

TEST REPORT

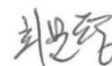
FCC PD Part 1 Test for SM-F766U
Certification

APPLICANT
SAMSUNG Electronics Co., Ltd.

REPORT NO.
HCT-SR-2504-FC005

DATE OF ISSUE
April 22, 2025

Tested by
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Technical Manager
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TEST REPORT

FCC Part 1 PD Test
for certification

REPORT NO.
HCT-SR-2504-FC005

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FCC ID
A3LSMF766U

Applicant	SAMSUNG Electronics Co., Ltd 129, Samsung-ro, Yeongtong-gu, Suwon-Si, Gyeonggi-do, 16677, Korea
Product Name Model Name Additional Model Name	Mobile Phone SM-F766U SM-F766U1
Date of Test	Mar. 20, 2025 ~ Apr. 02, 2025
Location of Test	☒ Permanent Testing Lab ☐ On Site Testing Lab (Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si,
FCC Rule Part(s)	CFR § 2.1093
Test Results	PASS (Power Density Limit : 1.0 mW/cm ²)

Band & Mode	Frequency Range	Measured psPD	Reported psPD
	[MHz]	mW /cm ²	mW /cm ²
n258	24250 - 24450, 24750 ~ 25250	0.683	0.708
n261	27500 - 28350	0.565	0.708
n260	37000 - 40000	0.583	0.708
Total exposure Ratio	0.979		

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	Apr. 22, 2025	Initial Release

Notice

Content

The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated.

The test results have only been applied with the test methods required by the standard(s).

The laboratory is not accredited for the test results marked *.

Information provided by the applicant is marked **.

Test results provided by external providers are marked ***.

When confirmation of authenticity of this test report is required, please contact www.hct.co.kr

The test results in this test report are not associated with the ((KS Q) ISO/IEC 17025) accreditation by KOLAS (Korea Laboratory Accreditation Scheme) / A2LA (American Association for Laboratory Accreditation) that are under the ILAC (International Laboratory Accreditation Cooperation) Mutual Recognition Agreement (MRA).

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1. Test Location

1.1 Test Laboratory

Company Name	HCT Co., Ltd.
Address	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
Telephone	031-645-6300
Fax.	031-645-6401

1.2 Test Facilities

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

Korea	National Radio Research Agency (Designation No. KR0032)
	KOLAS (Testing No. KT197)

2. Information of the EUT

Model Name	SM-F766U
Additional Model Name	SM-F766U1
Equipment Type	Mobile Phone
FCC ID	A3LSMF766U
Application Type	Certification
Applicant	SAMSUNG Electronics Co., Ltd.

2.1 NR FR2 Device Description.

Item.		Description					
Frequency Range	NR Band n258	24 250 MHz ~ 24 450 MHz; 24 750 MHz ~ 25 250 MHz					
	NR Band n260	37 000 MHz – 40 000 MHz					
	NR Band n261	27 000 MHz – 28 500 MHz					
Channel Bandwidths	NR Band n258	50 MHz, 100 MHz					
	NR Band n260	50 MHz, 100 MHz					
	NR Band n261	50 MHz, 100 MHz					
Ch. No.& Freq		Low channel		Middle channel		High Channel	
		Channel	Frequency	Channel	Frequency	Channel	Frequency
NR Band n261	100 MHz	2071667	27550.08	2077915	27924.96	2084165	28299.96
	50 MHz	2071249	27525	2077915	27924.96	2084581	28324.92
NR Band n260	100 MHz	2229999	37050	2254165	38499.96	2278331	39949.92
	50 MHz	2229853	37025.04	2254165	38499.96	2278749	39975
NR Band n258	100 MHz	2018333	24350.04	2025833	24800.04	2032499	25200
	50 MHz	2018333	24350.04	2025417	24775.08	2032915	25224.96
Subcarrier Spacing (kHz)		120					
Total Number of Supported UL CCs (SISO)		4 (DFT-s-OFDM, CP-OFDM)					
Total Number of Supported UL CCs (Tx Diversity)		4 (DFT-s-OFDM, CP-OFDM)					
Total Number of Supported UL CCs (MIMO)		4 (CP-OFDM Only)					
Modulations Supported in UL		DFT-s-OFDM: Pi/2 BPSK, QPSK, 16QAM, 64QAM CP-OFDM: QPSK, 16QAM, 64QAM					
LTE Anchor Bands (n261)		LTE Band 2/5/12/13/14/30/48/66					
LTE Anchor Bands (n260)		LTE Band 2/4/5/12/13/48/66					
LTE Anchor Bands (n258)		LTE Band 2/5/12/66/71					
NR FR1 Anchor Bands (n258)		NR Band n25/41/66/77					
NR FR1 Anchor Bands (n260)		NR Band n2/5/14/25/30/41/48/66/71/77					
NR FR1 Anchor Bands (n261)		NR Band n2/5/25/41/48/66/71/77					
Duplex Type (mmWave)		TDD					
Device Serial Numbers		YBQ0583M					
		The manufacturer has confirmed that the devices tested have the same physical, mechanical and thermal characteristics are within operational tolerances expected for production units.					

2.2 Time-Averaging Algorithm for RF Exposure Compliance

The device is enabled with The Samsung S.LSI proprietary TAS (Time Average SAR) algorithm feature.

This feature performs time averaging algorithm in real time to control and manage transmitting power and ensure the time-averaged RF exposure is in compliance with FCC requirements all the time.

The TAS (Time Average SAR) algorithm maintains the time-averaged transmit power, in turn, time-averaged RF exposure of SAR_design_target or PD_design_target, below the predefined time-averaged power limit (i.e., Plimit for sub-6 radio, and input.power.limit for 5G mmW NR), for each characterized technology and band (see Part 0 PD Report).

The TAS (Time Average SAR) algorithm allows the device to transmit at higher power instantaneously when needed, but manages power limiting to maintain time-averaged transmit power to input.power.limit. The purpose of this report (Part 1 test) is to demonstrate that the EUT meets FCC PD limits when transmitting in static transmission scenario at maximum allowable time-averaged power level given by input.power.limit

Power density Design Target and Uncertainty	
<i>PD_design_target</i> (mW/m ²)	0.589
Design Related Total Uncertainty (dB)	2.3

This device supports both WWAN mode and WLAN mode TAS, but WWAN mode uses Samsung LSI TAS algorithm and WLAN uses Qualcomm's Fast_connect TAS algorithm, so they do not work in conjunction with each other, but operate independently.

Therefore, the simultaneous transmission evaluation of FR2 mode and WWAN mode of the device is verified in the Part 2 WWAN TAS report that the FCC Limit is complied with. And the simultaneous transmission evaluation of WLAN/BT mode and FR2 mmWave mode is evaluated with TER (Total Exposure Ratio) in Chapter 8, and it is evaluated that the FCC limit is complied with.

2.3 Test Regulations

November 2017, October 2018, April 2019, November 2019 TCBC Workshop Notes

SPEAG DASY6 System Handbook (September 2019)

IEC TR 63170:2018

IEC/IEEE 63195-1 :2022

FCC KDB 865664 D02 v01r02

FCC KDB 447498 D01 v06

2.4 DUT Antenna Locations

The device has one patch antenna arrays (K Patch). Table below indicates the surfaces evaluated for part 1 near field power density evaluation.

Table 1: 5G mmWave NR Device Surfaces

Band	Antenna	Condition	Rear (S2)	Front (S1)	Left (S3)	Right (S4)	Bottom (S6)	Top (S5)
NR n261	Patch K	Open	No	Yes	Yes	No	No	No
NR n260	Patch K	Open	No	Yes	Yes	No	No	No
NR n258	Patch K	Open	No	Yes	Yes	No	No	No
NR n261	Patch K	Closed	No	No	Yes	No	No	No
NR n260	Patch K	Closed	No	No	Yes	No	No	No
NR n258	Patch K	Closed	No	No	Yes	No	No	No

Note: All test configurations are based on front position view.

