

1. Simulation methodology for power density (PD)

1.1 Simulation tool

1.1.1 Tool description

The simulation report is used ANSYS Electromagnetics suite version 2019 R3 (HFSS) to calculate power density (PD) for convertible platform with mmWave antenna module. ANSYS HFSS is a 3D full-wave electromagnetic simulator used for antenna and radio frequency structure design of high frequency components. ANSYS Electromagnetics suite version 2019 R3 (HFSS) is implemented based on Finite Element Method (FEM), which operates in the frequency domain.

1.1.2 Mesh and convergence criteria

In order to accurately analyze power density, ANSYS Electromagnetics suite version 2019 R3 (HFSS) uses automatic adaptive meshing techniques, which require you to specify proper geometry, material properties and the desired output. HFSS start with refine initial mesh based on wavelength and determines where the solved fields have errors due to the mesh's failure to capture field gradients accurately. The mesh is automatically refined in those locations, and the new mesh can be solved. This adaptive process continues until convergence criteria, delta S, is met. In ANSYS Electromagnetics suite version 2019 R3 (HFSS), the accuracy of converged results depends on the delta S. Figure 1 is an example of final adaptive mesh of the device (side view).

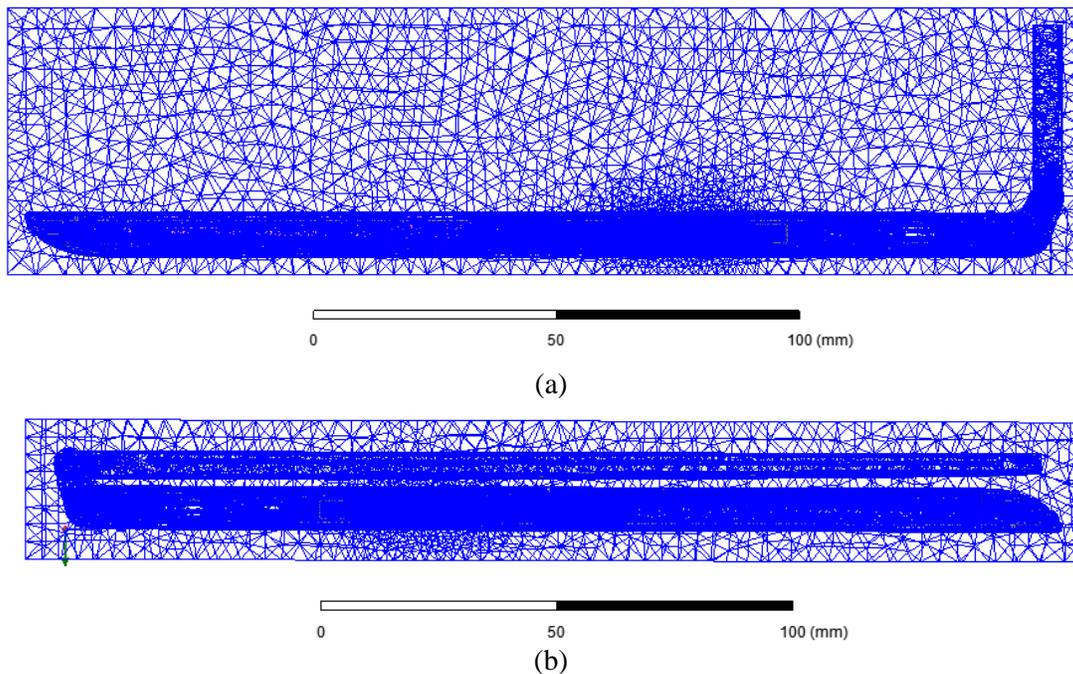


Figure 1 example of the adaptive mesh technique (side view)

(a) Laptop mode (b) Tablet mode

1.1.3 Power density calculation

After solved 3D full-wave electromagnetic simulation, various kinds of physical quantities can be obtained. An electric field (\vec{E}) and a magnetic field (\vec{H}) are needed for calculate power density evaluation. The actual consumption power can be expressed as the real term of the Poynting vector (\vec{S}) from the cross product of \vec{E} and complex conjugation of \vec{H} as shown below:

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

$\langle \vec{S} \rangle$ can be expressed as localized power density based on a peak value of each spatial point on mesh grids, and obtained directly from ANSYS Electromagnetics suite version 2019 R3 (HFSS).

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

$$PD_{av} = \frac{1}{A} \int_A \langle \vec{S} \rangle \cdot ds = \frac{1}{2A} \int_A |Re(\vec{E} \times \vec{H}^*)|$$

, where the spatial-averaged power density (PD_{av}) is total power density value considering on x, y and z components of localized power density $\langle \vec{S} \rangle$ and the evaluated area (A) is 4cm² shown as figure 2.

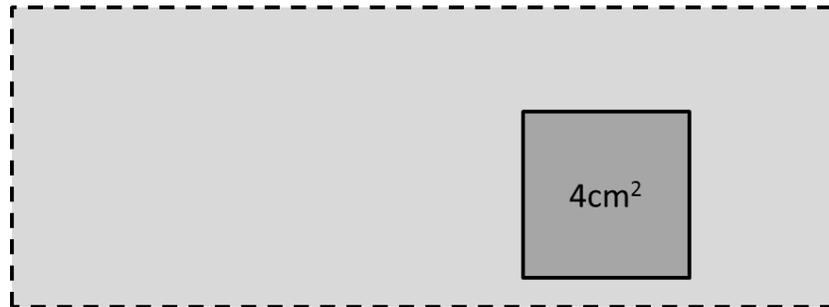


Figure 2 Averaging square size 4cm²

1.2 Simulation setup

1.2.1 3D modeling

The simulation model integrated with three mmWave antenna module shows in Figure 3. The simulation modeling includes complete mechanical structure of device such as Chassis, Main board, LCD, battery, Keyboard, all 5G sub-6/WiFi antennas and mmWave antenna modules called as Ant J, Ant K and Ant L. Ant J is placed on the right side and antennas are facing the right side of the device. Ant K is placed on the rear side under the LCD and antennas are facing the rear side, and Ant L is placed on the left side and antennas are facing the left side of the device.

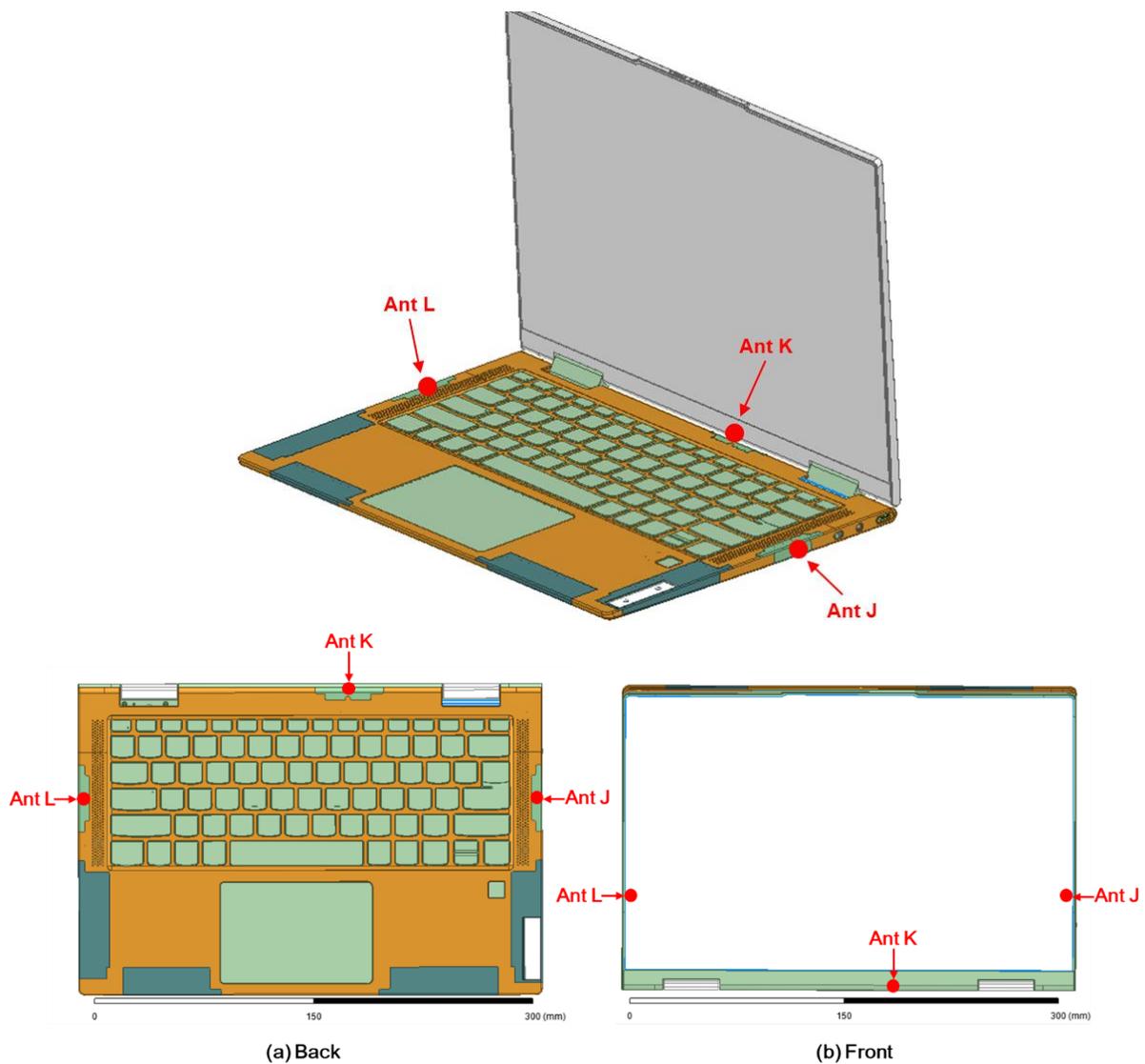


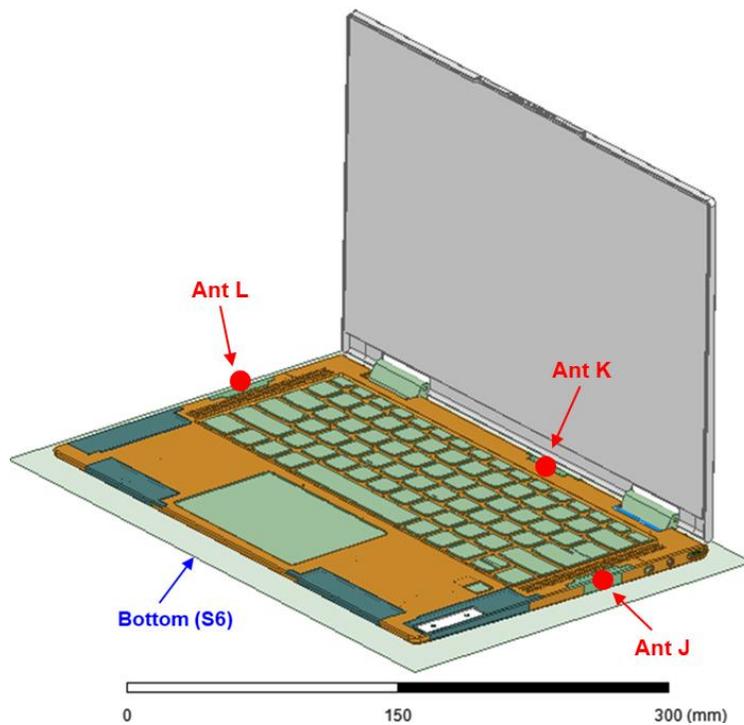
Figure 3 Simulation model which is mounted three mmWave antenna modules.

1.2.2 PD evaluation planes

For this DUT, based on the location of Ant J, Ant K, Ant L, and in different usage mode, the surface planes identified for PD evaluation to determine the worst-case PDs are selected and listed in Table 1. Figure 4 shows the PD evaluation planes and truncation area of the simulation model to find worst case of beamforming IDs. The relevant PD evaluation planes, S1, S2, S3, S4, S5 and S6 are spaced 2mm from the device.

Table 1. PD evaluation planes

	Tablet mode					Laptop
	Top Side	Bottom Side	Left Side	Right Side	Bottom Face	Bottom
	S1	S2	S3	S4	S5	S6
Ant J	O	O	X	O	O	O
Ant K	X	O	O	O	O	O
Ant L	O	O	O	X	O	O



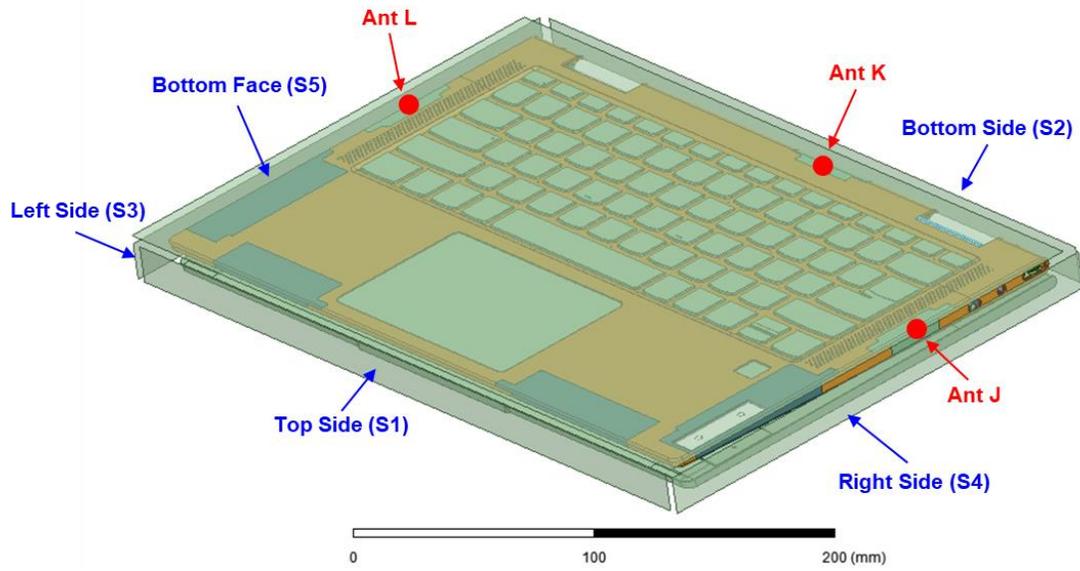


Figure 4. PD evaluation planes

1.2.3 Boundary condition

For radiation boundary, the first 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. ANSYS Electromagnetics suite version 2019 R3 (HFSS) can supports the absorbing boundary condition (ABC) for radiation boundary and make normally a quarter wave length from the radiating structure. In this report, about five wavelengths spacing from the DUT in all directions are applied to ensure convergence

1.2.4 Source excitation condition

Each antenna modules of Ant J, Ant K and Ant L are identical and has 16 feed-in ports. Out of 16 ports, 8 ports are for 1x4 patch array antenna at n260 band and others are for 1x4 patch array antenna at n261 band. Out of 8 ports of the patch array, 4 ports are for vertical polarization and 4 ports are for horizontal polarization.

Figure 5 shows the ANT J module structure. The QTM525-5 module is encrypted in the HFSS simulator and can only check the feed-in location.

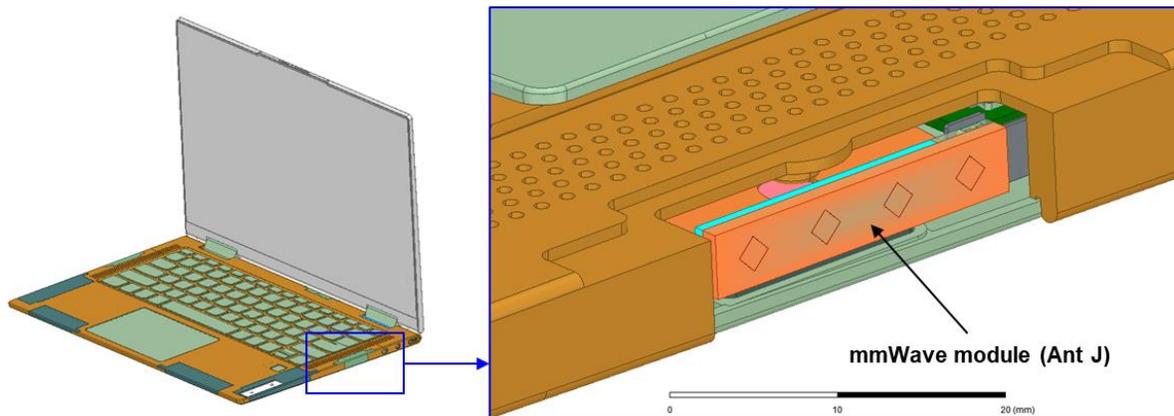


Figure 5. mmWave module (Ant J)

After finished the electromagnetic simulation of mmWave antenna module in HFSS simulator, the magnitude and phase information can be defined at each ports by using “Edit Sources” function in ANSYS Electromagnetics suite 2019 R3(HFSS). Figure 6 shows the mmWave antenna ports excitations in Ant J.

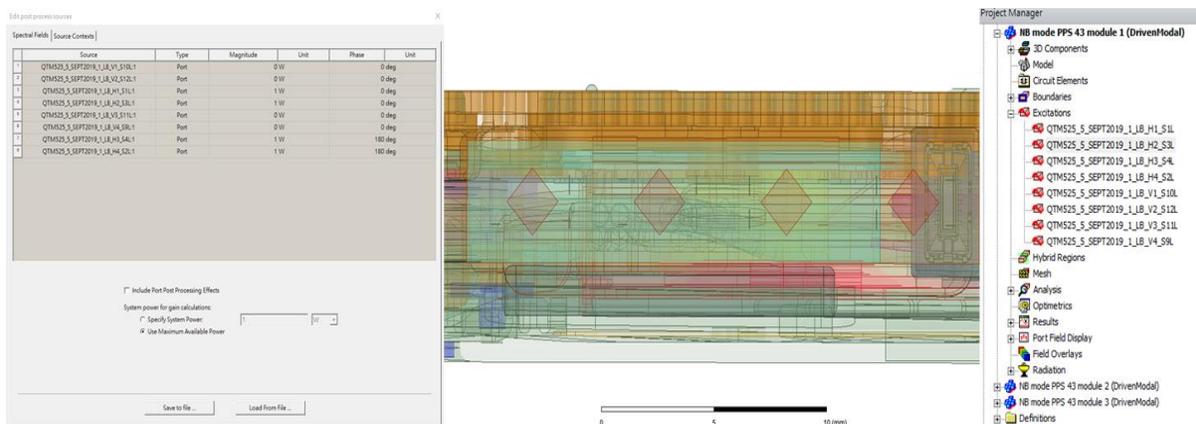


Figure 6. An example of port excitation (Ant J)

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 sets 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

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}) had mentioned in previous chapter. The real term of the Poynting vector can be described as the localized power density or peak power density. Using the localized power density, the total spatial-averaged power density can be obtained by the integral of 4 cm^2 of the localized power density result. Figure 7 shows examples of the distribution plot of the localized and averaged power density.

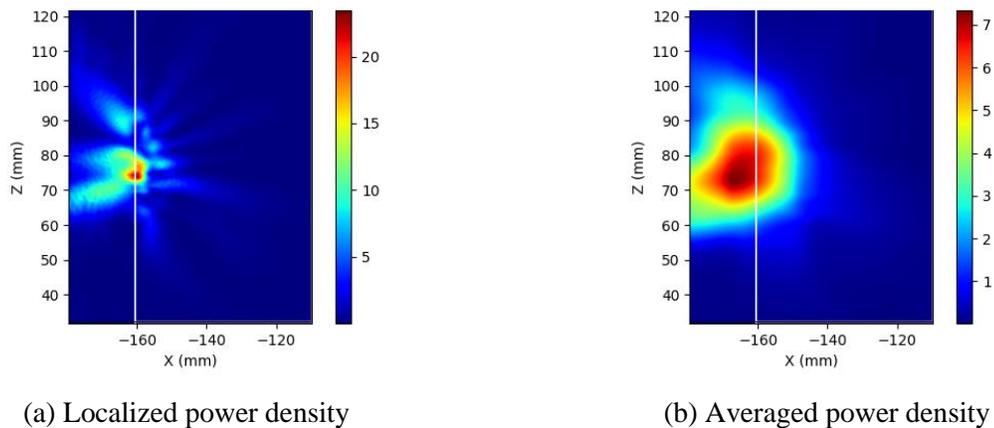


Figure 7. Power density distribution example

2.2 Comparison between simulation and measurement

The simulated and measured power density distributions are compared to each mmWave antennas in this section.

Based on comparison of power density distributions, simulated power density and measured power density have a good correlation. Measurement uncertainty in mmWave frequency in measurement side and inaccuracy of material properties in mmWave frequency in the simulation side are considered as error factors.

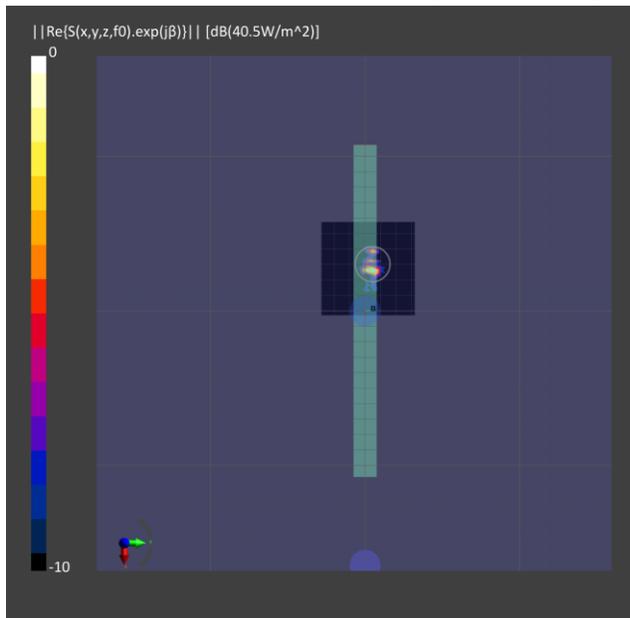
The input powers per each active port are below for both Simulation and Measurement validation and power density characterization. For Simulation, these values were entered directly into HFSS model. For measurement, FTM S/W was used to input these values for each active port also.

Mode/Band	Antenna	Input Power (in dBm) SISO	Input Power (in dBm) MIMO
5G NR n261	J Patch	6	6
	K Patch	6	6
	L Patch	6	6
5G NR n260	J Patch	6	6
	K Patch	6	6
	L Patch	6	6

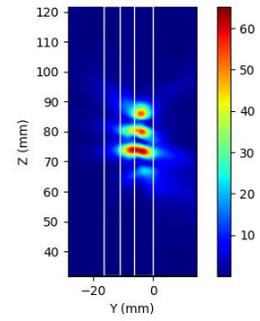
The below simulation and measurement result were performed at 2mm distance both 28GHz and 38.5GHz. Power limit was decided according to the simulation results and the output power that will be used on the live network will be reported after calculation.

