Part #0 Power Density Report
Power Density Characterization

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Power Density Characterization

1. Exposure Scenarios

At frequencies > 6 GHz, the total peak spatial averaged power density (psPD) is required to be assessed for all antenna configurations (beams) from all mmWave antenna modules installed inside the device. This device has 2 patch antenna arrays (L Patch, K Patch).

As showed in Figure 1, the surfaces near-by each mmW antenna module for PD characterization are identified and listed in Table 1.

Table 1. Evaluation Surfaces for PD Characterization

Band	Antenna Module	Front	Back	Left	Right	Top	Bottom
n261	K	O	O	O	X	X	X
n261	L	O	O	X	O	X	X
n260	K	O	O	O	X	X	X
n260	L	O	O	X	O	X	X

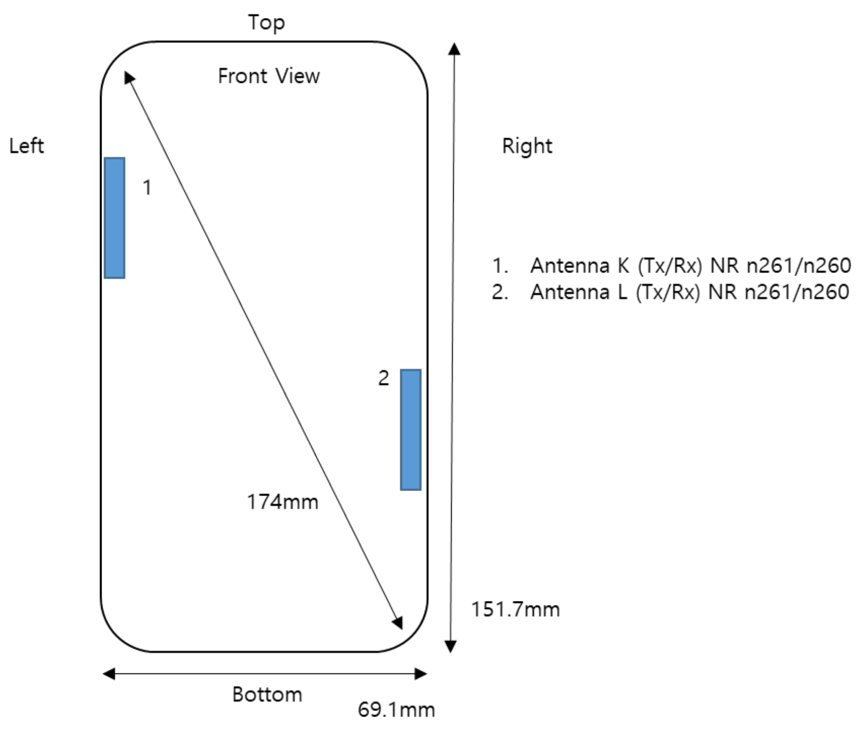

Figure 1: Location of mmWave Modules looking from front of the DUT

2. Power Density Characterization Method

Simulation modeling and validation

- Correlate the simulated PD distributions with measured PD distribution for the selected beams to validate simulation model

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Uncertainty Budget

- Calculate the total device design uncertainty to include worst case RF tune-up accuracy and device-to-device variation

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PD_design_target

Specify a power density design target, which should be less than power density regulatory limit to account for the total device design uncertainties

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Worst-case housing material Influence Quantification

- Determine

Δ_{min} = *min{simulated PD@reference_power – measured PD@reference_power}*

to quantify the worst-case housing influence

↓

PD Char Generation

- Use validated simulation approach to determine input power limit for all the beams after accounting for the worst-case housing influence

3. Codebook for all supported beams

Table 2. 5G mmW NR Band n261 Ant K Codebook

Band	Ant Module	Ant Type	Beam ID_1	Bema ID_2	Ant Feed no.
n261	K	Patch	1		1
			5		2
			6		2
			7		2
			10		2
			11		2
			17		4
			18		4
			19		4
			20		4
			21		4
			26		4
			27		4
			28		4
			29		4
			129		1
			133		2
			134		2
			135		2
			138		2
			139		2
			145		4
			146		4
			147		4
			148		4
			149		4
			154		4
			155		4
			156		4
			157		4
			1	129	2
			5	135	4
			6	134	4
			7	138	4
			10	139	4
			11	133	4
			17	157	8
			18	156	8
			19	154	8
			20	145	8
			21	149	8
			26	148	8
			27	155	8
			28	146	8
			29	147	8