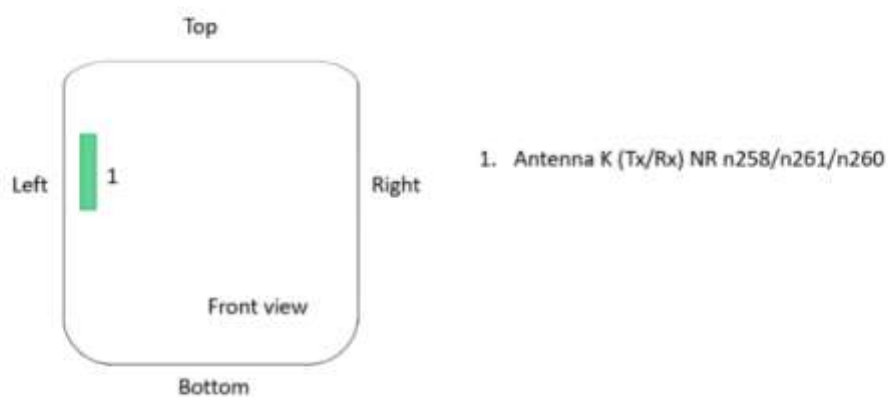


Figure 1: Location of mmW antenna modules looking from front of the DUT – Closed

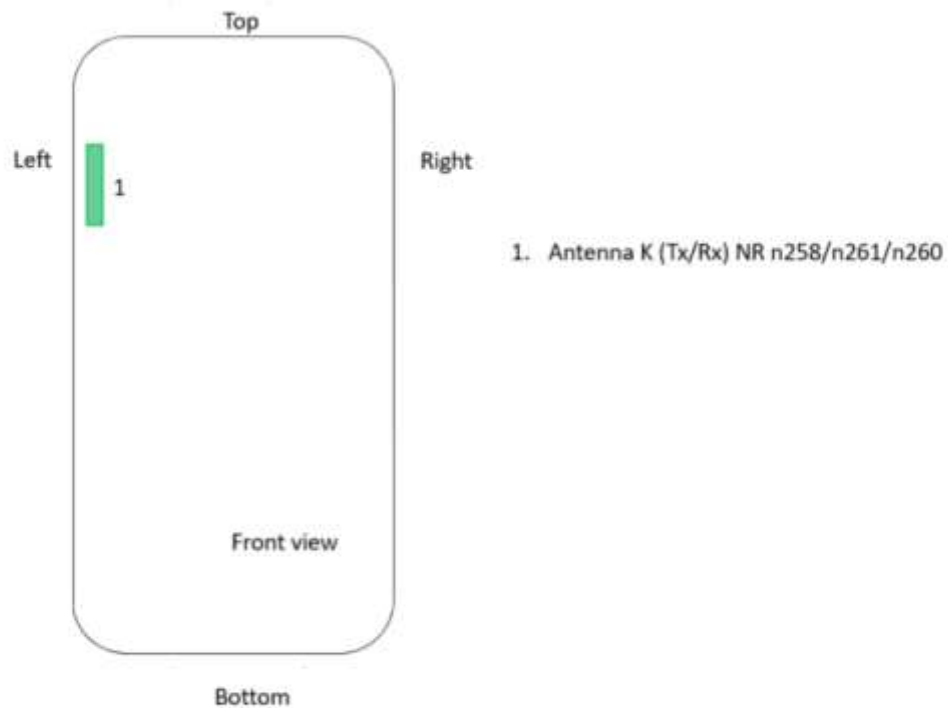


Figure 2: Location of mmW antenna modules looking from front of the DUT – Open

2.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be operating simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.

The device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06 4.3.2 procedures. Please see Part 1 SAR report

3. Description of test equipment

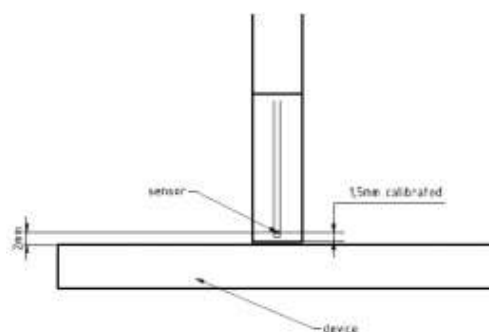
3.1 MEASUREMENT SETUP

Peak spatially averaged power density(psPD) measurements for mmWave frequencies were performed using the DASY6 with cDASY6 5G module.

The DASY6 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of a high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the 5G phantom. The robot is a six-axis industrial robot, performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF).

3.2 SPEAG EUmmWV3 Probe / E-Field 5G Probe

The EUmmWV4 probe consists of two dipoles optimally arranged to obtain pseudo-vector information.



Frequency Range	750 MHz – 110 GHz
Dynamic Range	< 20 V/m – 10,000 V/m with PRE-10 (min < 50 V/m – 3,000 V/m)
Position Precision	< 0.2 mm (cDASY6)
Dimensions	Probe Overall Length: 320 mm Probe Body Diameter: 8 mm Probe Tip Length: 23 mm Probe Tip Diameter: Encapsulation 8 mm Distance from Probe Tip to Sensor X Calibration Point: 1.5 mm Distance from Probe Tip to Sensor Y Calibration Point: 1.5 mm
Applications	E-field measurements of 5G devices and other mm-wave transmitters operating above 10 GHz in < 2 mm distance from device (free-space) Power density, H-field and far-field analysis using total field reconstruction
Compatibility	cDASY6 + 5G-Module SW

Figure 1. EUmmWV4 Probe

3.3 Peak Spatially Averaged Power Density Assessment Based on E-field Measurements

Within a short distance from the transmitting source, Power density was determined based on both electric and magnetic field. Generally, the magnitude and phase of two components of either the E-field or H-field were needed on a sufficiently large surface to fully characterized the total E-field and H-field can be used to compute power density. The general measurement approach used for this device was:

- a) The local E-field on the measurement surface was measured at a reference location where the field is well above the noise level. This reference level was used at the end of this procedure to assess output power drift of the DUT during the measurement.
- b) The electric field on the measurement surface was scanned. Measurements are conducted according to the instructions provided by the measurement system manufacturer. Measurement spatial resolution can depend on the measured field characteristic and measurement methodology used by the system. The planar scan step size was configured at $\lambda/4$.
- c) For cDasy6, H-field was calculated from the measured E-field using a reconstruction algorithm. As the power density calculation requires knowledge of both amplitude and phase, reconstruction algorithms can also be used to obtain field information from the measured E-field data (e.g. the phase from the amplitude if only the amplitude is measured). H-field and phase data was reconstructed from repeated measurements (three per measurement point) on two measurement planes separated by $\lambda/4$.
- d) The total Peak spatially averaged power density (psPD) distribution on the evaluation surface is determined per the below equation. The spatial averaging area, A_s , is specified by the applicable exposure limits or regulatory requirements. A circular shape was used.

$$psPD = \frac{1}{2A_{av}} \iint_{A_{av}} \|Re\{E \times H^*\}\| dA$$

- e) The maximum spatial-average on the evaluation surface is the final quantity to determine compliance against applicable limits.
- f) The local E-field reference value, at the same location as step 2, was re-measured after the scan was complete to calculate the power drift. If the drift deviated by more than 5%, the power density test and drift measurements were repeated.

3.4 Reconstruction Algorithm

Computation of the power density in general requires measurement information from the both E-field and H-field amplitudes and phases in the plane of incidence. Reconstruction of these quantities from pseudo-vector E-field measurements is feasible according to the manufacturer, as they are determined via Maxwell's equation. As such, the SPEAG reconstruction approach was based on the Gerchbergs. As such, the SPEAG reconstruction approach was based on the Gerchberg-Saxton algorithm, which benefits from the availability of the E-field polarization ellipse information obtained with the EUMMW4 probe.

4. RF Exposure Limits

Per § 1.1310 (d)(3), the MPE limits are applied for frequencies above 6 GHz. Power Density is expressed in units of W/m^2 or mW/cm^2 .

Peak Spatially Averaged Power Density was evaluated over a circular area of 4 cm^2 per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes.

HUMAN EXPOSURE	Limits For Occupational / Controlled Environments	Limits For General Population / Uncontrolled Environments
Frequency Range[MHz]	1,500 – 100,000	1,500 – 100,000
Power Density[mW/cm ²]	5.0	1.0
Average Time[Minutes]	6	30

NOTES: 1.0 mW/cm² is 10 W/m²

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.

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. This 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.

5. Input Power Specifications

All power density measurements for this device were performed at the input.power.limit given in below tables.

