RF EXPOSURE EVALUATION REPORT

FCC ID	**: 2ABZ2-EE149**
Equipment	**: Smart Phone**
Brand Name	**: ONEPLUS**
Model Name	**: IN2019**
Applicant	**: OnePlus Technology (Shenzhen) Co., Ltd 18C02, 18C03, 18C04 and 18C05, Shum Yip Terra Building, Binhe Avenue North, Futian District, Shenzhen**
Manufacturer	**: OnePlus Technology (Shenzhen) Co., Ltd 18C02, 18C03, 18C04 and 18C05, Shum Yip Terra Building, Binhe Avenue North, Futian District, Shenzhen**
Standard	**: FCC 47 CFR Part 2 (2.1093)**

We, SPORTON INTERNATIONAL INC have been evaluated in accordance with 47 CFR Part 2.1093 for the device and pass the limit.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, 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
FA9D0701B	01	Initial issue of report	Mar. 06, 2020
FA9D0701B	02	Update section1 and 10	May. 04, 2020

1. Summary

The maximum measured average power density found during testing for OnePlus Technology (Shenzhen) Co., Ltd, Smart Phone, are as follows.

Standalone transmission				Simultaneous transmission with other transmitters
RF Transmitter		Measured PD (mW/cm^2)	Reported PD (mW/cm^2)	Summation of Exposure Ratio
5G FR2	n260	0.456	0.63	0.991
	n261	0.46	0.59	
Result		PASS		

2. Guidance Applied

The Power Density testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2.1091
- FCC 47 CFR Part 2.1093
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r03
- TCBC workshop notes
- IEC Draft TR 63170

3. Equipment Under Test (EUT) Information

3.1 General Information

Product Feature & Specification	
Equipment Name	Smart Phone
Brand Name	ONEPLUS
FCC ID	2ABZ2-EE149
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WCDMA Band IV: 1712.4 MHz ~ 1752.6 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 7: 2502.5 MHz ~ 2567.5 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz LTE Band 13: 779.5 MHz ~ 784.5 MHz LTE Band 17: 706.5 MHz ~ 713.5 MHz LTE Band 25: 1850.7 MHz ~ 1914.3 MHz LTE Band 26: 814.7 MHz ~ 848.3 MHz LTE Band 30: 2307.5 MHz ~ 2312.5 MHz LTE Band 38: 2572.5 MHz ~ 2617.5 MHz LTE Band 41: 2498.5 MHz ~ 2687.5 MHz LTE Band 48: 3552.5 MHz ~ 3697.5 MHz LTE Band 66: 1710.7 MHz ~ 1779.3 MHz LTE Band 71: 665.5 MHz ~ 695.5 MHz 5G NR n2 : 1852.5 MHz ~ 1907.5 MHz 5G NR n5 : 826.5 MHz ~ 846.5 MHz 5G NR n66 : 1712.5 MHz ~ 1777.5 MHz 5G NR n260: 37GHz~40GHz 5G NR n261: 27.5GHz~28.35GHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC: 13.56 MHz
Mode	GSM/GPRS/EGPRS AMR / RMC 12.2Kbps HSDPA HSUPA DC-HSDPA LTE: QPSK, 16QAM, 64QAM 5G NR : CP-OFDM / DFT-s-OFDM，QPSK, 16QAM, 64QAM, 256QAM WLAN 2.4GHz : 802.11b/g/n/ac/ax HT20/HT40/VHT20/VHT40/HE20/HE40 WLAN 5GHz : 802.11a/n/ac/ax HT20/HT40/VHT20/VHT40/VHT80/HE20/HE40/HE80 Bluetooth BR/EDR/LE NFC:ASK
GSM / (E)GPRS Transfer mode	Class B – EUT cannot support Packet Switched and Circuit Switched Network simultaneously but can automatically switch between Packet and Circuit Switched Network.
EUT Stage	Identical Prototype

Reviewed by: Jason Wang
Report Producer: Wan Liu

4. RF Exposure Limits

4.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

4.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure above 6GHz to radio frequency (RF) radiation as specified in §1.1310.