Table 3. 5G mmW NR Band n261 Ant L Codebook

Band	Ant Module	Ant Type	Beam ID_1	Bema ID_2	Feed no.
n261	L	Patch	0		1
			2		2
			3		2
			4		2
			8		2
			9		2
			12		4
			13		4
			14		4
			15		4
			16		4
			22		4
			23		4
			24		4
			25		4
			128		1
			130		2
			131		2
			132		2
			136		2
			137		2
			140		4
			141		4
			142		4
			143		4
			144		4
			150		4
			151		4
			152		4
			153		4
			0	128	2
			2	130	4
			3	131	4
			4	132	4
			8	136	4
			9	137	4
			12	153	8
			13	150	8
			14	151	8
			15	152	8
			16	144	8
			22	140	8
			23	141	8
			24	142	8
			25	143	8

Table 4. 5G mmW NR Band n260 Ant K Codebook

Band	Module	Type	Beam ID_1	Bema ID_2	Feed no.
n260	K	Patch	1		1
			5		2
			6		2
			7		2
			10		2
			11		2
			17		4
			18		4
			19		4
			20		4
			21		4
			26		4
			27		4
			28		4
			29		4
			129		1
			133		2
			134		2
			135		2
			138		2
			139		2
			145		4
			146		4
			147		4
			148		4
			149		4
			154		4
			155		4
			156		4
			157		4
			1	129	2
			5	139	4
			6	138	4
			7	133	4
			10	134	4
			11	135	4
			17	148	8
			18	147	8
			19	154	8
			20	157	8
			21	146	8
			26	156	8
			27	155	8
			28	149	8
			29	145	8

Table 5. 5G mmW NR Band n260 Ant L Codebook

Band	Module	Type	Beam ID_1	Bema ID_2	Feed no.
n260	L	Patch	0		1
			2		2
			3		2
			4		2
			8		2
			9		2
			12		4
			13		4
			14		4
			15		4
			16		4
			22		4
			23		4
			24		4
			25		4
			128		1
			130		2
			131		2
			132		2
			136		2
			137		2
			140		4
			141		4
			142		4
			143		4
			144		4
			150		4
			151		4
			152		4
			153		4
			0	128	2
			2	137	4
			3	136	4
			4	130	4
			8	131	4
			9	132	4
			12	152	8
			13	141	8
			14	150	8
			15	140	8
			16	153	8
			22	142	8
			23	151	8
			24	144	8
			25	143	8

4. Simulation and Modeling Validation

Power density simulations of all beams and surfaces were performed. Details of these simulations and modeling validation can be found in the Power Density Simulation Report. Table below includes a summary of the validation results to support worst-case housing influence quantification in power density characterization for this model.

With an input power of 6 dBm for n261 band and 6 dBm for n260 band, PD measurements are conducted for at least one single beam per antenna module (K, L) on worst-surface(s). PD measurements are performed at mid cannel of each mmW band and with CW modulation. ALL measured PD values are listed in table below along with corresponding simulated PD values for the same configuration.

PD value will be used to determine worst-case housing influence for conservative assessment.

Table 6. Simulated and Measure PD

					4cm^2 avg. PD		
Band	**Beam ID**	**Antenna**	**Surface**	**Channel**	**Measured** (mW/cm^2)	**Simulated** (mW/cm^2)	**Delta = Simulated – Measure (dB)**
n261	18	K (patch)	Back	Mid	0.82	0.86	0.23
			Left	Mid	0.79	0.92	0.67
	154		Back	Mid	0.77	0.93	0.85
			Left	Mid	1.02	1.06	**0.17**
	14	L (patch)	Back	Mid	0.85	1.40	2.17
			Right	Mid	0.94	1.46	**1.93**
	144		Back	Mid	0.69	1.56	3.53
			Right	Mid	0.64	1.24	2.86
n260	17	K (patch)	Back	Mid	0.47	0.94	3.01
			Left	Mid	0.70	1.11	1.98
	156		Back	Mid	0.50	0.88	2.42
			Left	Mid	0.75	1.00	**1.26**
	15	L (patch)	Back	Mid	0.56	1.07	2.84
			Right	Mid	0.59	1.11	**2.73**
	140		Back	Mid	0.49	1.03	3.24
			Right	Mid	0.55	1.13	3.14