Table 5-1 5G NR n258 K Patch input.power.limit

Antenna	Beam ID_1	Beam ID_2	Input.power.limit(dBm)
K Patch	0	-	19.7
	1	-	18.6
	2	-	19.2
	3	-	18.8
	4	-	16.6
	5	-	16.2
	6	-	16.3
	7	-	15.7
	8	-	15.9
	-	9	19.2
	-	10	22.0
	-	11	20.7
	-	12	20.5
	-	13	18.2
	-	14	18.4
	-	15	18.4
	-	16	18.4
	-	17	19.0
	0	9	16.0
	1	10	15.8
	2	11	16.5
	3	12	15.4
	4	13	13.7
	5	14	13.8
	6	15	13.3
	7	16	13.0
	8	17	13.7

Table 5-3 5G NR n261 K Patch input.power.limit

Antenna	Beam ID_1	Beam ID_2	Input.power.limit(dBm)
K Patch	0	-	17.2
	1	-	16.5
	2	-	16.4
	3	-	16.3
	4	-	16.5
	5	-	16.5
	6	-	17.8
	7	-	17.9
	8	-	16.7
	-	9	17.1
	-	10	17.1
	-	11	18.5
	-	12	18.9
	-	13	16.9
	-	14	19.1
	-	15	18.2
	-	16	17.2
	-	17	17.4
	0	9	13.4
	1	10	13.2
	2	11	14.1
	3	12	13.8
	4	13	12.8
	5	14	13.4
	6	15	14.3
	7	16	14.2
	8	17	13.5

Table 5-3 5G NR n260 K Patch input.power.limit

Antenna	Beam ID_1	Beam ID_2	Input.power.limit(dBm)
K Patch	0	-	17.3
	1	-	17.3
	2	-	16.6
	3	-	17.6
	4	-	18.2
	5	-	17.3
	6	-	18.0
	7	-	17.1
	8	-	17.2
	-	9	12.9
	-	10	12.7
	-	11	12.6
	-	12	11.8
	-	13	12.4
	-	14	13.0
	-	15	13.8
	-	16	13.5
	-	17	12.9
	0	9	11.5
	1	10	11.2
	2	11	10.9
	3	12	10.4
	4	13	11.0
	5	14	11.2
	6	15	12.3
	7	16	11.8
	8	17	11.5

6. System Verification

The system was verified to be within ± 0.66 dB of the power density targets on the calibration certificate according to the test system specification in the user's manual and calibration facility recommendation. The 0.66 dB deviation threshold represents the expanded uncertainty for system performance checks using SPEAG's mmWave verification sources. The same spatial resolution and measurement region used in the source calibration was applied during the system check.

The measured power density distribution of verification source was also confirmed through visual inspection to have no noticeable differences, both spatially (shape) and numerically (level) from the distribution provide by the manufacturer, per November 2017 TCBC Workshop Notes.

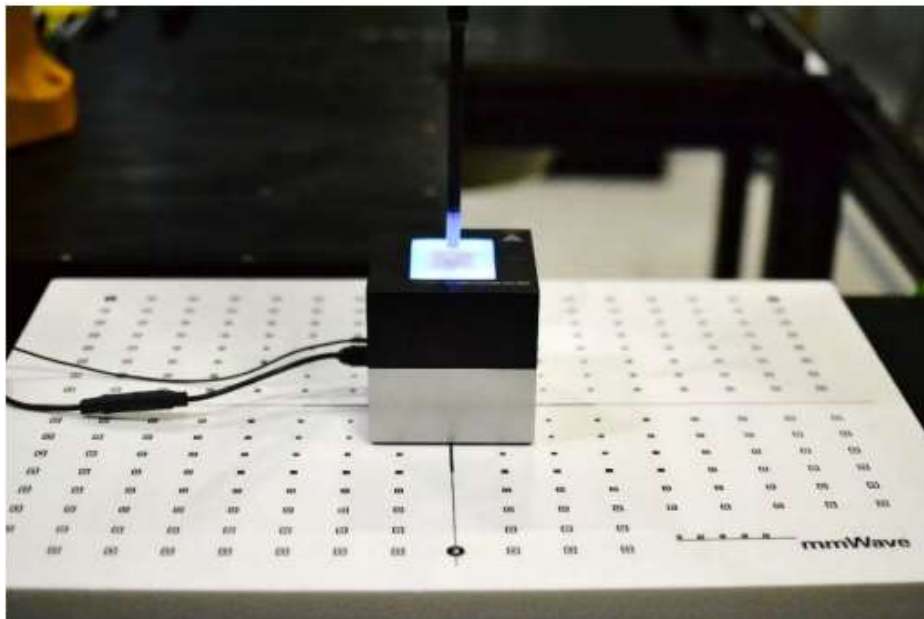


Fig. 6.1 System Verification Setup photo

6.1 System Check Results

System Verification										
Freq.	Date	Ambient Temp.	Source S/N	Probe S/N	Normal psPD (W/m ² over 4 cm ²)		Dev.	Total psPD (W/m ² over 4 cm ²)		Dev.
(GHz)		(°C)			Meas.	target	(dB)	Meas.	target	(dB)
30	03/20/2025	22.1	1011	9528	15.3	15.0	+ 0.09	15.6	15.2	+ 0.11
30	03/27/2025	21.8	1011	9528	15.0	15.0	+ 0.00	15.2	15.2	+ 0.00
30	03/28/2025	22.1	1011	9528	15.2	15.0	+ 0.06	15.4	15.2	+ 0.06
30	04/01/2025	23.0	1011	9528	15.3	15.0	+ 0.09	15.5	15.2	+ 0.08
30	04/02/2025	23.5	1011	9528	15.2	15.0	+ 0.06	15.5	15.2	+ 0.08

Note: A 10mm Distance spacing was used from the reference horn antenna aperture to the probe element. This includes 4.45 mm from the reference antenna horn aperture to the surface of the verification source plus 5.55 mm from the surface to the probe. The SPEAG software requires a setting of “5.55 mm” for the correct setup

7. Power Density Data Summary

7.1 Power Density Results

Power density measurements were performed with DUT transmitting at input.power.limit for one single beam for each polarization (H&V) and one beam pair, for each antenna on each worst surfaces

NR Band n258 - Folder Open												
Frequency		Ant.	Beam ID	Beam ID	Input.power	Ant	Test Position	Distance	Power Drift	Normal psPD	Total psPD	Plot No.
MHz	Ch.		1	2	(dBm)			(mm)	(dB)	(mW/cm²)	(mW/cm²)	
25200	2032499	K Patch	5	-	16.2	SISO	Front	2	-0.10	0.278	0.321	-
25200	2032499		7	-	15.7	SISO	Left	2	-0.18	0.224	0.343	-
25200	2032499		-	17	19	SISO	Front	2	-0.1	0.278	0.321	-
24800.04	2025833		-	15	18.4	SISO	Left	2	0.00	0.521	0.683	1
25200	2032499		5	14	13.8	MIMO	Front	2	0.11	0.266	0.289	-
24800.04	2025833		7	16	13.0	MIMO	Left	2	0.09	0.264	0.396	-
47 CFR § 1.1310 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population							Power Density 1 mW/cm² Averaged over 4 cm²					

NR Band n258 - Folder Close												
Frequency		Ant.	Beam ID	Beam ID	Input.power	Ant	Test Position	Distance	Power Drift	Normal psPD	Total psPD	Plot No.
MHz	Ch.		1	2	(dBm)			(mm)	(dB)	(mW/cm²)	(mW/cm²)	
25200	2032499	K Patch	7	-	15.7	SISO	Left	2	-0.16	0.284	0.418	2
25200	2032499		-	13	18.2	SISO	Left	2	-0.01	0.323	0.375	-
24800.04	2025833		7	16	13	MIMO	Left	2	-0.13	0.186	0.263	-
47 CFR § 1.1310 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population							Power Density 1 mW/cm² Averaged over 4 cm²					

NR Band n261 – Folder Open Power Density												
Frequency		Ant.	Beam ID	Beam ID	Input.power	Ant	Test Position	Distance	Power Drift	Normal psPD	Total psPD	Plot No.
MHz	Ch.		1	2	(dBm)			(mm)	(dB)	(mW/cm²)	(mW/cm²)	
27550.08	2071667	K Patch	8	-	16.7	SISO	Front	2	0.11	0.284	0.319	-
27550.08	2071667		4	-	16.5	SISO	Left	2	-0.14	0.438	0.565	3
27924.96	2077915		-	14	19.1	SISO	Front	2	0.03	0.29	0.308	-
28299.96	2084165		-	9	17.1	SISO	Left	2	0.11	0.201	0.356	-
27550.08	2071667		8	17	13.5	MIMO	Front	2	-0.13	0.146	0.153	-
27550.08	2071667		4	13	12.8	MIMO	Left	2	-0.12	0.27	0.378	-
47 CFR § 1.1310 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population							Power Density 1 mW/cm² Averaged over 4 cm²					

NR Band n261 – Folder Closed

Frequency		Ant.	Beam ID	Beam ID	Input.power	Ant	Test Position	Distance	Power Drift	Normal psPD	Total psPD	Plot No.
MHz	Ch.		1	2	(dBm)			(mm)	(dB)	(mW/cm²)	(mW/cm²)	
27550.08	2071667	K Patch	3	-	17.3	SISO	Left	2	-0.08	0.34	0.542	4
28299.96	2084165		-	13	17.9	SISO	Left	2	0.18	0.225	0.253	-
28299.96	2084165		4	13	13.8	MIMO	Left	2	-0.15	0.0879	0.126	-
47 CFR § 1.1310 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population							Power Density 1 mW/cm² Averaged over 4 cm²					

