RF Exposure Report

(Part 0: SAR and PD Char Evaluation)

FCC ID	**: 2AJOTTA-1257**
Equipment	**: Smart Phone**
Brand Name	**: NOKIA**
Model Name	**: TA-1257**
Applicant	**: HMD Global Oy Bertel Jungin aukio 9, 02600 Espoo, Finland**
Standard	**: FCC 47 CFR Part 2 (2.1093)**

We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample provide by manufacturer and the test data has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and has been meet FCC requirement.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Cona Huang

Approved by: Cona Huang / Deputy Manager

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History of this test report

Report No.	Version	Description	Issued Date
FA060302A	01	Initial issue of report	Sep. 07, 2020

1. Introduction

The FCC RF exposure limit is defined based on time-averaged RF exposure. The product implements Qualcomm Smart Transmit feature which controls the instantaneous transmitting power for WWAN transmitter sto ensure the product in compliance with FCC RF exposure limit over a defined time window, for SAR (transmit frequency ≤ 6GHz) and power density (transmit frequency > 6GHz). to control and manage transmitting power in real time and to ensure at all times the time-averaged RF exposure is compliant to the regulation requirement. Cannot operat without SAR and PD characterization at the device level, beforehand.

This report describes the procedures for the SAR char and PD char generation, and the parameters obtained from SAR and PD characterization (reffered to as SAR char and PD char, respectively) will be used as input for Smart Transmit. Both SAR char and PD char will be entered via the Embedded File System (EFS) to enable the Smart Transmit Feature.

Terminologies in this report

P_{limit}	The time-averaged RF power which corresponds to SAR_design_target.
P_{max}	Maximum target power level
SAR_design_target:	The design target for SAR compliance. It should be less than regulatory power density limit to account for all device design related uncertainties.
SAR char	P_{limit} for all the technologies/bands for all applicable DSI
PD_design_target:	The design target for PD compliance. It should be less than regulatory power density limit to account for all device design related uncertainties.
input.power.limit	For a PD characterized wireless device, the input power level at antenna port(s) for each beam corresponding to PD_design_target.
PD char	The table that contains input.power.limit fed to antenna port(s) for all supported beams.

2. Product Description

Product Feature & Specification	
Equipment Name	Smart Phone
FCC ID	2AJOTTA-1257
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV: 1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 48: 3550 MHz ~ 3700 MHz LTE Band 66: 1710 MHz ~ 1780 MHz 5G NR n2 : 1850 MHz ~ 1910 MHz 5G NR n5 : 824 MHz ~ 849 MHz 5G NR n66 : 1710 MHz ~ 1780 MHz 5G NR 260: 37GHz ~ 40GHz 5G NR 261: 27.5GHz ~ 28.35GHz WLAN 2.4GHz Band: 2400 MHz ~ 2483.5 MHz WLAN 5.2GHz Band: 5150 MHz ~ 5250 MHz WLAN 5.3GHz Band: 5250 MHz ~ 5350 MHz WLAN 5.6GHz Band: 5470 MHz ~ 5725 MHz WLAN 5.8GHz Band: 5725 MHz ~ 5825 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz NFC : 13.56 MHz
Mode	GSM/GPRS/EGPRS RMC/AMR 12.2Kbps HSDPA HSUPA DC-HSDPA LTE: QPSK, 16QAM, 64QAM 5G NR: DFT-s-OFDM/CP-OFDM, Pi/2 BPSK/QPSK/16QAM/64QAM/256QAM WLAN: 802.11a/b/g/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE NFC:ASK
EUT Stage	Identical Prototype

3. SAR Characterization

SAR char must be generated to cover all radio configurations and usage scenarios that the wireless device supports for operating at 6 GHz or below. It will then be used as input for Smart Transmit to control and manage RF exposure for f < 6 GHz.

3.1 SAR design target and uncertainty

Exposure conditions	Trigger Conditions	DSI	SAR design target	W/kg	Remark
Head	Earpiece on	2	1g SAR design target	0.79	Head
Body Worn	n/a	3	1g SAR design target	0.79	Body Worn
Hotspot	Hotspot om	4	1g SAR design target	0.79	Hotspot

Item	Uncertainty dB (k=2)
Total uncertainty	1.0

To account for total uncertainty, SAR_design_target should be determined as:

$$SAR\_design\_target < SAR_{regulatory\_limit} \times 10^{\frac{-total\ uncertainty}{10}}$$

3.2 SAR Char Table

SAR char must be generated to cover all radio configurations and usage scenarios that the wireless device supports for operating at 6 GHz or below. It will then be used as input for Smart Transmit to control and manage RF exposure for f < 6 GHz

Config 0

Band	Antenna	Head (DSI:2)	Hotspot (DSI4)	Body Worn (DSI3)	Pmax*
GSM850(2 Tx slots)**	0	31.2	29.2	29.2	23.0
GSM1900(2 Tx slots)**	2	32.6	25.1	27.4	20.5
WCDMA II	2	31.5	25.0	27.1	23.0
WCDMA IV	2	33.3	26.5	28.3	23.0
WCDMA V	0	30.0	27.4	27.4	23.0
LTE B2	2	31.7	24.9	27.3	22.0
LTE B66/4	2	32.1	25.5	27.6	22.0
LTE B5	0	30.2	27.5	27.5	22.0
LTE B7	2	31.2	25.1	25.8	22.0
LTE B12/B17	0	33.7	31.8	31.8	22.0
LTE B13	0	32.8	31.3	30.3	22.0
LTE B48**	4	15.3	18.0	22.8	20.0
FR1 n2	2	34.2	25.1	27.8	23.0
FR1 n5	0	37.6	32.7	32.7	23.0
FR1 n66	2	34.3	27.8	29.4	23.0

Config 1

Band	Antenna	Head (DSI:2)	Hotspot (DSI4)	Body Worn (DSI3)	Pmax*
GSM850(2 Tx slots)**	1	24.2	27.7	27.7	22.0
GSM1900(2 Tx slots)**	6	19.8	29.2	29.3	20.0
WCDMA II	6	20.6	27.5	28.6	22.5
WCDMA IV	6	20.4	26.4	28.6	22.5
WCDMA V	1	27.3	29.3	29.3	22.5
LTE B2	6	20.9	27.5	29.2	22.0
LTE B66/4	6	19.2	26.4	29.2	22.0
LTE B5	1	23.0	27.7	27.7	22.0
LTE B7	6	17.9	23.1	25.1	22.0
LTE B12/B17	1	24.8	30.5	30.4	22.0
LTE B13	1	25.1	29.9	29.9	22.0
LTE B48**	0	43.8	26.3	28.0	20.0
FR1 n2	6	21.3	28.8	29.8	23.0
FR1 n5	1	28.4	32.6	32.6	22.0
FR1 n66	6	20.7	27.0	29.5	22.0

*Pmax is used for RF tune up procedure. The maximum allowed output power is equal to Pmax + device uncertainty.

**All Plimit power levels entered in the Table correspond to average power levels after accounting for duty cycle in the case TDD modulation schemes (for e.g., GSM & LTE TDD & NR TDD).

The Plimit values, corresponding to SAR_design_target.

Maximum target power, P_{max}, is configured in NV settings in EUT to limit maximum transmitting power. This power is converted into peak power in NV settings for TDD schemes. The EUT maximum allowed output power is equal to P_{max} + 1.0dB device uncertainty

4. Power Density Characterization

The device with 5G mmW NR typically supports many beams and contains multiple mmW antenna arrays installed at different locations to achieve good coverage in the field. The power density (PD) measurement is a time-consuming test, and it is not practical to measure the power density for all the beams on all the surfaces of the device, thus a hybrid approach using electromagnetic (EM) simulation in combination with measurement is recommended for PD char generation

4.1 PD Char Table

The mmW device supports total N beams, where M out of N are single beams and the rest of (N-M) are beam pairs (where 2 single beams are excited at the same time).

The following figure outlines the PD char process.

Simulation modeling and validation

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

Uncertainty Budget

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

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

Worst-case housing material Influence Quantification

- Determine

$$\Delta_{min} = \min\{\textit{simulated PD@8dBm} - \textit{measured PD@8dBm}\}$$

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

4.2 Codebook for all beams

All the beams that the device supports are specified in the pre-defined codebook, and the codebook is device design specific and generated after evaluating radiation coverage from this particular device. In the field, a smartphone manages the beam selection and utilization based on this pre-defined codebook that is loaded and stored in the device.

Band	Beam_ID		Ant module	Ant Type	Num. of Feed
260	2		QTM0	PATCH	1
260	3		QTM0	PATCH	2
260	9		QTM0	PATCH	2
260	10		QTM0	PATCH	2
260	11		QTM0	PATCH	2
260	17		QTM0	PATCH	2
260	18		QTM0	PATCH	4
260	26		QTM0	PATCH	4
260	27		QTM0	PATCH	4
260	28		QTM0	PATCH	4
260	29		QTM0	PATCH	4
260	30		QTM0	PATCH	4
260	40		QTM0	PATCH	4
260	41		QTM0	PATCH	4
260	42		QTM0	PATCH	4
260	43		QTM0	PATCH	1
260		130	QTM0	PATCH	2
260		131	QTM0	PATCH	2
260		137	QTM0	PATCH	2
260		138	QTM0	PATCH	2
260		139	QTM0	PATCH	2
260		145	QTM0	PATCH	4
260		146	QTM0	PATCH	4
260		154	QTM0	PATCH	4
260		155	QTM0	PATCH	4
260		156	QTM0	PATCH	4
260		157	QTM0	PATCH	4
260		158	QTM0	PATCH	4
260		168	QTM0	PATCH	4
260		169	QTM0	PATCH	4
260		170	QTM0	PATCH	1
260		171	QTM0	PATCH	2
260	2	130	QTM0	PATCH	2
260	3	131	QTM0	PATCH	2
260	9	137	QTM0	PATCH	2
260	10	138	QTM0	PATCH	2
260	11	139	QTM0	PATCH	4
260	17	145	QTM0	PATCH	4
260	18	146	QTM0	PATCH	4
260	26	154	QTM0	PATCH	4
260	27	155	QTM0	PATCH	4
260	28	156	QTM0	PATCH	4
260	29	157	QTM0	PATCH	4
260	30	158	QTM0	PATCH	4
260	40	168	QTM0	PATCH	4
260	41	169	QTM0	PATCH	4
260	42	170	QTM0	PATCH	4
260	43	171	QTM0	PATCH	4