5. PD design target

Table 7. PD design target

PD_design_target	
$PD\_design\_target < PD\_regulatory\_limit \times 10^{\frac{-Total\ Uncertainty}{10}}$	
psPD over 4cm^2 Averaging Area (mW/cm^2)	
Total Uncertainty	*2.1 dB*
PD_regulatory_limit	*1.0 mW/cm^2*
PD_design_target	*0.6166 mW/cm^2*

6. Δmin

For non-metal material, the material property cannot be accurately characterized at mmW frequencies to date. The estimated material property for the device housing is used in the simulation model, which could influence the accuracy in simulation for PD amplitude quantification. Since the housing influence on PD could vary from surface to surface where the EM field propagates through, the most underestimated surface is used to quantify the worst-case housing influence for conservative assessment.

Since the mmW antenna modules are placed at different locations, only surrounding material/housing has impact on EM field propagation, and in turn power density. Furthermore, depending on the type of antenna array, i.e.m dipole antenna array or patch antenna array, the nature of EM field propagation in the near field is different. Therefore, the worst-case housing influence is determined per antenna module and per antenna type.

For this DUT, the below procedure was used to determine worst-case housing influence,

Δmin :

1. Based on PD simulation, for each module and antenna type, determine one or more worst-surface(s) that has highest 4cm2 PD for all the single beams per antenna module and per antenna type in the mid cannel of each band.
2. For identified worst surface(s) per antenna module and per antenna type group,
   a. First determine min based on identified worst surface(s), and derive input.power.limit
   b. Then prove all other near-by surface(s), i.e., non-selected surface(s), is not required for housing material loss quantification(in other words, these non-evaluated surfaces have no influence on the determined input.power.limit) by:
      i. re-scale all simulated 4cm2 PD at input.power.limit to identify the worst-PD beam per each non-evaluated surface
      ii. Measure 4cm2 PD at input.power.limit on identified worst-PD beam per each

non-evaluated surface

iii. Demonstrated all measured 4cam2 PD values are below PD_design_target

3. If any of the above surface(s) in Step(2.b.iii) have measured $4cm^2$ PD > PD_design_target, then those surfaces must be included in the min determination in Step(2.a), and re-evaluate input.power.limit with these added surfaces.

Following above procedure, based on Table 2 ~ Table 5 in Samsung PD simulation report, the worst-surface(s) having highest 4cm2 PD for all the single beams per each antenna type and each antenna module group in the mid cannel of n261 and n260 bands are identified as:

a. for K patch: Back (S2) & Left (S3)

b. for L patch: Back (S2) & Right (S4)

Thus, when comparing a simulated $4cm^2$-averaged PD and measured 4 cm^2-averaged PD for the identified worst surface(s), the worst error introduced for each antenna type and each antenna module group when using the estimated material property in the simulation is highlighted in bold numbers in Table 8. Thus, the worst-case housing influence, denoted as $\Delta_{min} = Sim.PD - Meas.PD$, is determined as

Table 8. Δ_{min} for Ant K and Ant L

Band	Antenna	Δmin (dB)
n261	K-Patch	**0.17**
	L-Patch	**1.93**
n260	K-Patch	**1.26**
	L-Patch	**2.73**

Δ_{min} represents the worst case where RF exposure is underestimated the most in simulation when using the estimated material property of the housing. For conservative assessment, the min is used as the worst-case factor and applied to all the beams in the corresponding antenna type and antenna module group to determine input power limits in PD char for compliance. The detail input.power.limit derivation is described in Section 7.

Simulated 4cam2 PD values in Table 2 ~ Table 5 in Power Density Simulation Report are scaled to input.power.limit and are listed in Tables 9 ~ 12 for all single beams for all identified surfaces, when assuming the simulation is performed with correct housing influence.

