derived as shown below:

$$PD_{av} = \frac{1}{A} \int_A (\vec{S}) \cdot d\vec{s} = \frac{1}{2A} \int_A |Re(\vec{E} \times \vec{H})| \cdot d\vec{s} ,$$

where the spatial-averaged power density PD_{av} is total power density value considering on x, y and z components of point power density ($\vec{S}$) and the evaluated are (A) is $4cm^2$.

1.2 Simulation setup

1.2.1 Modeling for simulation

The simulation approach to perform PD assessment for a smartphone requires accurate modeling for mmWave antenna module as well as the smartphone itself. Figure 1 shows the simulation model which is mounted two mmWave antenna modules. The simulation modeling includes most of the entire structure of device itself such as PCB, metal frame, battery, large components and legacy antennas as well as mmWave antenna modules QTM#0 and QTM#1. On the back front view, QTM#0 is placed on the left side and antennas are facing the left side of the device. QTM#1 is placed on the top side and antennas are facing the back side of the device.



Figure 1. HFSS simulation model which is mounted two mmWave antenna modules.

1.2.2 PD evaluation surfaces

Table 1 shows the PD evaluation surfaces for each mmWave antenna module and Figure 2 shows the PD evaluation planes and truncation area of the simulation model to find worst case of beam forming cases. In these cases, 5 PD evaluation surfaces except bottom side are set up. QTM#0 and QTM#1 are placed at the top of the device and the bottom side is excluded from the worst case because the distance from the bottom side is more than 10λ at 28GHz and 39GHz.

Table 1. PD evaluation surfaces

MODULE	Front	Back	Right	Left	Top	Bottom
QTM#0	○	○	○	○	○	×
QTM#1	○	○	○	○	○	×

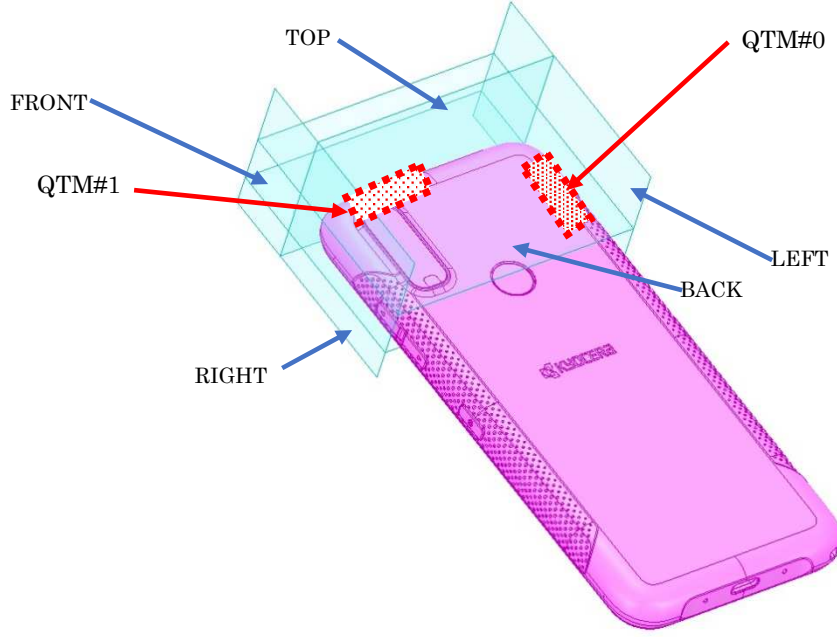


Figure 2. PD evaluation Surfaces

1.2.3 Radiation boundary condition

For radiation boundary, the 2nd order absorbing boundary condition (ABC) is used for all simulations in this report. This radiation boundary simulates an electrically open surface that allows waves to radiate infinitely far into space the system absorbs the wave via the 2nd order radiation boundary, essentially ballooning the boundary infinitely far away from the structure and into space. The radiation boundaries may also be placed relatively close to a structure and can be of arbitrary shape.

Per ANSYS recommendations for their simulation tool, the radiation boundary plane must be located at least a quarter wavelength from strongly radiating structure, or at least a tenth of a wavelength from a weakly radiating structure. In this simulation report, about 3 wavelengths spacing from the device surfaces in all main beam directions are applied to ensure convergence. By changing convergence error (i.e., maximum magnitude delta S) from 2% to 4% and moving the radiation boundary closer towards the device by 20%, the combined influence in PD value is $< 0.04\text{dB}$ which confirms that the simulation model is reliable using this setup.

1.2.4 Source excitation condition

Each of the two 5G mmWave array modules is the same part containing a 1×4 element array of dual-polarization patch antennas. The number of antenna ports of QTM#0 and QTM#1 for source excitation is equal to 16. The port of each patch antenna are separated in frequency and polarization. That is, the ports of each patch antenna are divided into a feed for 28 GHz and a feed for 39 GHz, and

a vertical polarity feed and a horizontal polarity feed are divided.

Figure 3 shows the QTM#1 module structure and surrounding structure. The QTM#1 module is encrypted in the ANSYS Electromagnetics suite (HFSS) and can only check the feeding position.

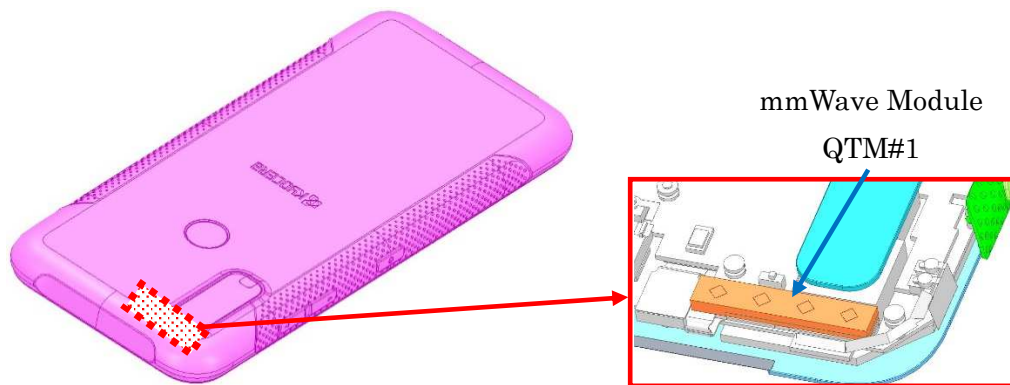


Figure 3. mmWave module

After finishing 3D full wave electromagnetic simulation of modeling structure, the magnitude and phase information can be loaded for each port by using “Edit Sources” function in ANSYS Electromagnetics suite (HFSS). Figure4 shows an example of antenna port excitations.

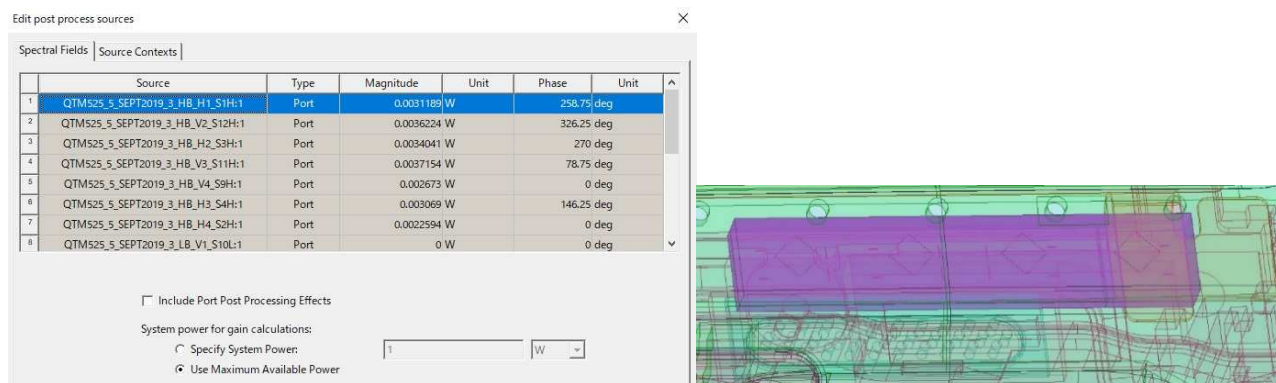


Figure 4. An example of port excitation (QTM#1)

Since ANSYS Electromagnetics suite (HFSS) uses FEM solver based on frequency domain analysis method, the input source for the port excitation applies sinusoidal waveform for each frequency.

1.2.5 Condition of simulation completion

The simulation completion condition of ANSYS Electromagnetics suite (HFSS) is defined as delta S. The ANSYS Electromagnetics suite (HFSS) calculates the S-parameter for the mesh conditions of each step and determines whether to proceed with the operation of the next step by comparing the difference between the S-parameters in the previous step. A difference between the previous step and the current step of S-parameter is expressed as delta S, and the delta S generally set 0.02. The simulation result of this report is the result of setting delta S to 0.02.

2. Simulation verification

2.1 Spatial-averaged power density

As mentioned in the previous chapter, 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 4cm^2 at 2.5 mm intervals of the point power density result. Figure 5 shows examples of the distribution plot of point power density and the averaged power density.