General Population Basic restriction for power density for frequencies between 1.5GHz and 100 GHz is 1.0 mW/cm^2 = 10 W/m^2

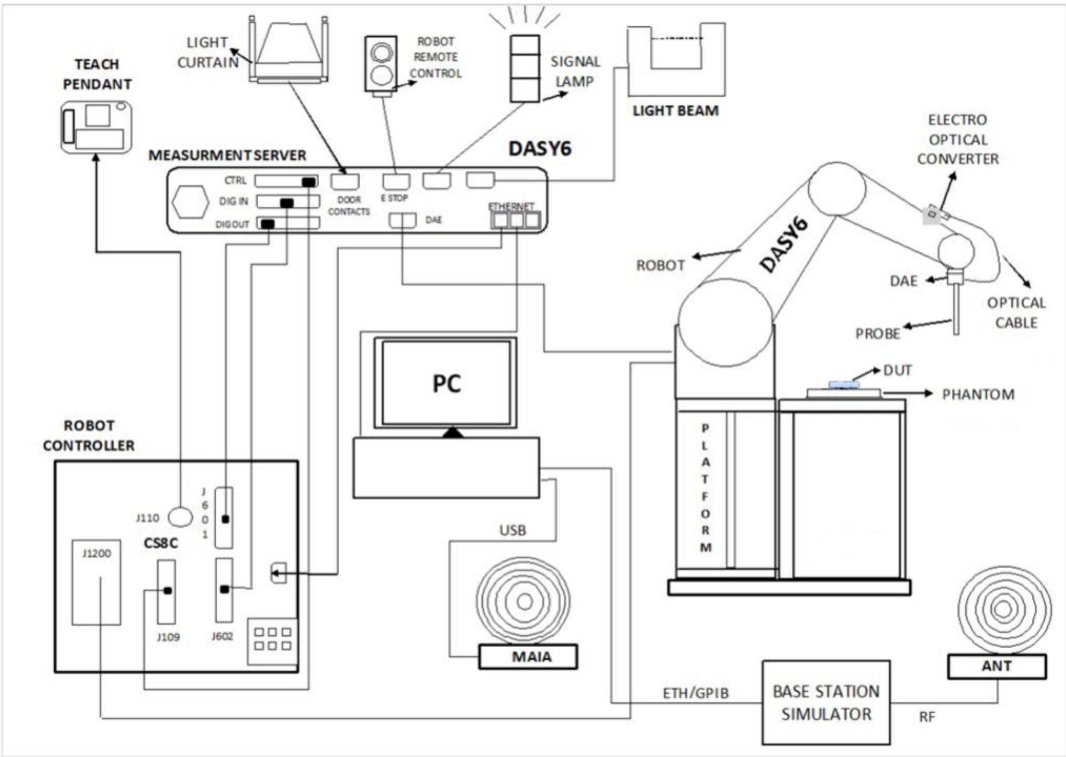
Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f2)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

Table 1

5. System Description and Setup

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

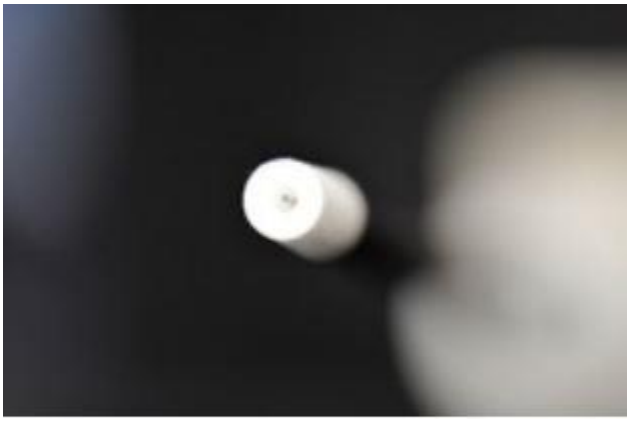
- SPEAG DASY6 system
- SPEAG cDASY6 5G module software
- EUmmWVx probe
- 5G Phantom cover

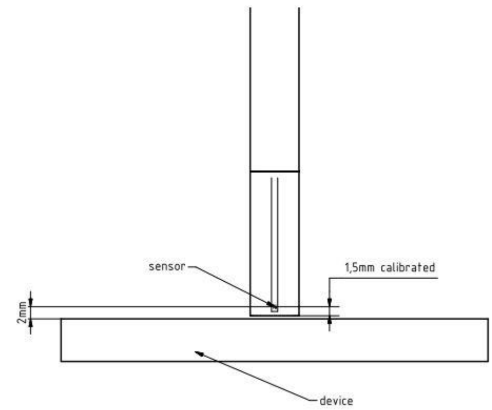


5.1 EUmmWave Probe / E-Field 5G Probe

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.