Determine the worst beam for each of non-selected surface(s), i.e.,

a. for L patch: Front

b. for M patch: Front

Then perform PD measurement for all determined worst-case beams, highlighted in orange in Tables 9~12, on the corresponding surface. Measurement is performed in the mid cannel of each hand with CW modulation. The evaluation distance is at 2 mm.

The test results in Table.13 shows that the all measured 4cm2 PD values are less than PD_desigh_target of 0.6166 mW/cm2, thus, the non-selected surfaces have no influence on the determined min land input.power.limit in Section 7.

Table 9. n261/mid channel, K Patch simulated $4cm^2$ PD at PD_Design_Target

(If simulation performed with correct housing material properties) (Δ_{min})

No.	Module	Beam ID_1	Simulated 4cm2 PD(mW/cm2) Corresponding to PD_design_target if the simulation was performed with correct No.Module Type housing material properties					
			S4(Right)	S3(Left)	S5(Top)	S6(Bottom)	S1(Front)	S2(Rear)
1	K	1	0.00	0.22	0.01	N/A	0.04	0.20
2		5	0.00	0.51	0.03	N/A	0.10	0.42
3		6	0.00	0.48	0.01	N/A	0.13	0.44
4		7	0.00	0.31	0.01	N/A	0.09	0.25
5		10	0.00	0.48	0.01	N/A	0.11	0.40
6		11	0.00	0.42	0.00	N/A	0.08	0.43
7		17	0.01	0.74	0.05	N/A	0.19	0.55
8		18	0.01	0.92	0.01	N/A	0.19	0.86
9		19	0.00	0.86	0.02	N/A	0.19	0.80
10		20	0.01	0.65	0.02	N/A	0.16	0.70
11		21	0.01	0.74	0.03	N/A	0.14	0.75
12		26	0.01	0.85	0.02	N/A	0.17	0.78
13		27	0.00	0.91	0.01	N/A	0.19	0.83
14		28	0.01	0.86	0.02	N/A	0.18	0.83
15		29	0.01	0.69	0.02	N/A	0.15	0.74
16		129	0.00	0.33	0.01	N/A	0.06	0.29
17		133	0.00	0.74	0.02	N/A	0.15	0.64
18		134	0.00	0.60	0.01	N/A	0.08	0.58
19		135	0.00	0.46	0.03	N/A	0.11	0.46
20		138	0.00	0.70	0.01	N/A	0.12	0.63
21		139	0.00	0.43	0.02	N/A	0.05	0.50
22		145	0.01	1.04	0.03	N/A	0.23	0.85
23		146	0.00	1.05	0.01	N/A	0.23	0.95
24		147	0.01	0.84	0.02	N/A	0.12	0.86
25		148	0.01	0.65	0.03	N/A	0.11	0.79
26		149	0.01	0.78	0.08	N/A	0.09	1.02
27		154	0.00	1.06	0.02	N/A	0.23	0.93
28		155	0.00	0.95	0.01	N/A	0.18	0.91
29		156	0.00	0.78	0.02	N/A	0.11	0.80
30		157	0.01	0.66	0.05	N/A	0.10	0.92

Table 10. n261/mid channel, L Patch simulated $4cm^2$ PD at PD_Design_Target

(If simulation performed with correct housing material properties) (Δ_{min})