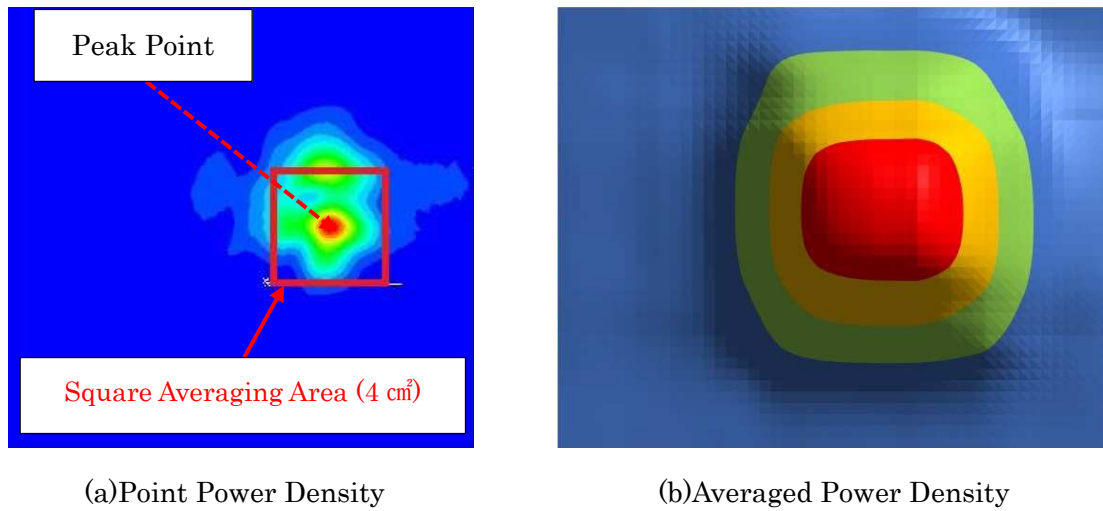


Figure 5. Power density distribution (Example)

2.2 Comparison between simulation and measurement

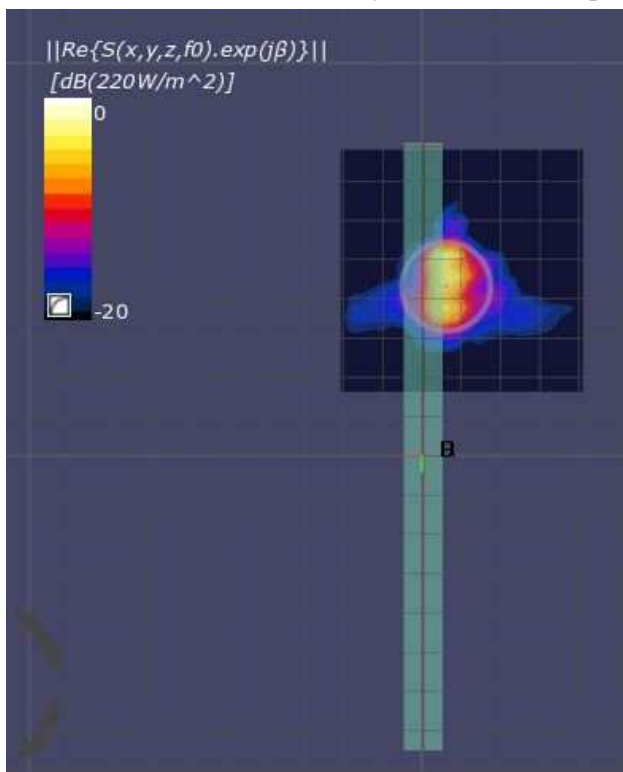
In this section, the simulated and measured power density distributions are compared with each mmWave antenna. Based on the comparison of the power density distribution, the simulated power density and the measured power density have a good correlation. The amplitude mismatch between the simulated 4cm^2 average power density and the measured 4cm^2 average power density is considered a housing influence. Input power per each active port is listed below for both simulation and measurement verification and power density characterization. For simulation, these values were entered directly into the HFSS model. For measurement, it was used to input these values for each active port using Factory Test Mode S/W.

Mode/Band	Antenna	Input Power (dBm) SISO	Input Power (dBm) MIMO
5G NR n261 (28GHz)	QTM#0 Patch	6.0	6.0
	QTM#1 Patch	6.0	6.0
5G NR n260 (39GHz)	QTM#0 Patch	6.0	6.0
	QTM#1 Patch	6.0	6.0

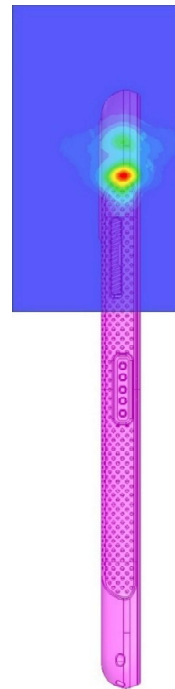
The simulation and measurement results below were performed at 2mm evaluation distance and 28 GHz / 39GHz.

6dBm input measurement/ simulation							4cm ² avg.PD (mW/cm ²)		Δ (dB)	Δ_{min} (dB)
Band	Ant Type	Module	Ant Group (Ant Polarization)	beam ID	Surface	Channel	Measured	Simulated		
n261	Patch	QTM#0	AG0(V)	17	Left	Mid	0.86	1.25	1.63	-1.18
			AG1(H)	149	Left	Mid	1.60	1.22	-1.18	
		QTM#1	AG0(V)	13	Back	Mid	0.81	1.17	1.60	0.84
			AG1(H)	141	Back	Mid	0.89	1.08	0.84	
n260	Patch	QTM#0	AG0(V)	22	Left	Mid	0.84	2.52	4.79	2.23
			AG1(H)	150	Left	Mid	1.09	1.81	2.23	
		QTM#1	AG0(V)	12	Back	Mch	0.62	2.43	5.96	4.31
			AG1(H)	140	Back	Mch	0.63	1.69	4.31	

n261 Patch antenna QTM#0 Ant_Group0(V-polarization) beam ID 17 Left-side Mid ch.

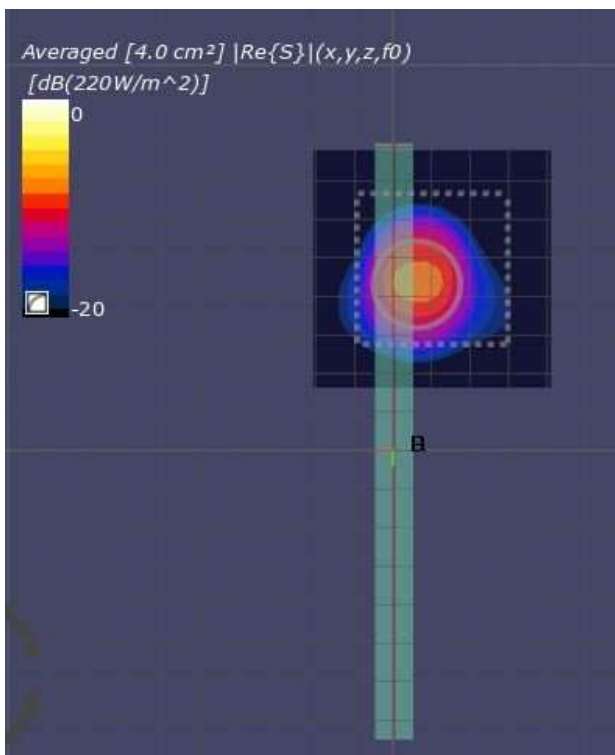


(a)Measurement

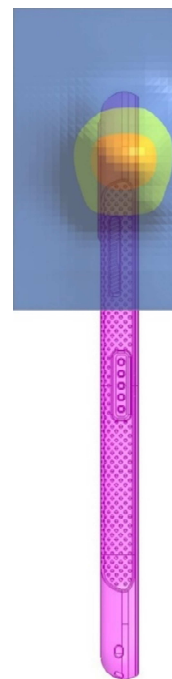


(b)Simulation

Patch antenna QTM#0 Ant_Group0(V-polarization) beam ID 17, Point power density



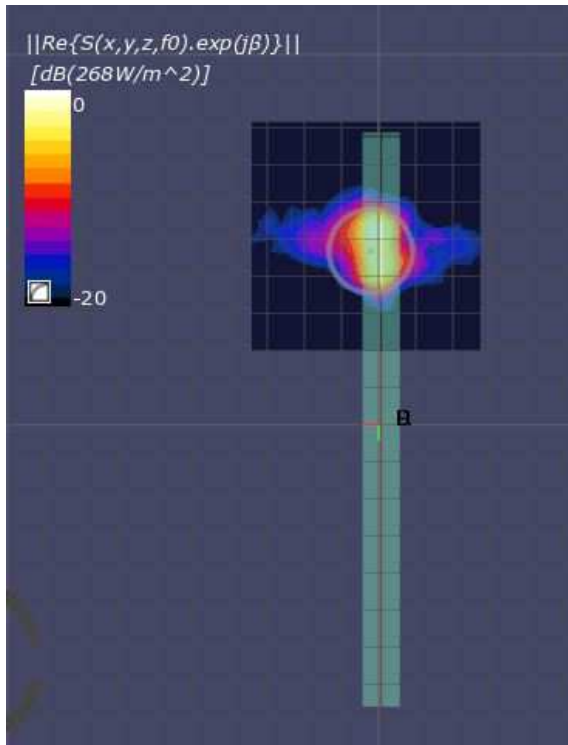
(a)Measurement



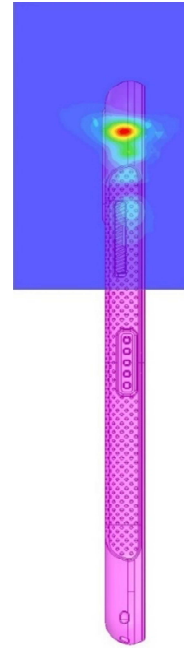
(b)Simulation

Patch antenna QTM#0 Ant_Group0(V-polarization) beam ID 17, 4cm² Averaged power density