Band	Beam_ID		Ant module	Ant Type	Num. of Feed
260	0		QTM1	PATCH	1
260	1		QTM1	PATCH	2
260	6		QTM1	PATCH	2
260	7		QTM1	PATCH	2
260	8		QTM1	PATCH	2
260	15		QTM1	PATCH	2
260	16		QTM1	PATCH	4
260	21		QTM1	PATCH	4
260	22		QTM1	PATCH	4
260	23		QTM1	PATCH	4
260	24		QTM1	PATCH	4
260	25		QTM1	PATCH	4
260	36		QTM1	PATCH	4
260	37		QTM1	PATCH	4
260	38		QTM1	PATCH	4
260	39		QTM1	PATCH	1
260		128	QTM1	PATCH	2
260		129	QTM1	PATCH	2
260		134	QTM1	PATCH	2
260		135	QTM1	PATCH	2
260		136	QTM1	PATCH	2
260		143	QTM1	PATCH	4
260		144	QTM1	PATCH	4
260		149	QTM1	PATCH	4
260		150	QTM1	PATCH	4
260		151	QTM1	PATCH	4
260		152	QTM1	PATCH	4
260		153	QTM1	PATCH	4
260		164	QTM1	PATCH	4
260		165	QTM1	PATCH	4
260		166	QTM1	PATCH	1
260		167	QTM1	PATCH	2
260	0	128	QTM1	PATCH	2
260	1	129	QTM1	PATCH	2
260	6	134	QTM1	PATCH	2
260	7	135	QTM1	PATCH	2
260	8	136	QTM1	PATCH	4
260	15	143	QTM1	PATCH	4
260	16	144	QTM1	PATCH	4
260	21	149	QTM1	PATCH	4
260	22	150	QTM1	PATCH	4
260	23	151	QTM1	PATCH	4
260	24	152	QTM1	PATCH	4
260	25	153	QTM1	PATCH	4
260	36	164	QTM1	PATCH	4
260	37	165	QTM1	PATCH	4
260	38	166	QTM1	PATCH	4
260	39	167	QTM1	PATCH	4

Band	Beam_ID		Ant module	Ant Type	Num. of Feed
260	4		QTM2	PATCH	1
260	5		QTM2	PATCH	2
260	12		QTM2	PATCH	2
260	13		QTM2	PATCH	2
260	14		QTM2	PATCH	2
260	19		QTM2	PATCH	2
260	20		QTM2	PATCH	4
260	31		QTM2	PATCH	4
260	32		QTM2	PATCH	4
260	33		QTM2	PATCH	4
260	34		QTM2	PATCH	4
260	35		QTM2	PATCH	4
260	44		QTM2	PATCH	4
260	45		QTM2	PATCH	4
260	46		QTM2	PATCH	4
260	47		QTM2	PATCH	1
260		132	QTM2	PATCH	2
260		133	QTM2	PATCH	2
260		140	QTM2	PATCH	2
260		141	QTM2	PATCH	2
260		142	QTM2	PATCH	2
260		147	QTM2	PATCH	4
260		148	QTM2	PATCH	4
260		159	QTM2	PATCH	4
260		160	QTM2	PATCH	4
260		161	QTM2	PATCH	4
260		162	QTM2	PATCH	4
260		163	QTM2	PATCH	4
260		172	QTM2	PATCH	4
260		173	QTM2	PATCH	4
260		174	QTM2	PATCH	1
260		175	QTM2	PATCH	2
260	4	132	QTM2	PATCH	2
260	5	133	QTM2	PATCH	2
260	12	140	QTM2	PATCH	2
260	13	141	QTM2	PATCH	2
260	14	142	QTM2	PATCH	4
260	19	147	QTM2	PATCH	4
260	20	148	QTM2	PATCH	4
260	31	159	QTM2	PATCH	4
260	32	160	QTM2	PATCH	4
260	33	161	QTM2	PATCH	4
260	34	162	QTM2	PATCH	4
260	35	163	QTM2	PATCH	4
260	44	172	QTM2	PATCH	4
260	45	173	QTM2	PATCH	4
260	46	174	QTM2	PATCH	4
260	47	175	QTM2	PATCH	4

Band	Beam_ID		Ant module	Ant Type	Num. of Feed
261	2		QTM0	PATCH	1
261	3		QTM0	PATCH	2
261	9		QTM0	PATCH	2
261	10		QTM0	PATCH	2
261	11		QTM0	PATCH	2
261	17		QTM0	PATCH	2
261	18		QTM0	PATCH	4
261	26		QTM0	PATCH	4
261	27		QTM0	PATCH	4
261	28		QTM0	PATCH	4
261	29		QTM0	PATCH	4
261	30		QTM0	PATCH	4
261	40		QTM0	PATCH	4
261	41		QTM0	PATCH	4
261	42		QTM0	PATCH	4
261	43		QTM0	PATCH	1
261		130	QTM0	PATCH	2
261		131	QTM0	PATCH	2
261		137	QTM0	PATCH	2
261		138	QTM0	PATCH	2
261		139	QTM0	PATCH	2
261		145	QTM0	PATCH	4
261		146	QTM0	PATCH	4
261		154	QTM0	PATCH	4
261		155	QTM0	PATCH	4
261		156	QTM0	PATCH	4
261		157	QTM0	PATCH	4
261		158	QTM0	PATCH	4
261		168	QTM0	PATCH	4
261		169	QTM0	PATCH	4
261		170	QTM0	PATCH	1
261		171	QTM0	PATCH	2
261	2	130	QTM0	PATCH	2
261	3	131	QTM0	PATCH	2
261	9	137	QTM0	PATCH	2
261	10	138	QTM0	PATCH	2
261	11	139	QTM0	PATCH	4
261	17	145	QTM0	PATCH	4
261	18	146	QTM0	PATCH	4
261	26	154	QTM0	PATCH	4
261	27	155	QTM0	PATCH	4
261	28	156	QTM0	PATCH	4
261	29	157	QTM0	PATCH	4
261	30	158	QTM0	PATCH	4
261	40	168	QTM0	PATCH	4
261	41	169	QTM0	PATCH	4
261	42	170	QTM0	PATCH	4
261	43	171	QTM0	PATCH	4

Band	Beam_ID		Ant module	Ant Type	Num. of Feed
261	0		QTM1	PATCH	1
261	1		QTM1	PATCH	2
261	6		QTM1	PATCH	2
261	7		QTM1	PATCH	2
261	8		QTM1	PATCH	2
261	15		QTM1	PATCH	2
261	16		QTM1	PATCH	4
261	21		QTM1	PATCH	4
261	22		QTM1	PATCH	4
261	23		QTM1	PATCH	4
261	24		QTM1	PATCH	4
261	25		QTM1	PATCH	4
261	36		QTM1	PATCH	4
261	37		QTM1	PATCH	4
261	38		QTM1	PATCH	4
261	39		QTM1	PATCH	1
261		128	QTM1	PATCH	2
261		129	QTM1	PATCH	2
261		134	QTM1	PATCH	2
261		135	QTM1	PATCH	2
261		136	QTM1	PATCH	2
261		143	QTM1	PATCH	4
261		144	QTM1	PATCH	4
261		149	QTM1	PATCH	4
261		150	QTM1	PATCH	4
261		151	QTM1	PATCH	4
261		152	QTM1	PATCH	4
261		153	QTM1	PATCH	4
261		164	QTM1	PATCH	4
261		165	QTM1	PATCH	4
261		166	QTM1	PATCH	1
261		167	QTM1	PATCH	2
261	0	128	QTM1	PATCH	2
261	1	129	QTM1	PATCH	2
261	6	134	QTM1	PATCH	2
261	7	135	QTM1	PATCH	2
261	8	136	QTM1	PATCH	4
261	15	143	QTM1	PATCH	4
261	16	144	QTM1	PATCH	4
261	21	149	QTM1	PATCH	4
261	22	150	QTM1	PATCH	4
261	23	151	QTM1	PATCH	4
261	24	152	QTM1	PATCH	4
261	25	153	QTM1	PATCH	4
261	36	164	QTM1	PATCH	4
261	37	165	QTM1	PATCH	4
261	38	166	QTM1	PATCH	4
261	39	167	QTM1	PATCH	4

Band	Beam_ID		Ant module	Ant Type	Num. of Feed
261	4		QTM2	PATCH	1
261	5		QTM2	PATCH	2
261	12		QTM2	PATCH	2
261	13		QTM2	PATCH	2
261	14		QTM2	PATCH	2
261	19		QTM2	PATCH	2
261	20		QTM2	PATCH	4
261	31		QTM2	PATCH	4
261	32		QTM2	PATCH	4
261	33		QTM2	PATCH	4
261	34		QTM2	PATCH	4
261	35		QTM2	PATCH	4
261	44		QTM2	PATCH	4
261	45		QTM2	PATCH	4
261	46		QTM2	PATCH	4
261	47		QTM2	PATCH	1
261		132	QTM2	PATCH	2
261		133	QTM2	PATCH	2
261		140	QTM2	PATCH	2
261		141	QTM2	PATCH	2
261		142	QTM2	PATCH	2
261		147	QTM2	PATCH	4
261		148	QTM2	PATCH	4
261		159	QTM2	PATCH	4
261		160	QTM2	PATCH	4
261		161	QTM2	PATCH	4
261		162	QTM2	PATCH	4
261		163	QTM2	PATCH	4
261		172	QTM2	PATCH	4
261		173	QTM2	PATCH	4
261		174	QTM2	PATCH	1
261		175	QTM2	PATCH	2
261	4	132	QTM2	PATCH	2
261	5	133	QTM2	PATCH	2
261	12	140	QTM2	PATCH	2
261	13	141	QTM2	PATCH	2
261	14	142	QTM2	PATCH	4
261	19	147	QTM2	PATCH	4
261	20	148	QTM2	PATCH	4
261	31	159	QTM2	PATCH	4
261	32	160	QTM2	PATCH	4
261	33	161	QTM2	PATCH	4
261	34	162	QTM2	PATCH	4
261	35	163	QTM2	PATCH	4
261	44	172	QTM2	PATCH	4
261	45	173	QTM2	PATCH	4
261	46	174	QTM2	PATCH	4
261	47	175	QTM2	PATCH	4