Band	Beam ID	Antenna	Surface	Channel	4cm2 avg. PD(W/m2)	
					Meas.	Sim
n260	22	L	S3	Mid	7.86	17.37
	150		S3	Mid	8.1	17.95
	21		S5	Mid	3.54	7.33
	150		S5	Mid	3.82	9.09
	37	J	S4	Mid	8.09	19.46
	155		S4	Mid	7.68	16.25
	37		S5	Mid	4.29	10.35
	165		S5	Mid	4.37	6.52
	43	K	S2	Mid	8.3	12.64
	169		S2	Mid	9.2	13.10
	28		S5	Mid	4.53	9.16
	159		S5	Mid	5.37	7.89
n261	20	L	S3	Mid	9.58	18.36
	162		S3	Mid	10.6	17.84
	34		S5	Mid	4.37	7.11
	148		S5	Mid	4.72	9.67
	38	J	S4	Mid	10.2	19.30
	152		S4	Mid	9.45	17.42
	24		S5	Mid	4.4	9.98
	152		S5	Mid	4.2	9.17
	30	K	S2	Mid	6.79	12.82
	170		S2	Mid	7.47	12.05
	30		S5	Mid	3.68	9.02
	158		S5	Mid	4.19	8.06

- n260 ANT L-Patch: Mid Channel, Beam ID 22, Left Side

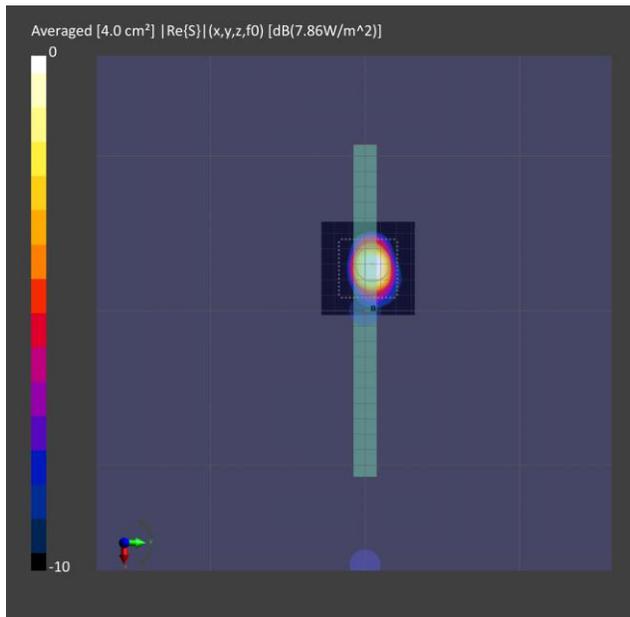


(a) Measurement

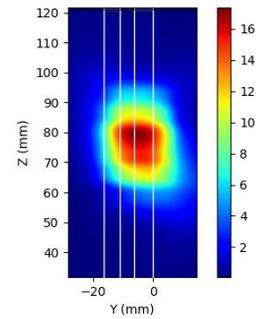


(b) Simulation

ANT L Patch: Mid Channel, Point power density



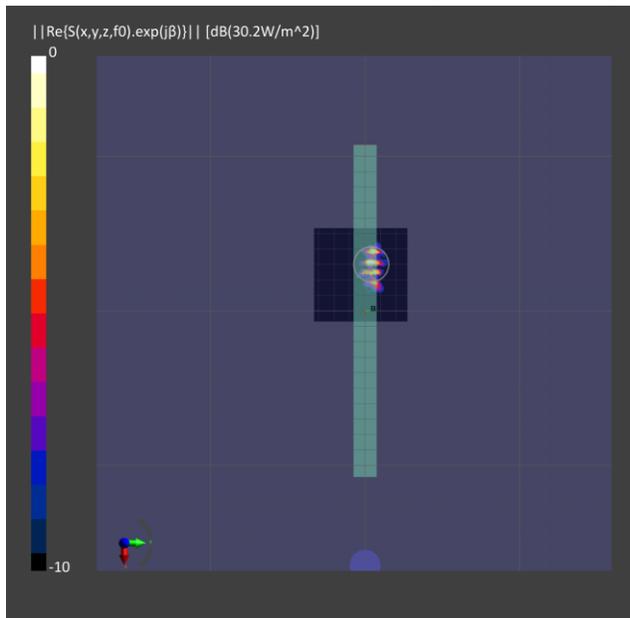
(a) Measurement



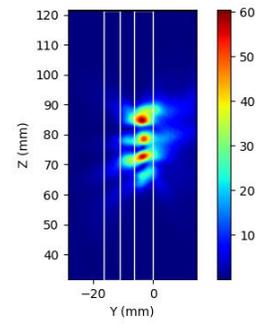
(b) Simulation

ANT L Patch: Mid Channel, Averaged power density

- n260 ANT L-Patch: Mid Channel, Beam ID 150, Left Side

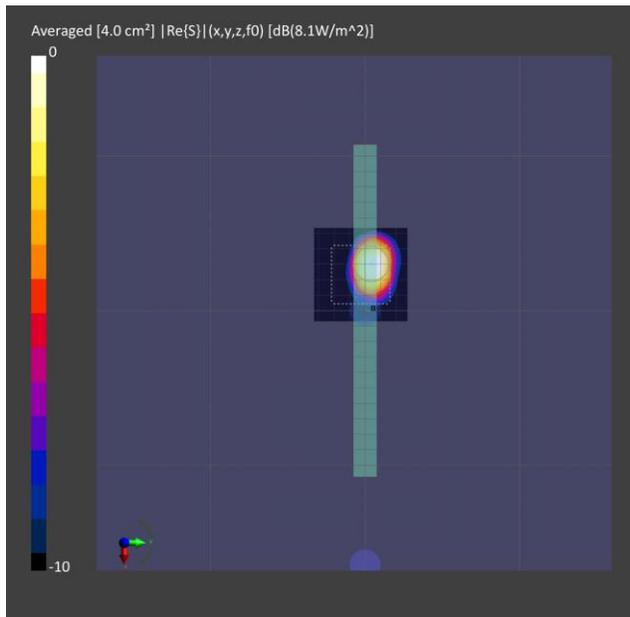


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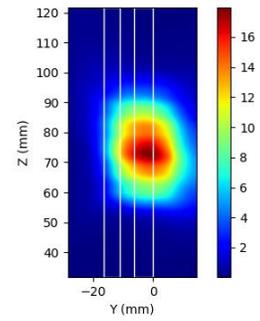


(b) Simulation

ANT L Patch: Mid Channel, Point power density



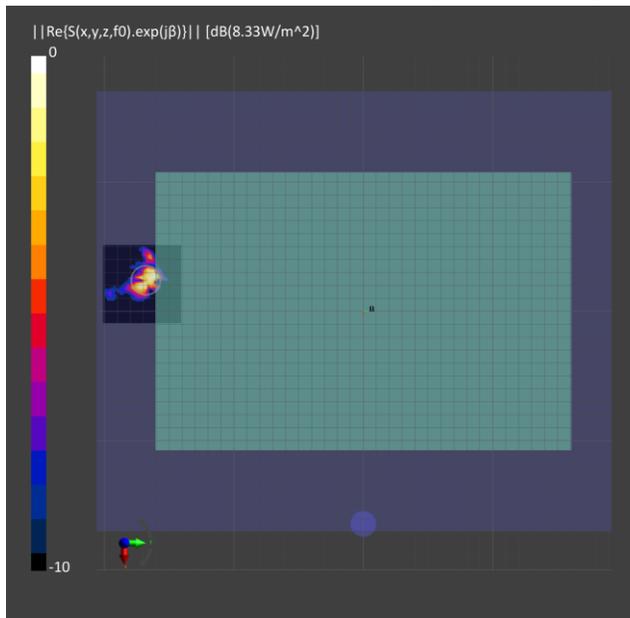
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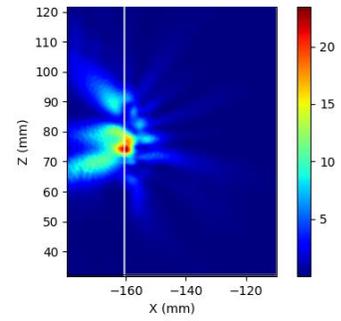
(b) Simulation

ANT L Patch: Mid Channel, Averaged power density

- n260 ANT L-Patch: Mid Channel, Beam ID 21, Bottom Face

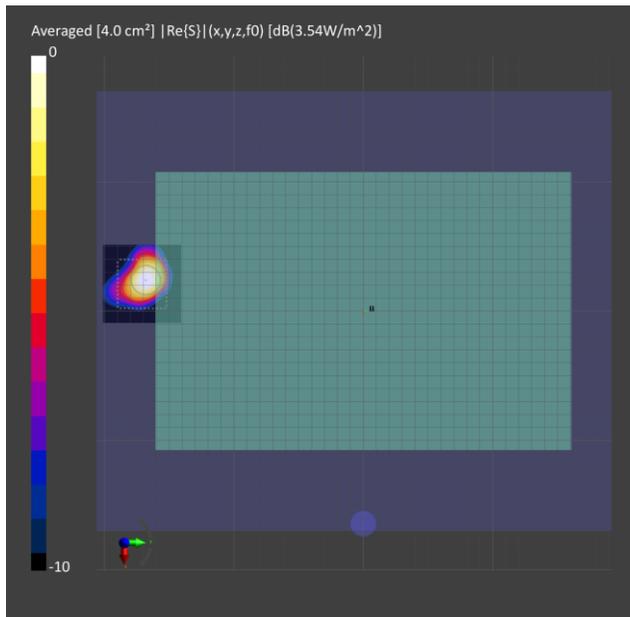


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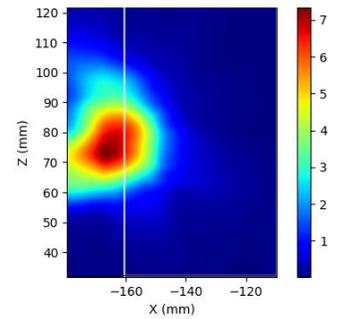


(b) Simulation

ANT L Patch: Mid Channel, Point power density



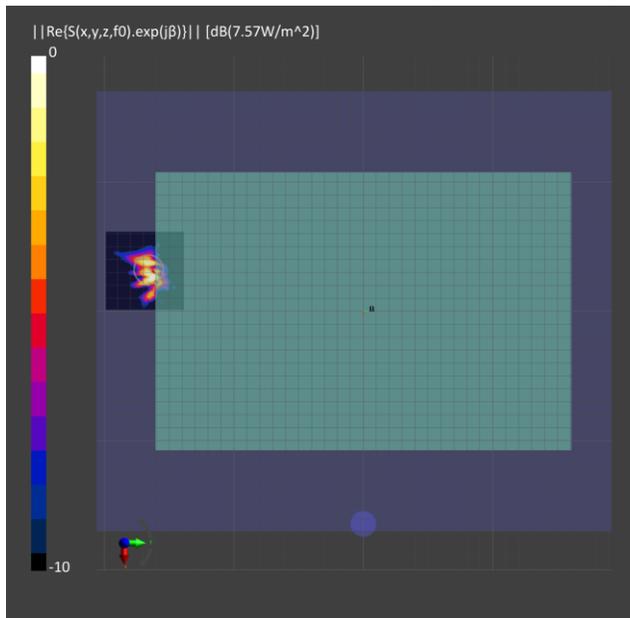
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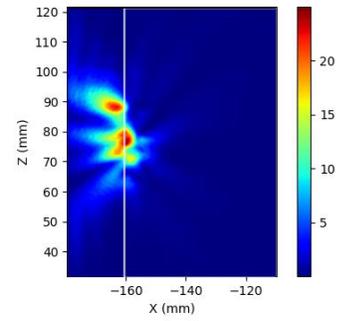
(b) Simulation

ANT L Patch: Mid Channel, Averaged power density

- n260 ANT L-Patch: Mid Channel, Beam ID 150, Bottom Face

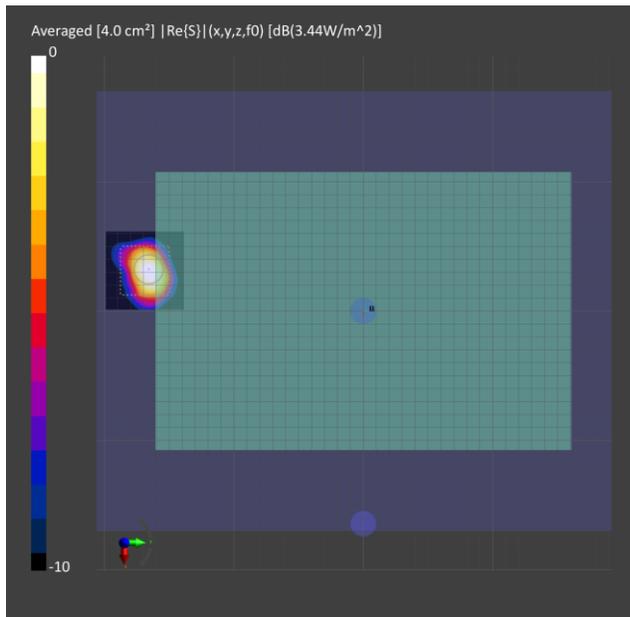


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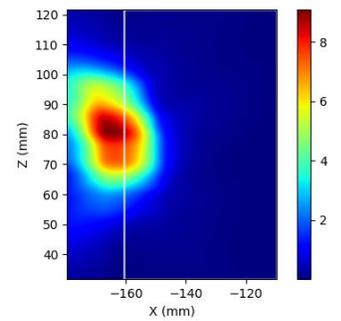


(b) Simulation

ANT L Patch: Mid Channel, Point power density



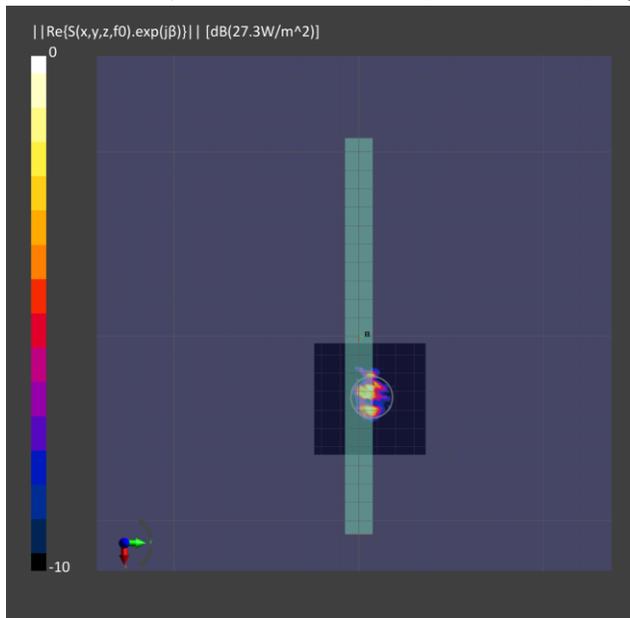
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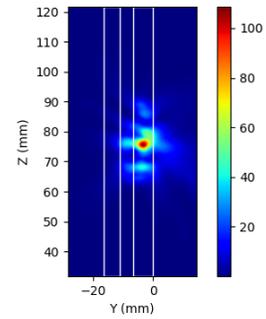
(b) Simulation

ANT L Patch: Mid Channel, Averaged power density

- n260 ANT J-Patch: Mid Channel, Beam ID 37, Right Side

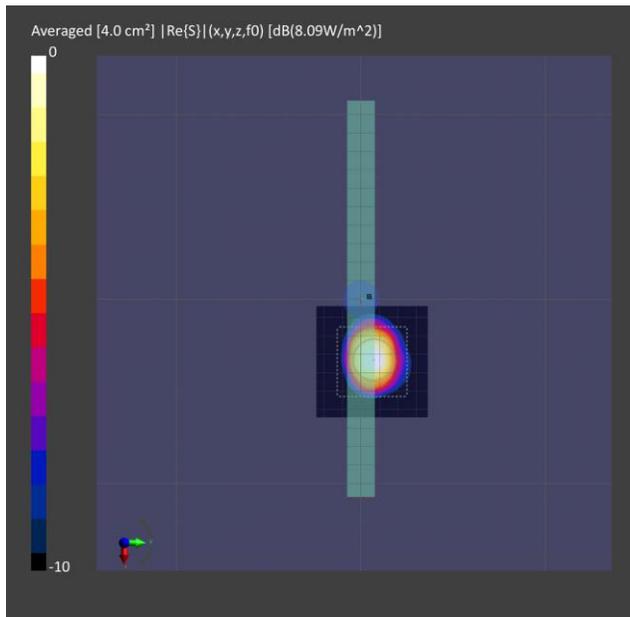


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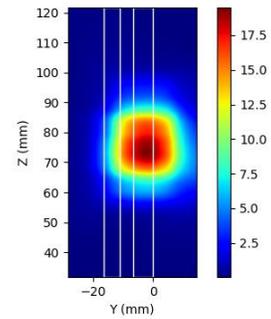


(b) Simulation

ANT J Patch: Mid Channel, Point power density



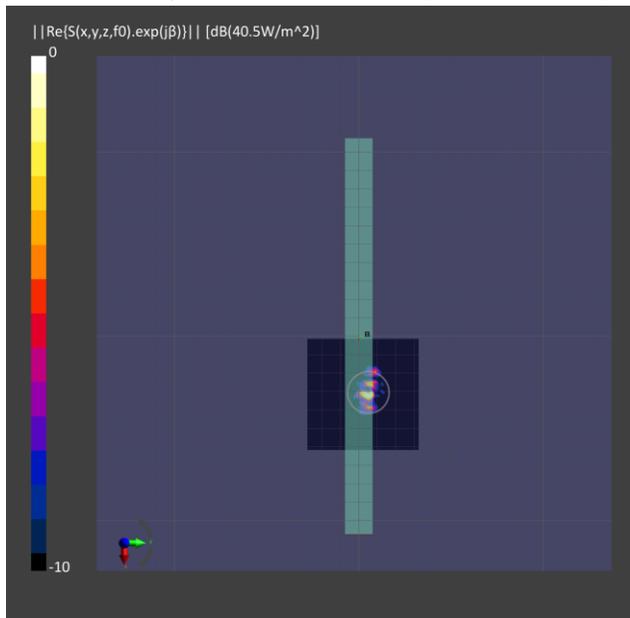
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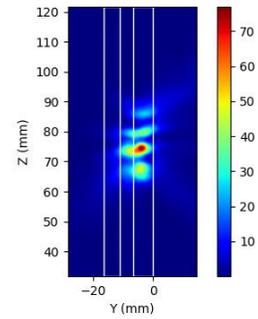
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ANT J Patch: Mid Channel, Averaged power density

- n260 ANT J-Patch: Mid Channel, Beam ID 155, Right Side

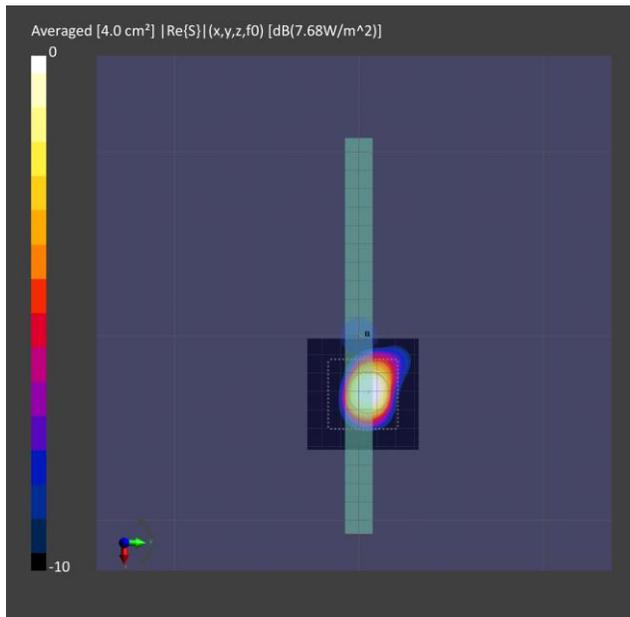


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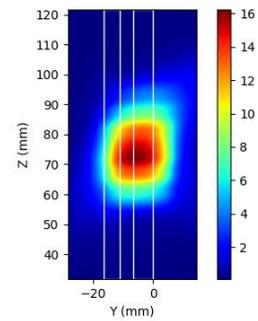


(b) Simulation

ANT J Patch: Mid Channel, Point power density



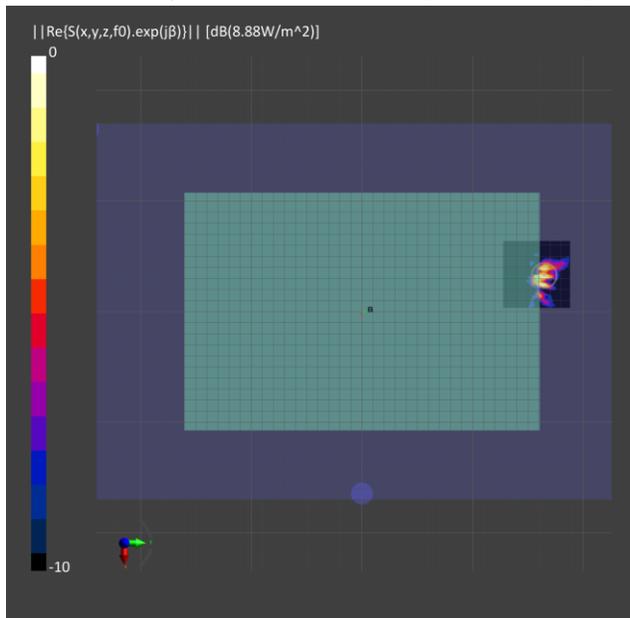
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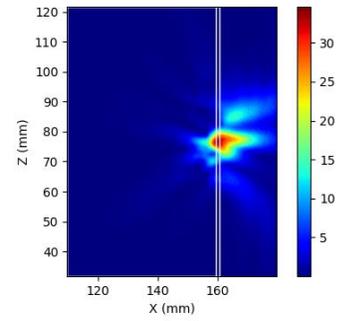
(b) Simulation