No.	Module	Beam ID_1	Simulated 4cm2 PD(mW/cm2) Corresponding to PD_design_target if the simulation was performed with correct No.Module Type housing material properties					
			S4(Right)	S3(Left)	S5(Top)	S6(Bottom)	S1(Front)	S2(Rear)
1	L	0	0.32	0.00	N/A	0.01	0.05	0.28
2		2	0.66	0.01	N/A	0.01	0.07	0.76
3		3	0.65	0.01	N/A	0.00	0.11	0.63
4		4	0.58	0.00	N/A	0.02	0.10	0.50
5		8	0.52	0.01	N/A	0.00	0.08	0.57
6		9	0.66	0.01	N/A	0.01	0.12	0.58
7		12	1.23	0.01	N/A	0.01	0.15	1.39
8		13	1.32	0.03	N/A	0.00	0.17	1.39
9		14	1.46	0.02	N/A	0.01	0.24	1.40
10		15	1.23	0.02	N/A	0.03	0.26	1.10
11		16	0.87	0.01	N/A	0.06	0.19	0.85
12		22	1.09	0.02	N/A	0.01	0.14	1.30
13		23	1.43	0.02	N/A	0.01	0.22	1.39
14		24	1.42	0.02	N/A	0.01	0.24	1.36
15		25	1.08	0.02	N/A	0.06	0.25	0.93
16		128	0.37	0.00	N/A	0.01	0.05	0.37
17		130	0.56	0.01	N/A	0.02	0.10	0.50
18		131	0.86	0.00	N/A	0.01	0.10	0.87
19		132	0.59	0.01	N/A	0.04	0.09	0.75
20		136	0.91	0.00	N/A	0.01	0.14	0.84
21		137	0.67	0.01	N/A	0.03	0.07	0.79
22		140	1.35	0.02	N/A	0.01	0.24	1.21
23		141	1.50	0.02	N/A	0.00	0.27	1.42
24		142	1.36	0.01	N/A	0.01	0.16	1.44
25		143	1.12	0.02	N/A	0.04	0.14	1.35
26		144	1.24	0.01	N/A	0.09	0.13	1.56
27		150	1.46	0.02	N/A	0.01	0.25	1.35
28		151	1.50	0.01	N/A	0.01	0.23	1.47
29		152	1.24	0.02	N/A	0.01	0.12	1.35
30		153	1.19	0.01	N/A	0.08	0.13	1.50

Table 11. n260/mid channel, K Patch simulated $4cm^2$ PD at PD_Design_Target

(If simulation performed with correct housing material properties) (Δ_{min})

No.	Module	Beam ID_1	Simulated 4cm2 PD(mW/cm2) Corresponding to PD_design_target if the simulation was performed with correct No.Module Type housing material properties					
			S4(Right)	S3(Left)	S5(Top)	S6(Bottom)	S1(Front)	S2(Rear)
1	K	1	0.01	0.28	0.02	N/A	0.08	0.23
2		5	0.01	0.62	0.06	N/A	0.15	0.46
3		6	0.01	0.56	0.02	N/A	0.16	0.47
4		7	0.01	0.61	0.06	N/A	0.15	0.45
5		10	0.01	0.51	0.02	N/A	0.16	0.45
6		11	0.01	0.62	0.05	N/A	0.17	0.46
7		17	0.02	1.11	0.08	N/A	0.39	0.94
8		18	0.03	0.65	0.06	N/A	0.27	0.62
9		19	0.01	0.91	0.05	N/A	0.25	0.62
10		20	0.02	1.01	0.09	N/A	0.37	0.92
11		21	0.02	0.96	0.14	N/A	0.27	0.76
12		26	0.02	0.85	0.11	N/A	0.27	0.80
13		27	0.03	0.73	0.07	N/A	0.29	0.68
14		28	0.02	1.04	0.08	N/A	0.35	0.79
15		29	0.03	0.96	0.13	N/A	0.28	0.93
16		129	0.00	0.20	0.01	N/A	0.07	0.17
17		133	0.01	0.67	0.03	N/A	0.23	0.49
18		134	0.01	0.56	0.02	N/A	0.17	0.48
19		135	0.01	0.46	0.03	N/A	0.13	0.40
20		138	0.01	0.43	0.02	N/A	0.16	0.47
21		139	0.01	0.67	0.03	N/A	0.23	0.49
22		145	0.03	0.99	0.06	N/A	0.35	0.96
23		146	0.02	0.56	0.04	N/A	0.23	0.53
24		147	0.03	0.86	0.05	N/A	0.29	0.68
25		148	0.03	0.92	0.07	N/A	0.33	0.91
26		149	0.03	0.94	0.05	N/A	0.31	1.00
27		154	0.02	0.54	0.04	N/A	0.25	0.58
28		155	0.02	0.65	0.05	N/A	0.25	0.56
29		156	0.02	1.00	0.06	N/A	0.32	0.88
30		157	0.03	0.88	0.06	N/A	0.36	0.97

Table 12. n260/mid channel, L Patch simulated $4cm^2$ PD at PD_Design_Target

(If simulation performed with correct housing material properties) (Δ_{min})