NR Band n260 – Folder Open

Frequency		Ant.	Beam ID	Beam ID	Input.power	Ant	Test Position	Distance	Power Drift	Normal psPD	Total psPD	Plot No.
MHz	Ch.		1	2	(dBm)			(mm)	(dB)	(mW/cm²)	(mW/cm²)	
37050	2229999	K Patch	1	-	17.3	SISO	Front	2	0.15	0.151	0.19	-
37050	2229999		2	-	16.6	SISO	Left	2	-0.10	0.349	0.456	5
37050	2229999		-	12	11.8	SISO	Front	2	-0.11	0.179	0.184	-
37050	2229999		-	12	11.8	SISO	Left	2	-0.13	0.262	0.293	-
37050	2229999		1	10	11.2	MIMO	Front	2	0.13	0.173	0.183	-
37050	2229999		3	12	10.4	MIMO	Left	2	-0.05	0.311	0.356	-
47 CFR § 1.1310 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population							Power Density 1 mW/cm² Averaged over 4 cm²					

NR Band n260 – Folder Closed

Frequency		Ant.	Beam ID	Beam ID	Input.power	Ant	Test Position	Distance	Power Drift	Normal psPD	Total psPD	Plot No.
MHz	Ch.		1	2	(dBm)			(mm)	(dB)	(mW/cm²)	(mW/cm²)	
37050	2229999	K Patch	2	-	16.6	SISO	Left	2	-0.03	0.342	0.583	6
37050	2229999		-	12	11.8	SISO	Left	2	0.17	0.211	0.251	-
37050	2229999		3	12	10.4	MIMO	Left	2	-0.17	0.197	0.225	-
47 CFR § 1.1310 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population							Power Density 1 mW/cm² Averaged over 4 cm²					

7.2 Power density Test Notes

General Notes:

1. The manufacturer has confirmed that the devices tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
2. Batteries are fully charged at the beginning of the measurements. The DUT was connected to a wall charger for some measurements due to the test duration. It was confirmed that the charger plugged into this DUT did not impact the near-field PD test results.
3. Power density was calculated by repeated E-field measurements on two measurement planes separated by $\lambda/4$.
4. DUT was configured to transmit with a manufacturer provided test software to control specific antenna(s), Beam ID(s), and signal type to ensure the test configurations constant for the entire evaluation.
5. Input.power.limit parameter for 5G mmW NR radio was calculated in Part 0 PD report.
6. The Samsung S.LSI proprietary TAS (Time Average SAR) algorithm was approved by the FCC through an inquiry from the S.LSI TAS manufacturer.
7. PD_design_target of 0.589 mW/cm² was used with mmW device design related uncertainty of 2.3 dB.
8. This device is enabled with The Samsung S.LSI proprietary TAS (Time Average SAR) algorithm feature to control and manage transmitting power in real time and to ensure that the time-averaged RF exposure from WWAN and mmWave FR2 Mode is in compliance with FCC requirements. Per FCC guidance for devices enabled with The Samsung S.LSI proprietary TAS (Time Average SAR) algorithm feature, 4G LTE/5G NR FR1 and 5G mmW NR FR2 simultaneous transmission scenario does not need to be evaluated under Total Exposure Ratio (TER). The validation of the time-averaging algorithm and compliance under the Tx varying transmission scenario for WWAN and 5G mmW NR FR2 technologies are reported in Part 2 report.
9. Per FCC guidance for devices enable with The Samsung S.LSI proprietary TAS (Time Average SAR) algorithm feature, simultaneous transmission analysis is evaluated by combining the exposure from WLAN/BT and NFC antenna. The simultaneous transmission scenario for 5G mmW NR FR2 WLAN/BT and NFC antenna. is evaluated under the Total Exposure Ratio (TER) in Section 8.
10. The Beam ID with one of the highest initial simulated power density for that surface and distance was selected for Part 1 Power Density measurements.
11. The device was configured to transmit CW wave signal for testing. Per FCC guidance for devices enabled with The Samsung S.LSI proprietary TAS (Time Average SAR) algorithm feature, additional testing was not required for different modulations(CP-OFDM QPSK, CP-OFDM 16QAM, CP-OFDM 64QAM, DFT-s-OFDM Pi/2BPSK, DFT-s ODFM QPSK, DFT-s-OFDM 16QAM, DFT-s-OFDM 64QAM), RB configurations, component carriers, channel configurations(low channel, mid channel, high channel) since the smart transmit algorithm monitors powers on a per symbol basis, which is independent of these signal characteristics.
12. The device was configured to MIMO configuration with H and V polarization beams transmitting together.
13. In some cases, the simulation vs. measurement for some surfaces can exceed the device's total uncertainty. Therefore, some additional tests were performed to support simultaneous transmission analysis. See Section8.

8. The Total Exposure Ratio

The Total Exposure Ratio (TER) is calculated by combining all SAR measurements and power density measurement after normalizing to their respective limits. The general expression is below.

$$TER = \sum_{a=1}^A \frac{SAR_a}{SAR_{a, limit}} + \sum_{b=1}^B \frac{psPD_b}{psPD_{b, limit}} < 1$$

The TER shall be less than unity to ensure compliance with the limits.

$$\sum_{n=1}^N \frac{4G \ SAR_n}{4G \ SAR_{n, limit}} + \sum_{m=1}^M \frac{5G \ mmW \ NR \ psPD_m}{5G \ mmW \ NR \ psPD_{m, limit}} + \sum_{p=1}^P \frac{WLAN \ SAR_p}{WLAN \ SAR_{p, limit}}$$

For 5G mmW NR FR2, 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 device uncertainty. For this device, the manufacturer has added an additional permanent back-off for every beam in the calculations for input.power.limits used in the Regy file. The back-off levels can be found in the Part 0 PD Test report. Therefore, 5G mmW NR RF exposure for this DUT is evaluated by reported psPD calculated as:

$$\text{reported_psPD} = (\text{PD_design_target} + \text{PD_uncertainty}) \times 10^{(-\text{Permanent back-off in dB})/10}$$

Note that since not all the beams supported by this EUT are measured, reported_psPD cannot be computed based on limited measured psPD data. Alternatively, since measured psPD for all the beams will be $\leq \text{PD_design_target} + \text{PD_uncertainty}$, reported_psPD is computed based on this worst-case psPD as shown above.

Note that the above reported psPD applies to the worst-case surfaces of the DUT at 2mm evaluation distance. Worst-case PD on other surfaces of the DUT are calculated from simulated PD data (see Power Density Simulation Report), by multiplying reported psPD with the highest proportion out of all beams and out of all three channels in each band, where the adjustment for each beam/channel is computed as the proportion of “simulated PD on desired surface” to “simulated PD on worst-surface”. For example, to determine worst-case PD on front surface (needed for Head RF Exposure evaluation during simultaneous transmission), highest proportion of (simulated PD on front surface)/(simulated PD on worst surface) was determined out of all supported beams and out of all three channels by the DUT in each band

In some cases, the simulation vs measurement for some surfaces can exceed the device's total uncertainty. In those cases, if the measured psPD > simulated adjusted psPD (assuming a linear congruency of the psPD across surfaces), then measured psPD should be used towards the simultaneous TX analysis. Table 8-1 lists the relevant worst-case reported psPD values based on the additional surfaces and evaluation distances needed to perform the TER analysis. The highest of the adjusted Reported_psPD and Measured Total psPD was chosen for TER analysis and the chosen values are indicated by bolded psPD values.

Table 8-1

The worst-case reported psPD values – 2mm							
Antenna Module	Folder Open	Configuration	Evaluation Distance	Adjustment Factor due to Simulation	Adjusted Reported psPD	Measured Total psPD	Final Reported psPD
					(mW/cm ²)	(mW/cm ²)	(mW/cm ²)
K	Open	Rear	2 mm	0.458	0.324	0.506	0.506
		Front	2 mm	0.830	0.588	0.321	0.588
		Left	2 mm	1.000	0.708	0.683	0.708
		Right	2 mm	0.081	0.057	-	0.057
		Top	2 mm	0.090	0.064	-	0.064
		Bottom	2 mm	0.031	0.022	-	0.022
	Close	Rear	2 mm	0.443	0.314	0.323	0.323
		Front	2 mm	0.451	0.319	0.341	0.341
		Left	2 mm	1.000	0.708	0.583	0.708
		Right	2 mm	0.059	0.042	-	0.042
		Top	2 mm	0.190	0.135	0.133	0.135
		Bottom	2 mm	0.122	0.086	-	0.086

The worst-case reported psPD values – 5mm							
Antenna Module	Folder Open	Configuration	Evaluation Distance	Adjustment Factor due to Simulation	Adjusted Reported psPD	Measured Total psPD	Final Reported psPD
					(mW/cm ²)	(mW/cm ²)	(mW/cm ²)
K	Open	Rear	5 mm	0.345	0.244	-	0.244
		Front	5 mm	0.723	0.512	-	0.512
		Left	5 mm	0.844	0.598	-	0.598
		Right	5 mm	0.051	0.036	-	0.036
		Top	5 mm	0.076	0.054	-	0.054
		Bottom	5 mm	0.028	0.020	-	0.020
	Close	Rear	5 mm	0.295	0.209	-	0.209
		Front	5 mm	0.336	0.238	-	0.238
		Left	5 mm	0.837	0.593	-	0.593
		Right	5 mm	0.052	0.037	-	0.037
		Top	5 mm	0.158	0.112	-	0.112
		Bottom	5 mm	0.078	0.055	-	0.055

Note: Adjusted factor is (simulated PD on desired exposure plane)/(PD on worst-surf ace at 2mm evaluation distance) out of all beams and out of all channels. See Power Density Simulation Report. The higher result was applied to the TER evaluation by comparing the measured psPD result to the adjusted psPD result.