n261 Patch antenna QTM#0 Ant_Group1(H-polarization) beam ID 149 Left-side Mid ch

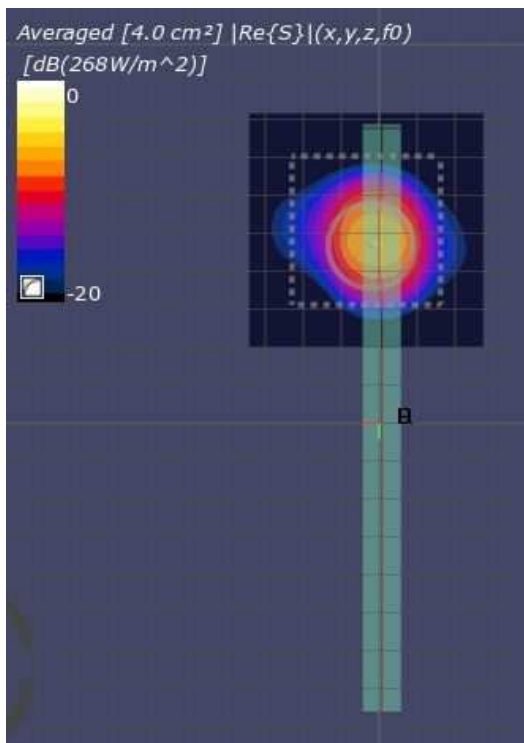


(a)Measurement

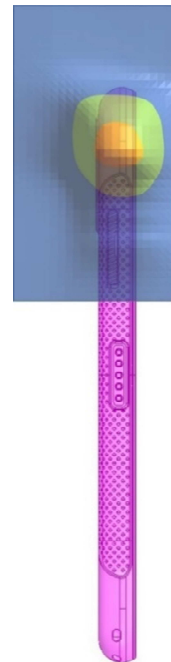


(b)Simulation

Patch antenna QTM#0 Ant_Group1(H-polarization) beam ID 149, Point power density



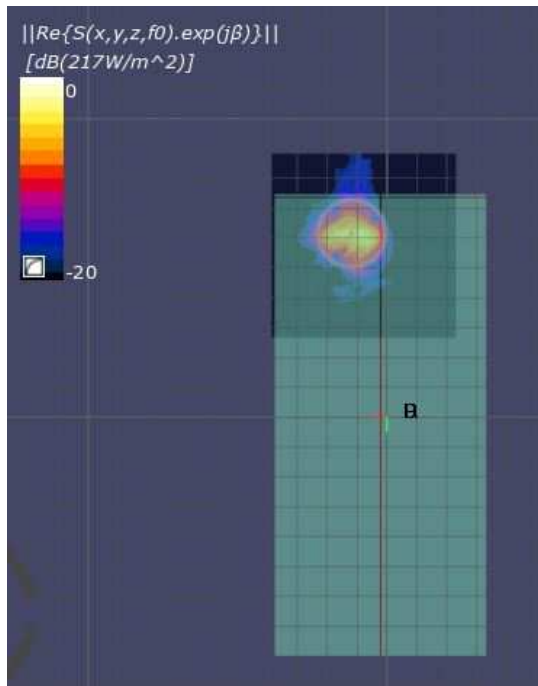
(a)Measurement



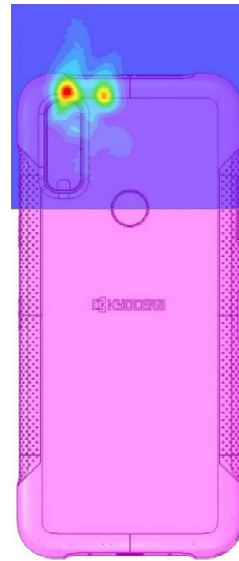
(b)Simulation

Patch antenna QTM#0 Ant_Group1(H-polarization) beam ID 149, 4cm² Averaged power density

n261 Patch antenna QTM#1 Ant_Group0(V-polarization) beam ID 13 Back-side Mid ch.



(a)Measurement



(b)Simulation

Patch antenna QTM#1 Ant_Group0(V-polarization) beam ID 13, Point power density



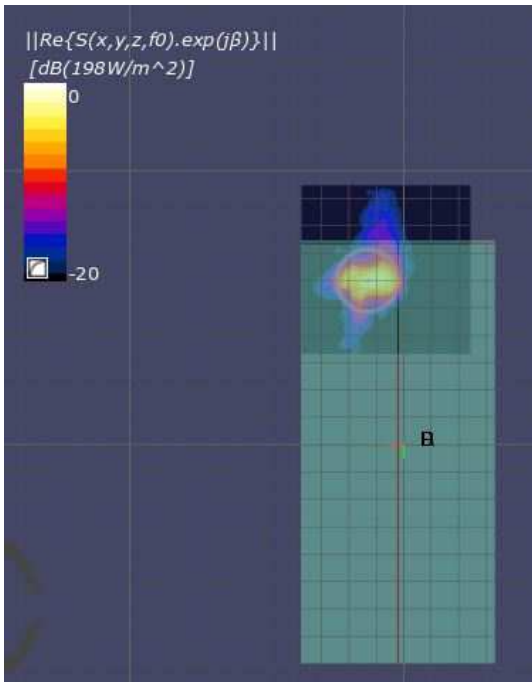
(a)Measurement



(b)Simulation

Patch antenna QTM#1 Ant_Group0(V-polarization) beam ID 13, 4cm² Averaged power density

n261 Patch antenna QTM#1 Ant_Group1(H-polarization) beam ID 141 Back-side Mid ch.

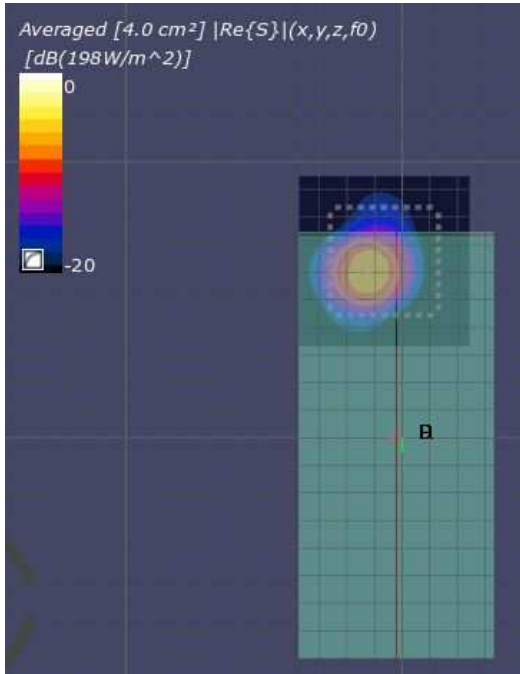


(a)Measurement



(b)Simulation

Patch antenna QTM#1 Ant_Group1(H-polarization) beam ID 141, Point power density



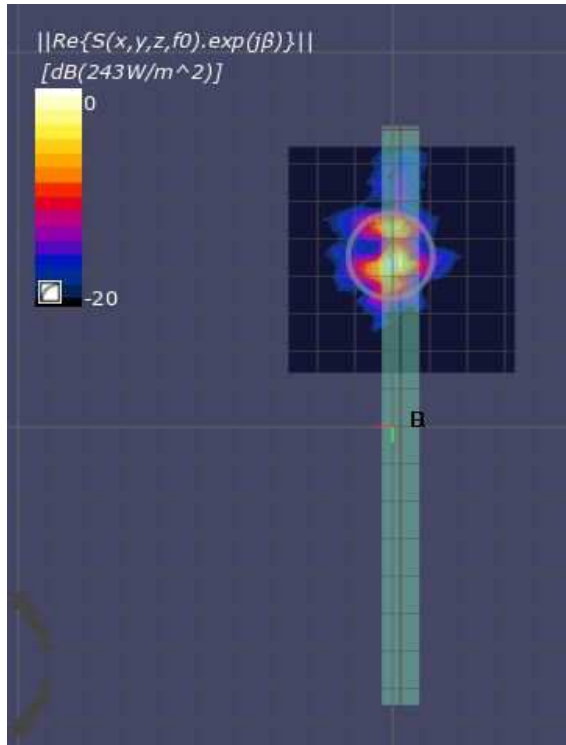
(a)Measurement



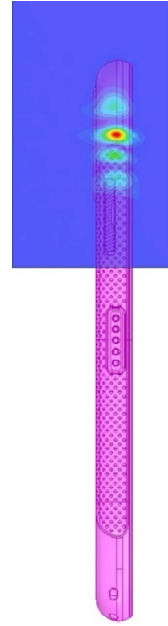
(b)Simulation

Patch antenna QTM#1 Ant_Group1(H-polarization) beam ID 141, 4cm² Averaged power density

n260 Patch antenna QTM#0 Ant_Group0(V-polarization) beam ID 22 Left-side Mid ch.

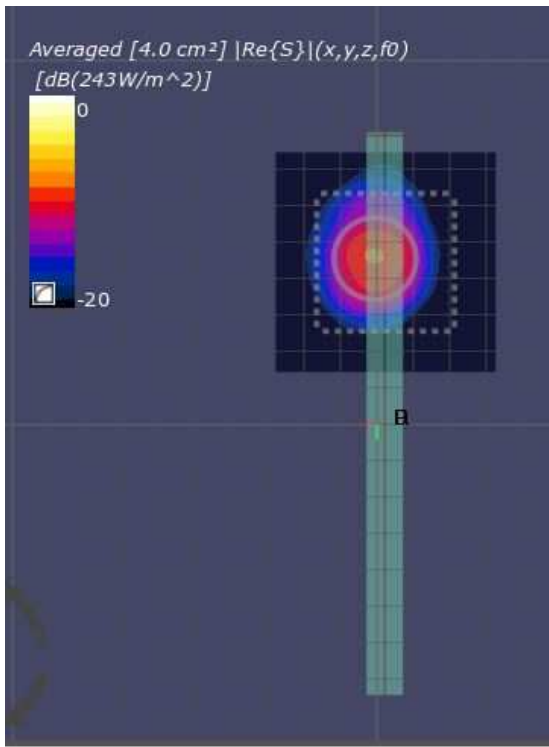


(a) Measurement

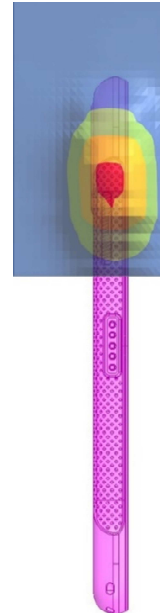


(b) Simulation

Patch antenna QTM#0 Ant_Group0(V-polarization) beam ID 22, Point power density



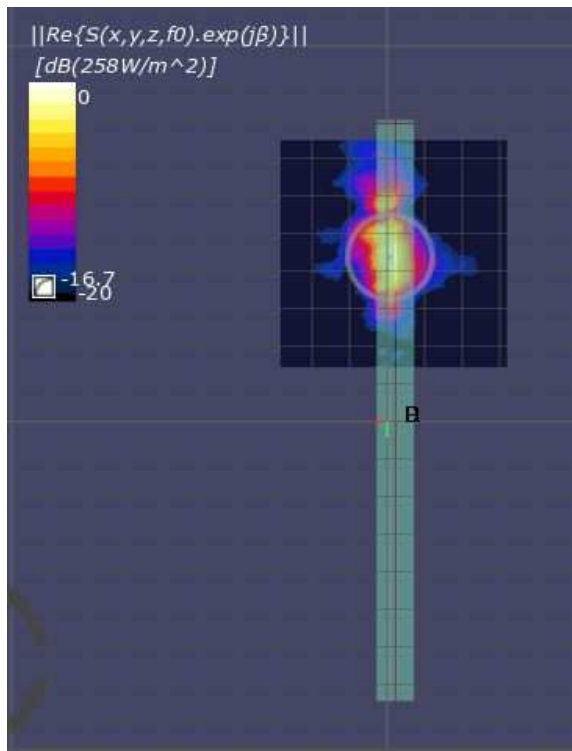
(a) Measurement



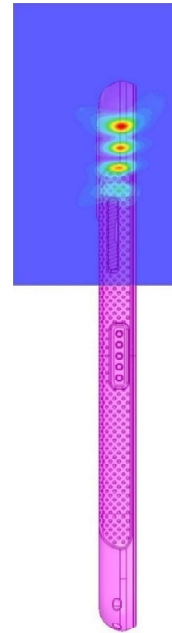
(b) Simulation

Patch antenna QTM#0 Ant_Group0(V-polarization) beam ID 22, 4cm² Averaged power density

n260 Patch antenna QTM#0 Ant_Group1(H-polarization) beam ID 150 Left-side Mid ch.