4.3 PD_design_target determination

To account for total uncertainty, PD_design_target should meet the criteria:

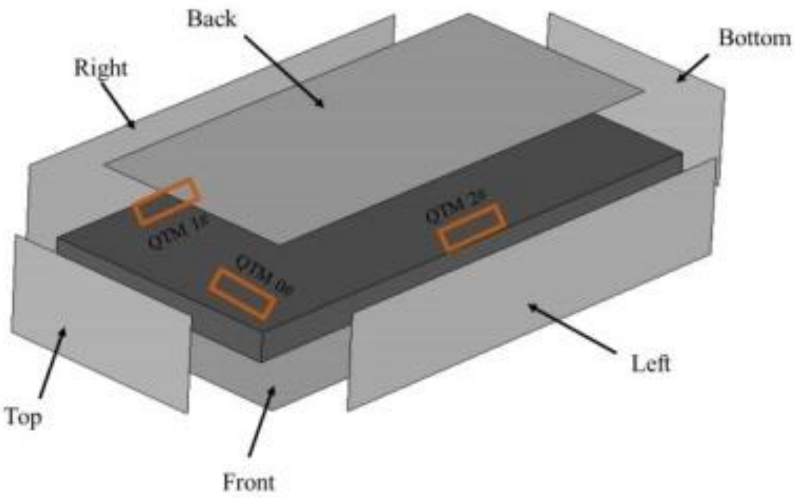
$$PD\_design\_target < PD_{regulatory\_limit} \times 10^{\frac{-totaluncertainty}{10}}$$

For this EUT, the PD design target and the uncertainty value are listed below

n260/n261	PD design target	Antenna Module	W/m^2
		Antenna Module 0/1/2	4.6

Item	Uncertainty dB (k=2)
Total uncertainty	2.1

4.4 Exposure positions for PD evaluation



Evaluation positions

	Front	Back	Left From Back View	Right From Back View	Top	Bottom
	S1	S2	S3	S4	S5	S6
QTM#0	O	O	O	O	O	X
QTM#1	O	O	O	O	X	O
QTM#2	O	O	O	O	O	X

Remark:

1. Referring to the PD simulation report for the reason of selecting surfaces/edges.
2. The exposure positions selection is based on the all edges and surfaces of the device with a transmitting antenna located within 25 mm from that surface or edge.

4.5 Simulation and modeling validation

Power density simulations of all beams and surfaces were performed by the manufacturer. Details of these simulations and modeling validation can be found in the Power Density Simulation Report. Following Table 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 and n260 band, PD measurements are conducted for at least one single beam per antenna type and per antenna module (0,1) on worst-surface(s) . PD measurements are performed at mid channel of each mmW band and with CW modulation.
PD value will be used to determine worst-case housing influence for conservative assessment

Band	antenna module	Beam ID 1	Beam ID 2	Frequency (GHz)	Exposure Surface	Test separation	modulation	Measured results Savg tot 4cm^2 (W/m2)	Simulated Pd (W/m^2), averaged over 4 cm2	Sim vs meas (dB)
n260	0	42	-	38.5	Front	2mm	CW	0.64	5.1854	9.093
n260	0	-	154	38.5	Back	2mm	CW	5.61	12.1885	3.370
n260	0	41	-	38.5	Back	2mm	CW	5.30	12.9812	3.890
n260	0	-	156	38.5	Left Side	2mm	CW	1.07	5.5716	7.166
n260	1	25	-	38.5	Back	2mm	CW	2.99	7.3559	3.910
n260	1	-	164	38.5	Back	2mm	CW	3.56	6.9541	2.908
n260	1	38	-	38.5	Right Side	2mm	CW	7.77	15.8666	3.101
n260	1	-	164	38.5	Right Side	2mm	CW	7.72	15.2458	2.955
n260	2	33	-	38.5	Back	2mm	CW	4.59	31.0258	8.299
n260	2	-	160	38.5	Back	2mm	CW	2.60	24.8002	9.795
n260	2	45	-	38.5	Left Side	2mm	CW	7.71	50.1841	8.135
n260	2	-	174	38.5	Left Side	2mm	CW	6.51	52.486	9.065
n261	0	43	-	27.925	Back	2mm	CW	6.36	9.3444	1.671
n261	0	-	158	27.925	Back	2mm	CW	9.36	9.6568	0.136
n261	0	40	-	27.925	Top Side	2mm	CW	2.73	3.4774	1.051
n261	0	-	155	27.925	Top Side	2mm	CW	2.60	3.191	0.890
n261	1	39	-	27.925	Back	2mm	CW	3.01	5.4155	2.551
n261	1	-	149	27.925	Back	2mm	CW	3.31	5.4342	2.153
n261	1	23	-	27.925	Right Side	2mm	CW	5.41	11.392	3.234
n261	1	-	149	27.925	Right Side	2mm	CW	5.63	11.493	3.099
n261	2	45	-	27.925	Front	2mm	CW	1.16	4.0007	5.377
n261	2	-	163	27.925	Front	2mm	CW	1.83	4.6042	4.007
n261	2	45	-	27.925	Left Side	2mm	CW	5.27	11.1736	3.264
n261	2	-	163	27.925	Left Side	2mm	CW	4.72	10.8348	3.609

4.6 PD Char

4.6.1 Simulated input power limit for single beams

Perform simulation at low, mid and high channel for each mmW band supported, with a given input power per active port, *sim.input.power.per.active.port* (6 dBm for this product):

1. Obtain $PD_{surface}$ value (the worst PD among all identified surfaces of the device) at all three channels for all single beams (1~M) specified in *codebook_sim*.
2. Adjust input power to determine a scaling factor at all three channels by:

$$s(i)_{low\_or\_mid\_high} = \frac{PD\ design\ target}{sim.PD_{surface}(i)},\ i = 1,2,\ldots M \qquad (4)$$

3. Determine the worst-case scaling factor among low, mid and high channels:

$$s(i) = \min\{s_{low}(i), s_{mid}(i), s_{high}(i)\},\ i = 1,2,\ldots M \qquad (5)$$

   Note: This scaling factor applies to the input power at each antenna port
4. Determine the simulated input power limit, sim.powerlimit, for single beam i by:

$$sim.\ power_{limit}.(i)dBm = 10 * \log(s(i)) + sim.input.power.per.active.port,\ i = 1,2,\ldots M \qquad (6)$$

4.6.2 Simulated input power limit for beam pairs

The relative phase between single beams of a beam pair is sweeped to find the worst case PD for beam-pairs operation, and PD simulation data has taken this into considerationfor beam-pair operations take consideration of the variation relative phase was reported

For beam pair, extract the E-fields and H-fields from the corresponding single beams at and high channel for each supported band and for all identified surfaces of the device.

For a given beam pair containing *beam_a* and *beam_b with relative phase Ø* and for a given channel, determine the worst-case $Ø_{worstcase}$ which results in the highest $t$otal PD (Ø) among all identified surfaces for this beam pair at this channel. When $Ø_{worstcase}$ is determined for all three channels, obtain the scaling factor given by the below equation for low, mid and high channels:

$$s(i)_{low\_or\_mid\_high} = \frac{PD\ design\ target}{total.PD(\emptyset(\mathrm{i})_{worstcase})},\ i = M+1,\ M+2,\ldots N \qquad (8)$$

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

$$s(i) = min\{s_{low}(i), s_{mid}(i), s_{high}(i)\},\ i = M+1,\ M+2,\ldots N \qquad (9)$$

The simulated input power limit, $sim.power_{limit}$, for beam pair *i* can be determined by

$$sim.power_{limit}(i)dBm = 10*\log(s(i)) + sim.input.power.per.active.port, i = M+1,\ M+2,\ \ldots N \qquad (10)$$

4.6.3 Worst-case housing influence determination

Referring to the PD simulation report for PD simulation data for all beams . For non-metal material, the material property cannot be accurately characterized at mmW frequencies. The estimated material property for the device housing is used in the simulation model, which could impact 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.

Referring to the PD simulation report for PD simulation data for all beams, and the worst beams are selected to be tested Power density simulation for all

The mmW antenna modules are placed at different locations and only surrounding material/housing has impact on EM field propagation and in turn power density, and depending on the type of 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 procedure to determine worst-case housing influence, denoted as $\Delta_{\min}$:

1. Based on PD simulation, determine one or more worst-surface(s) that contains all the highest 4cm^2-averaged PD for each of the beams, per antenna module and per antenna type in the mid channel of each band.
2. For identified worst surface(s) per antenna module and per antenna type group,
   a. First determine Δ_{min} based on identified worst surface(s) in Step 1, and then follow the procedures described in Section 4.6 to derive *input.power.limit* corresponding to *PD_design_target* for all the beams
   b. Then prove all other surface(s) near-by the mmW module, i.e., surface(s) not selected in Step 1, is not required for housing material loss quantification (in other words, these nonevaluated surfaces have no influence on the determined *input.power.limit*) by:
      i. Scale the simulated 4cm^2-averaged PD values for all single beams to correspond to their $sim.power_{limit}$, and identify the worst-PD beam per each non-selected surface.
      ii. Measure 4cm^2-averaged PD at *input.power.limit* for the identified worst-PD beam at each non-selected surface
      iii. Demonstrate all measured 4cm^2-averaged PD values are below *PD_design_target*.
3. If any of the above surface(s) in Step (2.b.iii) have measured 4cm^2-averaged PD ≥ *PD_design_target*, then those surfaces must be included in the Δ_{min} determination in Step (2.a), and follow the procedures in Section 4.6 to re-evaluate *input.power.limit* with these added surfaces.

Therefore, when comparing a simulated 4cm^2-avgeraged PD and measured 4cm^2-avgeraged PD for the above identified surfaces, the worst errors introduced when using the estimated material property in the simulation per module and per antenna type (worst out of both polarizations) is highlighted in bolded numbers in section 4.5. Thus, the worst-case housing influence, denoted as Δ_{min} (= minimum of (sim.PD – meas.PD) for the same antenna type of each module), is determined as:

Band	Antenna	Δ_{min} (dB)
n260	0	3.37
	1	2.91
	2	8.14
n261	0	0.14
	1	2.15
	2	3.26

Δ_{min} represents the worst case where RF exposure is underestimated the most by simulation upon using the estimated material property for glass/plastics of the housing. For conservative assessment, the Δ_{min} is used as the worst case correction and applied to each corresponding beam group to determine power limits in PD char for compliance. To ensure that condition described in Step (2.b.iii) is met, apply the correct input.power.limit to derive the PD simulated results for all beams, and select the worst beams (yellow highlighted in the PD table) for each of non-selected applicable surface(s).