ANT J Patch: Mid Channel, Averaged power density

- n260 ANT J-Patch: Mid Channel, Beam ID 37, Bottom Face

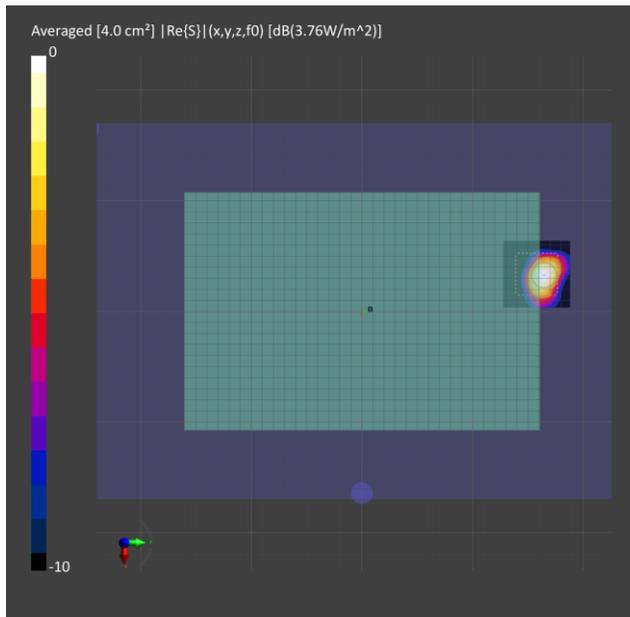


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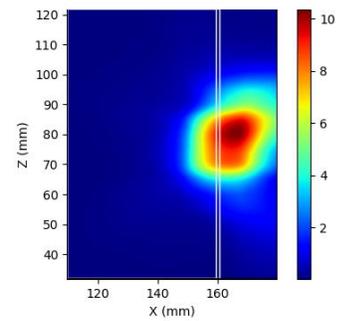


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ANT J Patch: Mid Channel, Point power density



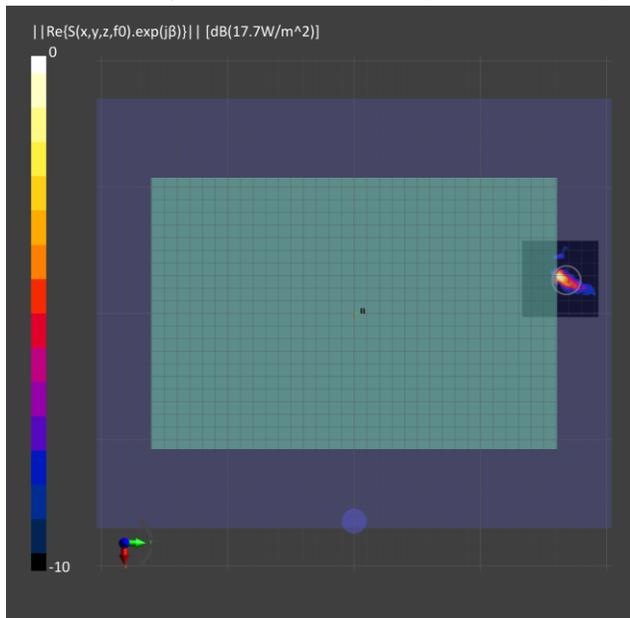
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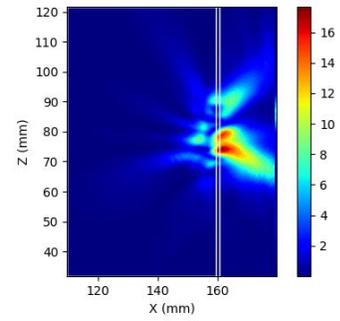
(b) Simulation

ANT J Patch: Mid Channel, Averaged power density

- n260 ANT J-Patch: Mid Channel, Beam ID 165, Bottom Face

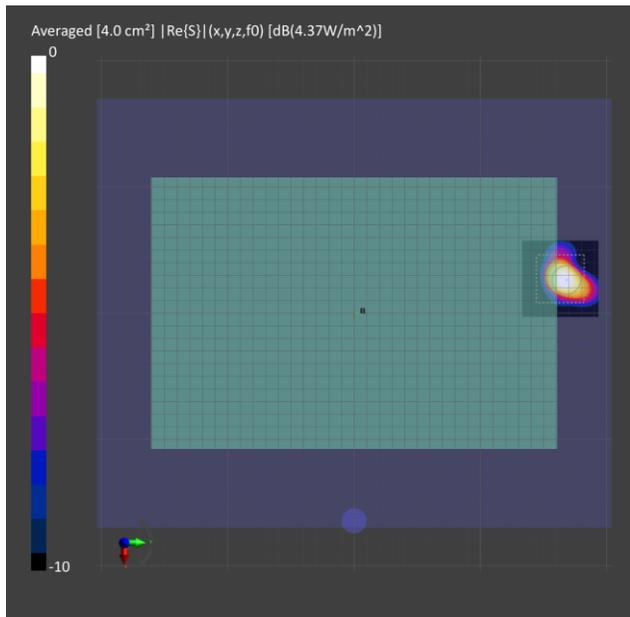


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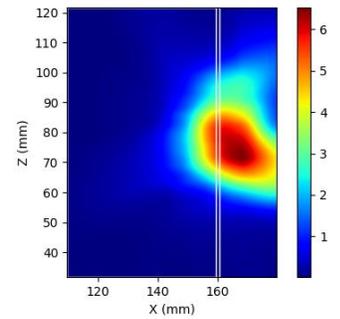


(b) Simulation

ANT J Patch: Mid Channel, Point power density



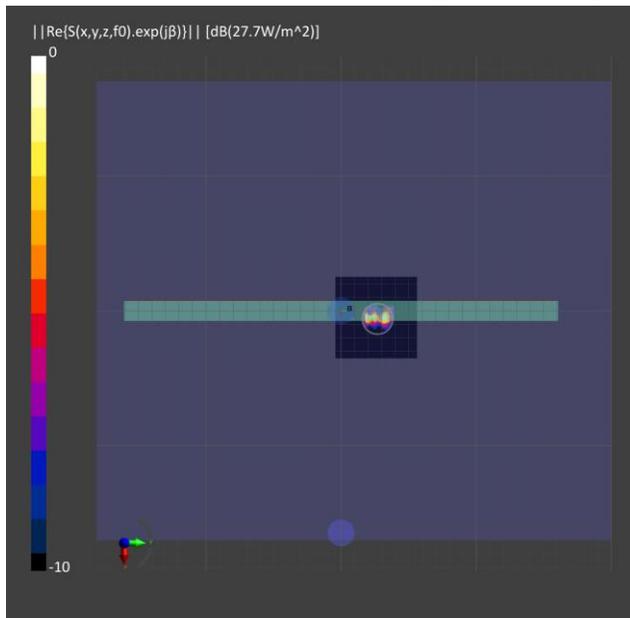
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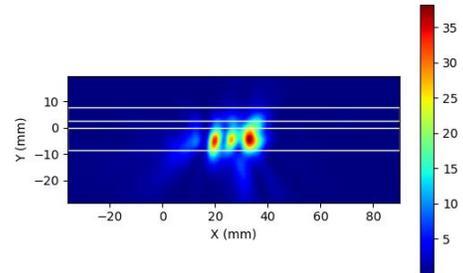
(b) Simulation

ANT J Patch: Mid Channel, Averaged power density

- n260 ANT K-Patch: Mid Channel, Beam ID 43, Bottom Side

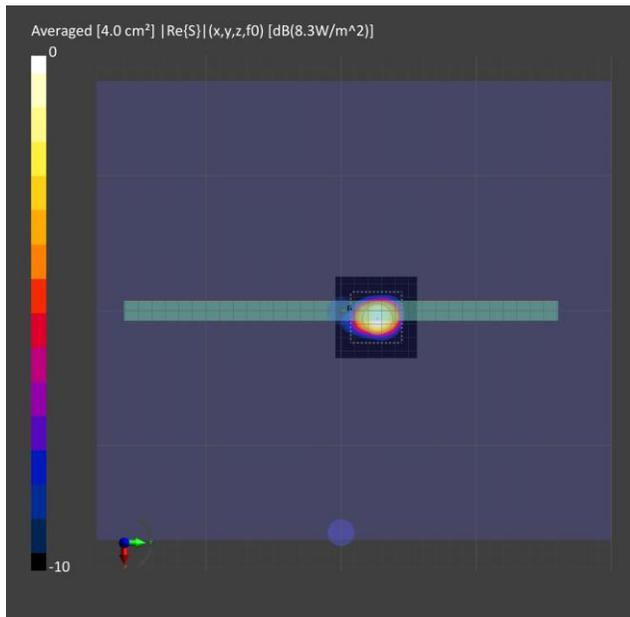


(a) Measurement

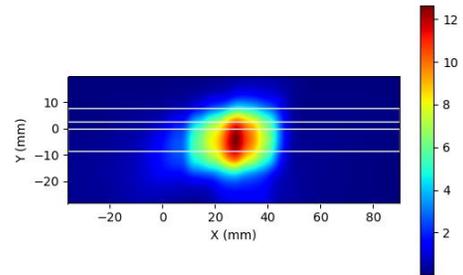


(b) Simulation

ANT K Patch: Mid Channel, Point power density



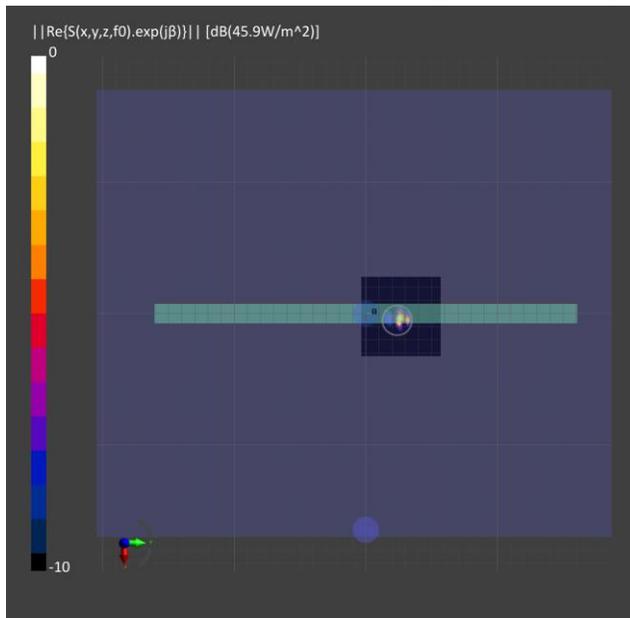
(a) Measurement



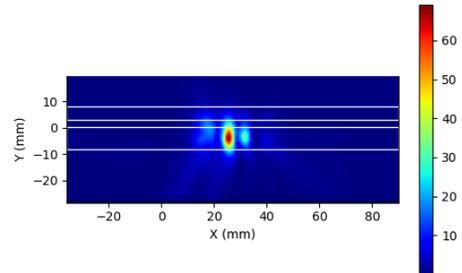
(b) Simulation

ANT K Patch: Mid Channel, Averaged power density

- n260 ANT K-Patch: Mid Channel, Beam ID 169, Bottom Side

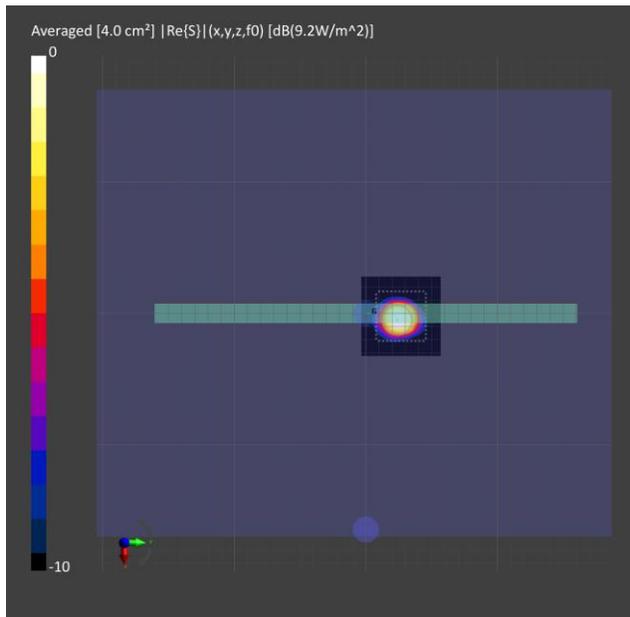


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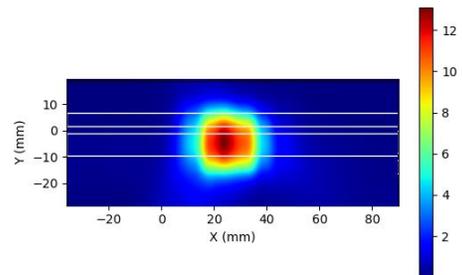