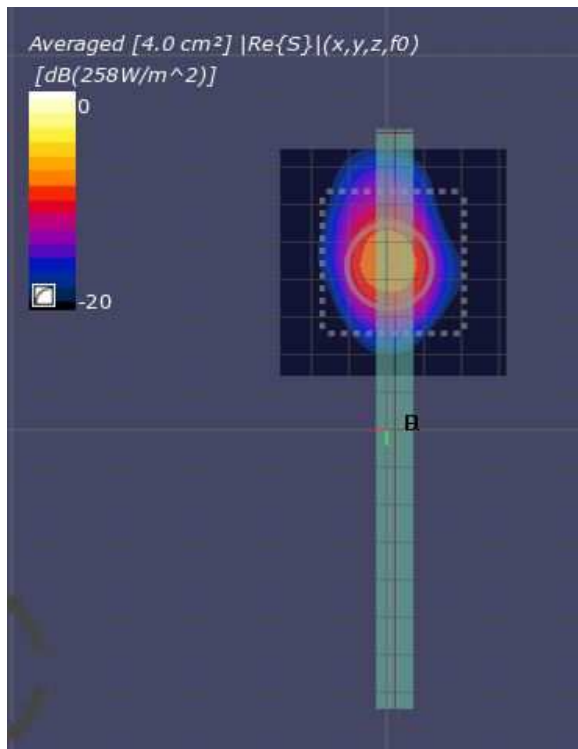


(a)Measurement

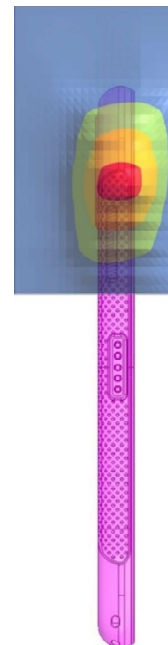


(b)Simulation

Patch antenna QTM#0 Ant_Group1(H-polarization) beam ID 150, Point power density



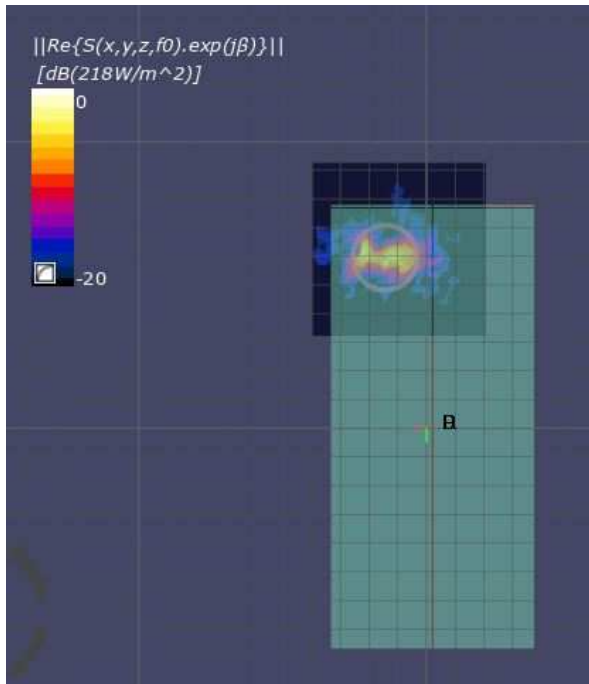
(a)Measurement



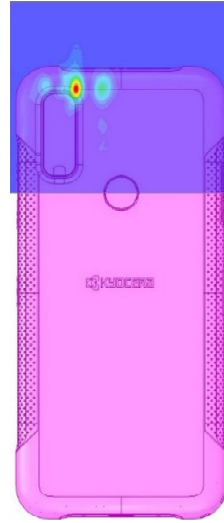
(b)Simulation

Patch antenna QTM#0 Ant_Group1(H-polarization) beam ID 150, 4cm² Averaged power density

n260 Patch antenna QTM#1 Ant_Group0(V-polarization) beam ID 12 Back-side Mid ch.

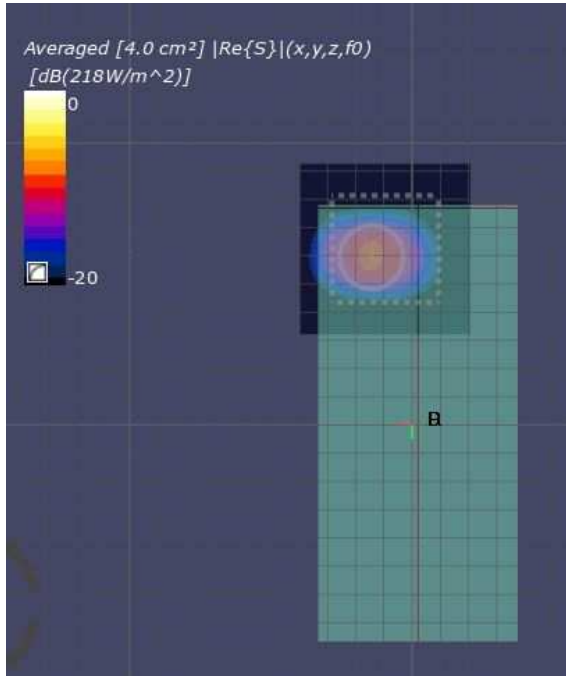


(a)Measurement



(b)Simulation

Patch antenna QTM#1 Ant_Group0(V-polarization) beam ID 12, Point power density



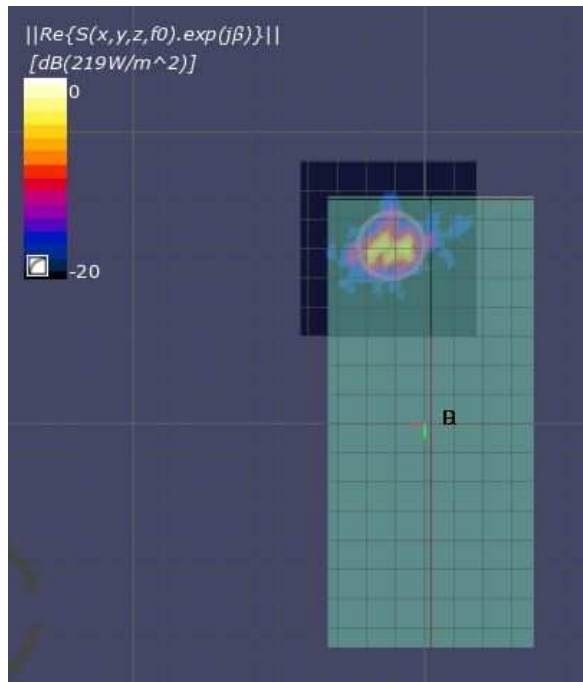
(a)Measurement



(b)Simulation

Patch antenna QTM#1 Ant_Group0(V-polarization) beam ID 12, 4cm² Averaged power density

n260 Patch antenna QTM#1 Ant_Group1(H-polarization) beam ID 140 Back-side Mid ch.

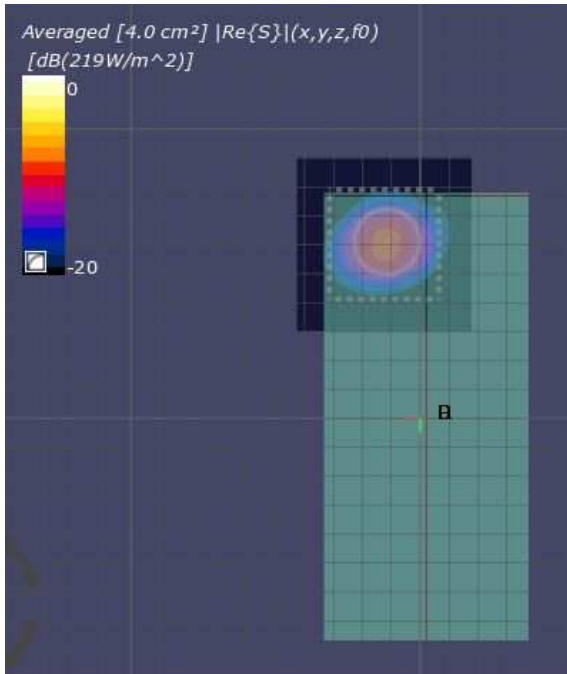


(a)Measurement



(b)Simulation

Patch antenna QTM#1 Ant_Group1(H-polarization) beam ID 140, Point power density



(a)Measurement



(b)Simulation

Patch antenna QTM#1 Ant_Group1(H-polarization) beam ID 140, 4cm² Averaged power density

Simulation results

This section shows the PD simulation results of QTM#0 and QTM#1 at 28GHz and 39GHz for each evaluation surface specified in Table 1 at 2mm distance.

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. The below tables MIMO results represent worst case of MIMO. After sweeping the relative phase between beams at 5° intervals from 0° to 360° , the highest value is attached to the MIMO simulation results.

2.3 PD for Low/Mid/High Channel at 28GHz / 39GHz

2.3.1 QTM#0 – Patch Antenna

Table 2 & Table 3 show the PD simulation evaluation of QTM#0 patch antenna at 28GHz / 39GHz for the corresponding evaluation surface specified in Table 1.

Table 2. PD of QTM#0 – patch antenna (28GHz)

QTM#0 Low Ch.