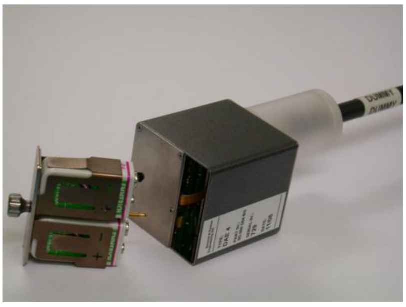
Frequency	750 MHz – 110 GHz
Probe Overall Length	320 mm
Probe Body Diameter	8.0 mm
Tip Length	23.0 mm
Tip Diameter	8.0 mm
Probe's two dipoles length	0.9 mm – Diode loaded
Dynamic Range	< 20 V/m - 10000 V/m with PRE-10 (min < 50 V/m - 3000 V/m)
Position Precision	< 0.2 mm
Distance between diode sensors 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





5.2 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.



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

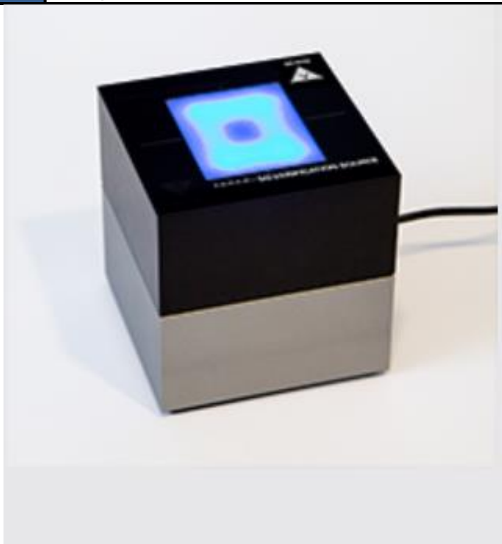
6. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	5G Verification Source	30 GHz	1007	Nov. 19, 2019	Nov. 18, 2020
SPEAG	EUmmWV Probe Tip Protection	EUmmWV4	9461	Nov. 05, 2019	Nov. 04, 2020
SPEAG	Data Acquisition Electronics	DAE4	376	Dec. 06, 2019	Dec. 05, 2020
Testo	Hygro meter	608-H1	45196600	Nov. 18, 2019	Nov. 17, 2020
Agilent	Spectrum Analyzer	N9010A	MY54200486	Oct. 28, 2019	Oct. 27, 2020
Custom Microwave	Standard Horn antenna	M15RH	V91113-A	NCR	NCR

7. 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



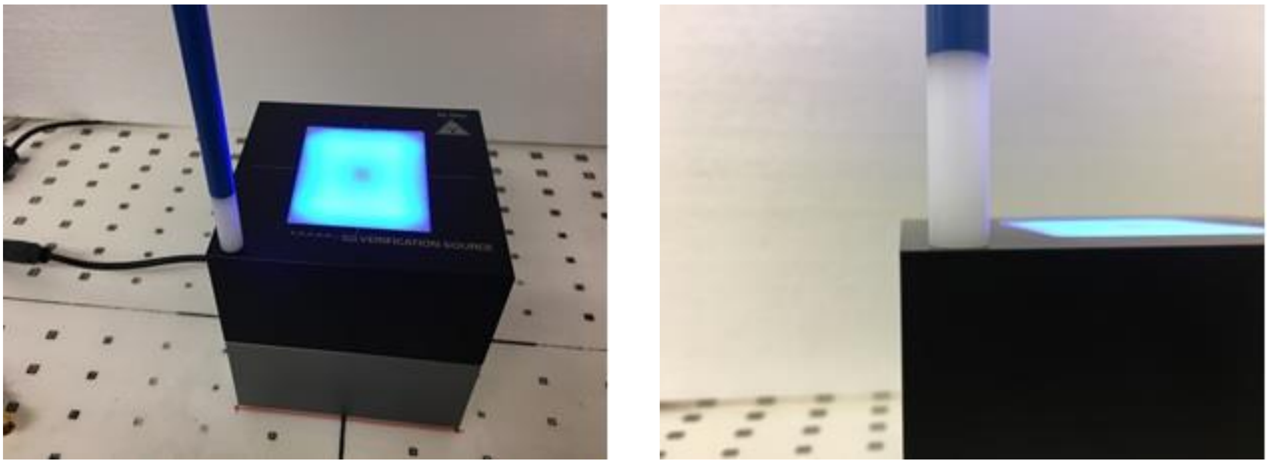
8. Power Density System Verification

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 0.66dB 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

9. System Verification Results

Date	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)
2020/2/9	30	30GHz_1007	9461	376	10	30.7	34.1	-0.41
2020/2/15	30	30GHz_1007	9461	376	10	30.8	34.1	-0.40

9.1 Computation of the Electric Field Polarization Ellipse

For the numerical description of an arbitrarily oriented ellipse in three-dimensional space, five parameters are needed: the semi-major axis (a), the semi-minor axis (b), two angles describing the orientation of the normal vector of the ellipse (∅, θ), and one angle describing the tilt of the semi-major axis (ψ). For the two extreme cases, i.e., circular and linear polarizations, three parameters only (a, ∅ and θ) are sufficient for the description of the incident field.