(b) Simulation

ANT K Patch: Mid Channel, Point power density



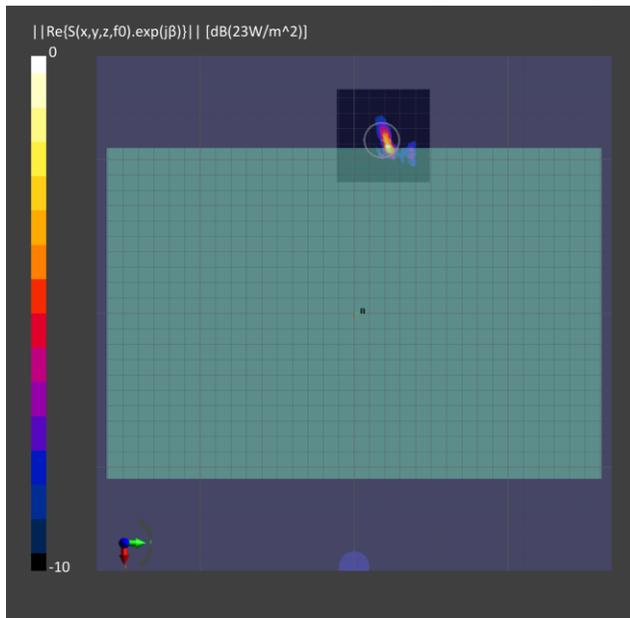
(a) Measurement



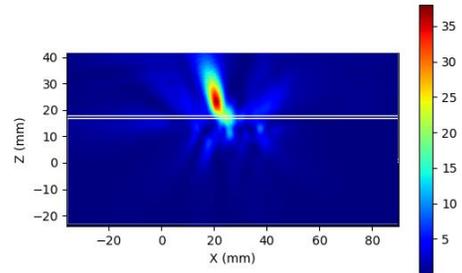
(b) Simulation

ANT K Patch: Mid Channel, Averaged power density

- n260 ANT K-Patch: Mid Channel, Beam ID 28, Bottom Face

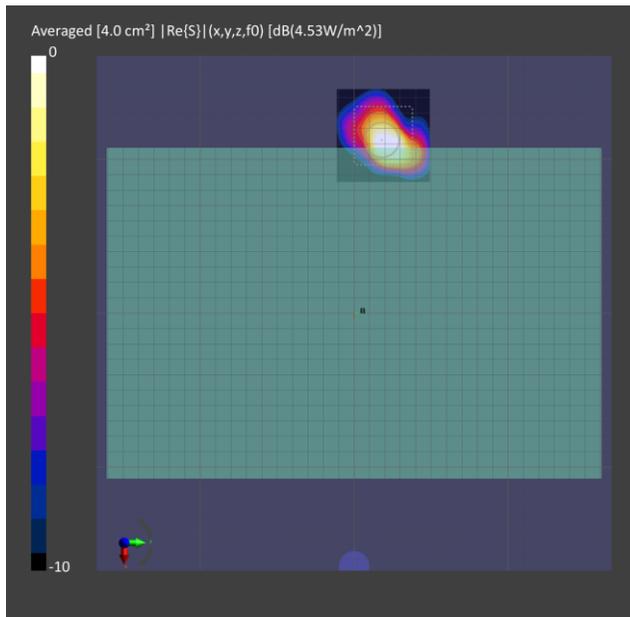


(a) Measurement

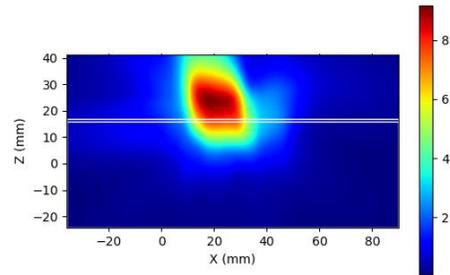


(b) Simulation

ANT K Patch: Mid Channel, Point power density



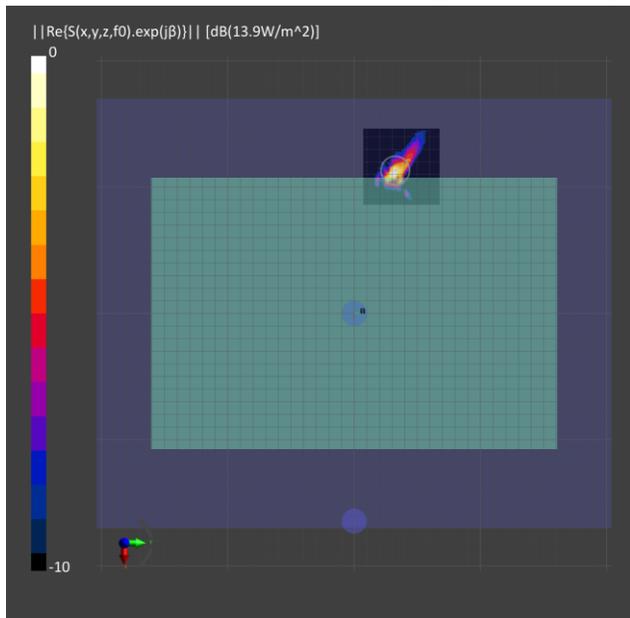
(a) Measurement



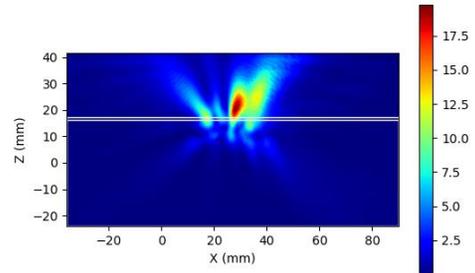
(b) Simulation

ANT K Patch: Mid Channel, Averaged power density

- n260 ANT K-Patch: Mid Channel, Beam ID 159, Bottom Face

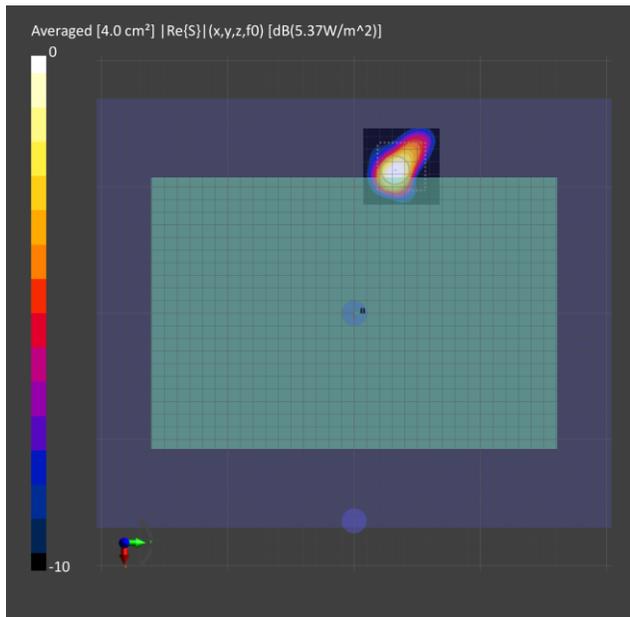


(a) Measurement

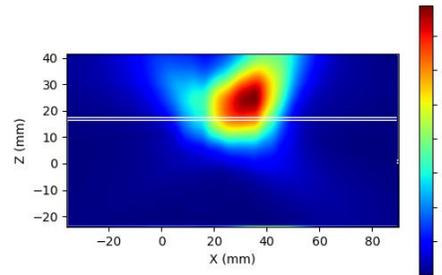


(b) Simulation

ANT K Patch: Mid Channel, Point power density



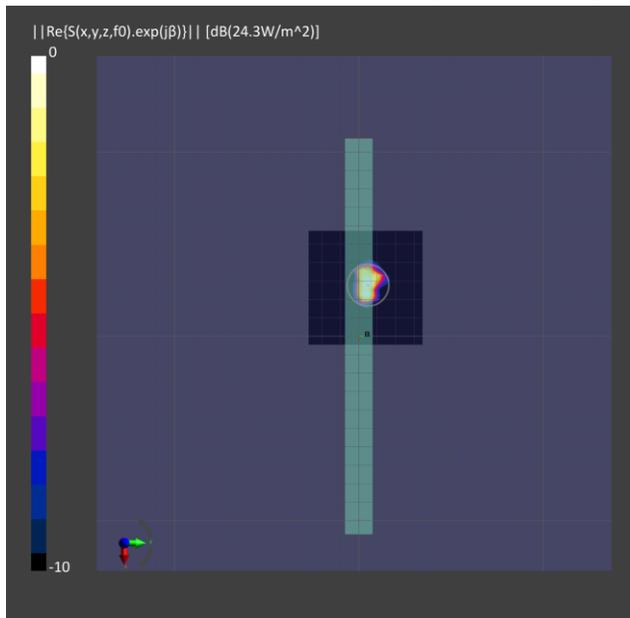
(a) Measurement



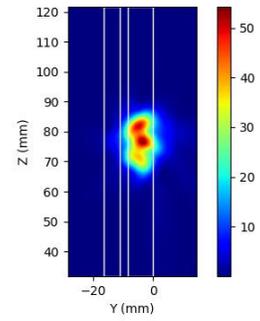
(b) Simulation

ANT K Patch: Mid Channel, Averaged power density

- n261 ANT L-Patch: Mid Channel, Beam ID 20, Left Side

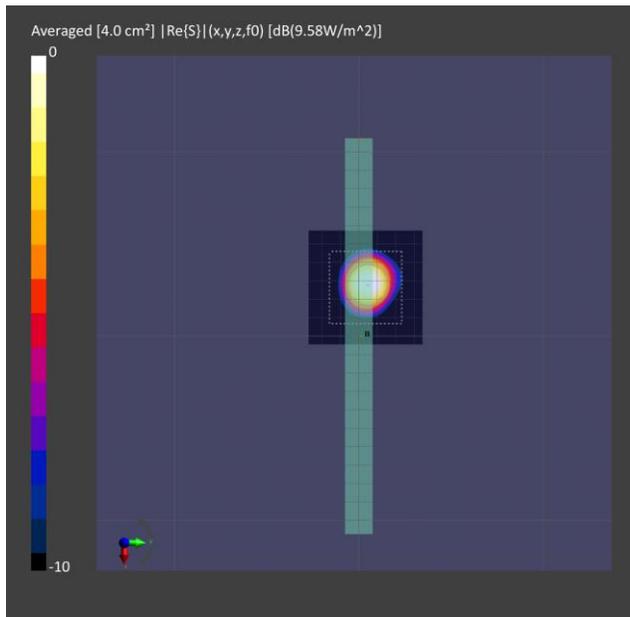


(a) Measurement

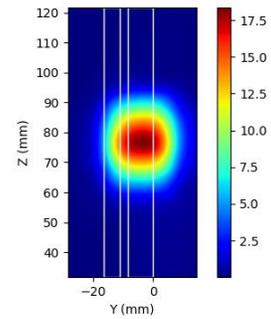


(b) Simulation

ANT L Patch: Mid Channel, Point power density



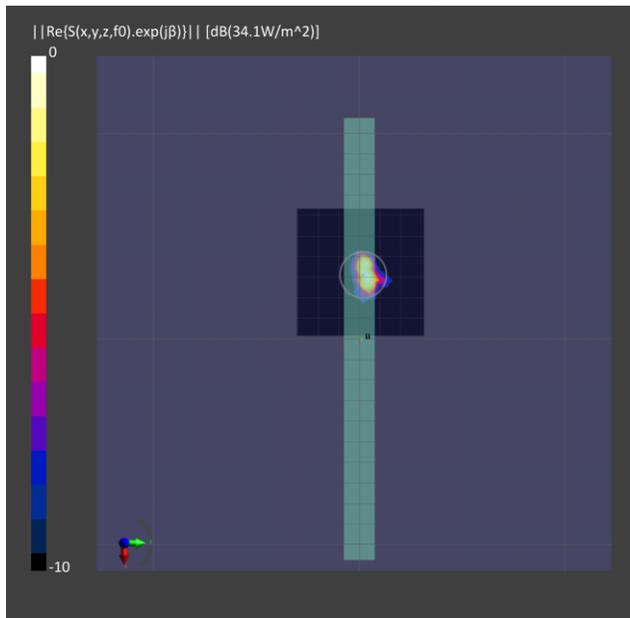
(a) Measurement



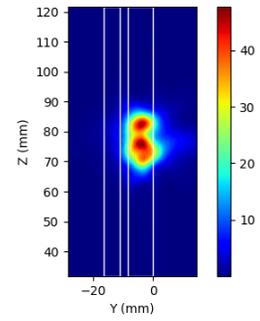
(b) Simulation

ANT L Patch: Mid Channel, Averaged power density

- n261 ANT L-Patch: Mid Channel, Beam ID 162, Left Side

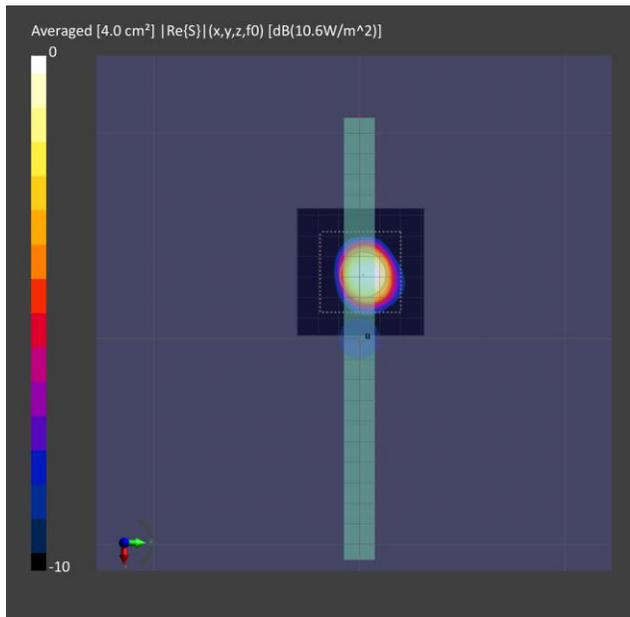


(a) Measurement

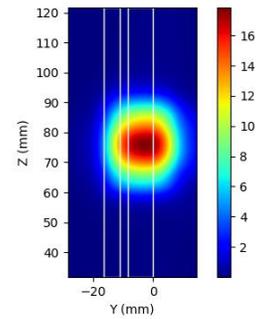


(b) Simulation

ANT L Patch: Mid Channel, Point power density



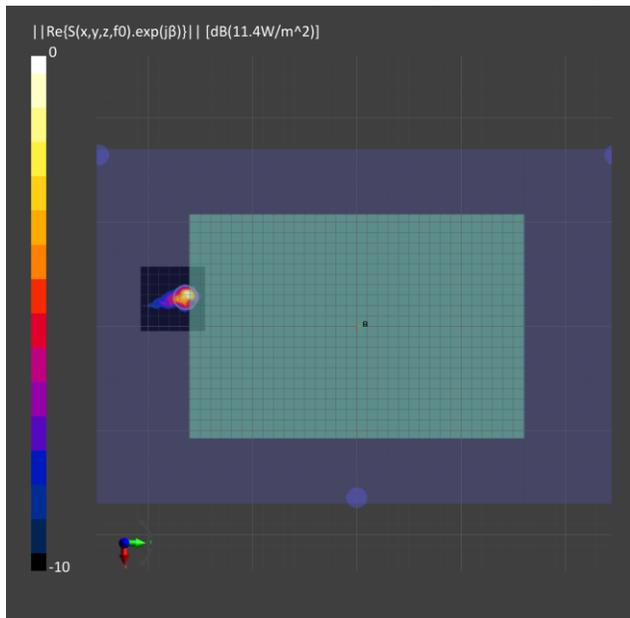
(a) Measurement



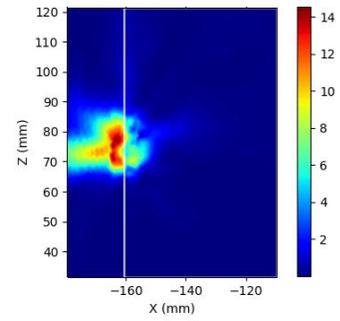
(b) Simulation

ANT L Patch: Mid Channel, Averaged power density

- n261 ANT L-Patch: Mid Channel, Beam ID 34, Bottom Face

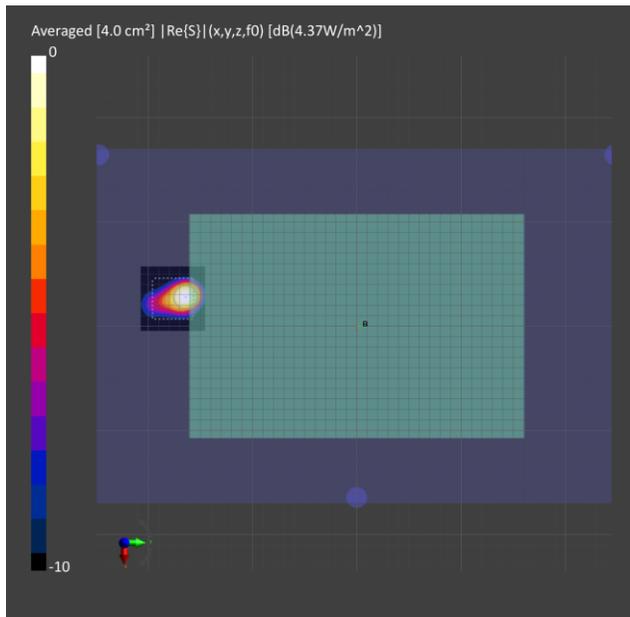


(a) Measurement

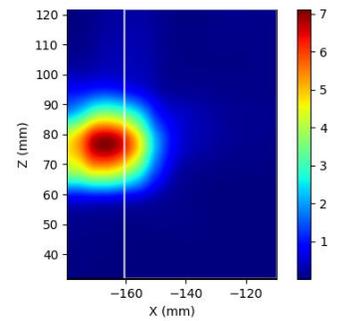


(b) Simulation

ANT L Patch: Mid Channel, Point power density



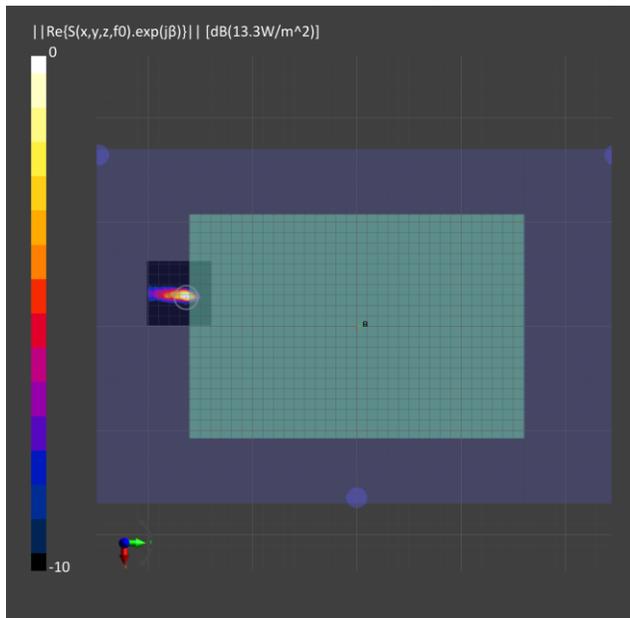
(a) Measurement



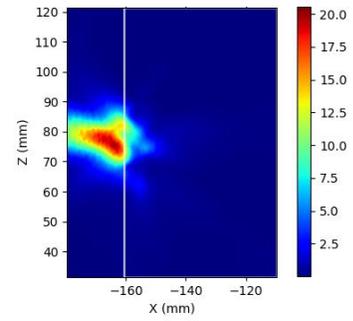
(b) Simulation

ANT L Patch: Mid Channel, Averaged power density

- n261 ANT L-Patch: Mid Channel, Beam ID 148, Bottom Face

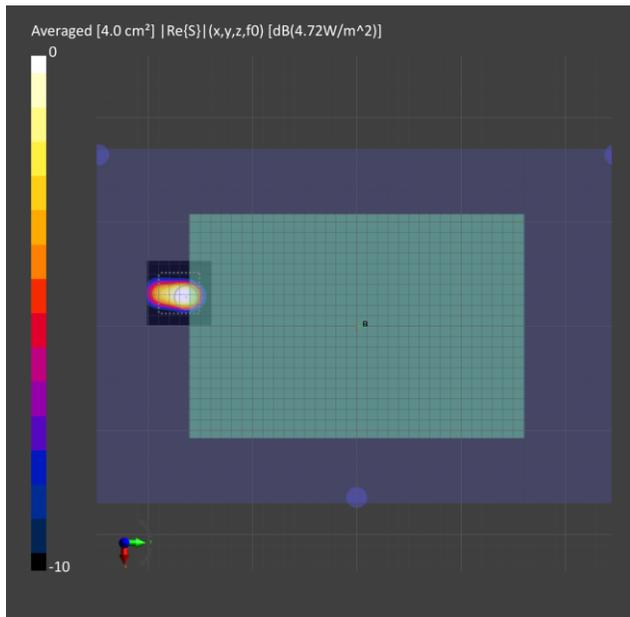


(a) Measurement

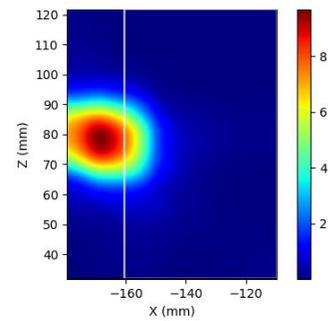


(b) Simulation

ANT L Patch: Mid Channel, Point power density



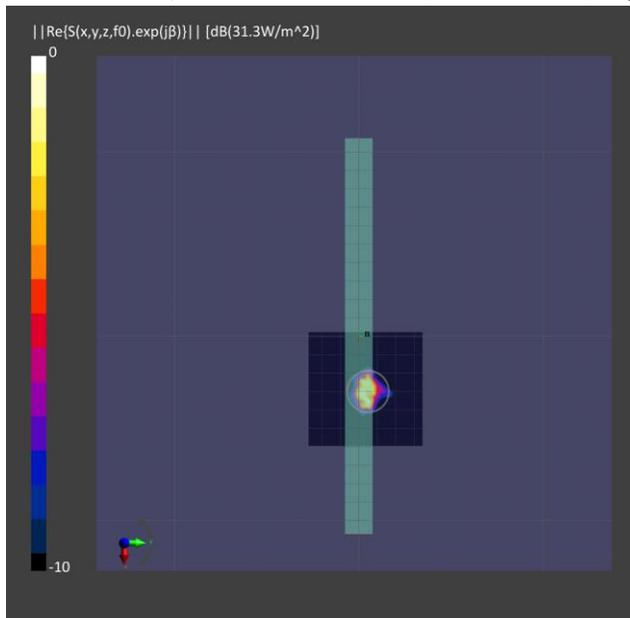
(a) Measurement



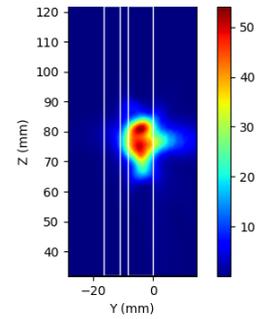
(b) Simulation

ANT L Patch: Mid Channel, Averaged power density

- n261 ANT J-Patch: Mid Channel, Beam ID 38, Right Side

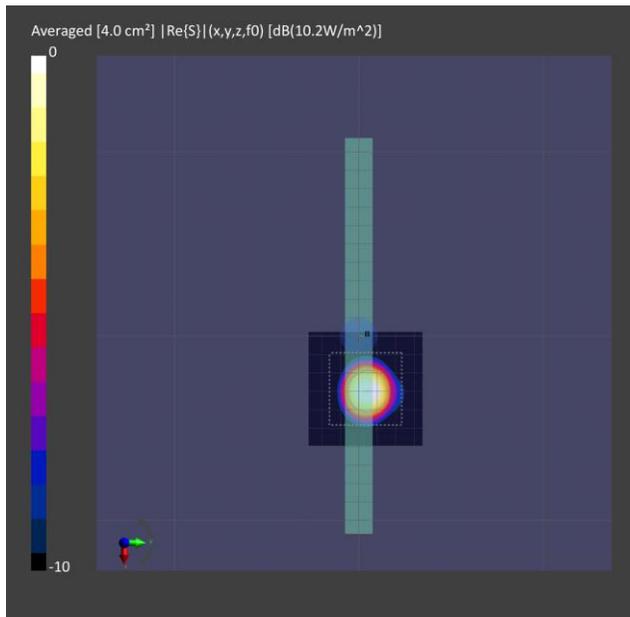


(a) Measurement

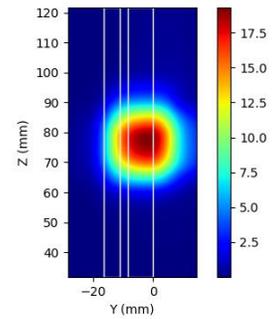


(b) Simulation

ANT J Patch: Mid Channel, Point power density



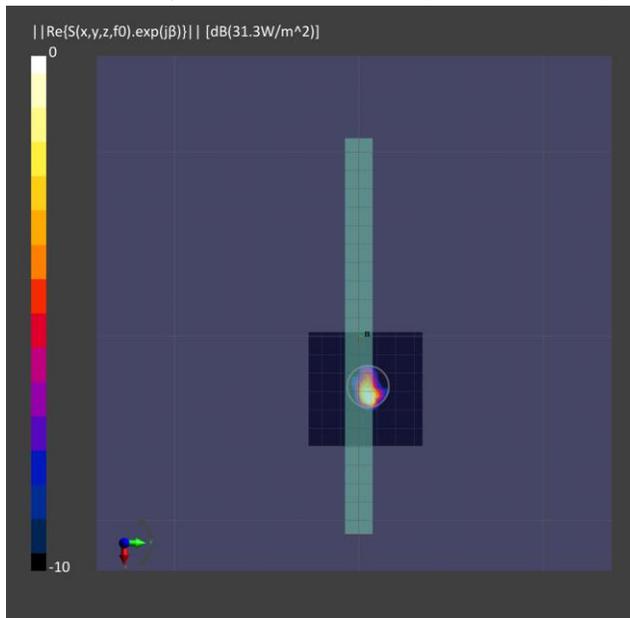
(a) Measurement



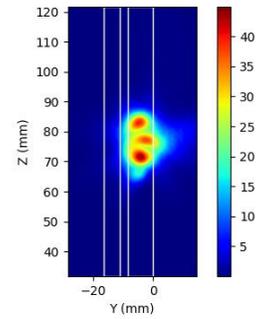
(b) Simulation

ANT J Patch: Mid Channel, Averaged power density

- n261 ANT J-Patch: Mid Channel, Beam ID 152, Right Side

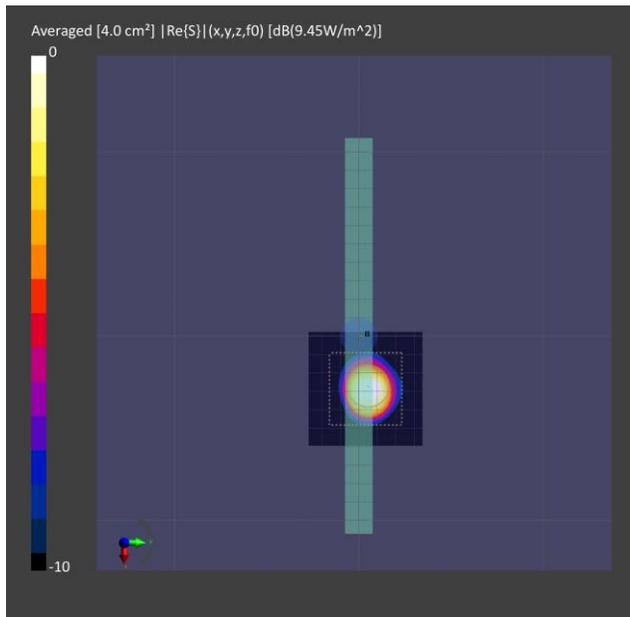


(a) Measurement

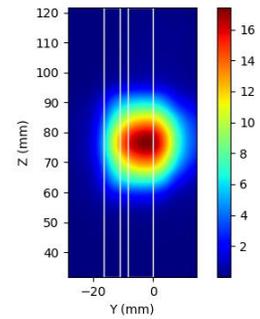


(b) Simulation

ANT J Patch: Mid Channel, Point power density



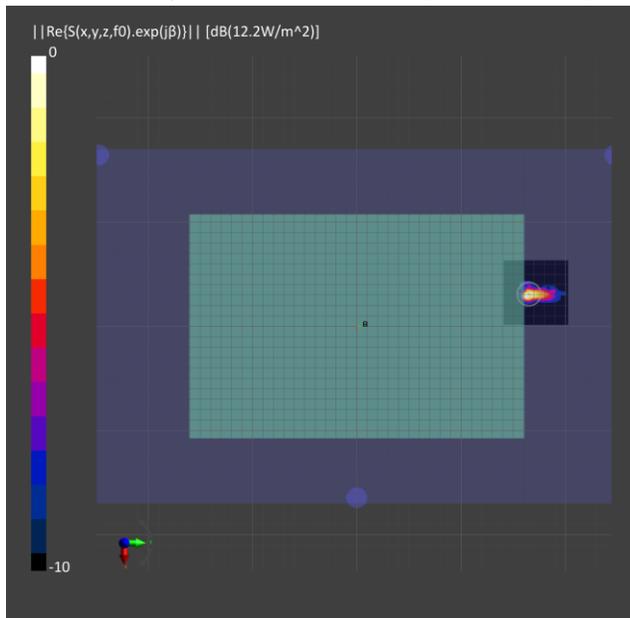
(a) Measurement



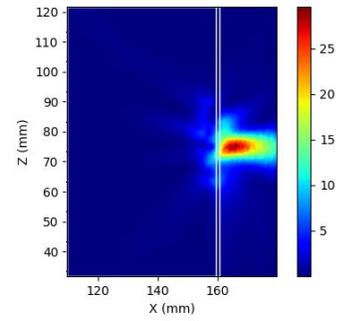
(b) Simulation

ANT J Patch: Mid Channel, Averaged power density

- n261 ANT J-Patch: Mid Channel, Beam ID 24, Bottom Face

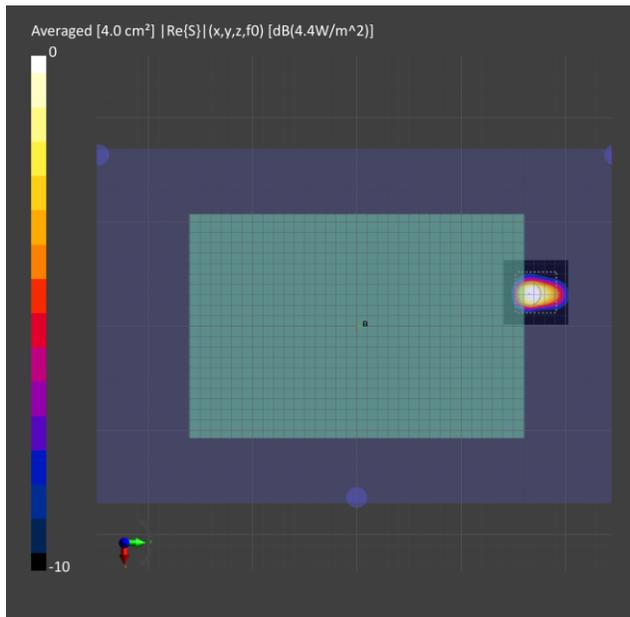


(a) Measurement

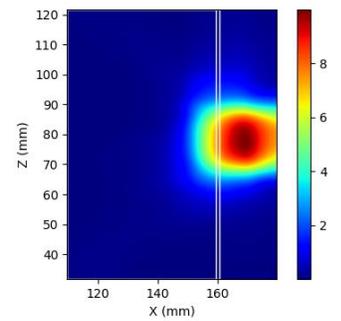


(b) Simulation

ANT J Patch: Mid Channel, Point power density



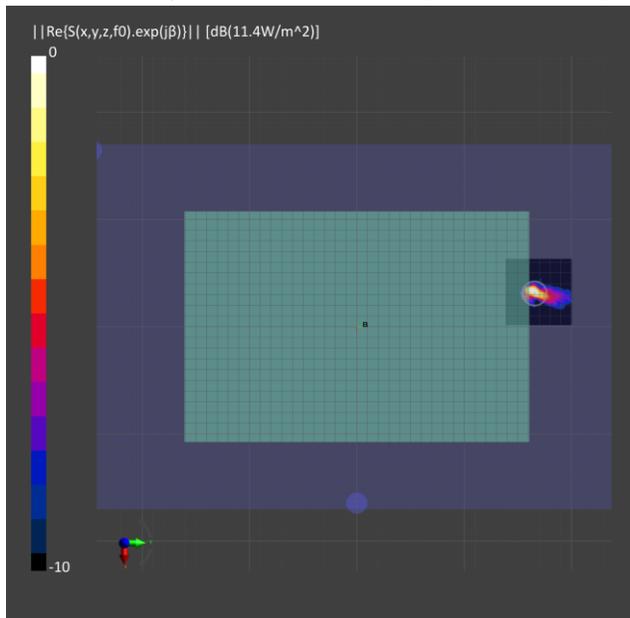
(a) Measurement



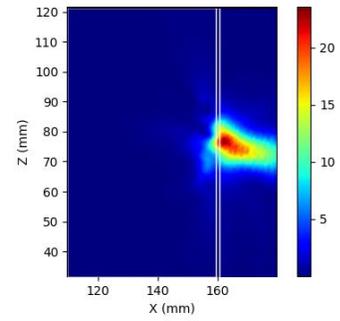
(b) Simulation

ANT J Patch: Mid Channel, Averaged power density

- n261 ANT J-Patch: Mid Channel, Beam ID 152, Bottom Face

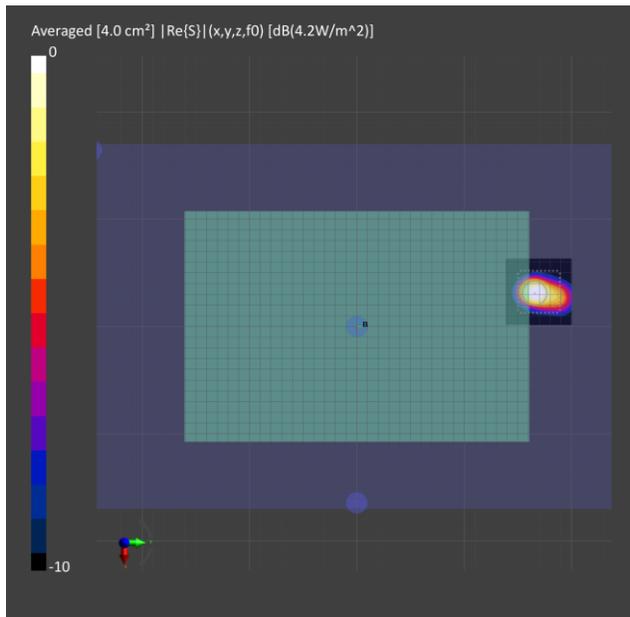


(a) Measurement

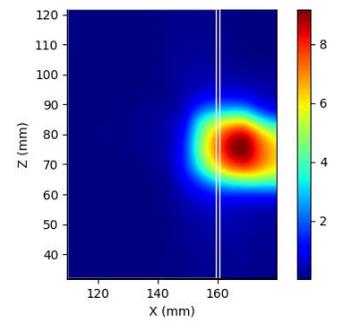


(b) Simulation

ANT J Patch: Mid Channel, Point power density



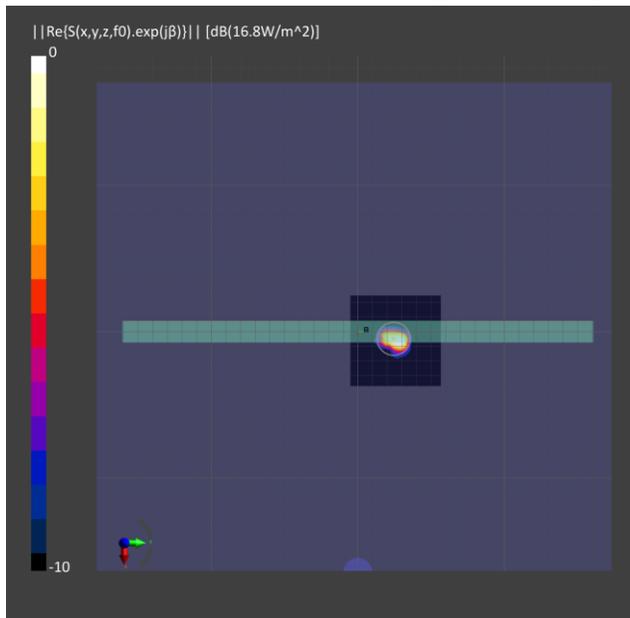
(a) Measurement



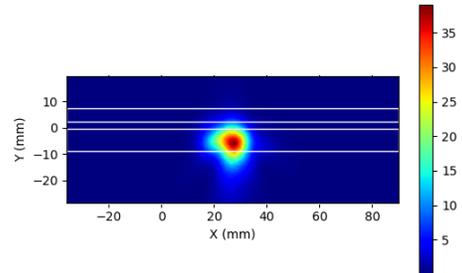
(b) Simulation

ANT J Patch: Mid Channel, Averaged power density

- n261 ANT K-Patch: Mid Channel, Beam ID 30, Bottom Side

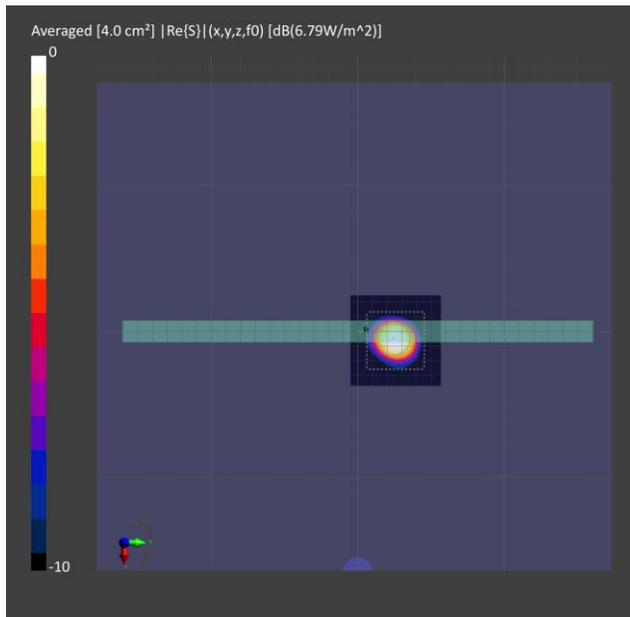


(a) Measurement

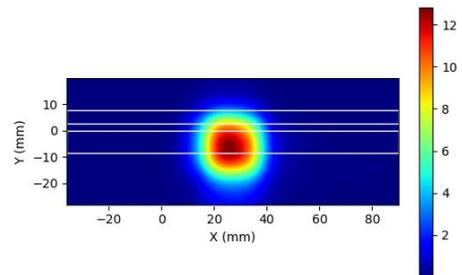


(b) Simulation

ANT K Patch: Mid Channel, Point power density



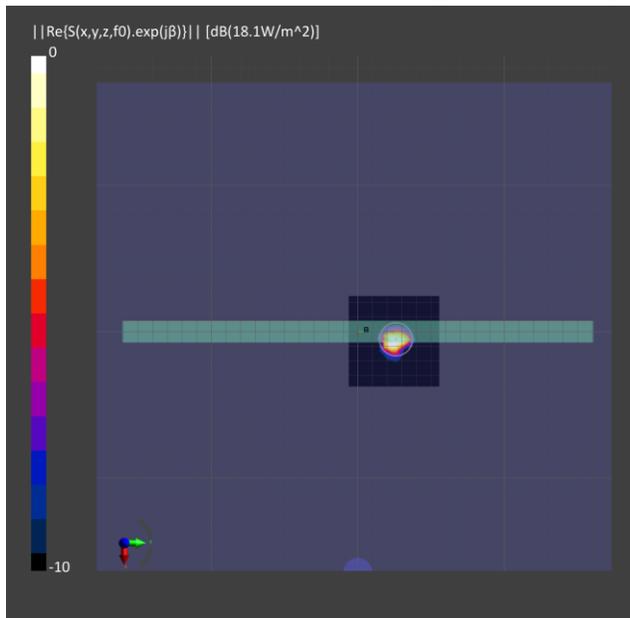
(a) Measurement



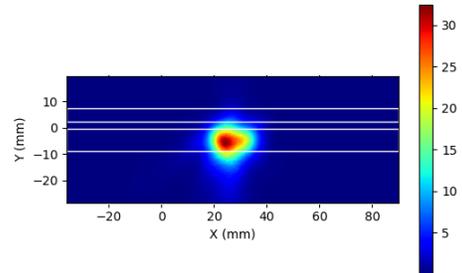
(b) Simulation

ANT K Patch: Mid Channel, Averaged power density

- n261 ANT K-Patch: Mid Channel, Beam ID 170, Bottom Side

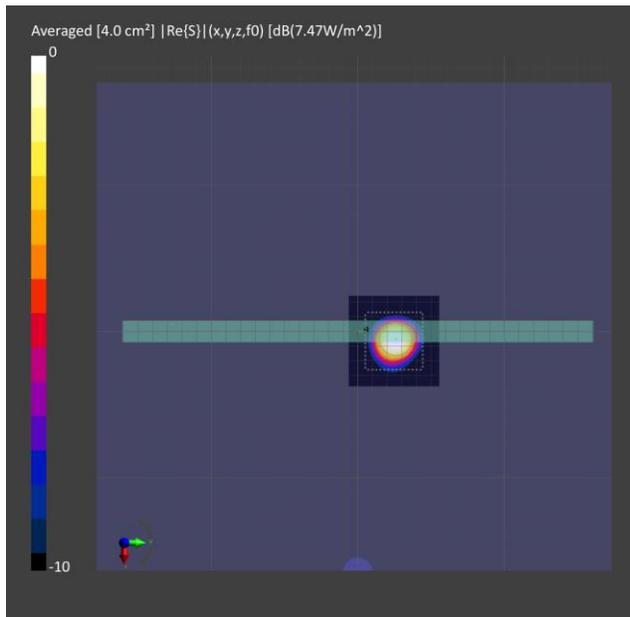


(a) Measurement

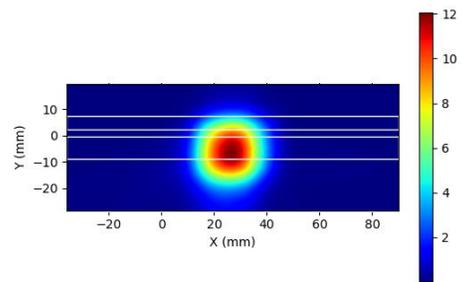


(b) Simulation

ANT K Patch: Mid Channel, Point power density



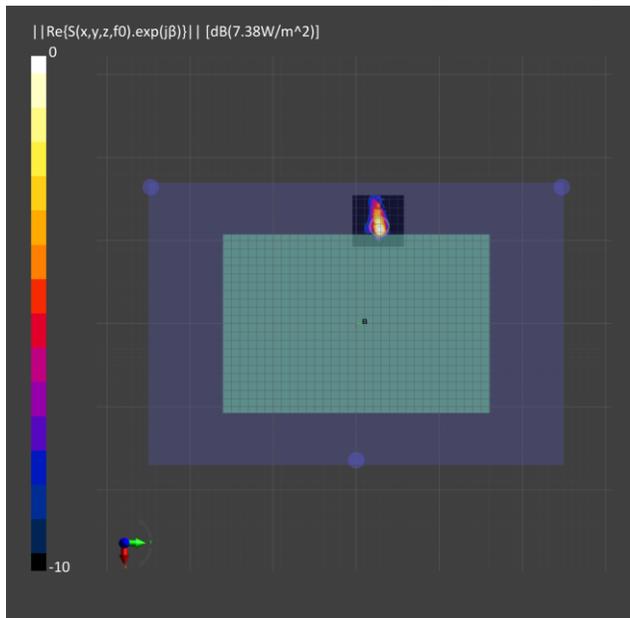
(a) Measurement



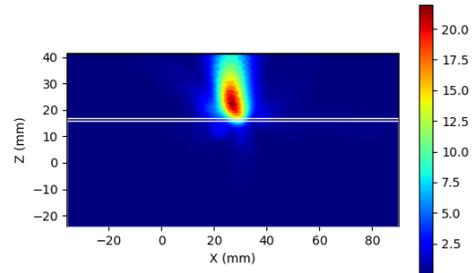
(b) Simulation