n261 Low Ch (27.56 GHz)						Power Density [mW/cm ²] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n261	1		QTM#0	Patch	1	0.382	0.001	0.012	-	0.007	0.075
n261	5		QTM#0	Patch	2	0.905	0.001	0.034	-	0.032	0.217
n261	6		QTM#0	Patch	2	0.876	0.001	0.012	-	0.032	0.226
n261	7		QTM#0	Patch	2	0.622	0.001	0.025	-	0.025	0.129
n261	10		QTM#0	Patch	2	0.930	0.001	0.026	-	0.024	0.244
n261	11		QTM#0	Patch	2	0.795	0.001	0.011	-	0.029	0.185
n261	14		QTM#0	Patch	4	0.882	0.002	0.078	-	0.041	0.309
n261	15		QTM#0	Patch	4	0.962	0.002	0.034	-	0.069	0.287
n261	16		QTM#0	Patch	4	1.179	0.002	0.008	-	0.068	0.259
n261	17		QTM#0	Patch	4	1.228	0.002	0.018	-	0.063	0.216
n261	18		QTM#0	Patch	4	0.958	0.003	0.048	-	0.029	0.194
n261	20		QTM#0	Patch	4	0.945	0.002	0.048	-	0.064	0.322
n261	21		QTM#0	Patch	4	1.014	0.002	0.018	-	0.071	0.268
n261	22		QTM#0	Patch	4	1.250	0.003	0.023	-	0.067	0.229
n261	23		QTM#0	Patch	4	1.221	0.003	0.022	-	0.042	0.212
n261		129	QTM#0	Patch	1	0.339	0.001	0.009	-	0.013	0.057
n261		133	QTM#0	Patch	2	1.105	0.001	0.010	-	0.019	0.248
n261		134	QTM#0	Patch	2	0.808	0.001	0.051	-	0.012	0.192
n261		135	QTM#0	Patch	2	0.899	0.001	0.025	-	0.031	0.204
n261		138	QTM#0	Patch	2	0.995	0.001	0.028	-	0.016	0.206
n261		139	QTM#0	Patch	2	0.742	0.001	0.064	-	0.014	0.158
n261		142	QTM#0	Patch	4	1.021	0.002	0.019	-	0.074	0.320
n261		143	QTM#0	Patch	4	1.108	0.001	0.019	-	0.057	0.323
n261		144	QTM#0	Patch	4	1.215	0.001	0.039	-	0.040	0.276
n261		145	QTM#0	Patch	4	0.636	0.004	0.144	-	0.037	0.298
n261		146	QTM#0	Patch	4	1.072	0.001	0.020	-	0.082	0.366
n261		148	QTM#0	Patch	4	0.990	0.002	0.015	-	0.068	0.306
n261		149	QTM#0	Patch	4	1.272	0.001	0.018	-	0.051	0.327
n261		150	QTM#0	Patch	4	0.931	0.003	0.108	-	0.033	0.206
n261		151	QTM#0	Patch	4	0.848	0.002	0.073	-	0.060	0.339
n261	1	129	QTM#0	Patch	1	0.404	0.002	0.029	-	0.016	0.091
n261	5	133	QTM#0	Patch	2	1.521	0.003	0.021	-	0.049	0.326
n261	6	134	QTM#0	Patch	2	1.493	0.002	0.047	-	0.044	0.229
n261	7	135	QTM#0	Patch	2	1.275	0.001	0.050	-	0.031	0.333
n261	10	138	QTM#0	Patch	2	1.722	0.002	0.068	-	0.043	0.533
n261	11	139	QTM#0	Patch	2	1.722	0.002	0.068	-	0.043	0.533
n261	14	142	QTM#0	Patch	4	1.553	0.005	0.095	-	0.070	0.652
n261	15	143	QTM#0	Patch	4	1.981	0.004	0.052	-	0.087	0.740
n261	16	144	QTM#0	Patch	4	1.940	0.004	0.058	-	0.080	0.593
n261	17	145	QTM#0	Patch	4	1.840	0.005	0.161	-	0.079	0.406
n261	18	146	QTM#0	Patch	4	1.978	0.004	0.071	-	0.063	0.562
n261	20	148	QTM#0	Patch	4	1.540	0.005	0.103	-	0.088	0.648
n261	21	149	QTM#0	Patch	4	2.203	0.003	0.027	-	0.082	0.662
n261	22	150	QTM#0	Patch	4	1.685	0.006	0.102	-	0.078	0.451
n261	23	151	QTM#0	Patch	4	1.893	0.004	0.133	-	0.056	0.493

QTM#0 Mid Ch.

n261 Mid Ch (27.925 GHz)						Power Density [mW/cm ²] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n261	1		QTM#0	Patch	1	0.358	0.001	0.011	-	0.009	0.079
n261	5		QTM#0	Patch	2	0.854	0.002	0.026	-	0.032	0.214
n261	6		QTM#0	Patch	2	0.837	0.001	0.010	-	0.036	0.210
n261	7		QTM#0	Patch	2	0.614	0.001	0.036	-	0.028	0.116
n261	10		QTM#0	Patch	2	0.917	0.001	0.022	-	0.028	0.239
n261	11		QTM#0	Patch	2	0.744	0.001	0.018	-	0.033	0.162
n261	14		QTM#0	Patch	4	0.866	0.002	0.082	-	0.049	0.280
n261	15		QTM#0	Patch	4	0.896	0.002	0.039	-	0.064	0.321
n261	16		QTM#0	Patch	4	1.020	0.001	0.011	-	0.069	0.297
n261	17		QTM#0	Patch	4	1.248	0.002	0.028	-	0.068	0.194
n261	18		QTM#0	Patch	4	0.895	0.003	0.040	-	0.034	0.199
n261	20		QTM#0	Patch	4	0.886	0.003	0.054	-	0.070	0.295
n261	21		QTM#0	Patch	4	0.925	0.002	0.026	-	0.064	0.334
n261	22		QTM#0	Patch	4	1.178	0.002	0.021	-	0.067	0.232
n261	23		QTM#0	Patch	4	1.161	0.003	0.021	-	0.033	0.209
n261		129	QTM#0	Patch	1	0.310	0.001	0.010	-	0.015	0.051
n261		133	QTM#0	Patch	2	1.088	0.001	0.005	-	0.016	0.260
n261		134	QTM#0	Patch	2	0.783	0.001	0.047	-	0.011	0.222
n261		135	QTM#0	Patch	2	0.811	0.002	0.033	-	0.025	0.199
n261		138	QTM#0	Patch	2	0.988	0.001	0.021	-	0.015	0.218
n261		139	QTM#0	Patch	2	0.747	0.001	0.070	-	0.014	0.185
n261		142	QTM#0	Patch	4	0.883	0.003	0.012	-	0.076	0.352
n261		143	QTM#0	Patch	4	1.037	0.002	0.014	-	0.058	0.300
n261		144	QTM#0	Patch	4	1.187	0.002	0.033	-	0.045	0.274
n261		145	QTM#0	Patch	4	0.566	0.004	0.166	-	0.045	0.213
n261		146	QTM#0	Patch	4	1.054	0.002	0.033	-	0.072	0.372
n261		148	QTM#0	Patch	4	0.930	0.003	0.012	-	0.071	0.329
n261		149	QTM#0	Patch	4	1.221	0.001	0.012	-	0.057	0.301
n261		150	QTM#0	Patch	4	0.912	0.004	0.093	-	0.035	0.235
n261		151	QTM#0	Patch	4	0.794	0.003	0.105	-	0.066	0.294
n261	1	129	QTM#0	Patch	1	0.380	0.002	0.030	-	0.024	0.090
n261	5	133	QTM#0	Patch	2	1.428	0.003	0.018	-	0.057	0.292
n261	6	134	QTM#0	Patch	2	1.530	0.002	0.052	-	0.045	0.197
n261	7	135	QTM#0	Patch	2	1.177	0.002	0.057	-	0.034	0.322
n261	10	138	QTM#0	Patch	2	1.641	0.004	0.042	-	0.048	0.569
n261	11	139	QTM#0	Patch	2	1.241	0.002	0.067	-	0.043	0.392
n261	14	142	QTM#0	Patch	4	1.652	0.006	0.095	-	0.092	0.716
n261	15	143	QTM#0	Patch	4	1.885	0.004	0.060	-	0.088	0.697
n261	16	144	QTM#0	Patch	4	1.842	0.005	0.048	-	0.103	0.584
n261	17	145	QTM#0	Patch	4	1.821	0.006	0.151	-	0.085	0.368
n261	18	146	QTM#0	Patch	4	1.694	0.004	0.108	-	0.066	0.615
n261	20	148	QTM#0	Patch	4	1.468	0.007	0.111	-	0.110	0.676
n261	21	149	QTM#0	Patch	4	2.140	0.003	0.039	-	0.077	0.615
n261	22	150	QTM#0	Patch	4	1.435	0.009	0.085	-	0.105	0.481
n261	23	151	QTM#0	Patch	4	1.717	0.006	0.191	-	0.067	0.490

QTM#0 High Ch

n261 High Ch (28.29 GHz)						Power Density [mW/cm^2] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n261	1		QTM#0	Patch	1	0.353	0.001	0.011	-	0.008	0.070
n261	5		QTM#0	Patch	2	0.837	0.001	0.025	-	0.044	0.198
n261	6		QTM#0	Patch	2	0.823	0.001	0.016	-	0.034	0.178
n261	7		QTM#0	Patch	2	0.577	0.001	0.024	-	0.020	0.089
n261	10		QTM#0	Patch	2	0.882	0.001	0.026	-	0.035	0.222
n261	11		QTM#0	Patch	2	0.728	0.001	0.014	-	0.034	0.128
n261	14		QTM#0	Patch	4	0.867	0.003	0.076	-	0.049	0.250
n261	15		QTM#0	Patch	4	0.854	0.002	0.042	-	0.052	0.313
n261	16		QTM#0	Patch	4	0.930	0.001	0.011	-	0.065	0.321
n261	17		QTM#0	Patch	4	1.144	0.002	0.025	-	0.057	0.216
n261	18		QTM#0	Patch	4	0.809	0.003	0.045	-	0.022	0.174
n261	20		QTM#0	Patch	4	0.855	0.002	0.054	-	0.053	0.278
n261	21		QTM#0	Patch	4	0.848	0.002	0.028	-	0.055	0.335
n261	22		QTM#0	Patch	4	1.099	0.002	0.019	-	0.063	0.285
n261	23		QTM#0	Patch	4	1.076	0.003	0.030	-	0.036	0.195
n261		129	QTM#0	Patch	1	0.286	0.001	0.009	-	0.015	0.034
n261		133	QTM#0	Patch	2	1.034	0.001	0.008	-	0.017	0.246
n261		134	QTM#0	Patch	2	0.778	0.002	0.047	-	0.015	0.206
n261		135	QTM#0	Patch	2	0.749	0.002	0.033	-	0.023	0.172
n261		138	QTM#0	Patch	2	0.966	0.001	0.023	-	0.018	0.206
n261		139	QTM#0	Patch	2	0.772	0.002	0.068	-	0.010	0.171
n261		142	QTM#0	Patch	4	0.855	0.002	0.015	-	0.071	0.323
n261		143	QTM#0	Patch	4	0.984	0.001	0.017	-	0.050	0.300
n261		144	QTM#0	Patch	4	1.105	0.002	0.046	-	0.047	0.259
n261		145	QTM#0	Patch	4	0.540	0.004	0.142	-	0.036	0.214
n261		146	QTM#0	Patch	4	1.029	0.002	0.043	-	0.073	0.305
n261		148	QTM#0	Patch	4	0.902	0.002	0.015	-	0.065	0.323
n261		149	QTM#0	Patch	4	1.103	0.001	0.020	-	0.054	0.285
n261		150	QTM#0	Patch	4	0.907	0.004	0.096	-	0.030	0.226
n261		151	QTM#0	Patch	4	0.760	0.003	0.108	-	0.054	0.249
n261	1	129	QTM#0	Patch	1	0.382	0.001	0.025	-	0.028	0.078
n261	5	133	QTM#0	Patch	2	1.338	0.003	0.029	-	0.068	0.228
n261	6	134	QTM#0	Patch	2	1.491	0.002	0.055	-	0.041	0.166
n261	7	135	QTM#0	Patch	2	1.130	0.004	0.062	-	0.038	0.307
n261	10	138	QTM#0	Patch	2	1.604	0.003	0.047	-	0.055	0.534
n261	11	139	QTM#0	Patch	2	1.319	0.004	0.080	-	0.057	0.348
n261	14	142	QTM#0	Patch	4	1.679	0.005	0.100	-	0.084	0.772
n261	15	143	QTM#0	Patch	4	1.699	0.003	0.071	-	0.080	0.732
n261	16	144	QTM#0	Patch	4	1.847	0.004	0.065	-	0.118	0.537
n261	17	145	QTM#0	Patch	4	1.744	0.007	0.151	-	0.087	0.384
n261	18	146	QTM#0	Patch	4	1.660	0.007	0.133	-	0.062	0.542
n261	20	148	QTM#0	Patch	4	1.410	0.005	0.118	-	0.098	0.686
n261	21	149	QTM#0	Patch	4	2.033	0.003	0.038	-	0.084	0.605
n261	22	150	QTM#0	Patch	4	1.416	0.006	0.093	-	0.115	0.514
n261	23	151	QTM#0	Patch	4	1.667	0.009	0.212	-	0.054	0.474