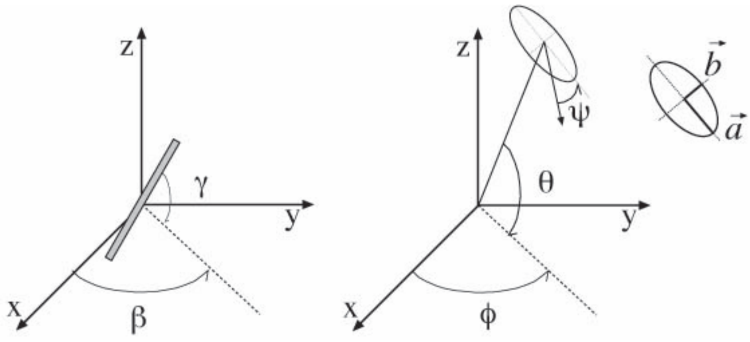


Illustration of the angles used for the numerical description of the sensor and the orientation of an ellipse in 3-D space.

For the reconstruction of the ellipse parameters from measured data, the problem can be reformulated as a nonlinear search problem. The semi-major and semi-minor axes of an elliptical field can be expressed as functions of the three angles (∅, θ and ψ). The parameters can be uniquely determined towards minimizing the error based on least-squares for the given set of angles and the measured data. In this way, the number of free parameters is reduced from five to three, which means that at least three sensor readings are necessary to gain sufficient information for the reconstruction of the ellipse parameters. However, to suppress the noise and increase the reconstruction accuracy, it is desirable that the system of equations be over determined. The solution to use a probe consisting of two sensors angled by r_1 and r_2 toward the probe axis and to perform measurements at three angular positions of the probe, i.e., at β_1, β_2 and β_3, results in over-determinations by a factor of two. If there is a need for more information or increased accuracy, more rotation angles can be added. The reconstruction of the ellipse parameters can be separated into linear and non-linear parts that are best solved by the Givens algorithm combined with a downhill simplex algorithm. To minimize the mutual coupling, sensor angles are set with a shift of 90 degree ($r_2 = r_1 + 90$ degree), and to simplify, the first rotation angle of the probe (β_1) can be set to 0 degree.

9.2 Total Field and Power Flux Density Reconstruction

Computation of the power density in general requires knowledge of the electric and magnetic field amplitudes and phases in the plane of incidence. Reconstruction of these quantities from pseudo-vector E-field measurements is feasible, as they are constrained by Maxwell's equations. SPEAG have developed a reconstruction approach based on the Gerchberg-Saxton algorithm, which benefits from the availability of the E-field polarization ellipse information obtained with the EUmmWV2 probe.
The average of the reconstructed power density is evaluated over a circular area in each measurement plane. Two average power density values can be computed, the average total power density and the average incident power density, and the average total power density is used to determine compliance.

- $|Re\{S\}|$ is the total Poynting vector
- $\mathrm{n} \cdot Re\{S\}$ is the normal Poything vector

The software post-processing reports to values, “S avg tot” and “S avg inc”. “S avg tot” represents average total power density (all three xyz components included), and “S avg inc” represents average normal power density. The average total power density “S avg tot” is reported to determine the device compliance.

9.3 Test Positions

Exposure Position	Measurement Plane					
	Front 2mm	Back 2mm	Left Side 2mm	Right Side 2mm	Top Side 2mm	Bottom Side 2mm
Test Required	No	Yes	Yes	YEs	No	No

From the Part 0 report, beam IDs with highest PD and corresponding input.power.limit were selected to be tested for each antenna module and for each frequency band

10. RF Exposure Evaluation Results

1. The PD test was performed of a 2mm separation between sensor and EUT surface (the probe tip is 0.5mm to the EUT surface).
2. According to TCBC Workshop in October 2018, 4 cm^2 averaging area are used.
3. This device is enabled with Qualcomm® Smart Transmit feature, smart transmit will manage and ensure LTE and 5G simultaneous transmission is compliant. The validation of the time-averaging algorithm and compliance under the Tx varying transmission scenario for WWAN technologies are reported in Part 2 report.
4. The device was configured to transmit CW wave signal for testing, due to Qualcomm® Smart Transmit feature, additional testing was not required for different modulations (CP-OFDM QPSK, CP-OFDM 16QAM, CP-OFDM 64QAM), RB configurations, component carriers, channel configurations (low channel, mid channel, high channel).
5. It's illustrated in Part 0 report that , for 5G mmW NR since there is total design-related uncertainty arising from TxAGC and device-to-device variation, the worst-case RF exposure should be determined by accounting for this device uncertainty of 2.1 dB, as well as n260 PD design target of 0.462 mW/cm^2 for antenna module 0/1, 0.52 mW/cm^2 for antenna module 2, as well as n261 PD design target of 0.462 mW/cm^2 for antenna module 0/1/2. Smart Transmit algorithm limits PD exposure to 75% of maximum to provide at least 25% margin allocated for 4G LTE anchor. Therefore, 5G mmW NR RF exposure for this DUT is evaluated by reported PD calculated as:

   n260 Reported PD=75% x (PD design target + 2.1 dB) =0.632 mW/cm^2

   n261 Reported PD=75% x (PD design target + 2.1 dB) =0.588 mW/cm^2

Test number	5G FR2	antenna module	Beam ID 1	Beam ID 2	Frequency (GHz)	Exposure Surface	Input Power limit(dB)	Test separation	modulation	Measured results Savg tot 4cm^2 (W/m2)	Epeak [V/m]	Hpeak [A/m]
	n261	0	20	-	27.55	Back	3.3	2mm	CW	4.22	79.7	0.24
01	n261	0	-	162	27.55	Back	3.8	2mm	CW	4.6	84.9	0.253
	n261	0	20	147	27.55	Back	0.4	2mm	CW	2.96	70.2	0.188
	n261	0	0	-	27.55	Back	9.3	2mm	CW	2.35	116	0.297
	n261	1	38	-	27.925	Left Side	3.9	2mm	CW	4.18	68.4	0.178
	n261	1	-	155	28.3	Left Side	5	2mm	CW	3.14	62.8	0.153
	n261	1	38	166	28.3	Left Side	0.9	2mm	CW	2.57	50.9	0.122
	n261	2	30	-	27.925	Right Side	3.6	2mm	CW	3.49	61	0.152
	n261	2	-	157	27.925	Right Side	3.9	2mm	CW	3.55	63.8	0.181
	n261	2	42	170	27.925	Right Side	0.4	2mm	CW	2.83	50.8	0.132
	n260	0	36	-	39.95	Back	4	2mm	CW	3.77	83.4	0.227
	n260	0	-	146	39.95	Back	4.5	2mm	CW	4.22	96.4	0.297
	n260	0	36	164	39.95	Back	1.1	2mm	CW	1.21	74.6	0.116
	n260	1	26	-	38.5	Left Side	3	2mm	CW	3.56	92.3	0.249
	n260	1	-	154	38.5	Left Side	3.5	2mm	CW	3.98	96.9	0.258
	n260	1	23	154	38.5	Left Side	-0.3	2mm	CW	1.78	62.5	0.149
	n260	2	31	-	38.5	Right Side	2.1	2mm	CW	2.81	78	0.232
	n260	2	-	159	38.5	Right Side	2.2	2mm	CW	1.8	54.7	0.14
	n260	2	31	159	39.95	Right Side	-0.9	2mm	CW	0.939	43.3	0.094
	n260	2	43	-	38.5	Right Side	2.3	2mm	CW	3.13	81.2	0.222
02	n260	2	2	-	38.5	Right Side	7.7	2mm	CW	4.56	87	0.245

11. 5G NR + LTE + WLAN + BT Sim-Tx analysis

In 5G NR + LTE + WLAN + BT simultaneous transmission, 5G NR and LTE transmission are managed and controlled by Qualcomm® Smart Transmit, while the RF exposure from WLAN and BT radios is managed using legacy approach, i.e., through a fixed power back-off if needed.

Since WLAN and BT do not employ time-averaging, 1gSAR and 10gSAR measurement for WLAN and BT need to be conducted at their corresponding rated power following current FCC test procedures to determine reported SAR values.

Smart Transmit current implementation assumes hotspots from 5G NR and LTE are collocated. Therefore, for a total of 100% exposure margin, if LTE uses x%, then the exposure margin left for 5G NR is capped to (100-x)%. Thus, the compliance equation for LTE + 5G NR is

$$x\% * A + (100-x)\% * B \leq 1.0,$$

Where, A is normalized reported time-averaged SAR exposure ratio from LTE, and A ≤ 1.0; B is normalized reported time-averaged exposure ratio from 5G NR (i.e., PD exposure for mmW NR or SAR exposure for sub6 NR), and B ≤1.0.