No.	Module	Beam ID_1	Simulated 4cm2 PD(mW/cm2) Corresponding to PD_design_target if the simulation was performed with correct No.Module Type housing material properties					
			S4(Right)	S3(Left)	S5(Top)	S6(Bottom)	S1(Front)	S2(Rear)
1	L	0	0.30	0.00	N/A	0.01	0.04	0.27
2		2	0.56	0.01	N/A	0.03	0.10	0.47
3		3	0.48	0.01	N/A	0.01	0.09	0.50
4		4	0.69	0.00	N/A	0.02	0.10	0.54
5		8	0.48	0.01	N/A	0.02	0.09	0.46
6		9	0.65	0.01	N/A	0.01	0.10	0.55
7		12	0.91	0.01	N/A	0.07	0.16	0.92
8		13	0.73	0.02	N/A	0.03	0.13	0.83
9		14	1.03	0.01	N/A	0.01	0.21	0.94
10		15	1.11	0.01	N/A	0.03	0.21	1.07
11		16	0.93	0.01	N/A	0.08	0.18	1.02
12		22	0.76	0.02	N/A	0.03	0.13	0.82
13		23	0.71	0.02	N/A	0.04	0.13	0.83
14		24	1.09	0.01	N/A	0.01	0.20	1.01
15		25	1.09	0.01	N/A	0.06	0.21	1.09
16		128	0.33	0.00	N/A	0.00	0.05	0.29
17		130	0.55	0.01	N/A	0.01	0.08	0.51
18		131	0.57	0.01	N/A	0.01	0.11	0.56
19		132	0.43	0.01	N/A	0.01	0.07	0.46
20		136	0.49	0.01	N/A	0.01	0.09	0.55
21		137	0.68	0.01	N/A	0.01	0.13	0.55
22		140	1.13	0.02	N/A	0.01	0.25	1.03
23		141	0.71	0.02	N/A	0.02	0.14	0.75
24		142	1.05	0.02	N/A	0.02	0.24	0.97
25		143	1.08	0.01	N/A	0.02	0.23	1.05
26		144	0.82	0.01	N/A	0.01	0.13	0.90
27		150	0.71	0.02	N/A	0.01	0.14	0.74
28		151	0.71	0.02	N/A	0.02	0.13	0.74
29		152	1.09	0.01	N/A	0.04	0.19	0.88
30		153	0.92	0.01	N/A	0.01	0.18	0.93

Table 13.

$4cm^2$ PD of the selected beams measured on the corresponding surfaces that are not selected for Δ_{min} determination

Band	Antenna	Beam ID	Surface	Tested Power Level (dBm)	input.power.limit (dBm)	Meas. $4cm^2$PD (mW/cm²)
n261	K (Patch)	7	Front (S1)	8.9	8.9	0.087
	L (Patch)	25	Front (S1)	4.7	4.7	0.103
n260	K (Patch)	147	Front (S1)	5.3	5.3	0.100
	L (Patch)	142	Front (S1)	5.7	5.7	0.112

7 PD Char

7.1 Single Beams

To determine the input power limit at each antenna port, simulation was performed at low, mid and high channel for each mmW band supported, with 6 dBm input power per active port for n261 band and 6 dBm input power per active port for n260 band:

1. Obtained PD surface value (the worst PD among all identified surfaces of the DUT) at all three channels for all single beams specified in the codebook.
2. Derived a sacling factor at low, mid and high channel, $s(i)_{low\_or\_mid\_or\_high}$ by:

$$s(i)_{low\_or\_mid\_or\_high} = \frac{PD\ design\ target}{sim.PD_{surface}(i)}, i \in single\ beams \qquad (1)$$

3. Determined the worst-case scaling factor, s(i), among low, mid and high channels :

$$\boldsymbol{s(i)} = min\{s_{low}(i), s_{mid}(i), s_{high}(i)\},\ i \in single\ beams \qquad (2)$$

and this caling factor appies to the input power at each antenna port.

7.2 Beam Pairs

Per the manufacturer, the relative phase between beam pair is not controlled in the chipset design and could vary from run to run. Therefore, for each beam pair, based on the simulation results, the worst-case scaling factor was determined mathematically to ensure the compliance. The worst-case PD for MIMO operations was found by sweeping the relative phase for all possible angles to ensure a conservative assessment. The power density simulation report contains the worst-case power density for each surface after sweeping through all relative phases between beams.