8.1 Total Exposure Ratio for each exposure condition

Table 8-1

5G mmWave NR FR2 +WLAN/BT Head Configuration Total Exposure Ratio

TER For Head Configuration		psPD	WLAN Worst SAR	WLAN 2.4GHz Ant2	WLAN5/6 GHz Worst SAR	Bluetooth Ant 1	Bluetooth Ant 2	Bluetooth Dual	psPD+WLAN Worst SAR	psPD+WLAN 2.4G Ant2+BT Ant 1	psPD+WLAN 5/6G+BT Ant 1	psPD+WLAN 5/6G+BT Ant 2	psPD+WLAN 5/6G+BT Dual
		mW/cm ²	W/kg	W/kg	W/kg	W/kg	W/kg	W/kg					
		1	2	3	4	5	6	7	1+2	1+3+5	1+4+5	1+4+6	1+4+7
Applicable Limit		1	1.6	1.6	1.6	1.6	1.6	1.6	1	1	1	1	1
Left Touch	psPD	0.588	0.471	0.296	0.204	0.141	0.288	0.162					
	Ratio to Limit	0.588	0.294	0.185	0.128	0.088	0.180	0.101	0.882	0.861	0.804	0.896	0.817
Left Tilt	psPD	0.588	0.574	0.188	0.179	0.185	0.196	0.208					
	Ratio to Limit	0.588	0.359	0.118	0.112	0.116	0.123	0.130	0.947	0.821	0.816	0.822	0.830
Right Touch	psPD	0.588	0.412	0.149	0.37	0.233	0.076	0.255					
	Ratio to Limit	0.588	0.258	0.093	0.231	0.146	0.048	0.159	0.846	0.827	0.965	0.867	0.979
Right Tilt	psPD	0.588	0.476	0.135	0.394	0.229	0.068	0.204					
	Ratio to Limit	0.588	0.298	0.084	0.246	0.143	0.043	0.128	0.886	0.816	0.977	0.877	0.962

Table 8-2

5G mmWave NR FR2 +AG0+WLAN/BT Body Open Configuration Total Exposure Ratio

TER For Body Configuration		psPD	AG0	WLAN Worst SAR	WLAN 2.4G Ant2	WLAN 5/6G Worst SAR	BT Ant 1	BT Ant 2	BT Dual	psPD+AG0+WLAN Worst SAR	psPD+AG0+WLAN 2.4G Ant2+BT Ant 1	psPD+AG0+WLAN 5/6G +BT Ant 1	psPD+AG0+WLAN 5/6G +BT Ant 2	psPD+AG0+WLAN 5/6G +BT Dual
		mW/cm ²	W/kg	W/kg	W/kg	W/kg	W/kg	W/kg	W/kg					
		1	2	3	4	5	6	7	8	1+2+3	1+2+4+6	1+2+5+6	1+2+5+7	1+2+5+8
Applicable Limit		1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1	1	1	1	1
Rear	psPD	0.244	1.144	0.614	0.079	0.447	0.223	0.147	0.364					
	Ratio to Limit	0.244	0.715	0.384	0.049	0.279	0.139	0.092	0.228	See sec 8.2 Plot #1	See sec 8.2 Plot #2	See sec 8.2 Plot #3	See sec 8.2 Plot #3	See sec 8.2 Plot #3
Front	psPD	0.512	0.848	0.452	0.209	0.452	0.236	0.271	0.416					
	Ratio to Limit	0.512	0.530	0.283	0.131	0.283	0.148	0.169	0.260	See sec 8.2 Plot #4	See sec 8.2 Plot #5	See sec 8.2 Plot #6	See sec 8.2 Plot #6	See sec 8.2 Plot #6
Left	psPD	0.598	0.727	0.969	0.000	0.969	0.052	0.000	0.034					
	Ratio to Limit	0.598	0.454	0.606	0.000	0.606	0.033	0.000	0.021	See sec 8.2 Plot #7	See sec 8.2 Plot #8	See sec 8.2 Plot #8	See sec 8.2 Plot #8	See sec 8.2 Plot #8
Right	psPD	0.051	0.752	0.127	0.036	0.127	0.000	0.046	0.032					
	Ratio to Limit	0.051	0.470	0.079	0.023	0.079	0.000	0.029	0.020	0.600	0.544	0.600	0.629	0.620
Top	psPD	0.076	0.000	0.999	0.158	0.538	0.766	0.274	0.773					
	Ratio to Limit	0.076	0.000	0.624	0.099	0.336	0.479	0.171	0.483	0.700	0.654	0.891	0.584	0.895
Bottom	psPD	0.028	1.121	0.000	0.000	0.000	0.000	0.000	0.000					
	Ratio to Limit	0.028	0.701	0.000	0.000	0.000	0.000	0.000	0.000	0.729	0.729	0.729	0.729	0.729

Table 8-3

5G mmWave NR FR2 +WLAN/BT Body Closed Configuration Total Exposure Ratio

TER For Body Configuration		psPD	WLAN Worst SAR	WLAN 2.4G Ant2	WLAN 5/6G Worst SAR	BT Ant 1	BT Ant 2	BT Dual	psPD+WLAN Worst SAR	psPD+WLAN 2.4G Ant2+BT Ant 1	psPD+WLAN 5/6G+BT Ant 1	psPD+WLAN 5/6G+BT Ant 2	psPD+WLAN 5/6G+BT Dual
		mW/cm ²	W/kg	W/kg	W/kg	W/kg	W/kg	W/kg					
		1	2	3	4	5	6	7	1+2	1+3+5	1+4+5	1+4+6	1+4+7
Applicable Limit		1	1.6	1.6	1.6	1.6	1.6	1.6	1	1	1	1	1
Rear	psPD	0.209	0.168	0.082	0.168	0.037	0.124	0.054					
	Ratio to Limit	0.209	0.105	0.051	0.105	0.023	0.078	0.034	0.314	0.283	0.337	0.392	0.348
Front	psPD	0.238	0.498	0.074	0.498	0.221	0.237	0.34					
	Ratio to Limit	0.238	0.311	0.046	0.311	0.138	0.148	0.213	0.549	0.422	0.687	0.697	0.762
Left	psPD	0.593	0.958	0	0.958	0.027	0	0.053					
	Ratio to Limit	0.593	0.599	0.000	0.599	0.017	0.000	0.033	See sec 8.2 Plot #9	0.610	See sec 8.2 Plot #9	See sec 8.2 Plot #9	See sec 8.2 Plot #9
Right	psPD	0.037	0.17	0.034	0.17	0	0.078	0.026					
	Ratio to Limit	0.037	0.106	0.021	0.106	0.000	0.049	0.016	0.143	0.058	0.143	0.192	0.160
Top	psPD	0.112	0.000	0.000	0.000	0.000	0.000	0.000					
	Ratio to Limit	0.112	0.000	0.000	0.000	0.000	0.000	0.000	0.112	0.112	0.112	0.112	0.112
Bottom	psPD	0.055	0.729	0.122	0.597	0.441	0.223	0.538					
	Ratio to Limit	0.055	0.456	0.076	0.373	0.276	0.139	0.336	0.511	0.407	0.704	0.568	0.764