Table 3. PD of QTM#0 – patch antenna (39GHz)

QTM#0 Low Ch

n260 Low Ch (37.05 GHz)						Power Density [mW/cm ²] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n260	1		QTM#0	Patch	1	0.493	0.001	0.009	-	0.004	0.051
n260	5		QTM#0	Patch	2	0.958	0.001	0.037	-	0.011	0.101
n260	6		QTM#0	Patch	2	1.115	0.002	0.024	-	0.026	0.085
n260	7		QTM#0	Patch	2	1.107	0.002	0.044	-	0.012	0.100
n260	10		QTM#0	Patch	2	1.550	0.002	0.047	-	0.021	0.082
n260	11		QTM#0	Patch	2	1.097	0.002	0.038	-	0.022	0.108
n260	14		QTM#0	Patch	4	1.451	0.003	0.069	-	0.037	0.250
n260	15		QTM#0	Patch	4	1.295	0.003	0.061	-	0.024	0.137
n260	16		QTM#0	Patch	4	2.054	0.002	0.052	-	0.027	0.186
n260	17		QTM#0	Patch	4	2.103	0.004	0.085	-	0.037	0.262
n260	18		QTM#0	Patch	4	1.579	0.002	0.073	-	0.033	0.279
n260	20		QTM#0	Patch	4	1.356	0.002	0.059	-	0.033	0.194
n260	21		QTM#0	Patch	4	1.653	0.004	0.084	-	0.019	0.163
n260	22		QTM#0	Patch	4	2.346	0.005	0.026	-	0.027	0.251
n260	23		QTM#0	Patch	4	1.824	0.003	0.089	-	0.037	0.345
n260		129	QTM#0	Patch	1	0.572	0.001	0.005	-	0.006	0.076
n260		133	QTM#0	Patch	2	0.997	0.001	0.031	-	0.018	0.072
n260		134	QTM#0	Patch	2	1.242	0.002	0.028	-	0.009	0.177
n260		135	QTM#0	Patch	2	1.464	0.001	0.033	-	0.019	0.166
n260		138	QTM#0	Patch	2	1.384	0.001	0.018	-	0.011	0.142
n260		139	QTM#0	Patch	2	1.227	0.002	0.046	-	0.014	0.179
n260		142	QTM#0	Patch	4	1.116	0.002	0.108	-	0.044	0.178
n260		143	QTM#0	Patch	4	1.134	0.002	0.064	-	0.027	0.172
n260		144	QTM#0	Patch	4	1.444	0.002	0.020	-	0.050	0.218
n260		145	QTM#0	Patch	4	1.320	0.004	0.119	-	0.038	0.242
n260		146	QTM#0	Patch	4	1.197	0.002	0.090	-	0.040	0.171
n260		148	QTM#0	Patch	4	1.223	0.002	0.088	-	0.045	0.158
n260		149	QTM#0	Patch	4	1.292	0.002	0.016	-	0.044	0.173
n260		150	QTM#0	Patch	4	1.845	0.003	0.086	-	0.061	0.295
n260		151	QTM#0	Patch	4	1.308	0.003	0.112	-	0.043	0.171
n260	1	129	QTM#0	Patch	1	1.308	0.003	0.112	-	0.043	0.171
n260	5	133	QTM#0	Patch	2	1.652	0.003	0.082	-	0.029	0.146
n260	6	134	QTM#0	Patch	2	2.239	0.003	0.046	-	0.042	0.180
n260	7	135	QTM#0	Patch	2	2.251	0.002	0.115	-	0.026	0.319
n260	10	138	QTM#0	Patch	2	2.008	0.003	0.040	-	0.028	0.230
n260	11	139	QTM#0	Patch	2	2.151	0.003	0.061	-	0.041	0.201
n260	14	142	QTM#0	Patch	4	2.836	0.005	0.261	-	0.080	0.569
n260	15	143	QTM#0	Patch	4	2.320	0.005	0.151	-	0.044	0.278
n260	16	144	QTM#0	Patch	4	2.844	0.004	0.070	-	0.083	0.489
n260	17	145	QTM#0	Patch	4	3.454	0.010	0.335	-	0.099	0.539
n260	18	146	QTM#0	Patch	4	2.442	0.006	0.220	-	0.059	0.464
n260	20	148	QTM#0	Patch	4	2.253	0.006	0.183	-	0.072	0.407
n260	21	149	QTM#0	Patch	4	2.513	0.006	0.095	-	0.060	0.346
n260	22	150	QTM#0	Patch	4	3.846	0.005	0.180	-	0.118	0.346
n260	23	151	QTM#0	Patch	4	2.782	0.006	0.313	-	0.062	0.623

QTM#0 Mid Ch

n260 Mid Ch (38.5 GHz)						Power Density [mW/cm ²] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n260	1		QTM#0	Patch	1	0.598	0.001	0.006	-	0.005	0.052
n260	5		QTM#0	Patch	2	0.957	0.001	0.040	-	0.017	0.121
n260	6		QTM#0	Patch	2	1.158	0.002	0.029	-	0.012	0.130
n260	7		QTM#0	Patch	2	1.049	0.002	0.044	-	0.014	0.117
n260	10		QTM#0	Patch	2	1.650	0.002	0.059	-	0.012	0.080
n260	11		QTM#0	Patch	2	1.153	0.002	0.036	-	0.015	0.167
n260	14		QTM#0	Patch	4	1.728	0.004	0.092	-	0.033	0.397
n260	15		QTM#0	Patch	4	1.374	0.004	0.067	-	0.018	0.165
n260	16		QTM#0	Patch	4	1.965	0.003	0.070	-	0.025	0.193
n260	17		QTM#0	Patch	4	2.291	0.003	0.075	-	0.038	0.306
n260	18		QTM#0	Patch	4	1.660	0.003	0.099	-	0.026	0.348
n260	20		QTM#0	Patch	4	1.489	0.003	0.091	-	0.023	0.331
n260	21		QTM#0	Patch	4	1.511	0.004	0.104	-	0.023	0.153
n260	22		QTM#0	Patch	4	2.518	0.002	0.034	-	0.023	0.262
n260	23		QTM#0	Patch	4	2.026	0.003	0.089	-	0.038	0.355
n260		129	QTM#0	Patch	1	0.690	0.001	0.008	-	0.006	0.105
n260		133	QTM#0	Patch	2	1.033	0.001	0.051	-	0.015	0.062
n260		134	QTM#0	Patch	2	1.367	0.002	0.045	-	0.018	0.244
n260		135	QTM#0	Patch	2	1.237	0.002	0.036	-	0.015	0.196
n260		138	QTM#0	Patch	2	1.274	0.001	0.035	-	0.012	0.184
n260		139	QTM#0	Patch	2	1.125	0.001	0.045	-	0.015	0.280
n260		142	QTM#0	Patch	4	1.198	0.003	0.136	-	0.029	0.320
n260		143	QTM#0	Patch	4	1.015	0.003	0.085	-	0.042	0.181
n260		144	QTM#0	Patch	4	1.352	0.002	0.031	-	0.058	0.250
n260		145	QTM#0	Patch	4	1.712	0.003	0.146	-	0.045	0.275
n260		146	QTM#0	Patch	4	1.274	0.002	0.118	-	0.028	0.262
n260		148	QTM#0	Patch	4	1.184	0.002	0.104	-	0.037	0.246
n260		149	QTM#0	Patch	4	1.329	0.002	0.042	-	0.031	0.274
n260		150	QTM#0	Patch	4	1.811	0.004	0.094	-	0.074	0.231
n260		151	QTM#0	Patch	4	1.224	0.002	0.138	-	0.029	0.302
n260	1	129	QTM#0	Patch	1	0.927	0.002	0.015	-	0.020	0.156
n260	5	133	QTM#0	Patch	2	1.533	0.004	0.136	-	0.033	0.177
n260	6	134	QTM#0	Patch	2	2.814	0.004	0.063	-	0.036	0.131
n260	7	135	QTM#0	Patch	2	2.523	0.004	0.124	-	0.028	0.502
n260	10	138	QTM#0	Patch	2	2.208	0.003	0.030	-	0.026	0.184
n260	11	139	QTM#0	Patch	2	2.453	0.004	0.076	-	0.030	0.208
n260	14	142	QTM#0	Patch	4	3.296	0.007	0.384	-	0.053	0.968
n260	15	143	QTM#0	Patch	4	2.899	0.010	0.261	-	0.042	0.571
n260	16	144	QTM#0	Patch	4	3.157	0.004	0.143	-	0.053	0.461
n260	17	145	QTM#0	Patch	4	4.076	0.006	0.329	-	0.103	0.697
n260	18	146	QTM#0	Patch	4	2.830	0.007	0.358	-	0.046	0.877
n260	20	148	QTM#0	Patch	4	2.994	0.008	0.306	-	0.048	0.836
n260	21	149	QTM#0	Patch	4	2.374	0.006	0.179	-	0.051	0.380
n260	22	150	QTM#0	Patch	4	3.836	0.005	0.153	-	0.095	0.582
n260	23	151	QTM#0	Patch	4	3.222	0.007	0.368	-	0.079	0.949