The PD test results for non-selected surfaces are less than PD_design_target, and meets condition in Step (2.b.iii), thus performing Step (3) is not needed

Simulated 4cm^2-averaged PD at input.power.limit

Determine the worst beam for each of non-selected surface(s)

n260 middle channel						Simulated 4cm 2 SAPD (W/m 2) corresponding to PD_design_target				
Band	Beam_ID		Ant module	Ant Type	Num. of Feed	Front	Back	Right	Left	Top
260	2		QTM0	PATCH	1	0.9742	2.7862	0.0013	0.8913	0.9139
260	3		QTM0	PATCH	2	0.7652	2.7656	0.0100	0.6643	0.5311
260	9		QTM0	PATCH	2	0.7844	4.0723	0.0147	0.9188	0.9725
260	10		QTM0	PATCH	2	0.7219	3.2253	0.0579	0.9071	0.5941
260	11		QTM0	PATCH	2	1.4150	4.4039	0.4796	1.2714	1.1155
260	17		QTM0	PATCH	2	0.5622	3.6433	0.3067	0.6071	0.9626
260	18		QTM0	PATCH	4	1.3850	3.7679	0.0683	1.3035	0.9509
260	26		QTM0	PATCH	4	1.1564	3.5175	0.0809	1.0512	0.8164
260	27		QTM0	PATCH	4	0.7009	4.5671	0.0080	0.6775	1.0546
260	28		QTM0	PATCH	4	1.4032	3.9696	0.1208	1.4722	0.8272
260	29		QTM0	PATCH	4	1.9486	4.6000	0.8660	1.8120	1.1556
260	30		QTM0	PATCH	4	1.1781	3.4575	0.3444	1.0609	0.8408
260	40		QTM0	PATCH	4	0.7065	4.0554	0.3144	0.7976	1.0808
260	41		QTM0	PATCH	4	0.7582	4.3734	0.3774	0.8256	0.8843
260	42		QTM0	PATCH	4	1.6186	3.9487	0.3915	1.4975	0.8279
260	43		QTM0	PATCH	1	1.7477	4.1791	0.7615	1.5771	1.0503
260		130	QTM0	PATCH	2	0.5455	4.0992	0.0944	0.6980	1.1048
260		131	QTM0	PATCH	2	0.8530	4.0158	0.0294	1.0521	0.9192
260		137	QTM0	PATCH	2	0.5265	4.3391	0.1874	0.7994	1.2891
260		138	QTM0	PATCH	2	0.9861	4.0914	0.6627	1.0498	1.0726
260		139	QTM0	PATCH	2	1.3005	4.3865	0.8140	1.6328	0.8746
260		145	QTM0	PATCH	4	0.6480	4.1758	0.5823	0.7627	1.3002
260		146	QTM0	PATCH	4	0.8227	3.5032	0.3458	0.9464	0.6580
260		154	QTM0	PATCH	4	1.0798	4.6000	0.5104	1.4328	1.0178
260		155	QTM0	PATCH	4	0.9839	3.8333	0.6999	1.3460	1.3249
260		156	QTM0	PATCH	4	0.7992	4.1398	0.3641	1.9784	1.2339
260		157	QTM0	PATCH	4	1.4360	4.4684	0.2680	1.7729	0.9067
260		158	QTM0	PATCH	4	0.9076	3.4824	0.5332	1.3912	0.8323
260		168	QTM0	PATCH	4	1.4338	4.6000	1.2601	1.7660	1.4149
260		169	QTM0	PATCH	4	0.7813	3.7852	0.6622	1.1548	1.3120
260		170	QTM0	PATCH	1	1.0540	4.6000	0.8294	1.9671	1.1527
260		171	QTM0	PATCH	2	1.2897	4.5145	0.4607	1.5263	0.8907

n260 middle channel						Simulated 4cm 2 SAPD (W/m 2) corresponding to PD_design_target				
Band	Beam_ID		Ant module	Ant Type	Num. of Feed	Front	Back	Right	Left	Top
260	0		QTM1	PATCH	1	1.5697	1.8680	4.6000	0.0142	0.0521
260	1		QTM1	PATCH	2	1.5084	1.2918	4.5024	0.0210	0.1227
260	6		QTM1	PATCH	2	1.8554	1.7912	4.6000	0.0171	0.1231
260	7		QTM1	PATCH	2	1.2788	1.2578	4.6000	0.0236	0.0899
260	8		QTM1	PATCH	2	1.8811	1.8183	4.6000	0.0149	0.1146
260	15		QTM1	PATCH	2	1.4364	1.4215	4.3741	0.0073	0.0371
260	16		QTM1	PATCH	4	1.6909	1.6312	4.6000	0.0259	0.1504
260	21		QTM1	PATCH	4	1.9116	1.9513	4.5064	0.0230	0.1015
260	22		QTM1	PATCH	4	1.8809	1.9469	4.6000	0.0089	0.0646
260	23		QTM1	PATCH	4	1.3299	1.6684	4.6000	0.0253	0.1244
260	24		QTM1	PATCH	4	1.3720	1.5217	4.3090	0.0308	0.2975
260	25		QTM1	PATCH	4	1.8063	2.3139	4.6000	0.0120	0.1330
260	36		QTM1	PATCH	4	2.0218	1.8211	4.6000	0.0133	0.0977
260	37		QTM1	PATCH	4	1.6367	1.9282	4.6000	0.0243	0.0821
260	38		QTM1	PATCH	4	1.4501	1.5339	4.6000	0.0230	0.2308
260	39		QTM1	PATCH	1	1.4643	2.0780	4.6000	0.0179	0.2479
260		128	QTM1	PATCH	2	1.4012	2.5851	4.3632	0.0181	0.0744
260		129	QTM1	PATCH	2	1.3301	1.8771	4.6000	0.0106	0.1404
260		134	QTM1	PATCH	2	1.6924	2.3825	4.6000	0.0203	0.1331
260		135	QTM1	PATCH	2	1.4671	2.1501	4.6000	0.0135	0.1213
260		136	QTM1	PATCH	2	1.6974	2.4473	4.6000	0.0185	0.1186
260		143	QTM1	PATCH	4	1.3685	2.3671	4.4189	0.0149	0.0651
260		144	QTM1	PATCH	4	1.4721	2.0218	4.5471	0.0248	0.1802
260		149	QTM1	PATCH	4	2.1634	2.0046	4.6000	0.0193	0.0724
260		150	QTM1	PATCH	4	2.0179	2.0865	4.6000	0.0197	0.0786
260		151	QTM1	PATCH	4	1.8154	2.0114	4.6000	0.0133	0.2253
260		152	QTM1	PATCH	4	1.5288	1.6394	4.6000	0.0180	0.2314
260		153	QTM1	PATCH	4	1.7937	2.2433	4.5426	0.0271	0.0718
260		164	QTM1	PATCH	4	2.0803	2.0982	4.6000	0.0098	0.0662
260		165	QTM1	PATCH	4	1.6601	2.0065	4.6000	0.0277	0.0653
260		166	QTM1	PATCH	1	1.4629	1.5734	4.6000	0.0182	0.2105
260		167	QTM1	PATCH	2	1.8242	1.9482	4.5177	0.0308	0.1286

n260 middle channel						Simulated 4cm 2 SAPD (W/m 2) corresponding to PD_design_target				
Band	Beam_ID		Ant module	Ant Type	Num. of Feed	Front	Back	Right	Left	Bottom
260	4		QTM2	PATCH	1	0.1431	2.4819	0.0335	4.5278	0.0857
260	5		QTM2	PATCH	2	0.2028	2.7513	0.0373	4.5945	0.0466
260	12		QTM2	PATCH	2	0.3080	2.8368	0.0292	4.5256	0.0508
260	13		QTM2	PATCH	2	0.2319	2.2780	0.0274	4.5130	0.0765
260	14		QTM2	PATCH	2	0.2451	2.9134	0.0313	4.5386	0.0671
260	19		QTM2	PATCH	2	0.3164	2.5104	0.0372	4.5611	0.0777
260	20		QTM2	PATCH	4	0.1808	2.6287	0.0349	4.5016	0.1121
260	31		QTM2	PATCH	4	0.4541	2.9139	0.0282	4.6000	0.0749
260	32		QTM2	PATCH	4	0.4685	2.4883	0.0307	4.5843	0.0420
260	33		QTM2	PATCH	4	0.6245	3.0501	0.0298	4.5082	0.0734
260	34		QTM2	PATCH	4	0.6218	2.5147	0.0404	4.5704	0.1016
260	35		QTM2	PATCH	4	0.6085	2.0259	0.0406	4.5374	0.0541
260	44		QTM2	PATCH	4	0.4298	3.1028	0.0304	4.5685	0.0649
260	45		QTM2	PATCH	4	0.5505	1.9810	0.0278	4.4731	0.0366
260	46		QTM2	PATCH	4	0.5756	1.9802	0.0316	4.5805	0.0822
260	47		QTM2	PATCH	1	0.6212	2.3402	0.0442	4.5617	0.0910
260		132	QTM2	PATCH	2	0.1790	2.4494	0.0375	4.5882	0.0890
260		133	QTM2	PATCH	2	0.1373	2.5702	0.0285	4.5583	0.0642
260		140	QTM2	PATCH	2	0.3558	2.5925	0.0307	4.5054	0.0377
260		141	QTM2	PATCH	2	0.3721	2.1273	0.0393	4.5372	0.0693
260		142	QTM2	PATCH	2	0.2744	2.7562	0.0314	4.6000	0.1077
260		147	QTM2	PATCH	4	0.3628	2.2675	0.0303	4.5274	0.0513
260		148	QTM2	PATCH	4	0.3101	2.1898	0.0344	4.5624	0.0754
260		159	QTM2	PATCH	4	0.5661	2.2024	0.0354	4.4508	0.0801
260		160	QTM2	PATCH	4	0.5214	2.3443	0.0373	4.6000	0.1269
260		161	QTM2	PATCH	4	0.4584	1.8940	0.0388	4.5271	0.0695
260		162	QTM2	PATCH	4	0.5387	2.5291	0.0250	4.6000	0.0856
260		163	QTM2	PATCH	4	0.6243	2.1363	0.0299	4.5185	0.0689
260		172	QTM2	PATCH	4	0.5626	2.2920	0.0385	4.6000	0.1257
260		173	QTM2	PATCH	4	0.4858	2.2062	0.0306	4.5727	0.0873
260		174	QTM2	PATCH	1	0.4777	2.0850	0.0366	4.5344	0.0639
260		175	QTM2	PATCH	2	0.5825	2.2911	0.0300	4.6000	0.0979