Once the power density was determined for the worst-case o, the scaling factor was obtained by the below equation for low, mid and high channels:

$$s(i)_{low\_or\_mid\_or\_high} = \frac{PD\ design\ target}{total\ PD\ (\emptyset(i)_{worstcase})}, i \in single\ beams \qquad (3)$$

The $total\ PD\ (\emptyset(i)_{worstcase})$ varies with channel and beam pair, the lowest scaling factor among all three channels,s(i), is determined for the beam pair i:

$$\boldsymbol{s(i)} = min\{s_{low}(i), s_{mid}(i), s_{high}(i)\}, \qquad i \in single\ beams \qquad (4)$$

7.3 Input.Power.Limit Calculations

The PD Char specifies the limit of input power at antenna port that corresponds to PD_design_target for all the beams.

Ideally, if there is no uncertainty associated with hardware design, the input power limit, denoted as $input.power.limit(i)$, for beam i can be obtained after accounting for the housing influence($\Delta_{\boldsymbol{min}}$) determined in Table 8, given by:

For n260 and n261

$$\boldsymbol{input.power.limit(i)} = 6\ dBm + 10 * \log(s(i)) + \Delta_{\boldsymbol{min}}, \qquad i \in all\ beams \qquad (5)$$

where 6dBm is the input power used in simulation for n261 and n260, respectively; s(i) is the scaling factor obtained from Eq. (2) or Eq. (4) for beam i; $\Delta_{\boldsymbol{min}}$ is the worst-case housing influence factor (determined in Table 10) for beam i.

If simulation overestimates the housing influence, then $\Delta_{\boldsymbol{min}}$ (=simulated PD - measured PD) is negative, which means that the measured PD would be higher than the simulated PD. The input power to antenna elements determined via simulation must be decreased for compliance.

Similarly, if simulation underestimates the loss, then Δ_{min} is positive (measured PD would be lower than the simulated value). Input power to antenna elements determined via simulation can be increased and still be PD compliant.

In reality the hardware design has uncertainty which must be properly considered. The device design related uncertainty is embedded in the process of Δ_{min} determination.

Since the device uncertainty is already accounted for in PD_design_target, it needs to be removed to avoid double counting this uncertainty.

Thus, Equation 5 is modified to:

If -TxAGC uncertainty < Δ_{min} < TxAGC uncertainty

$$\boldsymbol{input.power.limit(i)} = 6\ dBm + 10 * \log(s(i)),\ i \in all\ beams, for\ n260\ and\ n261 \qquad (6)$$

else if Δ_{min} < -TxAGC uncertainty,

$$\boldsymbol{input.power.limit(i)} = 6\ dBm + 10 * \log(s(i)) + (\Delta_{min} + TxAGC\ uncertainty),$$
$$i \in all\ beams, for\ n260\ and\ n261 \qquad (7)$$

else if Δ_{min} > TxAGC uncertainty,

$$\boldsymbol{input.power.limit(i)} = 6\ dBm + 10 * \log(s(i)) + (\Delta_{min} - TxAGC\ uncertainty),$$
$$i \in all\ beams, for\ n260\ and\ n261 \qquad (8)$$

Following above logic, the input.power.limit for this DUT can be calculated using Equations (6), (7) and (8), i.e.,

Table 14. $\boldsymbol{input.power.limit}$ **Calculation**

Band	Antenna	Δ_{min} (dB)	TxAGC Uncertainty (dB)	input.power.limit (dBm)	Notes
n261	K (Patch)	0.17	0.5	$\boldsymbol{input.power.limit(i)} = 6\ dBm + 10 * \log(s(i))$	Using Eq.6
	L (Patch)	1.93	0.5	$\boldsymbol{input.power.limit(i)} = 6\ dBm + 10 * \log(s(i)) + 1.43$	Using Eq.8
n260	K (Patch)	1.26	0.5	$\boldsymbol{input.power.limit(i)} = 6\ dBm + 10 * \log(s(i)) + 0.76$	Using Eq.8
	L (Patch)	2.73	0.5	$\boldsymbol{input.power.limit(i)} = 6\ dBm + 10 * \log(s(i)) + 2.23$	Using Eq.8