QTM#0 High Ch

n260 High Ch (39.95 GHz)						Power Density [mW/cm ²] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n260	1		QTM#0	Patch	1	0.600	0.001	0.006	-	0.004	0.087
n260	5		QTM#0	Patch	2	0.952	0.002	0.027	-	0.014	0.097
n260	6		QTM#0	Patch	2	1.243	0.001	0.046	-	0.007	0.150
n260	7		QTM#0	Patch	2	1.129	0.002	0.037	-	0.010	0.097
n260	10		QTM#0	Patch	2	1.673	0.001	0.051	-	0.010	0.076
n260	11		QTM#0	Patch	2	1.179	0.003	0.037	-	0.011	0.089
n260	14		QTM#0	Patch	4	1.735	0.006	0.080	-	0.038	0.216
n260	15		QTM#0	Patch	4	1.062	0.004	0.082	-	0.027	0.175
n260	16		QTM#0	Patch	4	1.708	0.002	0.105	-	0.015	0.183
n260	17		QTM#0	Patch	4	2.460	0.004	0.045	-	0.040	0.264
n260	18		QTM#0	Patch	4	1.420	0.005	0.087	-	0.032	0.245
n260	20		QTM#0	Patch	4	1.214	0.005	0.090	-	0.027	0.233
n260	21		QTM#0	Patch	4	1.202	0.004	0.086	-	0.014	0.166
n260	22		QTM#0	Patch	4	2.277	0.002	0.064	-	0.024	0.227
n260	23		QTM#0	Patch	4	2.113	0.005	0.058	-	0.044	0.226
n260		129	QTM#0	Patch	1	0.755	0.000	0.008	-	0.005	0.083
n260		133	QTM#0	Patch	2	1.014	0.001	0.044	-	0.014	0.096
n260		134	QTM#0	Patch	2	1.306	0.002	0.034	-	0.012	0.215
n260		135	QTM#0	Patch	2	1.049	0.001	0.043	-	0.013	0.154
n260		138	QTM#0	Patch	2	1.017	0.002	0.047	-	0.013	0.188
n260		139	QTM#0	Patch	2	1.200	0.001	0.040	-	0.013	0.184
n260		142	QTM#0	Patch	4	1.205	0.002	0.130	-	0.026	0.156
n260		143	QTM#0	Patch	4	1.058	0.002	0.100	-	0.024	0.153
n260		144	QTM#0	Patch	4	1.390	0.002	0.039	-	0.044	0.226
n260		145	QTM#0	Patch	4	1.610	0.002	0.115	-	0.048	0.186
n260		146	QTM#0	Patch	4	1.089	0.002	0.129	-	0.023	0.140
n260		148	QTM#0	Patch	4	0.905	0.002	0.123	-	0.019	0.140
n260		149	QTM#0	Patch	4	1.044	0.003	0.053	-	0.019	0.216
n260		150	QTM#0	Patch	4	1.697	0.002	0.063	-	0.057	0.219
n260		151	QTM#0	Patch	4	1.262	0.002	0.112	-	0.033	0.159
n260	1	129	QTM#0	Patch	1	1.051	0.002	0.011	-	0.011	0.134
n260	5	133	QTM#0	Patch	2	1.424	0.004	0.065	-	0.022	0.208
n260	6	134	QTM#0	Patch	2	2.749	0.003	0.066	-	0.026	0.178
n260	7	135	QTM#0	Patch	2	3.076	0.003	0.136	-	0.026	0.412
n260	10	138	QTM#0	Patch	2	2.317	0.003	0.021	-	0.026	0.127
n260	11	139	QTM#0	Patch	2	2.811	0.004	0.065	-	0.040	0.149
n260	14	142	QTM#0	Patch	4	3.578	0.009	0.251	-	0.059	0.447
n260	15	143	QTM#0	Patch	4	3.345	0.007	0.224	-	0.050	0.535
n260	16	144	QTM#0	Patch	4	2.623	0.005	0.208	-	0.035	0.517
n260	17	145	QTM#0	Patch	4	3.658	0.006	0.166	-	0.065	0.590
n260	18	146	QTM#0	Patch	4	3.500	0.011	0.265	-	0.052	0.445
n260	20	148	QTM#0	Patch	4	3.524	0.012	0.256	-	0.046	0.421
n260	21	149	QTM#0	Patch	4	2.035	0.007	0.208	-	0.039	0.493
n260	22	150	QTM#0	Patch	4	3.394	0.005	0.132	-	0.071	0.456
n260	23	151	QTM#0	Patch	4	3.502	0.007	0.183	-	0.063	0.501

2.3.2 QTM#1 – Patch Antenna

Table 4 & Table 5 show the PD simulation evaluation of QTM#1 patch antenna at 28GHz / 39GHz for the corresponding evaluation surface specified in Table 1.

Table 4. PD of QTM#1 – patch antenna (28GHz)

QTM#1 Low Ch

n261 Low Ch (27.56 GHz)						Power Density [mW/cm ²] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n261	0		QTM#1	Patch	1	0.004	0.044	0.088	-	0.004	0.536
n261	2		QTM#1	Patch	2	0.003	0.032	0.284	-	0.011	1.210
n261	3		QTM#1	Patch	2	0.003	0.014	0.306	-	0.014	0.995
n261	4		QTM#1	Patch	2	0.005	0.028	0.203	-	0.014	1.153
n261	8		QTM#1	Patch	2	0.004	0.015	0.296	-	0.012	0.962
n261	9		QTM#1	Patch	2	0.002	0.014	0.315	-	0.016	1.011
n261	12		QTM#1	Patch	4	0.006	0.027	0.281	-	0.029	1.078
n261	13		QTM#1	Patch	4	0.006	0.039	0.323	-	0.036	1.291
n261	19		QTM#1	Patch	4	0.007	0.024	0.303	-	0.031	1.180
n261		128	QTM#1	Patch	1	0.004	0.014	0.087	-	0.003	0.520
n261		130	QTM#1	Patch	2	0.006	0.055	0.068	-	0.009	0.625
n261		131	QTM#1	Patch	2	0.010	0.049	0.242	-	0.009	0.631
n261		132	QTM#1	Patch	2	0.006	0.042	0.257	-	0.013	0.876
n261		136	QTM#1	Patch	2	0.009	0.048	0.251	-	0.010	0.684
n261		137	QTM#1	Patch	2	0.009	0.048	0.251	-	0.010	0.684
n261		140	QTM#1	Patch	4	0.016	0.093	0.309	-	0.027	0.938
n261		141	QTM#1	Patch	4	0.013	0.089	0.304	-	0.025	1.198
n261		147	QTM#1	Patch	4	0.017	0.094	0.282	-	0.025	0.891
n261	0	128	QTM#1	Patch	1	0.006	0.071	0.116	-	0.009	0.582
n261	2	130	QTM#1	Patch	2	0.013	0.049	0.325	-	0.015	1.160
n261	3	131	QTM#1	Patch	2	0.013	0.080	0.493	-	0.018	1.605
n261	4	132	QTM#1	Patch	2	0.008	0.072	0.264	-	0.016	1.393
n261	8	136	QTM#1	Patch	2	0.018	0.033	0.588	-	0.024	1.497
n261	9	137	QTM#1	Patch	2	0.008	0.089	0.532	-	0.017	1.543
n261	12	140	QTM#1	Patch	4	0.029	0.099	0.490	-	0.040	2.133
n261	13	141	QTM#1	Patch	4	0.021	0.126	0.571	-	0.042	2.187
n261	19	147	QTM#1	Patch	4	0.027	0.103	0.489	-	0.038	1.790

QTM#1 Mid Ch

n261 Mid Ch (27.925 GHz)						Power Density [mW/cm ²] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n261	0		QTM#1	Patch	1	0.004	0.039	0.092	-	0.004	0.500
n261	2		QTM#1	Patch	2	0.003	0.034	0.281	-	0.010	1.123
n261	3		QTM#1	Patch	2	0.003	0.011	0.275	-	0.011	1.033
n261	4		QTM#1	Patch	2	0.005	0.027	0.199	-	0.013	1.113
n261	8		QTM#1	Patch	2	0.004	0.012	0.268	-	0.010	0.990
n261	9		QTM#1	Patch	2	0.002	0.011	0.284	-	0.012	1.087
n261	12		QTM#1	Patch	4	0.007	0.019	0.291	-	0.025	0.998
n261	13		QTM#1	Patch	4	0.007	0.044	0.316	-	0.028	1.171
n261	19		QTM#1	Patch	4	0.008	0.023	0.299	-	0.024	1.080
n261		128	QTM#1	Patch	1	0.003	0.015	0.092	-	0.003	0.501
n261		130	QTM#1	Patch	2	0.007	0.060	0.065	-	0.008	0.617
n261		131	QTM#1	Patch	2	0.009	0.045	0.282	-	0.014	0.608
n261		132	QTM#1	Patch	2	0.006	0.041	0.295	-	0.018	0.834
n261		136	QTM#1	Patch	2	0.008	0.045	0.292	-	0.015	0.660
n261		137	QTM#1	Patch	2	0.008	0.045	0.292	-	0.015	0.660
n261		140	QTM#1	Patch	4	0.016	0.088	0.380	-	0.030	0.840
n261		141	QTM#1	Patch	4	0.012	0.090	0.373	-	0.028	1.080
n261		147	QTM#1	Patch	4	0.016	0.091	0.346	-	0.027	0.802
n261	0	128	QTM#1	Patch	1	0.005	0.062	0.141	-	0.008	0.551
n261	2	130	QTM#1	Patch	2	0.014	0.065	0.308	-	0.014	1.059
n261	3	131	QTM#1	Patch	2	0.015	0.079	0.499	-	0.020	1.664
n261	4	132	QTM#1	Patch	2	0.009	0.066	0.296	-	0.021	1.423
n261	8	136	QTM#1	Patch	2	0.016	0.034	0.608	-	0.034	1.504
n261	9	137	QTM#1	Patch	2	0.010	0.082	0.510	-	0.016	1.572
n261	12	140	QTM#1	Patch	4	0.023	0.103	0.572	-	0.046	2.170
n261	13	141	QTM#1	Patch	4	0.022	0.151	0.643	-	0.053	2.194
n261	19	147	QTM#1	Patch	4	0.026	0.116	0.572	-	0.047	1.795