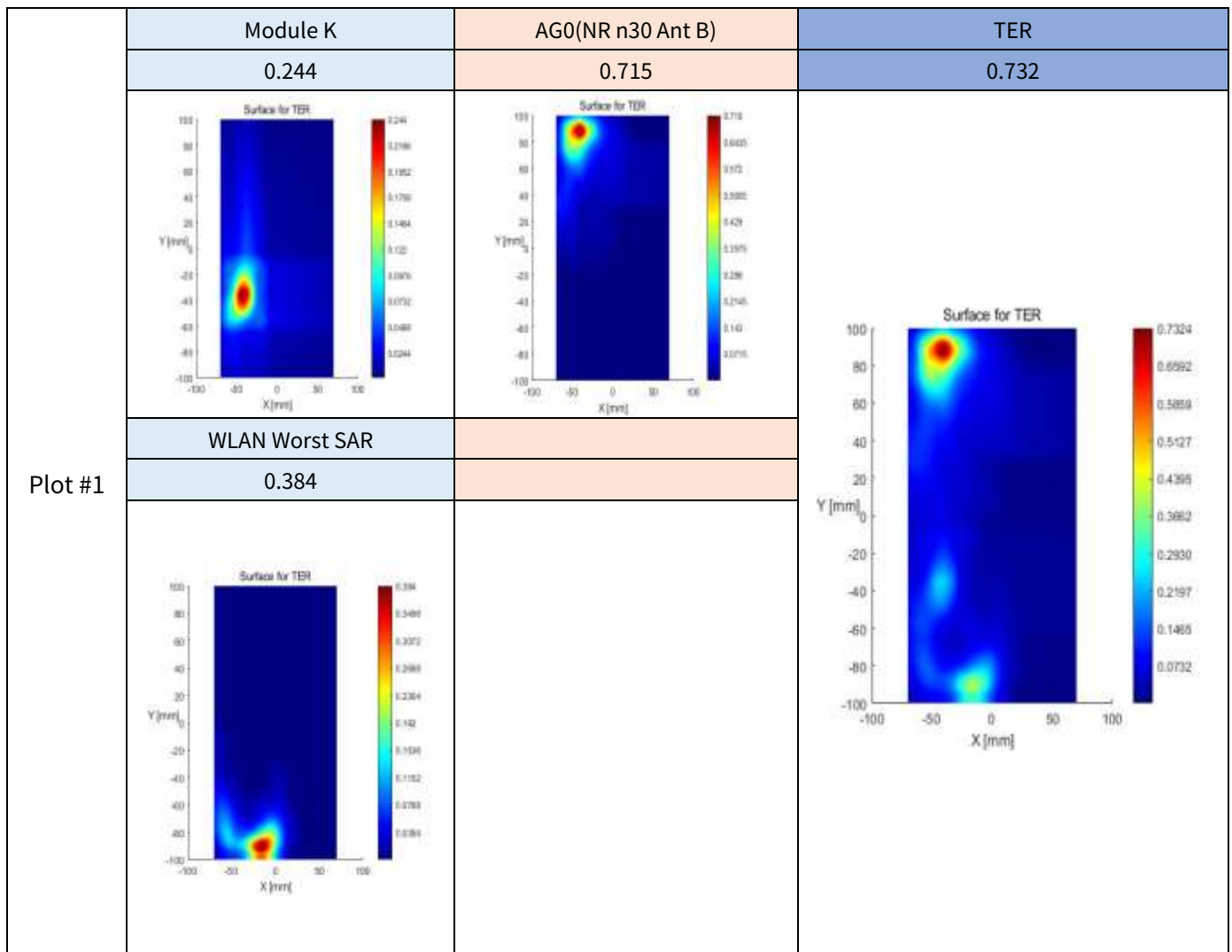
Table 8-4

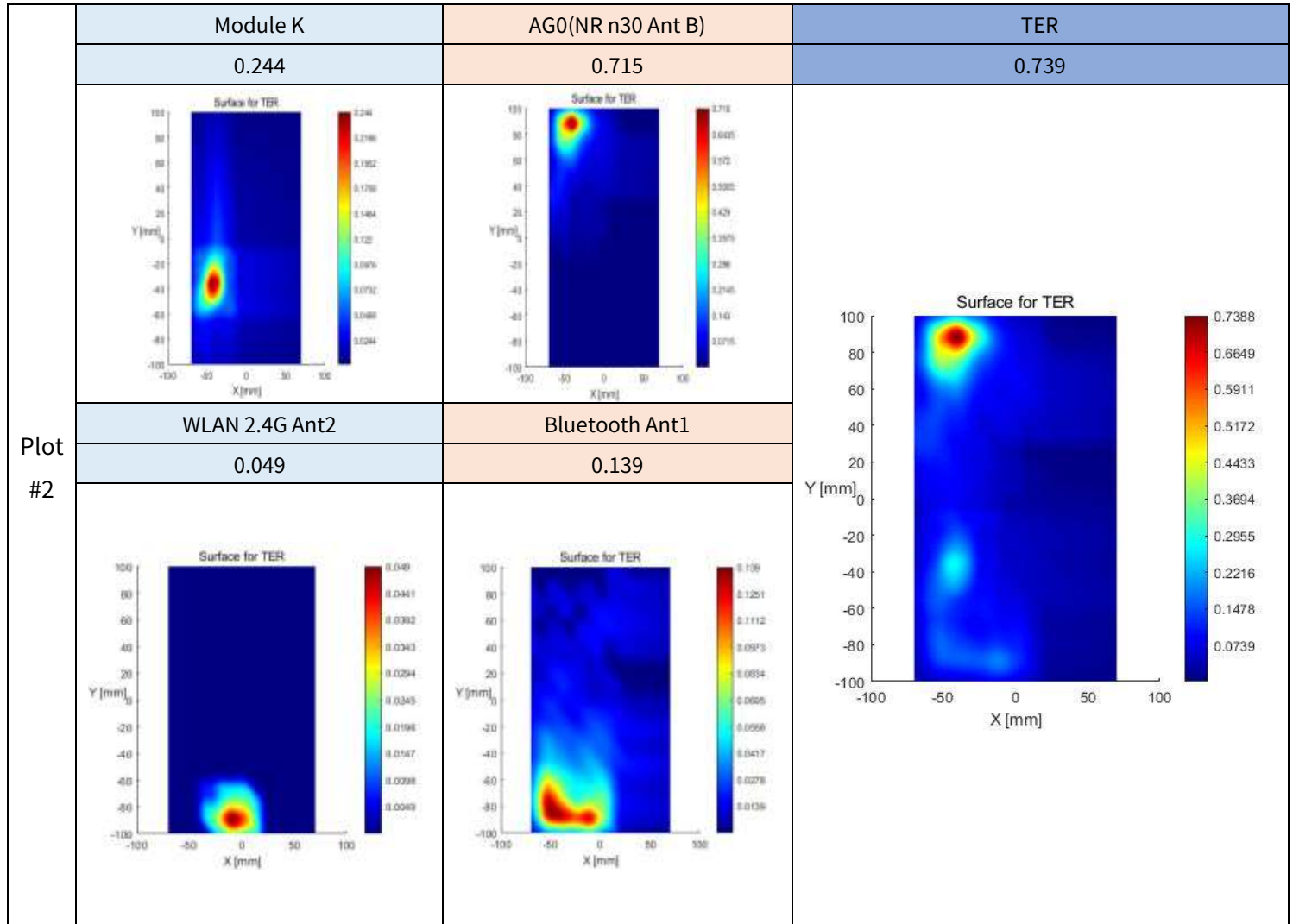
5G mmWave NR FR2 + NFC Phablet Configurations Total Exposure Ratio

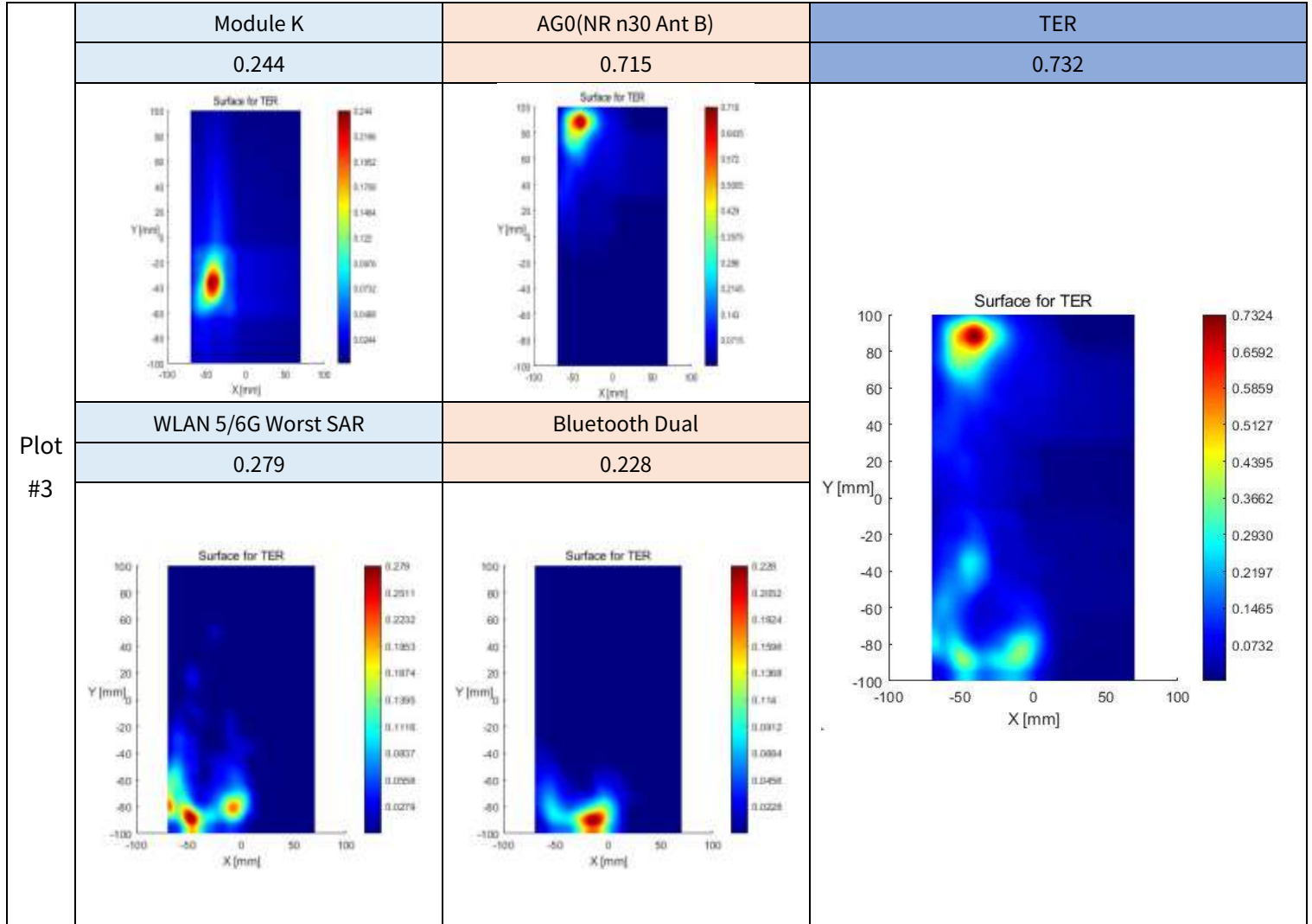
TER For Phablet Configuration		psPD	NFC	psPD+NFC
		mW/cm ²	W/kg	
		1	2	1+2+3
Applicable Limit		1	4	1
Rear	psPD	0.506	0.000	
	Ratio to Limit	0.506	0.000	0.506
Front	psPD	0.588	0.000	
	Ratio to Limit	0.588	0.000	0.588
Left	psPD	0.708	0.000	
	Ratio to Limit	0.708	0.000	0.708
Right	psPD	0.057	0.000	
	Ratio to Limit	0.057	0.000	0.057
Top	psPD	0.064	0.000	
	Ratio to Limit	0.064	0.000	0.064
Bottom	psPD	0.022	0.000	
	Ratio to Limit	0.022	0.000	0.022