ANT K Patch: Mid Channel, Averaged power density

- n261 ANT K-Patch: Mid Channel, Beam ID 30, Bottom Face

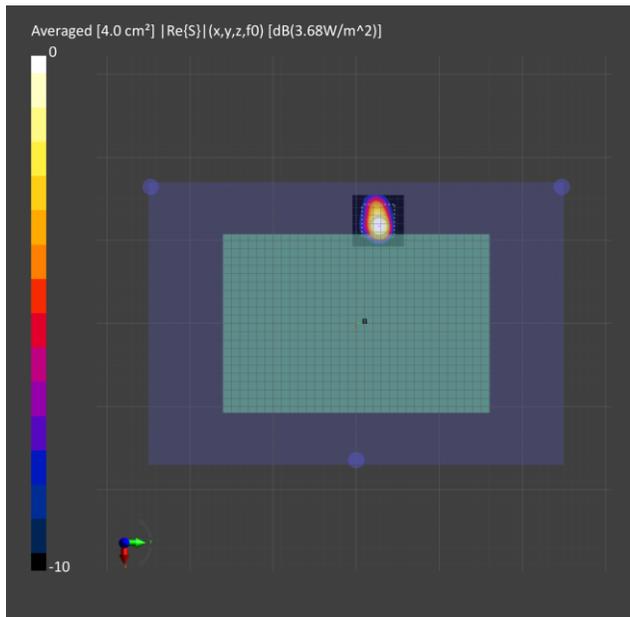


(a) Measurement

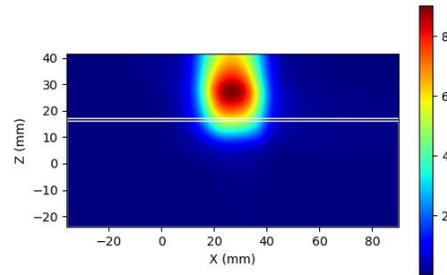


(b) Simulation

ANT K Patch: Mid Channel, Point power density



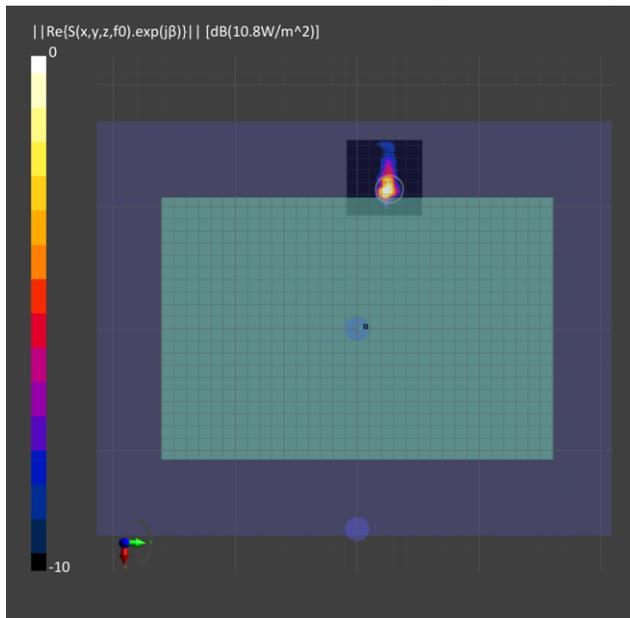
(a) Measurement



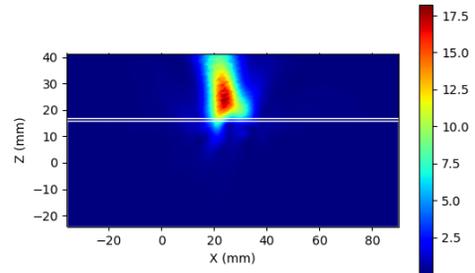
(b) Simulation

ANT K Patch: Mid Channel, Averaged power density

- n261 ANT K-Patch: Mid Channel, Beam ID 158, Bottom Face

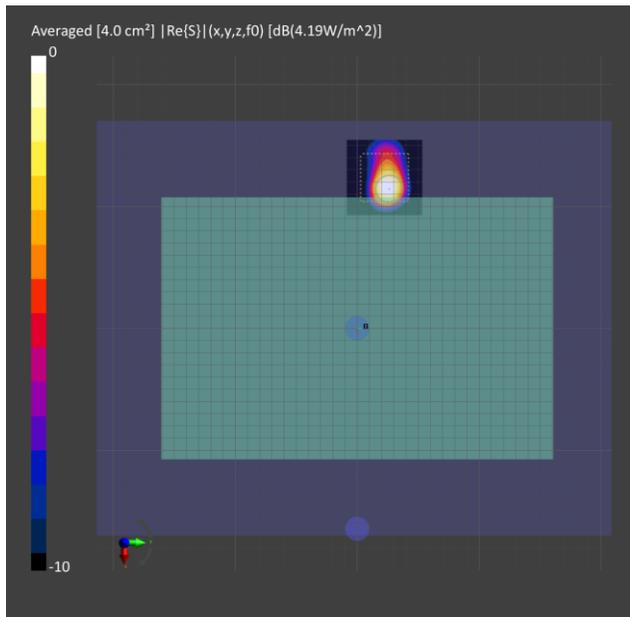


(a) Measurement

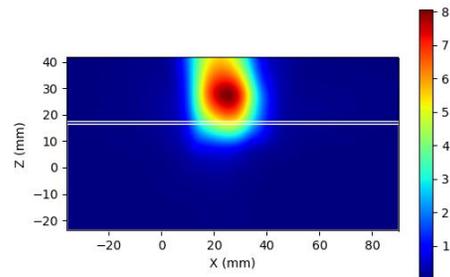


(b) Simulation

ANT K Patch: Mid Channel, Point power density



(a) Measurement



(b) Simulation

ANT K Patch: Mid Channel, Averaged power density

3. Simulation results

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

The following table 2 ~ 7 show the PD simulation evaluation of Ant J / Ant K / Ant L mmWave modules at 28GHz / 39GHz for each evaluation plane. 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 MIMO results represent the condition when the relative phase between each beam pair was at 0°. Table 8 ~ 13 includes the highest reported MIMO simulation results after sweeping across the relative phase between beams in a 5° step interval from 0° to 360° simulation results in section 3.2.

Table 2. PD of AntL-Patch antenna (n261)

L-Patch Low CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)							
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)		
L	Patch	0		1	0.03	0.05	5.37		2.33	1.66		
		3		2	0.11	0.15	9.22		3.03	3.43		
		4		2	0.01	0.05	9.27		4.29	4.44		
		5		2	0.11	0.09	9.00		3.90	2.86		
		12		2	0.05	0.11	8.55		3.51	3.20		
		13		2	0.05	0.11	9.21		4.15	3.90		
		18		4	0.13	0.48	14.68		5.32	5.48		
		19		4	0.06	0.08	17.24		8.57	7.59		
		20		4	0.01	0.10	17.87		8.75	8.65		
		21		4	0.04	0.17	13.90		7.53	5.16		
		22		4	0.38	0.34	12.17		6.46	4.59		
		33		4	0.08	0.29	14.60		6.47	5.38		
		34		4	0.01	0.09	18.37		8.60	8.47		
		35		4	0.02	0.09	16.25		8.63	7.56		
		36		4	0.17	0.20	12.75		7.39	4.28		
		128		1	0.03	0.12	4.25		1.84	1.25		
		131		2	0.03	0.14	8.30		3.73	2.15		
		132		2	0.01	0.09	9.62		4.92	3.89		
		133		2	0.10	0.24	9.18		3.41	2.92		
		140		2	0.02	0.08	8.83		4.50	3.40		
		141		2	0.06	0.20	9.80		4.29	3.63		
		146		4	0.07	0.14	12.68		8.00	3.10		
		147		4	0.02	0.09	16.49		9.03	6.83		
		148		4	0.03	0.10	17.57		9.56	7.30		
		149		4	0.17	0.21	13.00		5.69	5.53		
		150		4	0.22	0.44	13.43		5.63	4.84		
		161		4	0.08	0.16	14.49		7.89	4.52		
		162		4	0.01	0.08	17.34		9.07	7.51		
		163		4	0.04	0.09	14.89		8.05	6.10		
		164		4	0.22	0.34	13.34		5.81	5.21		
		0		128		2	0.08	0.19	9.98		4.59	2.72
		3		131		4	0.19	0.24	17.94		7.22	7.08
		4		132		4	0.02	0.07	20.25		9.84	8.52
		5		133		4	0.18	0.39	18.58		7.20	7.09
		12		140		4	0.06	0.14	18.00		7.72	7.07
		13		141		4	0.07	0.17	19.54		8.09	7.65
18		146		8	0.18	0.84	25.15		12.30	7.78		
19		147		8	0.05	0.09	33.28		18.14	13.90		
20		148		8	0.04	0.15	34.58		17.19	15.70		
21		149		8	0.18	0.26	27.14		11.64	11.35		
22		150		8	0.37	0.40	23.35		10.88	7.33		
33		161		8	0.09	0.51	27.08		13.04	9.53		
34		162		8	0.03	0.12	35.68		18.98	15.25		
35		163		8	0.04	0.09	32.20		15.91	13.96		
36		164		8	0.31	0.39	24.65		11.26	8.85		

L-Patch Mid CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)
		0		1	0.04	0.06	5.21		2.46	1.60
		3		2	0.11	0.17	8.11		2.26	3.47
		4		2	0.02	0.04	8.94		4.36	3.85
		5		2	0.11	0.07	8.87		3.01	3.04
		12		2	0.07	0.12	8.34		3.99	2.84
		13		2	0.04	0.09	8.87		4.13	3.56
		18		4	0.24	0.65	12.47		5.56	5.07
		19		4	0.07	0.07	16.54		6.66	7.44
		20		4	0.01	0.08	18.36		6.98	8.73
		21		4	0.08	0.20	12.67		5.10	5.10
		22		4	0.29	0.18	10.87		4.90	4.46
		33		4	0.18	0.48	12.86		5.52	5.28
		34		4	0.01	0.06	18.19		7.11	8.50
		35		4	0.03	0.08	15.76		6.43	7.15
		36		4	0.19	0.21	11.54		5.14	4.40
		128		1	0.04	0.05	4.13		1.95	1.44
		131		2	0.03	0.23	8.38		3.19	2.57
		132		2	0.01	0.10	9.46		4.54	4.39
		133		2	0.11	0.15	8.96		2.94	3.17
		140		2	0.03	0.11	8.60		4.49	3.57
		141		2	0.06	0.13	9.69		3.66	4.16
		146		4	0.08	0.37	12.11		6.31	3.72
		147		4	0.01	0.13	16.53		9.07	6.53
		148		4	0.01	0.08	17.54		9.67	7.47
		149		4	0.19	0.08	11.46		4.72	6.14
		150		4	0.22	0.20	11.72		5.43	5.00
		161		4	0.08	0.34	14.24		6.86	4.50
		162		4	0.01	0.05	17.84		9.45	7.94
		163		4	0.02	0.08	13.64		7.42	6.44
		164		4	0.23	0.12	11.43		5.22	5.48
		0	128	2	0.06	0.08	9.75		4.95	2.95
		3	131	4	0.17	0.23	17.15		6.55	6.95
		4	132	4	0.01	0.13	19.72		9.19	8.84
		5	133	4	0.14	0.26	18.50		6.21	7.78
		12	140	4	0.07	0.33	17.56		7.09	7.12
		13	141	4	0.09	0.17	18.88		7.60	7.93
		18	146	8	0.30	1.79	23.89		9.12	8.73
		19	147	8	0.04	0.20	31.55		15.19	13.57
		20	148	8	0.03	0.14	35.31		15.84	15.46
		21	149	8	0.21	0.26	23.69		8.01	11.45
		22	150	8	0.49	0.28	18.73		8.10	6.99
		33	161	8	0.18	1.36	25.62		9.53	10.23
		34	162	8	0.01	0.08	36.07		17.96	15.39
		35	163	8	0.03	0.12	30.52		13.05	14.38
		36	164	8	0.40	0.28	20.18		8.39	8.31