n261 middle channel						Simulated 4cm 2 SAPD (W/m 2) corresponding to PD_design_target				
Band	Beam_ID		Ant module	Ant Type	Num. of Feed	Front	Back	Right	Left	Top
261	2		QTM0	PATCH	1	0.152	4.035	0.083	0.340	0.536
261	3		QTM0	PATCH	2	0.207	3.608	0.126	0.713	0.958
261	9		QTM0	PATCH	2	0.332	4.269	0.054	0.932	1.401
261	10		QTM0	PATCH	2	0.219	4.401	0.118	0.430	1.017
261	11		QTM0	PATCH	2	0.209	4.447	0.183	0.622	0.702
261	17		QTM0	PATCH	2	0.192	3.989	0.068	0.923	1.133
261	18		QTM0	PATCH	4	0.236	4.600	0.188	0.508	0.618
261	26		QTM0	PATCH	4	0.382	4.361	0.132	0.877	1.644
261	27		QTM0	PATCH	4	0.294	4.072	0.060	0.967	1.285
261	28		QTM0	PATCH	4	0.340	4.518	0.065	0.361	1.344
261	29		QTM0	PATCH	4	0.192	3.930	0.157	0.726	0.876
261	30		QTM0	PATCH	4	0.417	4.548	0.175	1.339	0.790
261	40		QTM0	PATCH	4	0.329	4.174	0.090	0.968	1.664
261	41		QTM0	PATCH	4	0.294	4.149	0.055	0.766	1.195
261	42		QTM0	PATCH	4	0.332	4.190	0.135	0.557	1.193
261	43		QTM0	PATCH	1	0.229	4.381	0.173	0.877	0.986
261		130	QTM0	PATCH	2	0.303	4.063	0.173	0.408	0.759
261		131	QTM0	PATCH	2	0.254	3.660	0.110	0.529	1.047
261		137	QTM0	PATCH	2	0.249	3.996	0.116	0.595	1.348
261		138	QTM0	PATCH	2	0.279	3.876	0.214	0.505	0.901
261		139	QTM0	PATCH	2	0.313	3.966	0.132	0.559	0.884
261		145	QTM0	PATCH	4	0.276	3.804	0.180	0.413	1.266
261		146	QTM0	PATCH	4	0.325	4.172	0.178	0.619	0.747
261		154	QTM0	PATCH	4	0.252	4.292	0.068	0.506	1.563
261		155	QTM0	PATCH	4	0.211	4.152	0.078	0.717	1.576
261		156	QTM0	PATCH	4	0.445	4.111	0.281	1.606	1.577
261		157	QTM0	PATCH	4	0.427	3.930	0.145	1.390	1.144
261		158	QTM0	PATCH	4	0.278	4.230	0.070	0.765	1.106
261		168	QTM0	PATCH	4	0.234	4.218	0.069	0.590	1.540
261		169	QTM0	PATCH	4	0.247	4.119	0.105	1.041	1.579
261		170	QTM0	PATCH	1	0.455	4.031	0.269	1.905	1.835
261		171	QTM0	PATCH	2	0.279	4.155	0.094	0.751	0.981

n261 middle channel						Simulated 4cm 2 SAPD (W/m 2) corresponding to PD_design_target				
Band	Beam_ID		Ant module	Ant Type	Num. of Feed	Front	Back	Right	Left	Top
261	0		QTM1	PATCH	1	0.972	1.070	2.835	0.020	0.087
261	1		QTM1	PATCH	2	0.698	1.475	3.074	0.004	0.060
261	6		QTM1	PATCH	2	0.852	2.519	4.397	0.010	0.143
261	7		QTM1	PATCH	2	1.252	1.366	3.287	0.022	0.053
261	8		QTM1	PATCH	2	0.795	1.188	3.143	0.024	0.196
261	15		QTM1	PATCH	2	1.840	1.798	4.211	0.029	0.017
261	16		QTM1	PATCH	4	1.298	1.615	4.244	0.037	0.188
261	21		QTM1	PATCH	4	0.957	2.613	4.600	0.030	0.385
261	22		QTM1	PATCH	4	1.219	2.270	4.512	0.034	0.128
261	23		QTM1	PATCH	4	1.374	2.066	4.600	0.016	0.050
261	24		QTM1	PATCH	4	1.320	1.933	3.870	0.023	0.121
261	25		QTM1	PATCH	4	1.261	2.082	3.869	0.017	0.100
261	36		QTM1	PATCH	4	1.016	2.354	4.406	0.034	0.254
261	37		QTM1	PATCH	4	1.283	1.959	4.351	0.019	0.048
261	38		QTM1	PATCH	4	1.478	2.101	4.600	0.022	0.082
261	39		QTM1	PATCH	1	1.578	2.497	4.600	0.026	0.088
261		128	QTM1	PATCH	2	0.304	0.589	1.341	0.002	0.034
261		129	QTM1	PATCH	2	0.886	0.976	2.595	0.018	0.019
261		134	QTM1	PATCH	2	1.149	2.127	4.124	0.010	0.067
261		135	QTM1	PATCH	2	0.427	0.950	2.109	0.010	0.102
261		136	QTM1	PATCH	2	0.726	1.477	2.816	0.008	0.039
261		143	QTM1	PATCH	4	0.626	0.646	1.597	0.014	0.025
261		144	QTM1	PATCH	4	0.545	1.158	2.530	0.011	0.072
261		149	QTM1	PATCH	4	1.562	1.895	4.008	0.018	0.042
261		150	QTM1	PATCH	4	1.272	2.160	4.173	0.032	0.123
261		151	QTM1	PATCH	4	1.454	2.222	4.600	0.030	0.287
261		152	QTM1	PATCH	4	1.200	1.755	3.491	0.024	0.086
261		153	QTM1	PATCH	4	1.370	1.886	3.692	0.020	0.019
261		164	QTM1	PATCH	4	1.659	2.102	4.454	0.029	0.055
261		165	QTM1	PATCH	4	1.155	2.492	4.600	0.036	0.226
261		166	QTM1	PATCH	1	1.399	1.965	4.600	0.032	0.182
261		167	QTM1	PATCH	2	1.710	2.394	4.589	0.029	0.053

n261 middle channel						Simulated 4cm 2 SAPD (W/m 2) corresponding to PD_design_target				
Band	Beam_ID		Ant module	Ant Type	Num. of Feed	Front	Back	Right	Left	Bottom
261	4		QTM2	PATCH	1	0.816	1.192	0.019	4.483	0.042
261	5		QTM2	PATCH	2	1.487	1.101	0.022	4.503	0.104
261	12		QTM2	PATCH	2	0.838	0.965	0.016	4.158	0.073
261	13		QTM2	PATCH	2	0.889	0.538	0.013	4.384	0.040
261	14		QTM2	PATCH	2	0.757	0.956	0.005	4.600	0.058
261	19		QTM2	PATCH	2	0.885	0.626	0.021	4.402	0.066
261	20		QTM2	PATCH	4	1.602	0.645	0.016	4.380	0.044
261	31		QTM2	PATCH	4	1.322	0.889	0.029	4.434	0.138
261	32		QTM2	PATCH	4	1.521	1.005	0.036	4.465	0.050
261	33		QTM2	PATCH	4	1.556	0.752	0.032	4.280	0.042
261	34		QTM2	PATCH	4	1.288	0.735	0.033	4.260	0.044
261	35		QTM2	PATCH	4	1.187	1.415	0.020	4.535	0.134
261	44		QTM2	PATCH	4	1.404	0.898	0.021	4.404	0.054
261	45		QTM2	PATCH	4	1.547	0.779	0.033	4.320	0.027
261	46		QTM2	PATCH	4	1.502	0.763	0.035	4.233	0.028
261	47		QTM2	PATCH	1	1.253	0.823	0.030	4.543	0.084
261		132	QTM2	PATCH	2	1.765	0.982	0.014	4.121	0.056
261		133	QTM2	PATCH	2	0.861	0.409	0.004	3.928	0.081
261		140	QTM2	PATCH	2	1.804	1.253	0.019	4.481	0.069
261		141	QTM2	PATCH	2	1.566	0.951	0.027	4.438	0.064
261		142	QTM2	PATCH	2	1.761	0.841	0.017	4.156	0.024
261		147	QTM2	PATCH	4	1.455	1.186	0.014	4.359	0.080
261		148	QTM2	PATCH	4	1.552	0.744	0.024	3.970	0.037
261		159	QTM2	PATCH	4	1.144	0.703	0.017	3.905	0.085
261		160	QTM2	PATCH	4	1.095	1.161	0.021	3.974	0.208
261		161	QTM2	PATCH	4	1.393	0.688	0.016	4.474	0.078
261		162	QTM2	PATCH	4	1.746	0.641	0.022	4.536	0.041
261		163	QTM2	PATCH	4	1.703	0.587	0.012	4.008	0.030
261		172	QTM2	PATCH	4	1.197	0.856	0.017	4.069	0.128
261		173	QTM2	PATCH	4	1.074	1.031	0.011	4.173	0.137
261		174	QTM2	PATCH	1	1.592	0.593	0.017	4.446	0.062
261		175	QTM2	PATCH	2	1.911	0.672	0.013	4.549	0.035

4cm^2-averaged PD for the selected beams on non-selected surfaces for Δ_{min}determination

Band	antenna module	Beam ID 1	Beam ID 2	Frequency (GHz)	Exposure Surface	Test separation	modulation	Measured Results Savg tot 4cm^2 (W/m2)
n260	0	-	168	38.5	Right Side	2mm	CW	0.265
n260	0	-	156	38.5	Left Side	2mm	CW	0.786
n260	0	-	168	38.5	Top Side	2mm	CW	1.580
n260	1	-	149	38.5	Front	2mm	CW	1.480
n260	1	24	-	38.5	Left Side	2mm	CW	0.306
n260	1	24	-	38.5	Top Side	2mm	CW	0.144
n260	2	33	-	38.5	Front	2mm	CW	1.210
n260	2	47	-	38.5	Right Side	2mm	CW	0.428
n260	2	-	160	38.5	Bottom Side	2mm	CW	0.023
n261	0	-	170	27.925	Front	2mm	CW	0.682
n261	0	-	156	27.925	Right Side	2mm	CW	0.553
n261	0	-	170	27.925	Left Side	2mm	CW	0.557
n261	1	15	-	27.925	Front	2mm	CW	1.620
n261	1	16	-	27.925	Left Side	2mm	CW	0.347
n261	1	21	-	27.925	Top Side	2mm	CW	0.296
n261	2	35	-	27.925	Back	2mm	CW	2.440
n261	2	32	-	27.925	Right Side	2mm	CW	0.492
n261	2	-	160	27.925	Bottom Side	2mm	CW	0.125

4.7 PD Char

This section describes the PD char generation that complies with the *PD_design_target* and is in compliance with the regulatory power density limit.