8.2 Summation composite map For TER

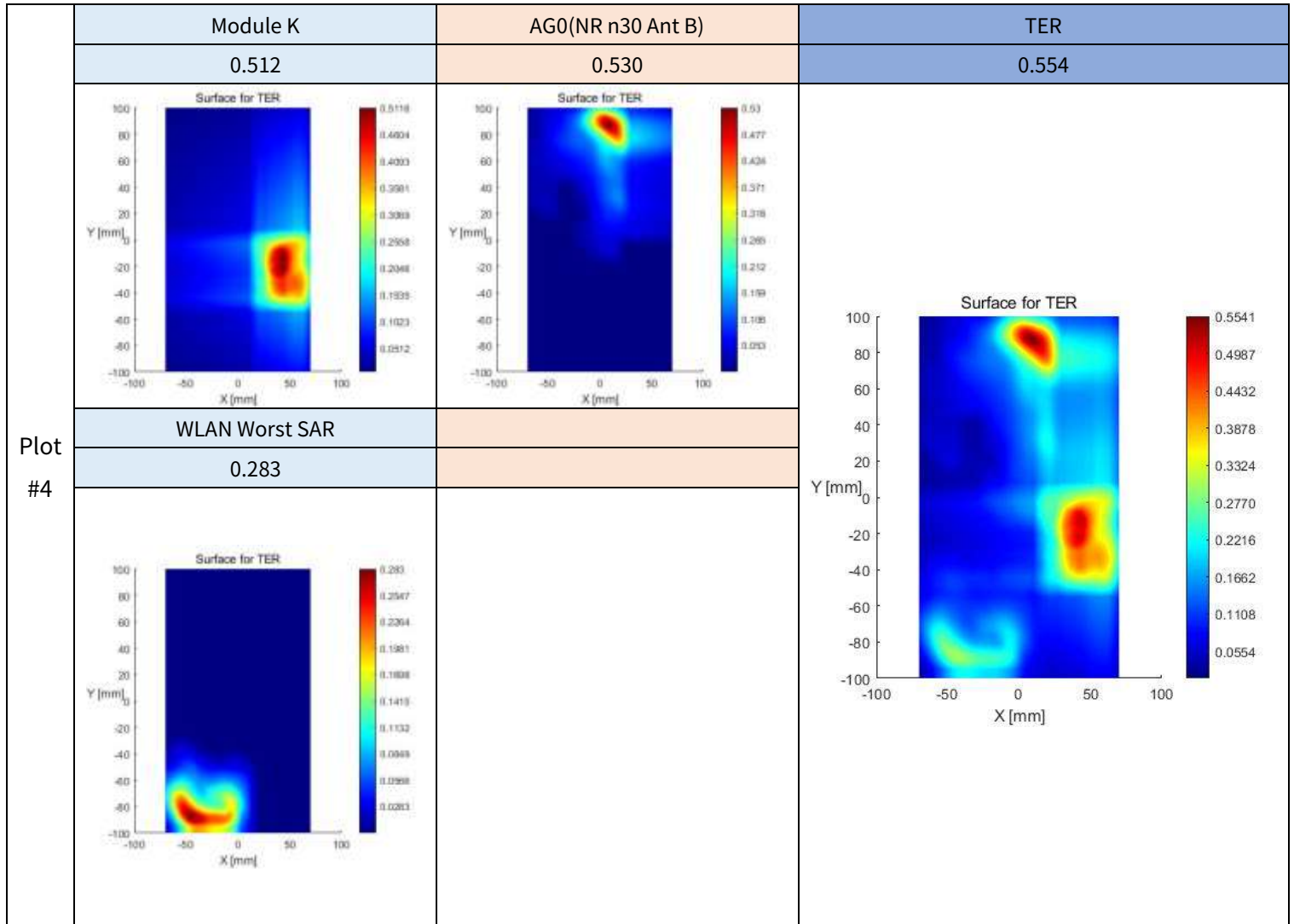
8.2.1 Body Open Rear Postion

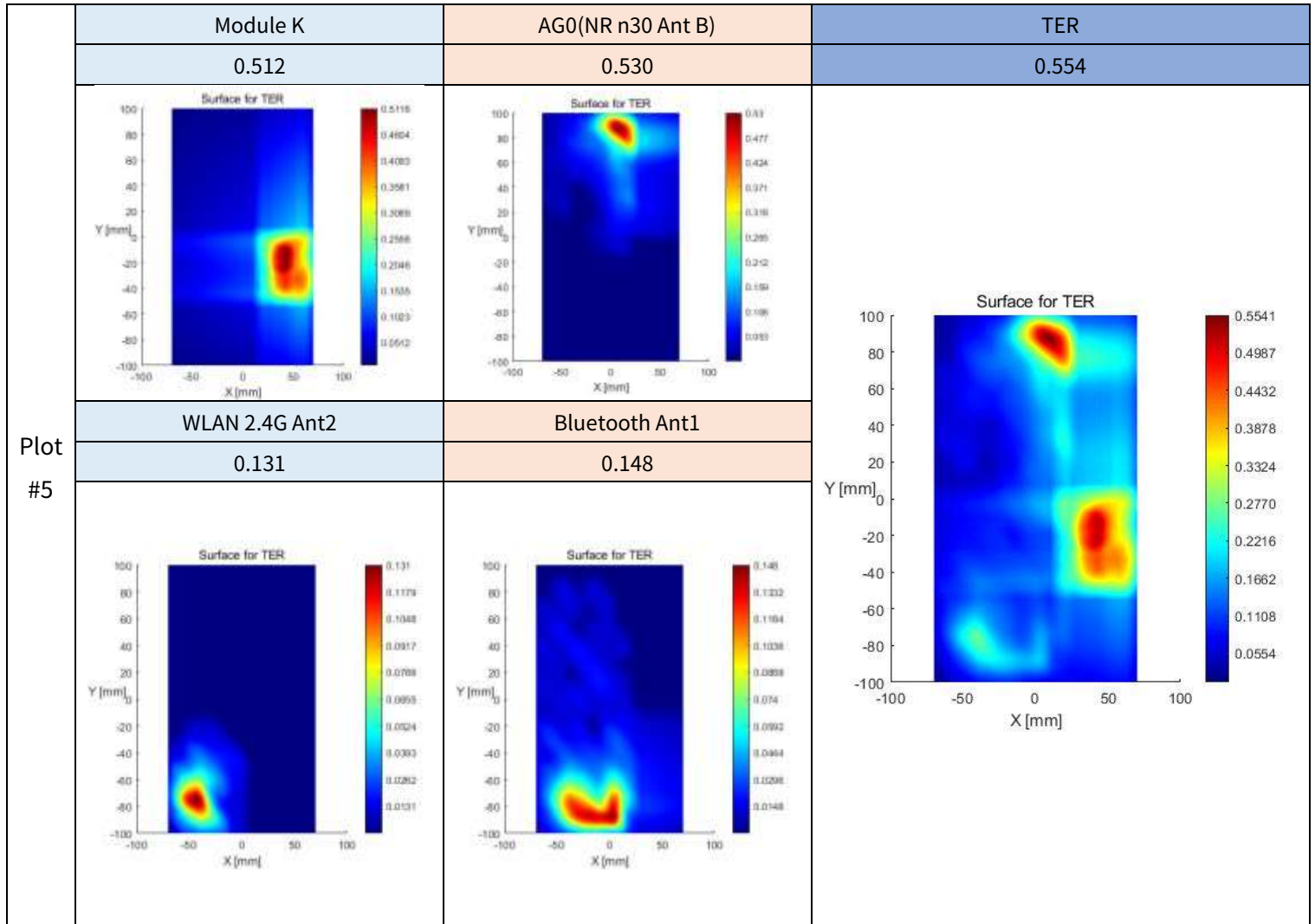