Table 15. 5G NR n261 K Patch $input.power.limit$

Antenna	Beam ID_1	Beam ID_2	*input.power.limit (dBm)*
n261	1		10.0
	5		6.6
	6		6.4
	7		8.9
	10		6.3
	11		7.1
	17		4.3
	18		3.7
	19		4.0
	20		4.9
	21		5.0
	26		3.7
	27		4.0
	28		3.8
	29		5.0
	129		8.4
	133		4.9
	134		5.5
	135		6.9
	138		5.0
	139		6.2
	145		3.4
	146		3.2
	147		4.2
	148		4.4
	149		3.8
	154		3.2
	155		3.7
	156		4.2
	157		4.2
	1	129	7.1
	5	135	3.1
	6	134	2.2
	7	138	2.8
	10	139	2.5
	11	133	2.2
	17	157	-0.1
	18	156	0.1
	19	154	-0.1
	20	145	0.0
	21	149	1.4
	26	148	0.2
	27	155	0.5
	28	146	-0.3
	29	147	1.4

Table 16. 5G NR n261 L Patch $input.power.limit$

Antenna	Beam ID_1	Beam ID_2	*input.power.limit (dBm)*
n261	0		10.2
	2		6.5
	3		7.1
	4		7.6
	8		7.5
	9		7.0
	12		3.8
	13		3.8
	14		3.6
	15		3.9
	16		5.9
	22		4.1
	23		3.6
	24		3.5
	25		4.7
	128		9.5
	130		7.6
	131		5.8
	132		6.6
	136		5.6
	137		6.3
	140		3.6
	141		3.5
	142		3.7
	143		4.0
	144		3.2
	150		3.4
	151		3.5
	152		4.0
	153		3.4
	0	128	5.9
	2	130	3.3
	3	131	2.2
	4	132	3.5
	8	136	2.5
	9	137	2.7
	12	153	1.7
	13	150	-0.6
	14	151	-0.4
	15	152	0.2
	16	144	0.3
	22	140	-0.2
	23	141	-0.4
	24	142	-0.4
	25	143	0.3

Table 17. 5G NR n260 K Patch $input.power.limit$

Antenna	Beam ID_1	Beam ID_2	*input.power.limit (dBm)*
n260	1		9.6
	5		5.6
	6		6.7
	7		6.0
	10		7.6
	11		5.4
	17		3.4
	18		4.9
	19		4.2
	20		3.4
	21		4.6
	26		4.0
	27		4.6
	28		3.7
	29		3.6
	129		10.5
	133		6.3
	134		7.2
	135		6.8
	138		7.4
	139		6.3
	145		3.7
	146		5.8
	147		5.3
	148		3.3
	149		4.1
	154		5.8
	155		5.9
	156		4.4
	157		3.6
	1	129	7.9
	5	139	2.6
	6	138	2.5
	7	133	2.6
	10	134	2.8
	11	135	3.6
	17	148	0.0
	18	147	0.9
	19	154	0.8
	20	157	0.0
	21	146	1.9
	26	156	0.7
	27	155	1.0
	28	149	0.5
	29	145	0.8

Table 18. 5G NR n260 L Patch $input.power.limit$

Antenna	Beam ID_1	Beam ID_2	*input.power.limit (dBm)*
n260	0		11.4
	2		8.3
	3		8.9
	4		7.6
	8		9.1
	9		7.8
	12		5.9
	13		5.3
	14		5.6
	15		4.6
	16		5.0
	22		5.3
	23		6.7
	24		5.3
	25		4.6
	128		10.8
	130		7.8
	131		8.0
	132		8.6
	136		8.5
	137		7.6
	140		4.7
	141		6.4
	142		5.7
	143		4.5
	144		6.4
	150		6.6
	151		6.5
	152		5.3
	153		5.2
	0	128	6.9
	2	137	4.0
	3	136	4.0
	4	130	5.1
	8	131	4.3
	9	132	5.4
	12	152	1.7
	13	141	2.3
	14	150	1.4
	15	140	1.2
	16	153	2.6
	22	142	1.9
	23	151	1.9
	24	144	1.4
	25	143	1.3