4.7.1 PD char generation

Ideally, if there is no uncertainty associated with hardware as described in Section 4.4, after accounting for the housing influence (**Δ_{min}**), *input.power.limit(i)*, for beam *i* can be obtained:

$$input.power.limit(i) = 6\ dBm + 10 * \log(s(i)) + \Delta_{min},\ i \in all\ beams \quad (11)$$

If simulation overestimates the housing influence, then **Δ_{min}** (= minimum {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 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 in equation (11). In Section 4.7, the TxAGC uncertainty at reference power level (6dBm in report) is embedded in the process of **Δ_{min}** determination and should be removed to avoid double counting this uncertainty.

If -TxAGC uncertainty at reference power level < *Δmin* < TxAGC uncertainty at reference power level,

$$Input.power.limit(i) = sim.power_{limit}(i), i = 1,2,..,N \quad (12)$$

else if Δmin < -TxAGC uncertainty at reference power level,

$$Input.power.limit(i) = sim.power_{limit}(i) + (\Delta min + TxAGC\ uncertainty),\ i = 1,2,..,N \quad (13)$$

else if Δmin > TxAGC uncertainty at reference power level,

$$Input.power.limit(i) = sim.power_{limit}(i) + (\Delta min - TxAGC\ uncertainty),\ i = 1,2,..,N \quad (14)$$

The input power limit is derived and listed in the table below

Band	Antenna Module	Δ_{min} (dB)	TxAGC uncertainty (dB)	Input.power.limit (dBm)
n260	0	3.37	0.5	6 +10* log(s(i))+2.87
	1	2.91	0.5	6 +10* log(s(i))+2.41
	2	8.14	0.5	6 +10* log(s(i))+7.64
n261	0	0.14	0.5	6 +10* log(s(i))
	1	2.15	0.5	6 +10* log(s(i))+1.65
	2	3.26	0.5	6 +10* log(s(i))+2.76

4.7.2 PD char Table

Combining the information in previous sections, PD char is derived and listed below

n260 middle ch.(38.5 GHz)							Input Power limit
Band	Beam_ID		Ant module	Ant Type	Num. of Feed		
260	2		QTM0	PATCH	1		9.17
260	3		QTM0	PATCH	2		7.02
260	9		QTM0	PATCH	2		6.64
260	10		QTM0	PATCH	2		5.53
260	11		QTM0	PATCH	2		7.29
260	17		QTM0	PATCH	2		5.55
260	18		QTM0	PATCH	4		6.23
260	26		QTM0	PATCH	4		3.89
260	27		QTM0	PATCH	4		4.56
260	28		QTM0	PATCH	4		4.06
260	29		QTM0	PATCH	4		4.98
260	30		QTM0	PATCH	4		3.82
260	40		QTM0	PATCH	4		4.54
260	41		QTM0	PATCH	4		4.15
260	42		QTM0	PATCH	4		3.81
260	43		QTM0	PATCH	1		4.65
260		130	QTM0	PATCH	2		10.97
260		131	QTM0	PATCH	2		9.51
260		137	QTM0	PATCH	2		7.69
260		138	QTM0	PATCH	2		7.24
260		139	QTM0	PATCH	2		6.98
260		145	QTM0	PATCH	4		7.21
260		146	QTM0	PATCH	4		6.71
260		154	QTM0	PATCH	4		4.64
260		155	QTM0	PATCH	4		4.42
260		156	QTM0	PATCH	4		4.37
260		157	QTM0	PATCH	4		5.50
260		158	QTM0	PATCH	4		4.20
260		168	QTM0	PATCH	4		5.32
260		169	QTM0	PATCH	4		4.37
260		170	QTM0	PATCH	1		4.78
260		171	QTM0	PATCH	2		4.89
260	2	130	QTM0	PATCH	2		8.13
260	3	131	QTM0	PATCH	2		5.14
260	9	137	QTM0	PATCH	2		4.53
260	10	138	QTM0	PATCH	2		3.53
260	11	139	QTM0	PATCH	4		4.36
260	17	145	QTM0	PATCH	4		3.17
260	18	146	QTM0	PATCH	4		2.97
260	26	154	QTM0	PATCH	4		0.77
260	27	155	QTM0	PATCH	4		1.57
260	28	156	QTM0	PATCH	4		1.43
260	29	157	QTM0	PATCH	4		1.49
260	30	158	QTM0	PATCH	4		1.17
260	40	168	QTM0	PATCH	4		2.20
260	41	169	QTM0	PATCH	4		0.94
260	42	170	QTM0	PATCH	4		2.22
260	43	171	QTM0	PATCH	4		0.85

n260 middle ch.(38.5 GHz)						Input Power limit
Band	Beam_ID		Ant module	Ant Type	Num. of Feed	
260	0		QTM1	PATCH	1	9.20
260	1		QTM1	PATCH	2	7.94
260	6		QTM1	PATCH	2	5.89
260	7		QTM1	PATCH	2	5.50
260	8		QTM1	PATCH	2	5.92
260	15		QTM1	PATCH	2	5.44
260	16		QTM1	PATCH	4	5.77
260	21		QTM1	PATCH	4	3.44
260	22		QTM1	PATCH	4	3.10
260	23		QTM1	PATCH	4	3.32
260	24		QTM1	PATCH	4	3.10
260	25		QTM1	PATCH	4	3.39
260	36		QTM1	PATCH	4	3.16
260	37		QTM1	PATCH	4	3.63
260	38		QTM1	PATCH	4	3.03
260	39		QTM1	PATCH	1	3.54
260		128	QTM1	PATCH	2	8.63
260		129	QTM1	PATCH	2	8.42
260		134	QTM1	PATCH	2	5.95
260		135	QTM1	PATCH	2	5.66
260		136	QTM1	PATCH	2	6.00
260		143	QTM1	PATCH	4	5.75
260		144	QTM1	PATCH	4	5.62
260		149	QTM1	PATCH	4	3.39
260		150	QTM1	PATCH	4	3.45
260		151	QTM1	PATCH	4	3.25
260		152	QTM1	PATCH	4	3.61
260		153	QTM1	PATCH	4	3.67
260		164	QTM1	PATCH	4	3.21
260		165	QTM1	PATCH	4	3.49
260		166	QTM1	PATCH	1	3.50
260		167	QTM1	PATCH	2	3.78
260	0	128	QTM1	PATCH	2	5.74
260	1	129	QTM1	PATCH	2	4.89
260	6	134	QTM1	PATCH	2	3.32
260	7	135	QTM1	PATCH	2	2.35
260	8	136	QTM1	PATCH	4	2.89
260	15	143	QTM1	PATCH	4	3.09
260	16	144	QTM1	PATCH	4	2.67
260	21	149	QTM1	PATCH	4	1.02
260	22	150	QTM1	PATCH	4	0.55
260	23	151	QTM1	PATCH	4	0.44
260	24	152	QTM1	PATCH	4	0.55
260	25	153	QTM1	PATCH	4	1.04
260	36	164	QTM1	PATCH	4	0.69
260	37	165	QTM1	PATCH	4	0.17
260	38	166	QTM1	PATCH	4	0.28
260	39	167	QTM1	PATCH	4	0.63

n260 middle ch.(38.5 GHz)						Input Power limit
Band	Beam_ID		Ant module	Ant Type	Num. of Feed	
260	4		QTM2	PATCH	1	3.78
260	5		QTM2	PATCH	2	4.21
260	12		QTM2	PATCH	2	4.28
260	13		QTM2	PATCH	2	3.42
260	14		QTM2	PATCH	2	4.08
260	19		QTM2	PATCH	2	3.62
260	20		QTM2	PATCH	4	3.53
260	31		QTM2	PATCH	4	4.12
260	32		QTM2	PATCH	4	3.60
260	33		QTM2	PATCH	4	3.56
260	34		QTM2	PATCH	4	3.39
260	35		QTM2	PATCH	4	3.57
260	44		QTM2	PATCH	4	3.97
260	45		QTM2	PATCH	4	3.14
260	46		QTM2	PATCH	4	3.39
260	47		QTM2	PATCH	1	3.46
260		132	QTM2	PATCH	2	3.97
260		133	QTM2	PATCH	2	4.12
260		140	QTM2	PATCH	2	4.07
260		141	QTM2	PATCH	2	3.74
260		142	QTM2	PATCH	2	4.32
260		147	QTM2	PATCH	4	3.62
260		148	QTM2	PATCH	4	3.30
260		159	QTM2	PATCH	4	3.84
260		160	QTM2	PATCH	4	3.39
260		161	QTM2	PATCH	4	3.41
260		162	QTM2	PATCH	4	3.83
260		163	QTM2	PATCH	4	3.50
260		172	QTM2	PATCH	4	3.71
260		173	QTM2	PATCH	4	3.37
260		174	QTM2	PATCH	1	3.00
260		175	QTM2	PATCH	2	3.55
260	4	132	QTM2	PATCH	2	3.52
260	5	133	QTM2	PATCH	2	3.89
260	12	140	QTM2	PATCH	2	3.78
260	13	141	QTM2	PATCH	2	3.14
260	14	142	QTM2	PATCH	4	3.82
260	19	147	QTM2	PATCH	4	3.00
260	20	148	QTM2	PATCH	4	2.69
260	31	159	QTM2	PATCH	4	3.12
260	32	160	QTM2	PATCH	4	2.37
260	33	161	QTM2	PATCH	4	2.61
260	34	162	QTM2	PATCH	4	3.07
260	35	163	QTM2	PATCH	4	3.25
260	44	172	QTM2	PATCH	4	2.77
260	45	173	QTM2	PATCH	4	2.23
260	46	174	QTM2	PATCH	4	1.96
260	47	175	QTM2	PATCH	4	2.81