L-Patch High CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)
L	Patch	0		1	0.03	0.04	5.14		2.53	1.56
		3		2	0.11	0.08	8.06		3.09	3.26
		4		2	0.02	0.02	8.81		4.55	3.39
		5		2	0.14	0.07	9.27		3.93	3.18
		12		2	0.06	0.10	8.53		4.51	2.67
		13		2	0.04	0.04	8.47		4.09	3.38
		18		4	0.15	0.40	11.56		6.70	5.06
		19		4	0.05	0.06	16.13		7.74	7.47
		20		4	0.01	0.06	18.25		9.00	8.30
		21		4	0.14	0.07	12.51		5.34	5.30
		22		4	0.37	0.15	11.28		5.72	4.71
		33		4	0.10	0.33	12.31		6.39	5.82
		34		4	0.01	0.03	17.86		8.71	8.14
		35		4	0.05	0.03	14.97		7.34	6.49
		36		4	0.28	0.13	12.07		5.47	5.06
		128		1	0.05	0.04	4.05		1.81	1.57
		131		2	0.03	0.18	9.11		3.37	3.27
		132		2	0.02	0.03	9.40		3.92	4.49
		133		2	0.09	0.18	8.38		2.86	3.25
		140		2	0.03	0.06	8.87		4.17	4.09
		141		2	0.06	0.11	9.00		3.21	4.08
		146		4	0.12	0.37	12.71		6.18	4.89
		147		4	0.02	0.05	16.19		8.27	6.88
		148		4	0.01	0.02	17.32		9.26	7.14
		149		4	0.26	0.14	9.92		5.06	4.88
		150		4	0.21	0.16	10.44		5.21	4.41
		161		4	0.12	0.22	14.15		6.61	5.34
		162		4	0.02	0.03	17.63		9.03	7.73
		163		4	0.06	0.06	13.39		7.25	5.27
		164		4	0.26	0.14	9.98		4.82	4.47
		0	128	2	0.04	0.11	9.81		5.20	3.10
		3	131	4	0.17	0.24	17.89		6.90	7.38
		4	132	4	0.01	0.06	19.40		8.43	8.87
		5	133	4	0.16	0.33	18.56		7.49	8.01
		12	140	4	0.06	0.23	17.44		6.57	7.50
		13	141	4	0.08	0.16	17.25		7.00	7.85
18	146	8	0.21	1.14	24.31		11.16	10.78		
19	147	8	0.04	0.15	29.39		15.07	12.67		
20	148	8	0.02	0.06	34.87		18.23	14.50		
21	149	8	0.32	0.34	20.86		8.61	11.23		
22	150	8	0.41	0.31	16.59		9.57	6.80		
33	161	8	0.16	0.89	25.84		10.98	11.95		
34	162	8	0.02	0.06	35.04		19.11	14.85		
35	163	8	0.06	0.09	28.64		14.71	12.75		
36	164	8	0.41	0.39	17.78		9.19	8.43		

Table 3. PD of AntJ-Patch antenna (n261)

J-Patch Low CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)						
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)	
J	Patch	1		1	0.03	0.08		3.61	1.67	1.11	
		6		2	0.14	0.18		7.25	3.34	1.43	
		7		2	0.01	0.02		8.93	4.87	3.22	
		8		2	0.09	0.18		9.08	3.54	3.19	
		14		2	0.04	0.04		8.08	4.49	2.61	
		15		2	0.03	0.11		9.55	4.42	3.58	
		23		4	0.12	0.21		13.42	8.03	3.17	
		24		4	0.03	0.04		18.02	9.89	7.01	
		25		4	0.04	0.04		17.47	10.07	6.45	
		26		4	0.16	0.16		14.22	5.53	5.67	
		27		4	0.16	0.46		12.96	6.34	3.63	
		37		4	0.07	0.03		15.63	8.43	5.60	
		38		4	0.05	0.05		18.40	10.14	7.21	
		39		4	0.13	0.06		13.32	5.77	5.17	
		40		4	0.20	0.28		14.46	5.68	5.45	
		129		1	0.01	0.10		4.03	1.62	1.57	
		134		2	0.07	0.13		8.62	3.60	2.07	
		135		2	0.01	0.03		9.61	4.36	4.21	
		136		2	0.08	0.10		8.50	3.95	2.66	
		142		2	0.03	0.09		8.86	4.23	3.51	
		143		2	0.05	0.14		8.89	3.62	3.29	
		151		4	0.06	0.35		12.43	4.93	4.05	
		152		4	0.03	0.07		17.37	9.17	7.17	
		153		4	0.02	0.09		15.49	7.32	6.96	
		154		4	0.11	0.21		11.55	6.46	3.58	
		155		4	0.22	0.23		11.95	5.72	3.82	
		165		4	0.04	0.15		13.37	6.49	4.85	
		166		4	0.02	0.12		16.60	7.94	6.83	
		167		4	0.04	0.12		12.87	6.55	5.04	
		168		4	0.22	0.20		11.63	6.32	3.76	
		1		129	2	0.02	0.05		6.86	2.65	2.45
		6		134	4	0.22	0.13		14.65	5.65	2.89
		7		136	4	0.11	0.10		16.40	7.05	6.87
		8		135	4	0.07	0.12		18.40	8.66	6.46
		14		142	4	0.08	0.06		17.13	10.03	4.74
		15		143	4	0.05	0.09		17.61	8.86	5.62
		23		151	8	0.14	0.31		22.86	11.13	5.03
		24		152	8	0.06	0.07		37.19	23.81	12.50
		25		153	8	0.03	0.04		34.98	21.63	12.16
		26		155	8	0.53	0.33		25.17	10.50	9.41
27		154	8	0.25	0.38		22.31	13.71	5.30		
37		165	8	0.11	0.16		28.31	15.91	7.64		
38		166	8	0.04	0.05		36.16	21.32	13.37		
39		168	8	0.58	0.25		26.31	12.39	10.09		
40		167	8	0.26	0.27		21.40	10.30	6.42		

J-Patch Mid CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)
J	Patch	1		1	0.03	0.05		4.17	1.66	1.36
		6		2	0.11	0.12		8.94	4.24	1.86
		7		2	0.01	0.02		9.31	4.63	3.69
		8		2	0.08	0.16		8.95	3.19	3.57
		14		2	0.02	0.03		9.22	4.96	3.24
		15		2	0.04	0.10		9.25	3.79	3.90
		23		4	0.16	0.14		13.57	7.76	4.62
		24		4	0.03	0.02		18.92	9.98	7.87
		25		4	0.04	0.03		17.94	9.73	6.27
		26		4	0.21	0.18		11.15	4.97	5.33
		27		4	0.14	0.34		12.57	5.55	4.09
		37		4	0.08	0.04		16.88	9.55	6.25
		38		4	0.03	0.03		19.30	9.94	7.78
		39		4	0.14	0.09		11.27	5.04	4.62
		40		4	0.21	0.26		11.93	5.10	5.39
		129		1	0.02	0.11		4.56	1.98	1.55
		134		2	0.08	0.17		8.76	4.22	2.15
		135		2	0.01	0.03		9.75	4.43	4.42
		136		2	0.09	0.07		8.39	3.65	3.35
		142		2	0.02	0.11		9.30	4.67	3.78
		143		2	0.05	0.15		9.18	3.96	3.64
		151		4	0.08	0.50		12.34	5.57	4.22
		152		4	0.02	0.06		17.42	9.17	7.26
		153		4	0.03	0.13		15.36	7.63	6.64
		154		4	0.14	0.17		11.53	5.13	4.69
		155		4	0.20	0.14		11.63	4.86	4.13
		165		4	0.05	0.21		13.70	6.52	4.93
		166		4	0.03	0.15		17.01	8.29	6.91
		167		4	0.05	0.12		12.52	5.82	5.28
		168		4	0.23	0.15		10.88	4.81	4.42
		1	129	2	0.03	0.09		8.46	3.32	2.25
		6	134	4	0.13	0.21		16.69	7.13	4.11
		7	136	4	0.09	0.05		17.16	6.41	8.11
		8	135	4	0.08	0.13		18.04	8.75	6.48
		14	142	4	0.06	0.13		19.40	11.72	5.08
		15	143	4	0.06	0.13		17.64	8.62	5.95
		23	151	8	0.20	0.42		23.92	12.45	6.13
		24	152	8	0.04	0.05		38.49	24.07	13.20
		25	153	8	0.07	0.13		35.46	21.18	12.33
		26	155	8	0.41	0.17		20.86	9.72	10.28
27	154	8	0.18	0.46		21.15	10.43	5.36		
37	165	8	0.15	0.29		32.24	18.86	7.25		
38	166	8	0.04	0.11		37.60	20.91	13.76		
39	168	8	0.50	0.12		22.02	11.05	9.37		
40	167	8	0.32	0.36		18.65	7.86	7.48		

J-Patch High CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)
J	Patch	1		1	0.01	0.03		3.77	1.69	1.48
		6		2	0.06	0.13		8.39	3.81	2.43
		7		2	0.01	0.02		8.87	4.23	3.87
		8		2	0.04	0.14		8.51	3.43	3.47
		14		2	0.02	0.03		8.90	4.35	3.71
		15		2	0.02	0.09		8.63	3.79	3.83
		23		4	0.04	0.18		12.66	7.07	5.10
		24		4	0.01	0.03		18.33	9.04	8.32
		25		4	0.04	0.03		17.03	9.05	6.55
		26		4	0.20	0.19		11.36	5.67	5.39
		27		4	0.10	0.45		11.29	5.59	3.84
		37		4	0.03	0.04		16.34	8.42	6.99
		38		4	0.03	0.03		18.81	9.26	8.10
		39		4	0.15	0.09		12.04	6.48	4.93
		40		4	0.20	0.29		11.75	5.23	5.28
		129		1	0.03	0.12		4.53	1.87	1.48
		134		2	0.08	0.16		8.31	4.28	2.19
		135		2	0.01	0.02		9.28	4.27	4.14
		136		2	0.09	0.05		8.66	3.60	3.64
		142		2	0.04	0.14		9.16	4.19	3.63
		143		2	0.04	0.13		8.90	4.06	3.67
		151		4	0.13	0.54		12.35	5.77	4.34
		152		4	0.02	0.04		16.69	7.85	7.61
		153		4	0.04	0.10		15.22	7.76	6.59
		154		4	0.15	0.19		12.62	5.35	5.50
		155		4	0.20	0.14		11.54	4.24	4.51
		165		4	0.08	0.31		14.02	6.60	5.26
		166		4	0.03	0.08		16.78	8.05	6.95
		167		4	0.06	0.16		12.86	6.09	5.59
		168		4	0.23	0.15		11.02	4.49	5.04
		1	129	2	0.04	0.09		8.66	3.93	2.10
		6	134	4	0.11	0.28		15.46	6.76	4.21
		7	136	4	0.09	0.05		17.41	6.54	8.68
		8	135	4	0.04	0.11		17.67	8.44	6.19
		14	142	4	0.06	0.18		18.70	11.48	4.72
		15	143	4	0.04	0.11		17.37	9.06	5.14
		23	151	8	0.25	0.34		23.84	13.01	7.94
		24	152	8	0.04	0.06		36.99	22.02	13.74
		25	153	8	0.09	0.14		34.51	21.14	12.62
		26	155	8	0.37	0.29		20.62	9.71	8.63
27	154	8	0.16	0.48		20.58	11.14	5.79		
37	165	8	0.11	0.39		30.50	19.83	7.11		
38	166	8	0.06	0.12		37.11	20.57	14.20		
39	168	8	0.45	0.19		22.00	11.26	7.69		
40	167	8	0.23	0.40		20.69	10.77	7.05		

Table 4. PD of AntK-Patch antenna (n261)

K-Patch Low CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)							
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)		
K	Patch	2		1		2.96	0.02	0.04	2.13	0.75		
		9		2		4.26	0.06	0.06	2.66	1.57		
		10		2		5.76	0.01	0.01	3.16	2.79		
		11		2		4.82	0.05	0.11	3.53	1.55		
		16		2		4.66	0.08	0.05	2.52	2.24		
		17		2		5.86	0.01	0.02	3.24	2.65		
		28		4		6.65	0.31	0.14	6.61	4.54		
		29		4		11.51	0.02	0.02	7.66	5.19		
		30		4		12.75	0.00	0.03	8.69	5.42		
		31		4		11.05	0.02	0.07	7.79	4.90		
		32		4		8.55	0.22	0.26	5.16	3.72		
		41		4		8.70	0.15	0.07	6.44	3.99		
		42		4		12.58	0.01	0.01	8.59	5.32		
		43		4		12.07	0.02	0.02	8.33	5.37		
		44		4		8.82	0.08	0.31	5.93	4.13		
		130		1		2.74	0.02	0.05	1.46	0.99		
		137		2		4.70	0.07	0.06	3.44	1.83		
		138		2		5.74	0.01	0.02	3.69	2.59		
		139		2		4.15	0.08	0.15	2.90	1.84		
		144		2		5.34	0.03	0.03	3.68	2.09		
		145		2		5.39	0.03	0.03	3.45	2.55		
		156		4		8.45	0.10	0.09	5.40	4.40		
		157		4		11.92	0.01	0.01	7.80	5.37		
		158		4		11.88	0.01	0.00	7.68	5.09		
		159		4		7.75	0.04	0.17	5.30	4.02		
		160		4		6.56	0.19	0.38	5.62	4.64		
		169		4		9.97	0.04	0.04	6.66	4.81		
		170		4		11.86	0.01	0.01	7.62	5.06		
		171		4		10.62	0.02	0.04	6.98	4.89		
		172		4		6.73	0.12	0.31	5.36	4.18		
		2		130		2		5.93	0.03	0.05	4.39	1.34
		9		137		4		8.94	0.12	0.16	5.65	3.07
		10		138		4		12.13	0.03	0.01	7.73	4.14
		11		139		4		9.96	0.16	0.36	6.39	4.97
		16		144		4		10.01	0.10	0.05	6.58	3.17
		17		145		4		11.49	0.05	0.05	7.68	3.78
		28		156		8		11.91	0.38	0.10	11.51	7.33
		29		157		8		23.05	0.03	0.02	14.23	10.69
		30		158		8		25.33	0.01	0.03	17.08	9.84
		31		159		8		20.93	0.07	0.32	15.48	7.16
		32		160		8		10.98	0.26	0.46	10.71	3.33
		41		169		8		16.41	0.12	0.06	10.31	7.49
		42		170		8		25.35	0.02	0.01	16.60	10.38
		43		171		8		24.20	0.04	0.10	17.53	8.59
44		172		8		14.20	0.21	0.54	11.44	4.81		

K-Patch Mid CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)
K	Patch	2		1		2.92	0.03	0.04	2.14	0.69
		9		2		4.20	0.05	0.06	2.53	1.71
		10		2		5.89	0.01	0.01	3.32	2.65
		11		2		4.93	0.05	0.10	3.39	1.40
		16		2		4.91	0.06	0.06	2.66	1.98
		17		2		6.09	0.01	0.02	3.34	2.72
		28		4		7.54	0.22	0.19	5.32	4.54
		29		4		10.84	0.01	0.03	7.21	4.76
		30		4		12.82	0.00	0.02	9.02	5.20
		31		4		10.58	0.03	0.09	7.69	4.52
		32		4		9.64	0.21	0.27	5.26	3.52
		41		4		8.61	0.10	0.09	6.19	3.87
		42		4		12.17	0.00	0.01	8.55	4.76
		43		4		11.91	0.02	0.02	8.64	5.25
		44		4		10.05	0.08	0.25	5.53	3.92
		130		1		2.57	0.02	0.06	1.31	0.98
		137		2		4.73	0.08	0.06	4.12	1.44
		138		2		5.70	0.01	0.03	3.87	2.19
		139		2		4.30	0.09	0.17	2.96	1.75
		144		2		5.41	0.05	0.04	4.32	1.69
		145		2		5.19	0.02	0.03	3.31	2.24
		156		4		7.82	0.16	0.12	5.02	3.56
		157		4		11.57	0.01	0.01	7.64	5.07
		158		4		11.98	0.01	0.01	8.06	4.69
		159		4		7.17	0.03	0.22	4.63	3.10
		160		4		6.64	0.15	0.35	5.75	4.44
		169		4		9.09	0.08	0.05	6.35	3.91
		170		4		12.05	0.02	0.01	7.90	4.78
		171		4		10.01	0.01	0.08	6.79	4.18
		172		4		6.66	0.08	0.31	5.17	3.75
		2	130	2		5.63	0.04	0.07	4.14	1.49
		9	137	4		8.43	0.14	0.16	5.35	2.90
		10	138	4		12.83	0.03	0.02	8.69	3.94
		11	139	4		9.95	0.14	0.37	6.30	4.30
		16	144	4		10.73	0.12	0.08	7.97	2.55
		17	145	4		11.97	0.04	0.06	7.90	3.69
		28	156	8		13.45	0.37	0.14	12.30	6.89
		29	157	8		22.34	0.03	0.03	13.39	9.99
		30	158	8		25.90	0.01	0.02	18.84	8.98
		31	159	8		20.67	0.08	0.39	15.59	6.32
		32	160	8		11.44	0.31	0.53	11.81	3.73
		41	169	8		16.37	0.12	0.09	10.17	6.71
		42	170	8		25.41	0.03	0.01	17.23	9.68
		43	171	8		24.26	0.03	0.13	18.69	7.99
44	172	8		15.17	0.22	0.55	10.62	4.32		

K-Patch High CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)						
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)	
K	Patch	2		1		2.69	0.02	0.03	2.08	0.54	
		9		2		3.82	0.04	0.05	2.54	1.33	
		10		2		6.10	0.02	0.01	3.48	2.42	
		11		2		4.62	0.04	0.09	3.22	1.25	
		16		2		5.08	0.07	0.08	3.10	1.86	
		17		2		6.21	0.01	0.02	3.32	2.65	
		28		4		7.43	0.22	0.21	5.84	3.79	
		29		4		10.41	0.03	0.03	7.30	4.03	
		30		4		12.60	0.00	0.01	8.91	4.97	
		31		4		10.16	0.03	0.10	7.28	4.10	
		32		4		8.65	0.13	0.29	4.78	4.02	
		41		4		8.17	0.14	0.12	6.14	3.25	
		42		4		11.92	0.01	0.01	8.39	4.56	
		43		4		11.59	0.02	0.03	8.66	4.76	
		44		4		9.74	0.06	0.21	4.69	4.55	
		130		1		2.43	0.02	0.06	1.07	0.99	
		137		2		4.58	0.09	0.07	4.13	1.15	
		138		2		5.55	0.01	0.03	4.06	1.70	
		139		2		4.27	0.10	0.17	2.79	1.73	
		144		2		5.30	0.07	0.06	4.39	1.34	
		145		2		4.92	0.02	0.03	3.39	1.85	
		156		4		7.31	0.18	0.09	5.03	2.92	
		157		4		11.02	0.02	0.02	7.10	4.75	
		158		4		11.68	0.01	0.04	7.73	4.42	
		159		4		6.76	0.03	0.23	4.19	2.79	
		160		4		6.62	0.13	0.29	5.30	4.16	
		169		4		8.33	0.11	0.05	5.38	3.18	
		170		4		11.98	0.02	0.02	7.69	4.64	
		171		4		9.15	0.01	0.14	5.93	3.60	
		172		4		6.70	0.07	0.27	4.79	3.61	
		2	130	2			4.72	0.03	0.05	3.46	1.44
		9	137	4			7.49	0.15	0.17	4.83	2.23
		10	138	4			12.85	0.04	0.03	9.18	3.31
		11	139	4			9.80	0.12	0.36	6.26	4.16
		16	144	4			11.00	0.12	0.13	8.48	2.00
		17	145	4			11.77	0.04	0.05	7.83	3.44
		28	156	8			14.05	0.27	0.20	10.23	6.94
		29	157	8			22.10	0.05	0.05	13.19	8.94
		30	158	8			25.45	0.01	0.04	18.88	8.19
		31	159	8			19.12	0.08	0.38	14.15	5.61
		32	160	8			10.47	0.33	0.39	11.29	4.23
		41	169	8			15.93	0.10	0.14	9.69	6.29
		42	170	8			25.25	0.04	0.02	17.22	8.80
		43	171	8			23.01	0.03	0.20	18.44	6.65
44	172	8			13.75	0.21	0.40	10.07	5.06		

Table 5. PD of AntL-Patch antenna (n260)

L-Patch Low CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)
L	Patch	0		1	0.02	0.02	3.99		2.31	1.19
		3		2	0.04	0.06	6.56		3.49	1.73
		4		2	0.04	0.06	5.90		3.39	2.16
		5		2	0.01	0.04	6.75		2.36	2.64
		12		2	0.02	0.01	6.54		2.59	3.08
		13		2	0.01	0.05	6.62		3.45	2.18
		18		4	0.04	0.08	10.83		4.82	4.44
		19		4	0.06	0.09	10.54		5.59	4.77
		20		4	0.02	0.08	10.94		5.33	5.10
		21		4	0.04	0.11	12.86		7.14	4.62
		22		4	0.04	0.08	13.20		6.05	4.11
		33		4	0.08	0.07	10.52		5.77	4.82
		34		4	0.03	0.07	10.82		5.09	4.66
		35		4	0.03	0.11	11.28		5.63	4.78
		36		4	0.03	0.09	12.73		6.15	4.11
		128		1	0.01	0.02	2.53		1.48	0.66
		131		2	0.02	0.04	6.94		3.84	2.12
		132		2	0.01	0.08	6.30		2.83	2.60
		133		2	0.03	0.03	6.33		3.56	1.43
		140		2	0.01	0.04	5.51		3.35	1.73
		141		2	0.02	0.11	7.16		3.55	2.51
		146		4	0.07	0.05	11.44		6.00	3.85
		147		4	0.03	0.12	10.50		5.26	4.18
		148		4	0.04	0.15	9.13		5.37	4.05
		149		4	0.02	0.22	11.42		7.14	4.49
		150		4	0.05	0.06	13.19		6.92	3.74
		161		4	0.06	0.08	11.02		5.56	4.18
		162		4	0.03	0.03	9.40		5.27	3.85
		163		4	0.04	0.23	9.26		5.52	4.11
		164		4	0.02	0.10	12.44		7.87	3.65
		0	128	2	0.03	0.03	5.66		3.34	1.53
		3	131	4	0.08	0.12	12.01		6.38	3.15
		4	132	4	0.07	0.09	11.33		5.31	4.77
		5	133	4	0.04	0.04	12.84		5.31	4.07
		12	140	4	0.02	0.06	13.07		6.44	4.88
		13	141	4	0.03	0.15	14.17		7.18	5.10
18	146	8	0.10	0.11	21.60		10.26	7.67		
19	147	8	0.06	0.25	20.65		11.25	8.77		
20	148	8	0.07	0.13	20.70		11.49	9.09		
21	149	8	0.03	0.35	22.47		9.90	10.23		
22	150	8	0.10	0.18	22.08		10.52	7.01		
33	161	8	0.12	0.11	21.24		11.60	8.67		
34	162	8	0.04	0.09	21.36		10.90	10.21		
35	163	8	0.09	0.22	21.47		12.40	9.08		
36	164	8	0.06	0.27	21.16		10.21	6.21		