QTM#1 High Ch

n261 High Ch (28.29 GHz)						Power Density [mW/cm ²] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n261	0		QTM#1	Patch	1	0.004	0.033	0.087	-	0.005	0.448
n261	2		QTM#1	Patch	2	0.004	0.032	0.269	-	0.012	1.003
n261	3		QTM#1	Patch	2	0.002	0.012	0.228	-	0.010	1.024
n261	4		QTM#1	Patch	2	0.006	0.025	0.184	-	0.014	1.014
n261	8		QTM#1	Patch	2	0.003	0.015	0.219	-	0.009	0.969
n261	9		QTM#1	Patch	2	0.002	0.011	0.238	-	0.011	1.073
n261	12		QTM#1	Patch	4	0.007	0.017	0.293	-	0.023	0.931
n261	13		QTM#1	Patch	4	0.006	0.041	0.290	-	0.027	1.045
n261	19		QTM#1	Patch	4	0.008	0.021	0.293	-	0.024	0.958
n261		128	QTM#1	Patch	1	0.003	0.013	0.096	-	0.004	0.484
n261		130	QTM#1	Patch	2	0.007	0.061	0.052	-	0.007	0.611
n261		131	QTM#1	Patch	2	0.008	0.043	0.296	-	0.015	0.605
n261		132	QTM#1	Patch	2	0.006	0.043	0.302	-	0.019	0.810
n261		136	QTM#1	Patch	2	0.007	0.044	0.304	-	0.017	0.656
n261		137	QTM#1	Patch	2	0.007	0.044	0.304	-	0.017	0.656
n261		140	QTM#1	Patch	4	0.015	0.094	0.405	-	0.031	0.799
n261		141	QTM#1	Patch	4	0.012	0.093	0.395	-	0.030	1.023
n261		147	QTM#1	Patch	4	0.015	0.097	0.381	-	0.029	0.765
n261	0	128	QTM#1	Patch	1	0.005	0.048	0.150	-	0.010	0.525
n261	2	130	QTM#1	Patch	2	0.014	0.075	0.283	-	0.015	0.975
n261	3	131	QTM#1	Patch	2	0.015	0.078	0.447	-	0.019	1.637
n261	4	132	QTM#1	Patch	2	0.010	0.063	0.304	-	0.024	1.393
n261	8	136	QTM#1	Patch	2	0.011	0.035	0.626	-	0.031	1.548
n261	9	137	QTM#1	Patch	2	0.011	0.082	0.406	-	0.017	1.480
n261	12	140	QTM#1	Patch	4	0.019	0.120	0.631	-	0.051	2.024
n261	13	141	QTM#1	Patch	4	0.019	0.168	0.703	-	0.057	2.176
n261	19	147	QTM#1	Patch	4	0.022	0.128	0.643	-	0.051	1.698

Table 5. PD of QTM#1 – patch antenna (39GHz)

QTM#1 Low Ch

n260 Low Ch (37.05 GHz)						Power Density [mW/cm ²] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n260	0		QTM#1	Patch	1	0.003	0.016	0.093	-	0.005	0.571
n260	2		QTM#1	Patch	2	0.006	0.060	0.241	-	0.010	1.016
n260	3		QTM#1	Patch	2	0.002	0.034	0.122	-	0.009	0.826
n260	4		QTM#1	Patch	2	0.002	0.034	0.122	-	0.009	0.826
n260	8		QTM#1	Patch	2	0.002	0.034	0.122	-	0.009	0.826
n260	9		QTM#1	Patch	2	0.002	0.034	0.122	-	0.009	0.826
n260	12		QTM#1	Patch	4	0.008	0.095	0.340	-	0.016	1.733
n260	13		QTM#1	Patch	4	0.009	0.087	0.350	-	0.017	1.767
n260	19		QTM#1	Patch	4	0.009	0.095	0.353	-	0.016	1.737
n260		128	QTM#1	Patch	1	0.002	0.011	0.037	-	0.002	0.365
n260		130	QTM#1	Patch	2	0.003	0.040	0.143	-	0.011	0.876
n260		131	QTM#1	Patch	2	0.003	0.042	0.136	-	0.011	0.894
n260		132	QTM#1	Patch	2	0.012	0.043	0.143	-	0.008	0.926
n260		136	QTM#1	Patch	2	0.003	0.042	0.136	-	0.011	0.894
n260		137	QTM#1	Patch	2	0.003	0.040	0.143	-	0.011	0.876
n260		140	QTM#1	Patch	4	0.010	0.115	0.245	-	0.020	1.257
n260		141	QTM#1	Patch	4	0.012	0.122	0.284	-	0.014	1.139
n260		147	QTM#1	Patch	4	0.012	0.124	0.280	-	0.014	1.104
n260	0	128	QTM#1	Patch	1	0.006	0.023	0.129	-	0.006	0.683
n260	2	130	QTM#1	Patch	2	0.007	0.073	0.538	-	0.016	1.354
n260	3	131	QTM#1	Patch	2	0.005	0.089	0.288	-	0.022	1.680
n260	4	132	QTM#1	Patch	2	0.014	0.098	0.280	-	0.023	1.293
n260	8	136	QTM#1	Patch	2	0.005	0.088	0.265	-	0.016	1.662
n260	9	137	QTM#1	Patch	2	0.006	0.075	0.217	-	0.012	1.644
n260	12	140	QTM#1	Patch	4	0.019	0.105	0.607	-	0.028	2.805
n260	13	141	QTM#1	Patch	4	0.025	0.126	0.626	-	0.030	2.564
n260	19	147	QTM#1	Patch	4	0.020	0.137	0.636	-	0.030	2.634

QTM#1 Mid Ch

n260 Mid Ch (38.5 GHz)						Power Density [mW/cm ²] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n260	0		QTM#1	Patch	1	0.007	0.024	0.093	-	0.006	0.663
n260	2		QTM#1	Patch	2	0.008	0.065	0.247	-	0.010	1.326
n260	3		QTM#1	Patch	2	0.003	0.037	0.177	-	0.017	1.083
n260	4		QTM#1	Patch	2	0.003	0.037	0.177	-	0.017	1.083
n260	8		QTM#1	Patch	2	0.003	0.037	0.177	-	0.017	1.083
n260	9		QTM#1	Patch	2	0.003	0.037	0.177	-	0.017	1.083
n260	12		QTM#1	Patch	4	0.010	0.100	0.350	-	0.018	2.425
n260	13		QTM#1	Patch	4	0.013	0.098	0.368	-	0.018	2.424
n260	19		QTM#1	Patch	4	0.012	0.115	0.377	-	0.018	2.296
n260		128	QTM#1	Patch	1	0.002	0.020	0.045	-	0.002	0.401
n260		130	QTM#1	Patch	2	0.003	0.038	0.189	-	0.011	1.101
n260		131	QTM#1	Patch	2	0.002	0.040	0.176	-	0.011	1.086
n260		132	QTM#1	Patch	2	0.011	0.048	0.152	-	0.013	1.150
n260		136	QTM#1	Patch	2	0.002	0.040	0.176	-	0.011	1.086
n260		137	QTM#1	Patch	2	0.003	0.038	0.189	-	0.011	1.101
n260		140	QTM#1	Patch	4	0.009	0.108	0.279	-	0.024	1.692
n260		141	QTM#1	Patch	4	0.012	0.116	0.262	-	0.023	1.466
n260		147	QTM#1	Patch	4	0.012	0.115	0.257	-	0.021	1.373
n260	0	128	QTM#1	Patch	1	0.009	0.041	0.202	-	0.006	0.914
n260	2	130	QTM#1	Patch	2	0.013	0.091	0.580	-	0.021	1.704
n260	3	131	QTM#1	Patch	2	0.007	0.094	0.297	-	0.027	2.372
n260	4	132	QTM#1	Patch	2	0.010	0.114	0.345	-	0.025	1.858
n260	8	136	QTM#1	Patch	2	0.007	0.080	0.252	-	0.017	2.210
n260	9	137	QTM#1	Patch	2	0.006	0.053	0.226	-	0.009	2.194
n260	12	140	QTM#1	Patch	4	0.029	0.089	0.872	-	0.041	3.327
n260	13	141	QTM#1	Patch	4	0.042	0.106	0.860	-	0.041	2.982
n260	19	147	QTM#1	Patch	4	0.034	0.111	0.905	-	0.040	3.036

QTM#1 High Ch

n260 High Ch (39.95 GHz)						Power Density [mW/cm ²] at 2mm evaluation surface @ 6dBm					
Band	BeamID		ANT Module	ANT Type	Num of Feed	Relative phase worst PD for MIMO					
	Vpol.	Hpol.				Left	Right	Top	Bottom	Front	Back
n260	0		QTM#1	Patch	1	0.006	0.022	0.066	-	0.005	0.760
n260	2		QTM#1	Patch	2	0.005	0.051	0.213	-	0.008	1.422
n260	3		QTM#1	Patch	2	0.004	0.031	0.190	-	0.017	1.078
n260	4		QTM#1	Patch	2	0.004	0.031	0.190	-	0.017	1.078
n260	8		QTM#1	Patch	2	0.004	0.031	0.190	-	0.017	1.078
n260	9		QTM#1	Patch	2	0.004	0.031	0.190	-	0.017	1.078
n260	12		QTM#1	Patch	4	0.011	0.115	0.375	-	0.024	2.484
n260	13		QTM#1	Patch	4	0.011	0.106	0.361	-	0.025	2.587
n260	19		QTM#1	Patch	4	0.011	0.125	0.345	-	0.022	2.379
n260		128	QTM#1	Patch	1	0.003	0.024	0.061	-	0.002	0.521
n260		130	QTM#1	Patch	2	0.004	0.032	0.220	-	0.007	1.055
n260		131	QTM#1	Patch	2	0.005	0.032	0.236	-	0.007	1.064
n260		132	QTM#1	Patch	2	0.008	0.041	0.147	-	0.013	1.010
n260		136	QTM#1	Patch	2	0.005	0.032	0.236	-	0.007	1.064
n260		137	QTM#1	Patch	2	0.004	0.032	0.220	-	0.007	1.055
n260		140	QTM#1	Patch	4	0.008	0.103	0.302	-	0.020	1.678
n260		141	QTM#1	Patch	4	0.011	0.108	0.311	-	0.018	1.349
n260		147	QTM#1	Patch	4	0.011	0.106	0.336	-	0.020	1.301
n260	0	128	QTM#1	Patch	1	0.007	0.060	0.176	-	0.007	1.055
n260	2	130	QTM#1	Patch	2	0.009	0.092	0.451	-	0.021	1.734
n260	3	131	QTM#1	Patch	2	0.015	0.083	0.286	-	0.029	2.540
n260	4	132	QTM#1	Patch	2	0.012	0.091	0.345	-	0.028	1.615
n260	8	136	QTM#1	Patch	2	0.016	0.074	0.191	-	0.023	2.356
n260	9	137	QTM#1	Patch	2	0.014	0.055	0.218	-	0.016	2.115
n260	12	140	QTM#1	Patch	4	0.020	0.108	0.899	-	0.036	3.361
n260	13	141	QTM#1	Patch	4	0.029	0.112	0.864	-	0.033	2.935
n260	19	147	QTM#1	Patch	4	0.025	0.132	0.854	-	0.036	2.917