n261 Middle ch.(27.92GHz)						Input Power limit
Band	Beam_ID		Ant module	Ant Type	Num. of Feed	
261	2		QTM0	PATCH	1	6.95
261	3		QTM0	PATCH	2	7.57
261	9		QTM0	PATCH	2	5.62
261	10		QTM0	PATCH	2	5.10
261	11		QTM0	PATCH	2	4.82
261	17		QTM0	PATCH	2	4.86
261	18		QTM0	PATCH	4	4.92
261	26		QTM0	PATCH	4	3.17
261	27		QTM0	PATCH	4	2.52
261	28		QTM0	PATCH	4	2.88
261	29		QTM0	PATCH	4	2.27
261	30		QTM0	PATCH	4	3.55
261	40		QTM0	PATCH	4	2.80
261	41		QTM0	PATCH	4	2.65
261	42		QTM0	PATCH	4	2.71
261	43		QTM0	PATCH	1	2.71
261		130	QTM0	PATCH	2	8.94
261		131	QTM0	PATCH	2	7.97
261		137	QTM0	PATCH	2	5.12
261		138	QTM0	PATCH	2	5.64
261		139	QTM0	PATCH	2	5.79
261		145	QTM0	PATCH	4	5.68
261		146	QTM0	PATCH	4	6.04
261		154	QTM0	PATCH	4	3.00
261		155	QTM0	PATCH	4	2.94
261		156	QTM0	PATCH	4	3.63
261		157	QTM0	PATCH	4	3.76
261		158	QTM0	PATCH	4	2.89
261		168	QTM0	PATCH	4	2.89
261		169	QTM0	PATCH	4	3.19
261		170	QTM0	PATCH	1	4.06
261		171	QTM0	PATCH	2	3.10
261	2	130	QTM0	PATCH	2	4.79
261	3	131	QTM0	PATCH	2	4.78
261	9	137	QTM0	PATCH	2	2.09
261	10	138	QTM0	PATCH	2	2.39
261	11	139	QTM0	PATCH	4	2.24
261	17	145	QTM0	PATCH	4	2.72
261	18	146	QTM0	PATCH	4	2.67
261	26	154	QTM0	PATCH	4	0.71
261	27	155	QTM0	PATCH	4	0.38
261	28	156	QTM0	PATCH	4	0.90
261	29	157	QTM0	PATCH	4	0.20
261	30	158	QTM0	PATCH	4	0.10
261	40	168	QTM0	PATCH	4	0.76
261	41	169	QTM0	PATCH	4	0.16
261	42	170	QTM0	PATCH	4	0.59
261	43	171	QTM0	PATCH	4	0.08

n261 Middle ch.(27.92GHz)						Input Power limit
Band	Beam_ID		Ant module	Ant Type	Num. of Feed	
261	0		QTM1	PATCH	1	7.48
261	1		QTM1	PATCH	2	6.97
261	6		QTM1	PATCH	2	6.04
261	7		QTM1	PATCH	2	5.49
261	8		QTM1	PATCH	2	6.00
261	15		QTM1	PATCH	2	6.53
261	16		QTM1	PATCH	4	7.01
261	21		QTM1	PATCH	4	4.91
261	22		QTM1	PATCH	4	4.40
261	23		QTM1	PATCH	4	3.71
261	24		QTM1	PATCH	4	3.34
261	25		QTM1	PATCH	4	3.88
261	36		QTM1	PATCH	4	4.53
261	37		QTM1	PATCH	4	3.64
261	38		QTM1	PATCH	4	3.77
261	39		QTM1	PATCH	1	4.29
261		128	QTM1	PATCH	2	3.35
261		129	QTM1	PATCH	2	7.68
261		134	QTM1	PATCH	2	5.19
261		135	QTM1	PATCH	2	3.52
261		136	QTM1	PATCH	2	3.90
261		143	QTM1	PATCH	4	4.03
261		144	QTM1	PATCH	4	3.97
261		149	QTM1	PATCH	4	3.07
261		150	QTM1	PATCH	4	3.89
261		151	QTM1	PATCH	4	5.76
261		152	QTM1	PATCH	4	4.01
261		153	QTM1	PATCH	4	3.11
261		164	QTM1	PATCH	4	3.90
261		165	QTM1	PATCH	4	4.80
261		166	QTM1	PATCH	1	5.69
261		167	QTM1	PATCH	2	4.29
261	0	128	QTM1	PATCH	2	4.61
261	1	129	QTM1	PATCH	2	6.67
261	6	134	QTM1	PATCH	2	4.57
261	7	135	QTM1	PATCH	2	2.34
261	8	136	QTM1	PATCH	4	3.80
261	15	143	QTM1	PATCH	4	1.87
261	16	144	QTM1	PATCH	4	2.51
261	21	149	QTM1	PATCH	4	1.57
261	22	150	QTM1	PATCH	4	1.80
261	23	151	QTM1	PATCH	4	2.04
261	24	152	QTM1	PATCH	4	2.30
261	25	153	QTM1	PATCH	4	0.82
261	36	164	QTM1	PATCH	4	1.48
261	37	165	QTM1	PATCH	4	1.79
261	38	166	QTM1	PATCH	4	2.06
261	39	167	QTM1	PATCH	4	1.67

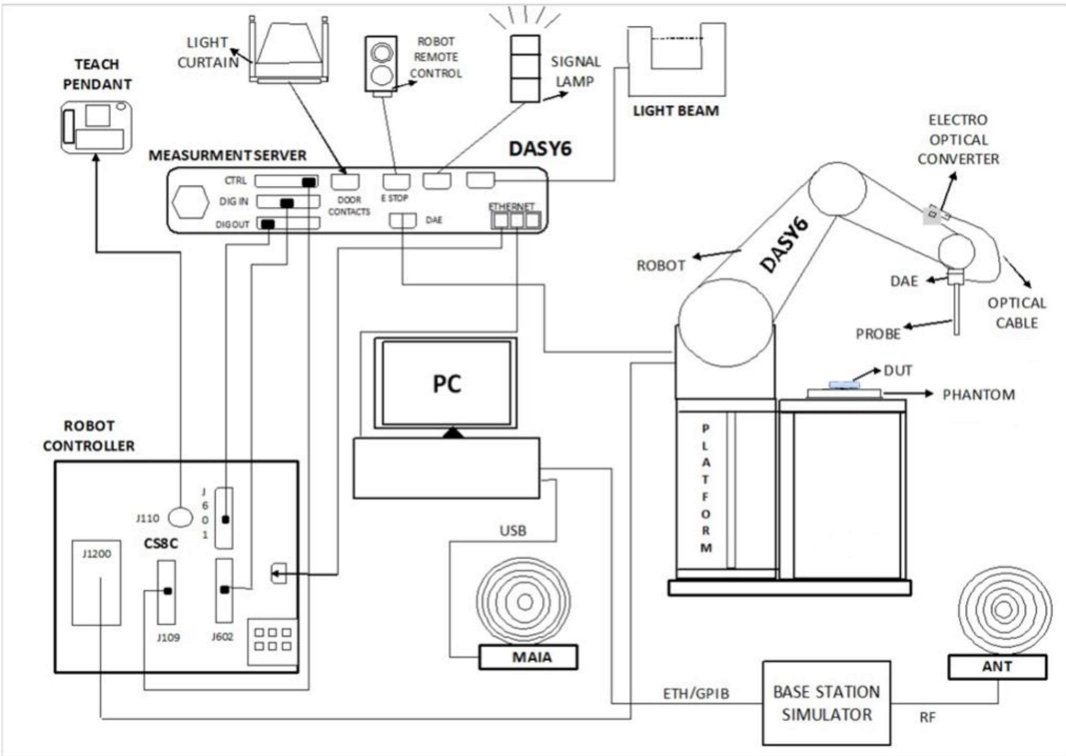
n261 Middle ch.(27.92GHz)						Input Power limit
Band	Beam_ID		Ant module	Ant Type	Num. of Feed	
261	4		QTM2	PATCH	1	10.81
261	5		QTM2	PATCH	2	10.90
261	12		QTM2	PATCH	2	7.60
261	13		QTM2	PATCH	2	6.94
261	14		QTM2	PATCH	2	7.19
261	19		QTM2	PATCH	2	7.43
261	20		QTM2	PATCH	4	7.28
261	31		QTM2	PATCH	4	5.95
261	32		QTM2	PATCH	4	5.68
261	33		QTM2	PATCH	4	4.67
261	34		QTM2	PATCH	4	4.89
261	35		QTM2	PATCH	4	6.56
261	44		QTM2	PATCH	4	5.64
261	45		QTM2	PATCH	4	4.63
261	46		QTM2	PATCH	4	4.84
261	47		QTM2	PATCH	1	5.43
261		132	QTM2	PATCH	2	10.91
261		133	QTM2	PATCH	2	9.56
261		140	QTM2	PATCH	2	8.69
261		141	QTM2	PATCH	2	8.42
261		142	QTM2	PATCH	2	7.01
261		147	QTM2	PATCH	4	9.13
261		148	QTM2	PATCH	4	7.21
261		159	QTM2	PATCH	4	5.14
261		160	QTM2	PATCH	4	6.63
261		161	QTM2	PATCH	4	6.14
261		162	QTM2	PATCH	4	5.22
261		163	QTM2	PATCH	4	4.44
261		172	QTM2	PATCH	4	6.03
261		173	QTM2	PATCH	4	6.58
261		174	QTM2	PATCH	1	5.36
261		175	QTM2	PATCH	2	4.99
261	4	132	QTM2	PATCH	2	8.06
261	5	133	QTM2	PATCH	2	7.67
261	12	140	QTM2	PATCH	2	5.39
261	13	141	QTM2	PATCH	2	4.41
261	14	142	QTM2	PATCH	4	4.23
261	19	147	QTM2	PATCH	4	5.25
261	20	148	QTM2	PATCH	4	4.74
261	31	159	QTM2	PATCH	4	3.27
261	32	160	QTM2	PATCH	4	3.43
261	33	161	QTM2	PATCH	4	2.41
261	34	162	QTM2	PATCH	4	2.01
261	35	163	QTM2	PATCH	4	2.61
261	44	172	QTM2	PATCH	4	3.10
261	45	173	QTM2	PATCH	4	2.96
261	46	174	QTM2	PATCH	4	2.03
261	47	175	QTM2	PATCH	4	2.20