L-Patch Mid CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)
L	Patch	0		1	0.01	0.04	5.03		2.35	1.70
		3		2	0.02	0.07	9.52		3.39	3.06
		4		2	0.02	0.08	7.94		3.79	2.76
		5		2	0.01	0.06	8.44		2.93	3.41
		12		2	0.02	0.02	9.37		2.93	5.23
		13		2	0.01	0.10	8.43		4.02	2.50
		18		4	0.03	0.07	15.89		5.35	5.13
		19		4	0.04	0.06	16.06		6.08	7.77
		20		4	0.03	0.11	13.27		5.56	5.70
		21		4	0.03	0.12	16.45		7.34	7.50
		22		4	0.04	0.10	17.37		6.42	6.92
		33		4	0.05	0.05	16.16		5.93	7.55
		34		4	0.03	0.12	15.53		6.25	7.39
		35		4	0.02	0.10	14.18		6.33	5.78
		36		4	0.02	0.14	16.96		6.67	6.01
		128		1	0.01	0.02	3.56		2.27	0.90
		131		2	0.02	0.04	9.86		4.71	3.24
		132		2	0.02	0.09	8.90		4.56	3.43
		133		2	0.02	0.03	8.72		4.60	2.43
		140		2	0.02	0.02	7.75		4.91	2.36
		141		2	0.01	0.09	9.77		4.64	3.14
		146		4	0.04	0.04	16.74		8.95	5.49
		147		4	0.07	0.07	15.15		8.06	5.19
		148		4	0.04	0.15	13.34		6.29	5.45
		149		4	0.04	0.20	13.98		7.46	4.93
		150		4	0.03	0.05	17.96		9.09	4.69
		161		4	0.05	0.08	15.66		8.02	5.60
		162		4	0.05	0.14	12.80		6.74	5.35
		163		4	0.03	0.14	13.74		6.32	5.41
		164		4	0.03	0.12	17.34		8.50	4.36
		0	128	2	0.02	0.06	7.17		3.63	2.14
		3	131	4	0.04	0.15	18.26		8.25	5.66
		4	132	4	0.05	0.11	16.59		7.08	5.67
		5	133	4	0.03	0.05	17.74		8.12	6.62
		12	140	4	0.03	0.04	17.32		10.27	6.47
		13	141	4	0.01	0.17	17.35		9.70	4.41
18	146	8	0.06	0.10	29.40		11.76	10.03		
19	147	8	0.10	0.09	30.55		13.73	14.25		
20	148	8	0.07	0.34	26.23		12.83	11.05		
21	149	8	0.04	0.21	28.55		12.56	13.74		
22	150	8	0.08	0.12	31.26		13.61	10.22		
33	161	8	0.11	0.09	29.78		12.42	15.08		
34	162	8	0.06	0.18	26.83		11.46	13.52		
35	163	8	0.06	0.31	28.08		13.33	10.79		
36	164	8	0.03	0.18	29.89		11.95	8.76		

L-Patch High CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)
L	Patch	0		1	0.02	0.04	5.36		3.02	1.68
		3		2	0.03	0.06	10.10		4.67	2.99
		4		2	0.03	0.05	7.85		4.39	2.82
		5		2	0.02	0.09	10.51		3.30	4.16
		12		2	0.05	0.05	10.17		3.47	4.82
		13		2	0.01	0.13	9.32		4.44	2.32
		18		4	0.03	0.08	17.05		6.30	7.44
		19		4	0.06	0.12	17.50		7.65	8.08
		20		4	0.04	0.23	14.98		7.59	5.72
		21		4	0.04	0.30	15.54		7.80	5.84
		22		4	0.07	0.14	16.04		8.09	5.42
		33		4	0.05	0.08	17.35		6.67	8.42
		34		4	0.07	0.15	16.11		7.52	6.84
		35		4	0.03	0.26	15.18		8.00	5.52
		36		4	0.04	0.15	16.29		7.81	5.40
		128		1	0.01	0.02	3.64		2.05	1.13
		131		2	0.10	0.07	9.94		4.72	3.40
		132		2	0.04	0.07	10.16		4.10	4.80
		133		2	0.05	0.04	9.26		4.93	2.45
		140		2	0.05	0.05	7.25		4.84	1.86
		141		2	0.02	0.09	11.15		4.08	3.85
		146		4	0.09	0.07	17.04		8.62	5.65
		147		4	0.13	0.10	14.34		8.20	5.62
		148		4	0.03	0.11	15.94		7.09	7.21
		149		4	0.09	0.23	15.22		6.63	5.44
		150		4	0.07	0.06	16.54		7.91	4.42
		161		4	0.11	0.08	16.54		9.01	5.89
		162		4	0.07	0.15	15.44		6.49	7.09
		163		4	0.02	0.12	15.68		6.78	7.11
		164		4	0.06	0.09	16.97		8.28	4.86
		0	128	2	0.02	0.08	8.07		4.48	2.33
		3	131	4	0.07	0.17	19.08		10.99	5.02
		4	132	4	0.08	0.10	17.77		7.65	7.37
		5	133	4	0.09	0.06	19.43		9.54	6.92
		12	140	4	0.07	0.15	16.85		10.06	5.46
		13	141	4	0.03	0.23	19.68		10.47	3.70
18	146	8	0.14	0.11	32.05		13.96	12.34		
19	147	8	0.19	0.15	33.33		14.31	17.15		
20	148	8	0.08	0.43	28.25		16.72	8.76		
21	149	8	0.07	0.24	28.60		13.88	11.18		
22	150	8	0.11	0.23	28.90		15.45	7.12		
33	161	8	0.18	0.09	35.14		14.79	16.46		
34	162	8	0.19	0.16	31.73		14.52	15.97		
35	163	8	0.07	0.48	27.94		16.14	8.90		
36	164	8	0.07	0.20	29.34		14.07	10.30		

Table 6. PD of AntJ-Patch antenna (n260)

J-Patch Low CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)						
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)	
J	Patch	1		1	0.01	0.08		4.00	2.54	1.14	
		6		2	0.03	0.08		7.35	4.08	1.70	
		7		2	0.02	0.04		6.33	2.50	2.30	
		8		2	0.02	0.08		7.39	3.94	2.44	
		14		2	0.03	0.04		7.39	4.42	2.06	
		15		2	0.02	0.06		5.73	2.82	2.14	
		23		4	0.03	0.07		12.24	7.73	3.25	
		24		4	0.07	0.13		11.57	5.69	4.42	
		25		4	0.04	0.10		10.98	5.89	3.99	
		26		4	0.04	0.34		9.90	6.10	3.63	
		27		4	0.02	0.08		10.92	7.72	2.82	
		37		4	0.08	0.10		12.26	6.37	4.55	
		38		4	0.03	0.16		11.40	5.63	4.06	
		39		4	0.04	0.21		10.37	6.18	4.20	
		40		4	0.01	0.18		10.13	6.94	2.93	
		129		1	0.02	0.02		3.40	2.03	1.08	
		134		2	0.04	0.06		6.82	3.68	1.60	
		135		2	0.03	0.06		6.35	3.59	2.60	
		136		2	0.05	0.06		6.65	3.68	1.65	
		142		2	0.01	0.07		6.84	3.56	2.09	
		143		2	0.04	0.06		6.17	3.51	2.24	
		151		4	0.07	0.09		11.26	5.84	3.63	
		152		4	0.01	0.11		9.73	5.07	4.61	
		153		4	0.05	0.09		10.80	5.37	5.02	
		154		4	0.06	0.10		10.69	4.95	4.80	
		155		4	0.05	0.11		10.58	4.63	4.15	
		165		4	0.04	0.16		10.78	5.91	4.08	
		166		4	0.02	0.05		10.35	4.99	5.37	
		167		4	0.07	0.10		10.45	5.70	4.68	
		168		4	0.06	0.08		10.49	4.65	4.30	
		1		129	2	0.04	0.11		7.35	4.92	1.81
		6		134	4	0.09	0.11		11.73	7.72	2.77
		7		135	4	0.05	0.06		12.10	6.85	3.67
		8		136	4	0.04	0.05		14.45	8.45	4.45
		14		143	4	0.06	0.13		12.16	7.36	3.72
		15		142	4	0.02	0.18		12.87	5.31	4.41
		23		155	8	0.09	0.08		24.00	12.93	6.68
		24		153	8	0.10	0.16		21.03	10.61	10.09
		25		152	8	0.04	0.22		21.16	10.16	9.75
		26		151	8	0.10	0.30		19.29	9.79	7.48
27		154	8	0.10	0.14		20.04	12.20	6.61		
37		167	8	0.12	0.14		21.00	11.32	9.30		
38		166	8	0.04	0.19		22.40	9.45	11.09		
39		165	8	0.06	0.33		20.15	10.07	8.74		
40		168	8	0.05	0.33		19.45	11.30	6.25		

J-Patch Mid CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)
		1		1	0.02	0.05		6.28	3.10	2.02
		6		2	0.02	0.08		10.85	5.22	3.19
		7		2	0.02	0.02		9.33	4.03	3.16
		8		2	0.03	0.07		11.44	5.45	3.47
		14		2	0.02	0.03		11.01	5.94	3.30
		15		2	0.01	0.06		8.39	4.13	3.41
		23		4	0.05	0.11		18.01	8.51	5.19
		24		4	0.05	0.08		18.62	9.55	6.19
		25		4	0.04	0.08		15.59	7.58	6.24
		26		4	0.07	0.27		14.52	7.71	4.86
		27		4	0.03	0.14		16.92	8.43	5.76
		37		4	0.03	0.06		19.49	10.35	6.47
		38		4	0.08	0.09		16.97	8.52	5.93
		39		4	0.05	0.15		15.20	7.30	5.54
		40		4	0.05	0.25		14.42	7.82	5.02
		129		1	0.01	0.03		4.80	1.93	1.91
		134		2	0.01	0.06		10.08	3.76	3.54
		135		2	0.03	0.06		8.07	4.07	3.17
		136		2	0.02	0.07		9.91	3.77	3.48
		142		2	0.01	0.08		9.46	3.82	3.39
		143		2	0.02	0.05		8.65	3.92	3.20
		151		4	0.03	0.12		14.67	5.92	5.87
		152		4	0.03	0.12		14.52	6.09	6.56
		153		4	0.03	0.06		15.54	6.19	8.03
		154		4	0.04	0.12		15.91	6.04	7.16
		155		4	0.01	0.07		16.24	5.57	6.80
		165		4	0.04	0.12		15.33	6.53	6.85
		166		4	0.03	0.10		14.23	6.25	7.21
		167		4	0.03	0.08		15.40	5.90	8.08
		168		4	0.02	0.07		15.76	5.66	6.36
J	Patch	1	129	2	0.04	0.08		11.32	5.89	4.01
		6	134	4	0.04	0.19		18.03	7.67	6.22
		7	135	4	0.05	0.08		16.65	9.07	3.53
		8	136	4	0.04	0.12		20.99	8.09	8.46
		14	143	4	0.04	0.13		16.79	8.84	6.67
		15	142	4	0.04	0.14		18.19	6.41	8.27
		23	155	8	0.06	0.18		34.03	13.52	12.43
		24	153	8	0.08	0.10		32.44	13.00	17.34
		25	152	8	0.04	0.19		31.50	12.54	15.06
		26	151	8	0.05	0.27		27.86	10.31	11.49
		27	154	8	0.05	0.36		29.45	10.34	13.18
		37	167	8	0.05	0.08		31.71	13.56	16.25
		38	166	8	0.08	0.17		33.78	14.30	14.88
		39	165	8	0.05	0.31		29.78	10.97	14.41
		40	168	8	0.08	0.42		28.98	11.45	10.27

J-Patch High CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)							
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)		
J	Patch	1		1	0.04	0.10		5.59	3.02	1.97		
		6		2	0.05	0.20		11.12	5.34	3.36		
		7		2	0.04	0.05		9.49	3.71	4.11		
		8		2	0.03	0.11		9.94	4.93	3.72		
		14		2	0.06	0.10		10.34	5.93	3.03		
		15		2	0.03	0.08		9.30	4.37	4.59		
		23		4	0.04	0.19		16.55	7.80	5.64		
		24		4	0.12	0.24		17.78	8.84	6.10		
		25		4	0.10	0.17		16.20	6.61	6.65		
		26		4	0.04	0.28		13.85	7.52	6.25		
		27		4	0.03	0.22		16.16	8.19	5.67		
		37		4	0.12	0.16		17.40	8.44	5.69		
		38		4	0.13	0.22		15.70	8.32	6.45		
		39		4	0.04	0.13		16.33	8.22	6.93		
		40		4	0.04	0.45		14.33	7.63	6.17		
		129		1	0.02	0.04		4.88	2.83	1.55		
		134		2	0.04	0.07		10.82	5.05	2.97		
		135		2	0.02	0.06		8.14	4.25	2.93		
		136		2	0.04	0.07		10.64	4.86	3.16		
		142		2	0.02	0.12		9.91	4.95	2.33		
		143		2	0.04	0.04		8.94	4.19	3.42		
		151		4	0.06	0.16		15.94	7.38	5.33		
		152		4	0.04	0.25		13.97	7.59	5.69		
		153		4	0.05	0.08		14.35	6.79	6.32		
		154		4	0.06	0.07		14.94	7.06	5.93		
		155		4	0.03	0.10		15.29	7.51	4.85		
		165		4	0.05	0.26		14.93	7.84	5.23		
		166		4	0.04	0.12		14.25	5.91	6.46		
		167		4	0.06	0.06		14.42	6.73	6.73		
		168		4	0.03	0.06		15.27	7.41	5.19		
		1		129		2	0.03	0.21		10.82	5.79	4.08
		6		134		4	0.06	0.48		18.67	9.62	6.62
		7		135		4	0.05	0.12		15.61	8.95	3.75
		8		136		4	0.09	0.19		20.39	7.17	9.08
		14		143		4	0.06	0.19		17.34	10.21	6.81
		15		142		4	0.05	0.21		20.04	9.31	8.55
		23		155		8	0.09	0.32		33.77	17.77	12.04
		24		153		8	0.18	0.34		29.92	12.11	13.17
		25		152		8	0.10	0.33		30.27	14.68	12.52
		26		151		8	0.09	0.26		28.30	16.06	11.62
27		154		8	0.09	0.38		27.99	11.45	12.10		
37		167		8	0.15	0.25		30.55	12.46	13.43		
38		166		8	0.13	0.22		30.55	13.80	14.54		
39		165		8	0.09	0.44		31.19	16.28	11.11		
40		168		8	0.08	0.51		28.54	11.96	12.68		

Table 7. PD of AntK-Patch antenna (n260)

K-Patch Low CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)							
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)		
K	Patch	2		1		2.07	0.01	0.00	1.37	0.80		
		9		2		4.90	0.03	0.01	3.06	1.59		
		10		2			5.30	0.04	0.02	3.08	2.83	
		11		2			4.90	0.01	0.03	2.36	1.49	
		16		2			4.97	0.02	0.04	2.53	1.67	
		17		2			5.24	0.06	0.00	2.70	2.55	
		28		4			9.47	0.08	0.03	6.93	3.94	
		29		4			9.47	0.04	0.04	5.36	3.90	
		30		4			10.55	0.03	0.02	5.79	5.10	
		31		4			8.85	0.10	0.02	4.98	3.89	
		32		4			10.72	0.02	0.05	5.82	4.23	
		41		4			10.09	0.03	0.05	7.18	3.93	
		42		4			11.00	0.05	0.03	5.74	5.41	
		43		4			10.89	0.10	0.01	5.39	5.09	
		44		4			9.77	0.01	0.04	5.59	3.84	
		130		1			1.92	0.01	0.00	0.76	0.91	
		137		2			4.14	0.03	0.02	1.70	2.18	
		138		2			5.18	0.03	0.03	3.17	2.26	
		139		2			5.09	0.01	0.04	2.60	1.98	
		144		2			5.18	0.01	0.01	2.16	3.18	
		145		2			5.20	0.01	0.02	2.90	1.46	
		156		4			9.39	0.02	0.06	3.90	4.82	
		157		4			9.81	0.03	0.04	4.36	5.34	
		158		4			9.77	0.02	0.02	5.20	4.85	
		159		4			7.87	0.05	0.02	5.55	2.50	
		160		4			9.70	0.03	0.06	4.73	3.44	
		169		4			9.88	0.03	0.07	4.08	5.50	
		170		4			9.73	0.06	0.02	5.05	4.56	
		171		4			8.04	0.10	0.01	5.05	3.48	
		172		4			7.69	0.02	0.05	5.28	2.51	
		2		130	2			3.78	0.03	0.01	1.95	1.74
		9		137	4			9.08	0.09	0.02	4.33	4.02
		10		138	4			11.24	0.04	0.05	5.85	6.11
		11		139	4			10.70	0.03	0.05	4.90	4.11
		16		144	4			8.62	0.03	0.04	4.28	3.43
		17		145	4			11.07	0.08	0.02	5.32	4.43
		28		156	8			18.05	0.16	0.14	9.01	9.94
		29		157	8			21.46	0.03	0.07	12.13	9.31
		30		158	8			19.57	0.04	0.05	8.80	10.74
		31		159	8			15.56	0.19	0.03	8.39	5.46
		32		160	8			21.02	0.05	0.13	8.13	8.98
		41		169	8			19.95	0.03	0.10	11.99	9.94
		42		170	8			21.61	0.08	0.04	10.69	10.45
		43		171	8			20.82	0.15	0.02	10.66	9.65
44		172	8			17.45	0.05	0.08	9.02	5.53		

K-Patch Mid CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)
K	Patch	2		1		2.78	0.01	0.02	1.80	0.84
		9		2		6.75	0.05	0.02	3.59	2.16
		10		2		5.98	0.04	0.05	4.62	2.43
		11		2		6.58	0.01	0.03	3.60	2.23
		16		2		6.57	0.02	0.03	3.69	2.23
		17		2		6.10	0.04	0.02	4.51	2.40
		28		4		11.80	0.14	0.10	9.16	3.58
		29		4		12.11	0.07	0.06	8.91	3.89
		30		4		12.58	0.04	0.06	7.06	6.18
		31		4		10.56	0.08	0.07	6.54	5.36
		32		4		11.44	0.05	0.18	5.74	4.95
		41		4		12.63	0.05	0.11	8.62	4.21
		42		4		11.57	0.09	0.14	7.91	4.54
		43		4		12.64	0.10	0.02	6.71	6.04
		44		4		11.20	0.03	0.17	6.41	4.49
		130		1		2.47	0.03	0.01	0.99	1.26
		137		2		5.81	0.03	0.01	2.99	2.73
		138		2		5.57	0.04	0.04	3.46	2.88
		139		2		6.92	0.01	0.08	3.21	2.78
		144		2		6.44	0.02	0.03	3.27	3.53
		145		2		6.87	0.02	0.03	3.49	2.35
		156		4		12.00	0.05	0.05	5.26	5.82
		157		4		12.39	0.07	0.07	4.56	7.39
		158		4		11.30	0.05	0.08	7.18	4.89
		159		4		10.83	0.06	0.05	7.89	3.74
		160		4		12.01	0.03	0.12	7.59	4.31
		169		4		13.10	0.06	0.10	5.64	6.87
		170		4		12.00	0.11	0.06	6.42	5.89
		171		4		10.33	0.13	0.02	6.91	3.39
		172		4		10.53	0.07	0.07	7.54	3.78
		2	130	2		5.13	0.05	0.02	1.55	2.38
		9	137	4		13.41	0.14	0.04	6.63	5.44
		10	138	4		12.54	0.08	0.05	5.68	7.79
		11	139	4		15.56	0.03	0.06	4.99	7.09
		16	144	4		11.24	0.05	0.07	6.55	4.62
		17	145	4		13.62	0.07	0.07	6.58	5.43
		28	156	8		22.04	0.26	0.18	9.81	10.27
		29	157	8		26.69	0.18	0.18	15.39	11.82
		30	158	8		22.85	0.10	0.17	10.63	12.96
		31	159	8		22.54	0.11	0.11	12.92	7.78
		32	160	8		24.76	0.07	0.39	13.43	10.98
		41	169	8		27.60	0.13	0.20	14.60	12.07
		42	170	8		23.46	0.17	0.26	14.94	10.90
		43	171	8		24.82	0.16	0.02	12.97	10.85
44	172	8		24.50	0.10	0.23	12.50	9.20		

K-Patch High CH

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)
K	Patch	2		1		2.69	0.01	0.01	1.72	1.00
		9		2		6.52	0.03	0.02	3.85	2.86
		10		2		6.08	0.05	0.04	4.08	2.84
		11		2		7.01	0.02	0.03	3.52	2.37
		16		2		6.97	0.02	0.03	3.54	2.43
		17		2		6.20	0.06	0.02	4.12	2.75
		28		4		10.86	0.09	0.09	7.27	4.12
		29		4		12.37	0.07	0.08	7.25	4.48
		30		4		11.83	0.12	0.04	6.01	5.54
		31		4		10.89	0.10	0.06	5.73	4.95
		32		4		11.96	0.09	0.07	4.51	4.25
		41		4		10.83	0.03	0.10	6.42	3.99
		42		4		12.89	0.08	0.08	6.39	5.84
		43		4		10.01	0.17	0.04	6.07	4.57
		44		4		10.67	0.06	0.10	4.91	4.47
		130		1		2.67	0.01	0.00	1.18	1.05
		137		2		6.06	0.01	0.01	3.04	2.07
		138		2		6.41	0.02	0.04	2.91	2.96
		139		2		6.46	0.04	0.07	3.51	2.58
		144		2		5.57	0.02	0.01	3.22	2.27
		145		2		6.52	0.05	0.03	3.56	2.64
		156		4		9.40	0.05	0.07	6.03	4.79
		157		4		11.99	0.04	0.09	4.93	5.58
		158		4		11.14	0.04	0.03	5.82	4.66
		159		4		11.43	0.05	0.02	5.48	3.78
		160		4		10.59	0.08	0.06	6.60	3.10
		169		4		9.92	0.07	0.11	5.51	4.90
		170		4		12.20	0.07	0.04	6.11	4.97
		171		4		9.49	0.11	0.03	5.51	3.25
		172		4		11.62	0.03	0.04	5.73	4.12
		2	130	2		5.27	0.03	0.01	1.63	2.46
		9	137	4		11.96	0.05	0.03	6.98	5.07
		10	138	4		14.82	0.06	0.07	5.41	8.27
		11	139	4		15.78	0.05	0.09	5.60	7.51
		16	144	4		11.37	0.05	0.05	6.27	3.83
		17	145	4		13.38	0.16	0.04	5.60	6.09
		28	156	8		20.03	0.22	0.18	10.77	10.28
		29	157	8		27.79	0.06	0.11	14.36	12.66
		30	158	8		22.93	0.19	0.05	9.94	11.67
		31	159	8		23.12	0.16	0.06	12.37	7.97
		32	160	8		23.81	0.17	0.18	10.49	8.38
		41	169	8		21.52	0.09	0.26	12.54	10.10
		42	170	8		27.21	0.16	0.07	12.65	12.83
		43	171	8		19.28	0.31	0.04	10.96	7.84
44	172	8		24.35	0.08	0.14	11.26	9.27		