Let C = normalized reported SAR exposure ratio from WLAN+BT, then for compliance,

$$x\% * A + (100-x)\% * B + C \leq 1.0 \qquad (1)$$

$$x\% * A + (100-x)\% * B \leq x\% * \max(A, B) + (100-x)\% * \max(A, B) \leq \max(A, B)$$

$$x\% * A + (100-x)\% * B + C \leq \max(A, B) + C \leq 1.0 \qquad (2)$$

if A + C ≤ 1.0 and B + C ≤ 1.0 can be proven, then “x% * A + (100-x)% * B + C ≤ 1.0”. Therefore simultaneous transmission analysis for 5G NR + LTE + WLAN + BT can be performed in two steps

Step 1: Prove total exposure ratio (TER) of LTE + WLAN + BT < 1
Step 2: Prove total exposure ratio (TER) of 5G NR + WLAN + BT < 1

Step 1: it’s justified in Part 1 SAR report (Sporton report number FA9D0701A, rev.01)
Step 2: it’s justified in section 12.1

During TER analysis, the ***reported*** **time-averaged PD** (assuming *input.power.limit* for at least one beam < NV setting *Pmax*) applies only to the worst-surface of the device. For other surfaces, worst-case PD needs to be calculated to assess TER for the corresponding surface. To determine worst-case PD for other surfaces, using simulation results

1. Calculate ratio of simulated PD for desired surface to simulated PD of worstsurface for a given beam

2. Repeat 1 to obtain ratios for all supported beams, and determine maximum ratio

3. Repeat 1~2 to obtain the corresponding worst-case PD for rest of surfaces (non worst-case surfaces) needed for TER analysis.

For example, if the back surface of device has highest PD and is determined as worst-surface, then,

- *Back_surface_worst-case_PD* = ***reported*** **time-averaged PD**
  where, ***reported*** **time-averaged PD** = *PD_design_target* + mmW device design related uncertainty

- *For other surfaces*
  - *front_surface_worst-case_PD = PD_ratio_front_to_back* * ***reported*** **timeaveraged PD**
    where, PD_ratio_front_to_back =*max* $\left\{\frac{simulated\ PD_{front(i)}}{simulated\ P\_back(i)}, beam\ i = 1,2 \ldots N\right\}$,N= total N beams (all beams) supported by the mmW module being evaluated being evaluated.

  - *Follow similar approach to determine worst-case PD for bottom/top/left/right (if applicable).*

- *For body-worn and hotspot scenario, if SAR was measured at 15mm and 10mm, respectively, then the worst-case PD at 15mm and 10mm separation distance should be determined per surface as*
  - *15mm_worst-case_PD = PD_ratio_15mm_to_0mm* * ***reported*** **timeaveraged PD**
    Here, PD_ratio_15 mm _to_0mm =*max* $\left\{\frac{simulated\ Pd\ at\ 15\ mm\ (i)}{simulated\ PD\ at\ 0\ mm\ (i)}, beam\ i = 1,2 \ldots N\right\}$, , N = total number of beams (**all** beams) supported by the mmW module being evaluated.

  - *10mm_worst-case_PD = PD_ratio_10mm_to_0mm* * ***reported*** **timeaveraged PD**
    Here, PD_ratio_15 mm _to_0mm =*max* $\left\{\frac{simulated\ Pd\ at\ 10\ mm\ (i)}{simulated\ PD\ at\ 0\ mm\ (i)}, beam\ i = 1,2 \ldots N\right\}$, , N = total number of beams (**all** beams) supported by the mmW module being evaluated.

  - Note the validated model/simulation should be used in worst-case PD determination.

12. Simultaneous-Tx analysis

NO.	Simultaneous Transmission Configurations	Exposure Positions			
		Head	Hotspot	Body-worn	Extremity
1.	2.4GHz WLAN ANT7+9 + LTE+ n260/n261	Yes	Yes	Yes	Yes
2.	2.4GHz WLAN Ant7+9 + 5GHz WLAN Ant7+8 + LTE+ n260/n261	Yes	Yes	Yes	Yes
3.	5GHz WLAN Ant7+8 + BT Ant 7 + LTE+ n260/n261	Yes	Yes	Yes	Yes

General Note:

1. The WLAN and Bluetooth SAR test results were referring the report of FCC ID: 2ABZ2-EE149 (Sporton SAR Report No. FA9D0701A).
2. Considering n260/n261 transmitter with WLAN and Bluetooth can transmit simultaneously, the basic restrictions are on SAR and power density, and summation of these quantities should follow below formula and the simultaneous transmission analysis was following below step.
   i) Use the standalone SAR according original report to collocate with n260/n261 transmitter power density at each exposure positions, if the result < 1, additional analysis is not necessary.

The [∑ of (the highest measured or estimated SAR for each standalone antenna configuration, adjusted for maximum tune-up tolerance) / 1.6 W/kg] + [∑ of MPE ratios] is ≤ 1.0.