5. PD Test Setup

5.1 PD Test – System Setup

The system to be used for the near field power density measurement

- SPEAG DASY6 system
    - SPEAG cDASY6 5G module software
    - EUmmWVx probe
- 5G Phantom cover



5.2 Test Side Location

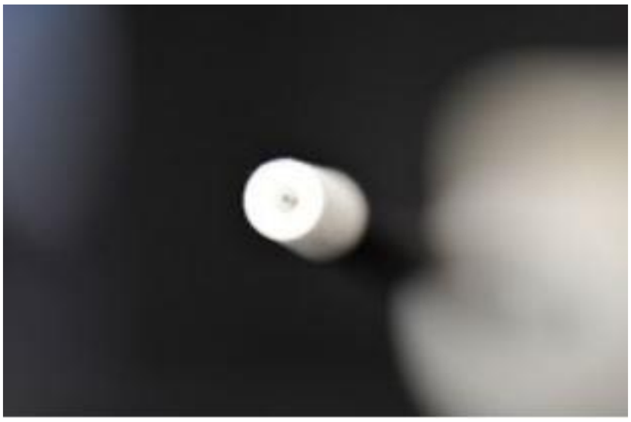
Sporton Lab and below test site location are accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190) and the FCC designation No. TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

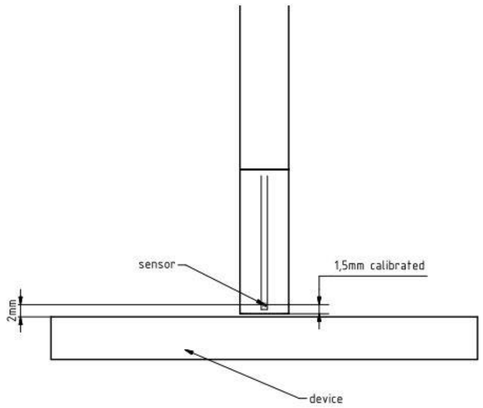
Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
Test Site Location	TW1190 No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, CHINESE TAIPEI
Test Site No.	SAR06-HY

5.3 EUmmWave Probe / E-Field 5G Probe

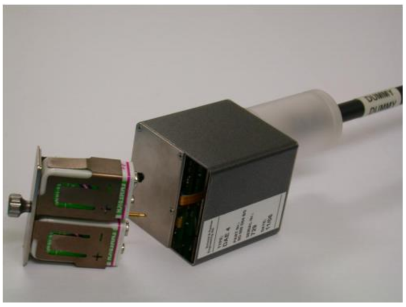
The probe design allows measurements at distances as small as 2 mm from the sensors to the surface of the device under test (DUT). The typical sensor to probe tip distance is 1.5 mm.

Frequency	750 MHz – 110 GHz
Probe Overall Length	320 mm
Probe Body Diameter	8.0 mm
Tip Length	23.0 mm
Tip Diameter	8.0 mm
Probe's two dipoles length	0.9 mm – Diode loaded
Dynamic Range	< 20 V/m - 10000 V/m with PRE-10 (min < 50 V/m - 3000 V/m)
Position Precision	< 0.2 mm
Distance between diode sensors and probe's tip	1.5 mm
Minimum Mechanical separation between probe tip and a Surface	0.5 mm
Applications	E-field measurements of 5G devices and other mm-wave transmitters operating above 10GHz in < 2 mm distance from device (free-space) Power density, H-field and far-field analysis using total field reconstruction.
Compatibility	cDASY6 + 5G-Module SW1.0 and higher





5.4 Data Acquisition Electronics (DAE)



The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

5.5 Scan configuration

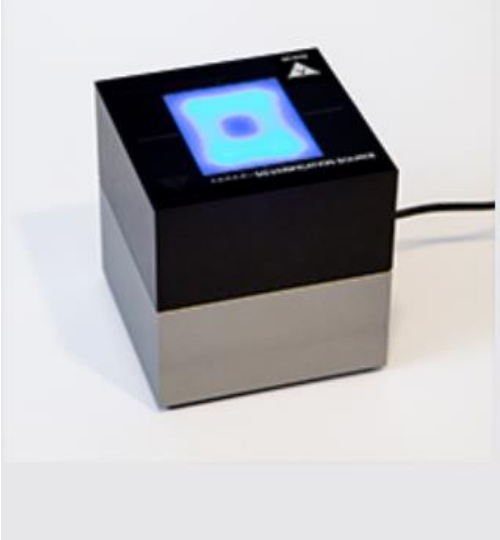
Fine-resolution scans on 2 different planes are performed to reconstruct the E- and H-fields as well as the power density; the z-distance between the 2 planes is set to λ/4.

The (x, y) grid step is also setλ/4, the grid extent is set to sufficiently large to identify the field pattern and the peak.

5.6 System Verification Source

The System Verification sources at 30 GHz and above comprise horn-antennas and very stable signal generators.

Model	Ka-band horn antenna
Calibrated frequency:	30 GHz at 10mm from the case surface
Frequency accuracy	± 100 MHz
E-field polarization	linear
Harmonics	-20 dBc
Total radiated power	14 dBm
Power stability	0.05 dB
Power consumption	5 W
Size	00 x 100 x 100 mm
Weight	1 kg



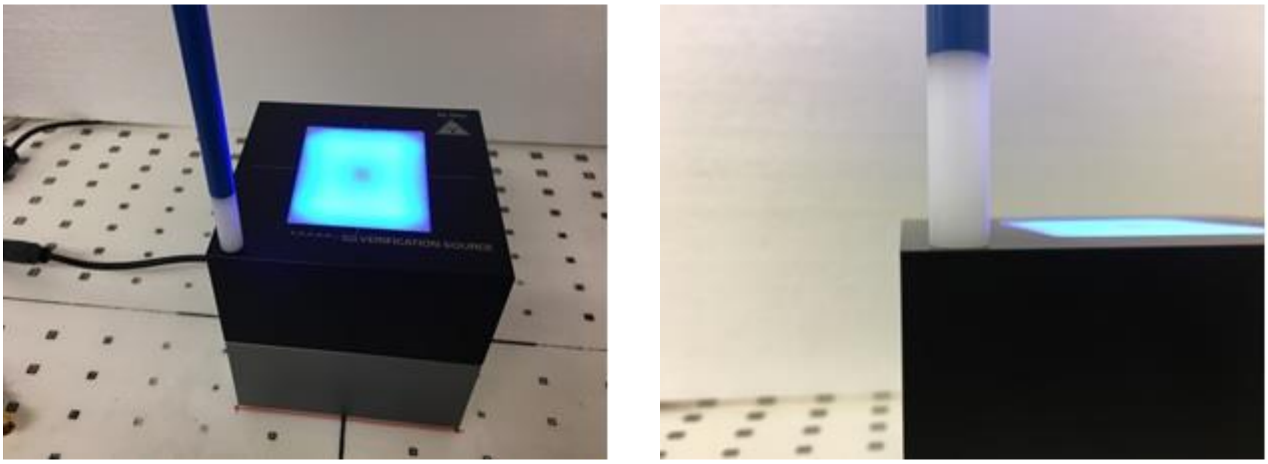
5.7 Power Density System Verification

The system performance check verifies that the system operates within its specifications.

The EUT is replaced by a calibrated source, the same spatial resolution, measurement region and the test separation used in the calibration was applied to system check. Through visual inspection into the measured power density distribution, both spatially (shape) and numerically (level) have no noticeable difference. The measured results should be within 0.66B of the calibrated targets.

Frequency [GHz]	Grid step	Grid extent X/Y [mm]	Measurement points
10	$0.25\ (\frac{\lambda}{4})$	120/120	16×16
30	$0.25\ (\frac{\lambda}{4})$	60/60	24×24
60	$0.25\ (\frac{\lambda}{4})$	32.5/32.5	26×26
90	$0.25\ (\frac{\lambda}{4})$	30/30	36×36

Settings for measurement of verification sources



Verification Setup photo

5.8 System Verification Results

Frequency (GHz)	5G Verification Source	Probe S/N	DAE S/N	Distance (mm)	Measured 4 cm^2 (W/m^2)	Targeted 4 cm^2 (W/m^2)	Deviation (dB)	Date
30G	30GHz_1007	9461	1424	10	32.6	34.1	-0.187	2020/7/29
30G	30GHz_1007	9461	1424	10	31.5	34.1	-0.3189	2020/8/19

6. Uncertainty Assessment

The budget is valid for evaluation distances > λ/2π. For specific tests and configurations, the Uncertainty could be considerably smaller.

Preliminary Module mmWave Uncertainty Budget Evaluation Distances to the Antennas > λ / 2π						
Error Description	**Uncertainty Value (± dB)**	**Probability**	**Divisor**	**(Ci)**	**Standard Uncertainty (±dB)**	**(Vi) Veff**
Measurement System						
Probe Calibration	0.49	N	1	1	0.49	∞
Hemispherical Isotropy	0.50	R	1.732	1	0.29	∞
Linearity	0.20	R	1.732	0	0.12	∞
System Detection Limits	0.04	R	1.732	1	0.02	∞
Modulation Response	0.40	R	1.732	1	0.23	∞
Readout Electronics	0.03	N	1	1	0.03	∞
Response Time	0.00	R	1.732	1	0.00	∞
Integration Time	0.00	R	1.732	1	0.00	∞
RF Ambient Noise	0.2	R	1.732	1	0.12	∞
RF Ambient Reflections	0.21	R	1.732	1	0.12	∞
Probe Positioner	0.04	R	1.732	1	0.02	∞
Probe Positioning	0.30	R	1.732	1	0.17	∞
S_{avg} Reconstruction	0.60	R	1.732	1	0.35	∞
Test Sample Related						
Power Drift	0.2	R	1.732	1	0.12	∞
Input Power	0	N	1	0	0.00	∞
Combined Std. Uncertainty					0.76 dB	∞
Coverage Factor for 95 %					K=2	
Expanded STD Uncertainty					1.52 dB	