3.2 PD with MIMO Relative Phase for Low/Mid/High Channel at 28GHz / 39GHz

Table 8. PD with MIMO Relative Phase (n261_Low CH)

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)						
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)	Max_S.
J	Patch	1	129	2	0.06	0.32		8.68	4.07	3.03	8.68
		6	134	4	0.25	0.44		15.12	8.32	4.35	15.12
		7	136	4	0.11	0.14		17.82	10.36	6.92	17.82
		8	135	4	0.15	0.32		19.59	9.31	9.24	19.59
		14	142	4	0.13	0.18		17.75	10.17	7.58	17.75
		15	143	4	0.10	0.43		20.24	9.54	8.64	20.24
		23	151	8	0.25	0.86		30.15	15.18	11.36	30.15
		24	152	8	0.11	0.15		37.22	25.02	18.59	37.22
		25	153	8	0.09	0.21		35.45	23.72	16.90	35.45
		26	155	8	0.62	0.61		28.90	12.30	13.21	28.90
		27	154	8	0.46	0.96		27.89	13.98	10.49	27.89
		37	165	8	0.15	0.20		30.50	15.91	13.92	30.50
		38	166	8	0.09	0.31		37.19	25.19	18.34	37.19
39	168	8	0.58	0.42		28.11	12.60	11.93	28.11		
40	167	8	0.34	0.55		32.15	12.43	13.27	32.15		
K	Patch	2	130	2		5.95	0.06	0.12	4.40	2.27	5.95
		9	137	4		10.30	0.20	0.19	7.60	3.74	10.30
		10	138	4		12.70	0.03	0.03	7.73	6.65	12.70
		11	139	4		10.12	0.23	0.37	7.29	5.11	10.12
		16	144	4		10.99	0.17	0.11	6.75	5.81	10.99
		17	145	4		12.59	0.09	0.08	7.81	6.67	12.59
		28	156	8		20.09	0.61	0.24	14.53	12.03	20.09
		29	157	8		26.23	0.04	0.04	18.69	12.24	26.23
		30	158	8		29.15	0.01	0.04	20.06	11.45	29.15
		31	159	8		21.03	0.07	0.39	15.55	10.68	21.03
		32	160	8		19.30	0.81	0.87	13.11	13.75	19.30
		41	169	8		21.44	0.28	0.19	16.42	11.02	21.44
		42	170	8		28.64	0.02	0.04	19.84	11.42	28.64
43	171	8		25.87	0.04	0.10	18.57	12.35	25.87		
44	172	8		18.66	0.38	0.95	12.84	12.22	18.66		
L	Patch	0	128	2	0.08	0.20	9.99		4.75	3.07	9.99
		3	131	4	0.20	0.35	18.23		7.22	8.29	18.23
		4	132	4	0.02	0.25	20.38		11.57	10.66	20.38
		5	133	4	0.19	0.39	18.58		7.45	7.76	18.58
		12	140	4	0.09	0.21	18.93		8.84	8.83	18.93
		13	141	4	0.12	0.58	20.21		10.10	9.91	20.21
		18	146	8	0.27	0.84	32.15		15.23	12.42	32.15
		19	147	8	0.09	0.27	34.35		21.36	17.49	34.35
		20	148	8	0.06	0.34	37.78		25.21	19.63	37.78
		21	149	8	0.31	0.58	30.19		13.56	14.47	30.19
		22	150	8	0.90	1.34	29.94		12.44	14.10	29.94
		33	161	8	0.25	0.52	31.34		15.21	13.49	31.34
		34	162	8	0.03	0.28	37.33		24.21	19.08	37.33
35	163	8	0.06	0.33	33.78		21.66	17.82	33.78		
36	164	8	0.60	0.93	30.44		13.43	13.92	30.44		

Table 9.PD with MIMO Relative Phase (n261_Mid CH)

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)						
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)	Max.S.
J	Patch	1	129	2	0.05	0.27		9.27	4.62	3.64	9.27
		6	134	4	0.16	0.43		18.16	10.24	4.89	18.16
		7	136	4	0.10	0.13		18.12	9.70	8.11	18.12
		8	135	4	0.13	0.26		19.84	9.23	9.94	19.84
		14	142	4	0.08	0.16		19.91	11.72	8.91	19.91
		15	143	4	0.11	0.43		19.96	9.11	9.47	19.96
		23	151	8	0.21	0.86		30.35	14.44	13.30	30.35
		24	152	8	0.08	0.11		38.51	25.02	18.98	38.51
		25	153	8	0.07	0.23		35.75	23.78	16.78	35.75
		26	155	8	0.51	0.51		26.46	11.38	11.38	26.46
		27	154	8	0.41	0.65		28.99	11.00	12.42	28.99
		37	165	8	0.15	0.29		32.45	18.99	15.22	32.45
		38	166	8	0.08	0.25		38.17	25.19	19.16	38.17
		39	168	8	0.51	0.40		26.75	12.29	10.80	26.75
40	167	8	0.38	0.52		31.09	11.15	13.10	31.09		
K	Patch	2	130	2		5.72	0.08	0.13	4.14	2.02	5.72
		9	137	4		9.22	0.17	0.18	7.05	3.46	9.22
		10	138	4		13.25	0.03	0.05	8.70	5.91	13.25
		11	139	4		10.20	0.24	0.38	6.98	4.34	10.20
		16	144	4		10.74	0.15	0.15	7.97	5.09	10.74
		17	145	4		12.72	0.06	0.09	8.08	6.30	12.72
		28	156	8		18.93	0.52	0.42	13.95	10.56	18.93
		29	157	8		25.00	0.03	0.04	17.95	10.39	25.00
		30	158	8		28.79	0.02	0.05	20.55	10.74	28.79
		31	159	8		20.76	0.08	0.50	15.62	8.47	20.76
		32	160	8		20.84	0.66	0.72	11.85	12.55	20.84
		41	169	8		19.71	0.26	0.22	15.14	9.37	19.71
		42	170	8		28.30	0.03	0.04	19.94	10.67	28.30
		43	171	8		25.66	0.03	0.14	19.29	10.67	25.66
44	172	8		20.60	0.30	0.87	12.43	10.83	20.60		
L	Patch	0	128	2	0.09	0.15	9.90		5.05	3.48	9.90
		3	131	4	0.18	0.60	18.05		6.58	8.65	18.05
		4	132	4	0.05	0.23	19.76		11.22	10.69	19.76
		5	133	4	0.27	0.26	19.16		6.46	8.69	19.16
		12	140	4	0.08	0.34	17.81		9.79	8.50	17.81
		13	141	4	0.13	0.39	19.87		9.41	10.20	19.87
		18	146	8	0.37	1.79	28.94		14.87	12.54	28.94
		19	147	8	0.13	0.27	34.99		19.09	17.07	34.99
		20	148	8	0.04	0.21	38.43		22.81	19.99	38.43
		21	149	8	0.48	0.32	29.14		10.40	15.47	29.14
		22	150	8	0.73	0.54	28.65		10.47	13.42	28.65
		33	161	8	0.36	1.37	29.17		14.51	14.36	29.17
		34	162	8	0.03	0.18	38.02		22.06	19.67	38.02
35	163	8	0.08	0.27	32.95		18.56	16.84	32.95		
36	164	8	0.62	0.45	30.04		10.55	14.56	30.04		

Table 10. PD with MIMO Relative Phase (n261_High CH)

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)						
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)	Max.S.
J	Patch	1	129	2	0.05	0.22		9.03	4.45	3.92	9.03
		6	134	4	0.13	0.42		17.48	9.65	5.40	17.48
		7	136	4	0.10	0.09		18.14	8.66	8.95	18.14
		8	135	4	0.08	0.24		19.15	8.94	10.22	19.15
		14	142	4	0.07	0.23		19.14	11.50	10.02	19.14
		15	143	4	0.09	0.36		18.33	9.15	10.11	18.33
		23	151	8	0.25	1.11		30.48	13.38	14.83	30.48
		24	152	8	0.06	0.09		37.10	23.04	19.82	37.10
		25	153	8	0.12	0.19		35.29	23.70	16.88	35.29
		26	155	8	0.47	0.42		26.70	11.53	12.22	26.70
		27	154	8	0.32	0.95		29.28	11.14	12.51	29.28
		37	165	8	0.14	0.47		31.51	19.97	17.96	31.51
		38	166	8	0.08	0.12		38.07	24.53	18.85	38.07
		39	168	8	0.47	0.31		28.26	12.50	13.77	28.26
40	167	8	0.41	0.66		30.15	13.24	14.85	30.15		
K	Patch	2	130	2		5.47	0.06	0.13	3.50	1.84	5.47
		9	137	4		8.35	0.20	0.19	7.19	2.62	8.35
		10	138	4		12.99	0.05	0.05	9.23	5.33	12.99
		11	139	4		9.88	0.24	0.39	6.53	4.16	9.88
		16	144	4		11.12	0.20	0.18	8.49	4.37	11.12
		17	145	4		12.01	0.04	0.07	8.14	5.96	12.01
		28	156	8		18.22	0.59	0.38	11.73	9.45	18.22
		29	157	8		23.44	0.08	0.05	17.23	9.33	23.44
		30	158	8		27.34	0.02	0.06	19.56	10.69	27.34
		31	159	8		19.31	0.09	0.55	14.19	7.75	19.31
		32	160	8		20.75	0.44	0.55	11.41	12.37	20.75
		41	169	8		18.46	0.39	0.23	13.62	8.39	18.46
		42	170	8		27.18	0.04	0.04	18.95	10.39	27.18
		43	171	8		23.69	0.05	0.25	18.67	9.49	23.69
44	172	8		22.47	0.22	0.66	12.35	11.59	22.47		
L	Patch	0	128	2	0.08	0.12	10.07		5.21	3.80	10.07
		3	131	4	0.18	0.37	18.93		6.94	9.13	18.93
		4	132	4	0.05	0.08	19.65		10.75	10.67	19.65
		5	133	4	0.20	0.34	19.94		7.96	9.05	19.94
		12	140	4	0.07	0.24	18.86		10.85	8.71	18.86
		13	141	4	0.12	0.27	19.03		8.35	10.05	19.03
		18	146	8	0.27	1.30	30.63		14.48	14.60	30.63
		19	147	8	0.12	0.17	35.56		20.82	18.02	35.56
		20	148	8	0.04	0.08	37.92		25.76	19.28	37.92
		21	149	8	0.57	0.36	28.55		11.23	14.97	28.55
		22	150	8	0.68	0.42	27.47		12.34	12.14	27.47
		33	161	8	0.23	0.94	30.30		14.24	16.27	30.30
		34	162	8	0.04	0.09	37.28		24.81	19.47	37.28
35	163	8	0.21	0.09	30.95		19.60	15.24	30.95		
36	164	8	0.64	0.44	29.70		12.43	13.81	29.70		

Table 11. PD with MIMO Relative Phase (n260_Low CH)

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)						
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)	Max.S.
J	Patch	1	129	2	0.05	0.15		7.51	4.99	2.67	7.51
		6	136	4	0.09	0.24		11.87	7.82	3.78	11.87
		7	135	4	0.07	0.16		13.24	7.05	5.99	13.24
		8	134	4	0.08	0.24		14.69	9.18	5.05	14.69
		14	143	4	0.06	0.16		12.21	7.73	4.66	12.21
		15	142	4	0.06	0.21		12.95	7.41	4.66	12.95
		23	153	8	0.11	0.29		26.15	12.95	8.96	26.15
		24	155	8	0.13	0.38		23.74	12.19	10.48	23.74
		25	151	8	0.08	0.26		22.10	12.80	10.16	22.10
		26	152	8	0.18	0.60		23.74	14.01	7.49	23.74
		27	154	8	0.12	0.28		22.54	12.25	8.87	22.54
		37	165	8	0.14	0.35		24.42	12.48	10.86	24.42
		38	167	8	0.05	0.28		22.59	11.28	11.36	22.59
		39	166	8	0.14	0.52		21.94	13.63	8.93	21.94
40	168	8	0.09	0.44		22.51	11.63	7.91	22.51		
K	Patch	2	130	2		4.57	0.04	0.01	2.35	2.08	4.57
		9	137	4		9.59	0.09	0.03	5.07	4.02	9.59
		10	138	4		12.92	0.10	0.08	7.78	6.33	12.92
		11	139	4		11.54	0.04	0.14	6.00	4.36	11.54
		16	144	4		10.55	0.03	0.08	4.40	5.82	10.55
		17	145	4		11.39	0.11	0.03	5.64	4.48	11.39
		28	156	8		19.47	0.16	0.15	12.21	10.88	19.47
		29	157	8		23.45	0.09	0.12	12.19	11.27	23.45
		30	158	8		24.34	0.07	0.08	13.72	11.89	24.34
		31	159	8		18.89	0.23	0.07	10.53	7.67	18.89
		32	160	8		23.89	0.07	0.21	13.13	9.76	23.89
		41	169	8		20.98	0.10	0.21	12.79	10.57	20.98
		42	170	8		27.16	0.19	0.09	13.68	12.87	27.16
		43	171	8		20.95	0.27	0.03	12.25	9.71	20.95
44	172	8		18.79	0.06	0.16	10.60	8.05	18.79		
L	Patch	0	128	2	0.04	0.07	5.94		3.49	1.70	5.94
		3	131	4	0.08	0.13	14.53		8.47	4.79	14.53
		4	132	4	0.07	0.18	12.92		7.12	5.22	12.92
		5	133	4	0.05	0.10	13.94		6.35	4.80	13.94
		12	140	4	0.05	0.06	13.08		6.50	4.98	13.08
		13	141	4	0.04	0.16	15.14		7.41	5.51	15.14
		18	146	8	0.17	0.21	22.86		11.22	9.32	22.86
		19	147	8	0.12	0.27	21.86		11.30	9.57	21.86
		20	148	8	0.09	0.34	21.78		11.49	9.94	21.78
		21	149	8	0.10	0.37	28.46		16.98	11.42	28.46
		22	150	8	0.14	0.21	30.36		15.80	9.01	30.36
		33	161	8	0.16	0.18	22.69		11.68	9.72	22.69
		34	162	8	0.11	0.15	21.45		10.90	10.32	21.45
35	163	8	0.10	0.44	22.09		12.41	9.38	22.09		
36	164	8	0.08	0.28	30.08		16.98	9.44	30.08		

Table 12. PD with MIMO Relative Phase (n260_Mid CH)

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)						
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)	Max_S.
J	Patch	1	129	2	0.04	0.11		11.33	5.89	4.30	11.33
		6	136	4	0.04	0.21		18.38	9.06	6.31	18.38
		7	135	4	0.07	0.11		19.58	9.45	9.51	19.58
		8	134	4	0.05	0.25		20.99	9.74	8.49	20.99
		14	143	4	0.07	0.13		17.57	9.27	6.74	17.57
		15	142	4	0.05	0.15		18.28	9.23	8.67	18.28
		23	153	8	0.08	0.23		37.75	16.74	12.90	37.75
		24	155	8	0.09	0.22		37.50	18.74	17.77	37.50
		25	151	8	0.11	0.20		31.89	16.32	15.38	31.89
		26	152	8	0.13	0.49		32.32	17.17	12.43	32.32
		27	154	8	0.09	0.40		36.17	17.76	13.60	36.17
		37	165	8	0.08	0.24		37.62	19.00	17.45	37.62
		38	167	8	0.12	0.21		35.63	18.74	15.81	35.63
		39	166	8	0.13	0.38		31.54	17.35	14.72	31.54
40	168	8	0.09	0.45		32.82	15.31	11.86	32.82		
K	Patch	2	130	2		6.05	0.07	0.05	4.04	2.80	6.05
		9	137	4		13.43	0.14	0.05	9.58	6.17	13.43
		10	138	4		14.77	0.14	0.14	10.71	7.86	14.77
		11	139	4		15.66	0.04	0.18	8.85	7.11	15.66
		16	144	4		12.69	0.06	0.10	6.56	6.47	12.69
		17	145	4		13.93	0.09	0.07	9.20	5.74	13.93
		28	156	8		26.03	0.31	0.20	19.06	11.09	26.03
		29	157	8		29.74	0.24	0.19	16.83	12.47	29.74
		30	158	8		29.24	0.14	0.20	20.56	13.65	29.24
		31	159	8		22.63	0.17	0.15	14.14	10.40	22.63
		32	160	8		29.14	0.11	0.52	16.45	11.86	29.14
		41	169	8		27.65	0.17	0.25	17.17	12.19	27.65
		42	170	8		28.02	0.38	0.34	19.22	11.34	28.02
		43	171	8		26.95	0.32	0.06	15.43	11.98	26.95
44	172	8		25.04	0.14	0.34	14.18	9.78	25.04		
L	Patch	0	128	2	0.03	0.07	8.41		4.54	2.31	8.41
		3	131	4	0.05	0.16	19.67		8.30	7.26	19.67
		4	132	4	0.05	0.27	17.76		9.76	8.05	17.76
		5	133	4	0.03	0.16	17.90		8.79	6.64	17.90
		12	140	4	0.06	0.04	17.97		10.28	8.99	17.97
		13	141	4	0.04	0.21	19.75		10.40	6.70	19.75
		18	146	8	0.10	0.16	34.71		15.85	12.76	34.71
		19	147	8	0.13	0.21	34.46		18.78	15.42	34.46
		20	148	8	0.07	0.37	28.93		14.93	12.66	28.93
		21	149	8	0.13	0.42	32.58		14.79	13.95	32.58
		22	150	8	0.10	0.16	39.08		17.47	13.74	39.08
		33	161	8	0.12	0.18	34.20		16.60	15.28	34.20
		34	162	8	0.13	0.32	30.88		15.63	13.61	30.88
		35	163	8	0.06	0.35	30.78		15.79	13.07	30.78
36	164	8	0.06	0.39	38.98		16.42	12.96	38.98		

Table 13. PD with MIMO Relative Phase (n260_High CH)

Module	Type	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)						
					S1 (Top Side)	S2 (Bottom Side)	S3 (Left Side)	S4 (Right Side)	S5 (Bottom Face)	S6 (Bottom)	Max_S.
J	Patch	1	129	2	0.06	0.22		10.90	6.30	4.12	10.90
		6	136	4	0.08	0.49		18.71	10.19	6.65	18.71
		7	135	4	0.06	0.14		19.66	9.07	10.68	19.66
		8	134	4	0.12	0.21		20.94	11.95	9.24	20.94
		14	143	4	0.10	0.20		17.81	10.22	7.04	17.81
		15	142	4	0.05	0.25		20.60	9.72	9.27	20.60
		23	153	8	0.10	0.33		36.97	19.33	12.20	36.97
		24	155	8	0.21	0.42		35.45	19.26	15.15	35.45
		25	151	8	0.14	0.64		30.63	15.75	13.76	30.63
		26	152	8	0.14	0.71		32.42	16.82	12.69	32.42
		27	154	8	0.13	0.39		34.78	18.62	12.10	34.78
		37	165	8	0.17	0.28		34.67	17.98	14.86	34.67
		38	167	8	0.26	0.46		31.98	15.87	14.58	31.98
		39	166	8	0.14	0.59		33.35	17.01	13.53	33.35
40	168	8	0.09	0.59		32.77	17.85	12.68	32.77		
K	Patch	2	130	2		5.84	0.04	0.02	4.26	2.74	5.84
		9	137	4		14.65	0.05	0.05	9.86	6.78	14.65
		10	138	4		15.59	0.08	0.13	9.07	8.31	15.59
		11	139	4		16.47	0.08	0.16	10.44	7.52	16.47
		16	144	4		11.37	0.06	0.07	6.54	3.88	11.37
		17	145	4		14.11	0.17	0.09	9.69	6.66	14.11
		28	156	8		22.89	0.22	0.23	16.99	10.97	22.89
		29	157	8		28.86	0.13	0.26	15.10	12.74	28.86
		30	158	8		23.26	0.21	0.10	14.66	11.73	23.26
		31	159	8		23.12	0.18	0.14	13.06	9.37	23.12
		32	160	8		26.32	0.26	0.23	13.75	9.29	26.32
		41	169	8		21.82	0.13	0.26	13.71	10.12	21.82
		42	170	8		28.34	0.29	0.21	15.69	13.11	28.34
		43	171	8		20.31	0.35	0.08	15.12	9.16	20.31
44	172	8		24.98	0.10	0.24	13.09	9.28	24.98		
L	Patch	0	128	2	0.03	0.08	8.26		4.67	2.68	8.26
		3	131	4	0.17	0.19	20.21		11.25	8.71	20.21
		4	132	4	0.11	0.17	20.30		9.94	10.42	20.30
		5	133	4	0.09	0.20	20.47		11.46	7.50	20.47
		12	140	4	0.16	0.16	19.33		11.13	9.13	19.33
		13	141	4	0.05	0.24	22.89		10.77	8.91	22.89
		18	146	8	0.18	0.22	35.99		16.00	14.54	35.99
		19	147	8	0.31	0.38	34.92		19.12	17.28	34.92
		20	148	8	0.09	0.45	33.39		17.66	17.84	33.39
		21	149	8	0.14	0.73	33.73		15.66	13.04	33.73
		22	150	8	0.13	0.27	37.16		16.74	12.79	37.16
		33	161	8	0.24	0.26	36.53		17.99	17.33	36.53
		34	162	8	0.25	0.51	31.73		14.97	15.97	31.73
		35	163	8	0.07	0.49	33.80		17.38	16.88	33.80
36	164	8	0.09	0.39	39.09		17.43	13.29	39.09		

4. Uncertainty

The amplitude level of PD simulation is biased due to material property parameter configuration in device housing at high frequencies. Material property is difficult to model due to complexity of material and operating frequency. Therefore, it is not possible to assign an exact uncertainty for simulation result. However, for this RF exposure evaluation, simulation results were only used to select highest beam ID for measurement. Power density results between measurement and simulation showed similar trend to justify selection of Beam ID used for measurement. All final power density evaluations were performed on measurement system with mmW module design related uncertainty of 2.1dB.