12.1 Simultaneous transmission analysis for WiFi/BT + 5G NR

NR Band	Antenna Module	Surface	Evaluation Distance (mm)	Ratio*	PD_Design Target + Total uncertainty (W/m^2)	(PD_Design Target + total uncertainty)* Ratio (W/m^2)
n260	0/1	worst-surface	2	1	7.5	7.500
		Front	2	0.643	7.5	4.823
		worst-surface	10mm	0.726	7.5	5.445
		worst-surface	15mm**	0.726	7.5	5.445
n260	2	worst-surface	2	1	8.43	8.430
		Front	2	0.643	8.43	5.420
		Back	2	0.841	8.43	7.090
		worst-surface	10mm	0.726	8.43	6.120
		worst-surface	15mm**	0.726	8.43	6.120
n261	2000/1/2	worst-surface	2	1	7.5	7.500
		Front	2	0.623	7.5	4.673
		worst-surface	10mm	0.728	7.5	5.460
		worst-surface	15mm**	0.728	7.5	5.460

*Ratio is highest ratio of (PD on desired exposure plane) / (PD on worst-surface at 2mm evaluation distance) out of all beams and out of all channels include in Power Density Simulation Report.
**Ratio at 10mm is used for conservative evaluation.

<Head Exposure Condition>

Band	Exposure Position	2 2.4GHz WLAN Ant 7+9 1g SAR (W/kg)	3 5GHz WLAN Ant 7+8 1g SAR (W/kg)	4 Bluetooth Ant 7 1g SAR (W/kg)	8 PD 4cm^2(W/m^2)	Reported SAR/1.6 + PD/10 Summation 2+8 Summed Ratio	3+8 Summed Ratio	2+3+8 Summed Ratio	3+4+8 Summed Ratio
N260 Module 0/1	Right Cheek	0.165	0.033	0.059	4.823	**0.585**	**0.503**	**0.606**	**0.540**
	Right Tilted	0.128	0.047	0.038	4.823	**0.562**	**0.512**	**0.592**	**0.535**
	Left Cheek	0.508	0.098	0.194	4.823	**0.800**	**0.544**	**0.861**	**0.665**
	Left Tilted	0.344	0.039	0.137	4.823	**0.697**	**0.507**	**0.722**	**0.592**
N260 Module 2	Right Cheek	0.165	0.033	0.059	5.420	**0.645**	**0.563**	**0.666**	**0.600**
	Right Tilted	0.128	0.047	0.038	5.420	**0.622**	**0.571**	**0.651**	**0.595**
	Left Cheek	0.508	0.098	0.194	5.420	**0.860**	**0.603**	**0.921**	**0.725**
	Left Tilted	0.344	0.039	0.137	5.420	**0.757**	**0.566**	**0.781**	**0.652**
N261 Module 0/1/2	Right Cheek	0.165	0.033	0.059	4.673	**0.570**	**0.488**	**0.591**	**0.525**
	Right Tilted	0.128	0.047	0.038	4.673	**0.547**	**0.497**	**0.577**	**0.520**
	Left Cheek	0.508	0.098	0.194	4.673	**0.785**	**0.529**	**0.846**	**0.650**
	Left Tilted	0.344	0.039	0.137	4.673	**0.682**	**0.492**	**0.707**	**0.577**

<Hotspot Exposure Condition>

Band	Exposure Position	2 2.4GHz WLAN Ant 7+9 1g SAR (W/kg)	3 5GHz WLAN Ant 7+8 1g SAR (W/kg)	4 Bluetooth Ant 7 1g SAR (W/kg)	8 PD 4cm^2(W/m^2)	Reported SAR/1.6 + PD/10 Summation 2+8 Summed Ratio	3+8 Summed Ratio	2+3+8 Summed Ratio	3+4+8 Summed Ratio
N260 Module 0/1	Front	0.116	0.001	0.033	5.445	**0.617**	**0.545**	**0.618**	**0.566**
	Back	0.134	0.427	0.044	5.445	**0.628**	**0.811**	**0.895**	**0.839**
	Left side				5.445	**0.545**	**0.545**	**0.545**	**0.545**
	Right side	0.100	0.074	0.035	5.445	**0.607**	**0.591**	**0.653**	**0.613**
	Top side	0.065	0.100	0.013	5.445	**0.585**	**0.607**	**0.648**	**0.615**
	Bottom side				5.445	**0.545**	**0.545**	**0.545**	**0.545**
N260 Module 2	Front	0.116	0.001	0.033	6.120	**0.685**	**0.613**	**0.685**	**0.633**
	Back	0.134	0.427	0.044	6.120	**0.696**	**0.879**	**0.963**	**0.906**
	Left side				6.120	**0.612**	**0.612**	**0.612**	**0.612**
	Right side	0.100	0.074	0.035	6.120	**0.675**	**0.658**	**0.721**	**0.680**
	Top side	0.065	0.100	0.013	6.120	**0.653**	**0.675**	**0.715**	**0.683**
	Bottom side				6.120	**0.612**	**0.612**	**0.612**	**0.612**
N261 Module 0/1/2	Front	0.116	0.001	0.033	5.460	**0.619**	**0.547**	**0.619**	**0.567**
	Back	0.134	0.427	0.044	5.460	**0.630**	**0.813**	**0.897**	**0.840**
	Left side				5.460	**0.546**	**0.546**	**0.546**	**0.546**
	Right side	0.100	0.074	0.035	5.460	**0.609**	**0.592**	**0.655**	**0.614**
	Top side	0.065	0.100	0.013	5.460	**0.587**	**0.609**	**0.649**	**0.617**
	Bottom side				5.460	**0.546**	**0.546**	**0.546**	**0.546**

<Body-Worn Exposure Condition>

Band	Exposure Position	2	3	4	8	Reported SAR/1.6 + PD/10 Summation			
		2.4GHz WLAN Ant 7+9	5GHz WLAN Ant 7+8	Bluetooth Ant 7	PD	2+8 Summed Ratio	3+8 Summed Ratio	2+3+8 Summed Ratio	3+4+8 Summed Ratio
		1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	4cm^2(W/m^2)				
N260 Module 0/1	Front	0.056	0.001	0.016	5.445	**0.580**	**0.545**	**0.580**	**0.555**
	Back	0.067	0.287	0.022	5.445	**0.586**	**0.724**	**0.766**	**0.738**
N260 Module 2	Front	0.056	0.001	0.016	6.120	**0.647**	**0.613**	**0.648**	**0.623**
	Back	0.067	0.287	0.022	6.120	**0.654**	**0.791**	**0.833**	**0.805**
N261 Module 0/1/2	Front	0.056	0.001	0.016	5.460	**0.581**	**0.547**	**0.582**	**0.557**
	Back	0.067	0.287	0.022	5.460	**0.588**	**0.725**	**0.767**	**0.739**

<Product Specific Exposure Condition>

Band	Exposure Position	2	3	4	8	Reported SAR/4 + PD/10 Summation			
		2.4GHz WLAN Ant 7+9	5GHz WLAN Ant 7+8	Bluetooth Ant 7	PD	2+8 Summed Ratio	3+8 Summed Ratio	2+3+8 Summed Ratio	3+4+8 Summed Ratio
		10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)	4cm^2(W/m^2)				
N260 Module 0/1	Front		0.059		7.500	**0.750**	**0.765**	**0.765**	**0.765**
	Back		0.963		7.500	**0.750**	**0.991**	**0.991**	**0.991**
	Left side				7.500	**0.750**	**0.750**	**0.750**	**0.750**
	Right side		0.280		7.500	**0.750**	**0.820**	**0.820**	**0.820**
	Top side		0.188		7.500	**0.750**	**0.797**	**0.797**	**0.797**
	Bottom side				7.500	**0.750**	**0.750**	**0.750**	**0.750**
N260 Module 2	Front		0.059		8.430	**0.843**	**0.858**	**0.858**	**0.858**
	Back		0.963		7.090	**0.709**	**0.950**	**0.950**	**0.950**
	Left side				8.430	**0.843**	**0.843**	**0.843**	**0.843**
	Right side		0.280		8.430	**0.843**	**0.913**	**0.913**	**0.913**
	Top side		0.188		8.430	**0.843**	**0.890**	**0.890**	**0.890**
	Bottom side				8.430	**0.843**	**0.843**	**0.843**	**0.843**
N261 Module 0/1/2	Front		0.059		7.500	**0.750**	**0.765**	**0.765**	**0.765**
	Back		0.963		7.500	**0.750**	**0.991**	**0.991**	**0.991**
	Left side				7.500	**0.750**	**0.750**	**0.750**	**0.750**
	Right side		0.280		7.500	**0.750**	**0.820**	**0.820**	**0.820**
	Top side		0.188		7.500	**0.750**	**0.797**	**0.797**	**0.797**
	Bottom side				7.500	**0.750**	**0.750**	**0.750**	**0.750**

Test Engineer： Steven Chang and Tom Jiang

13. 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	

14. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[3] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.

[4] FCC KDB 648474 D04 v01r03, “SAR Evaluation Considerations for Wireless Handsets”, Oct 2015.