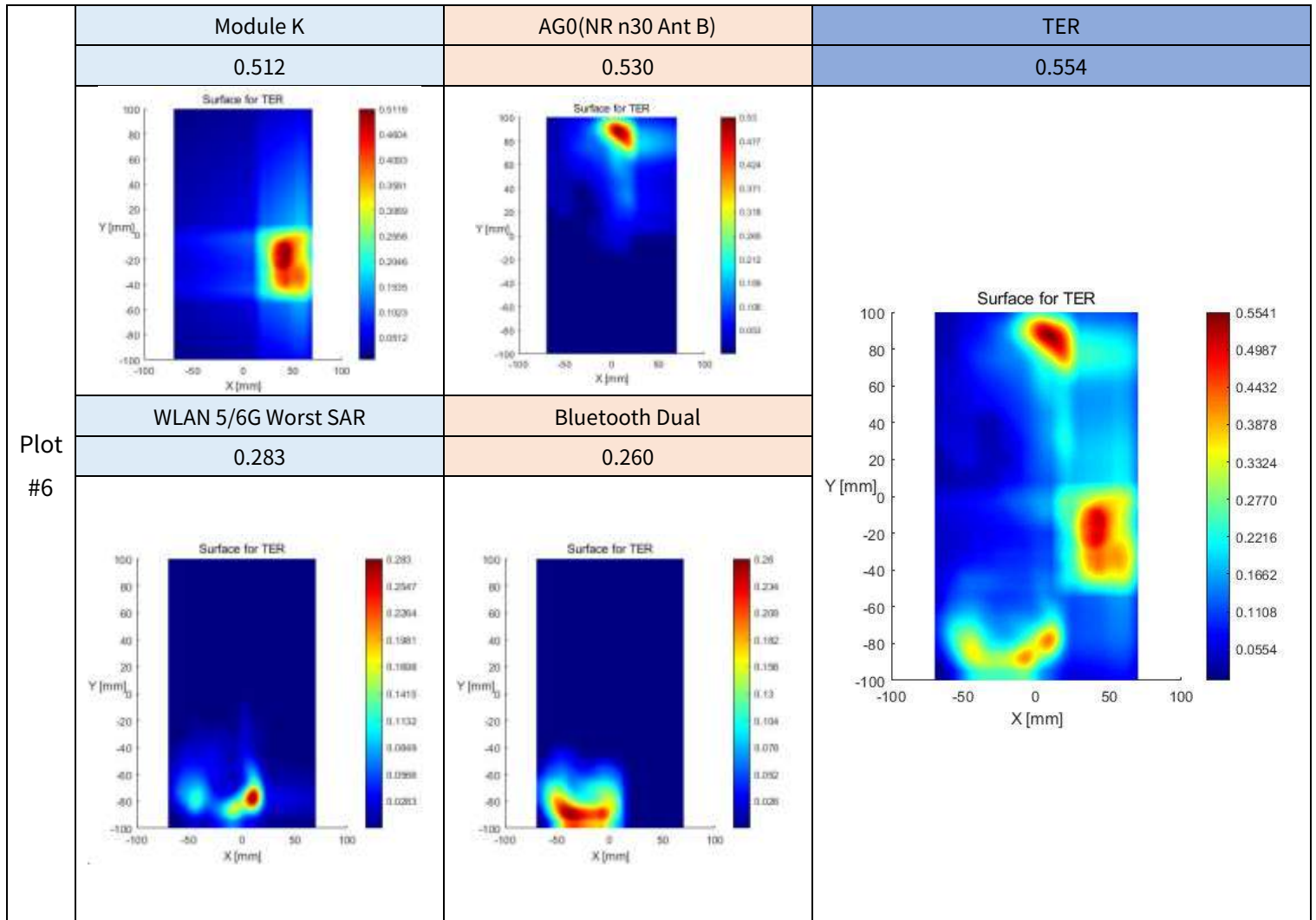




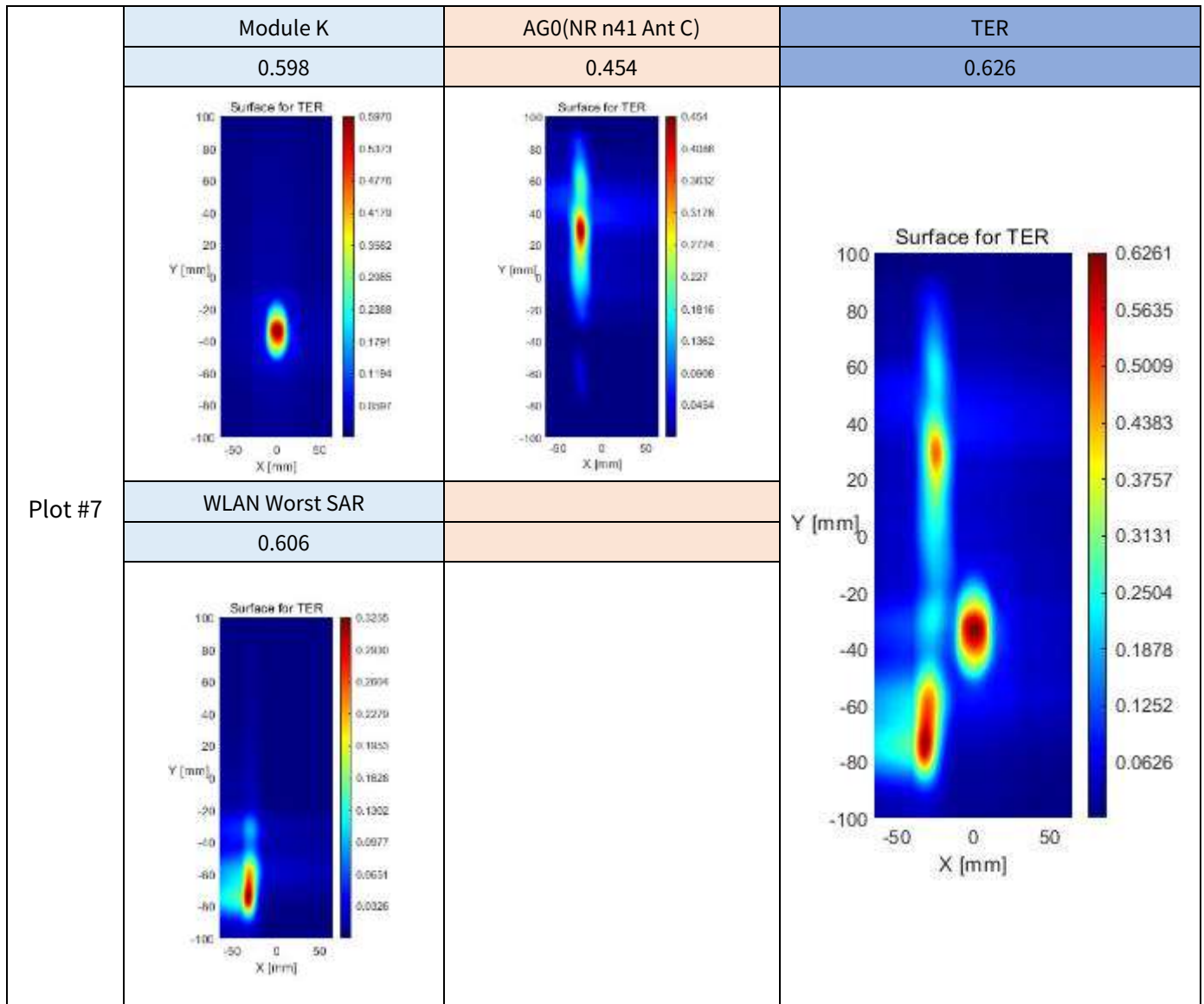
8.2.2 Body Open Front Postion

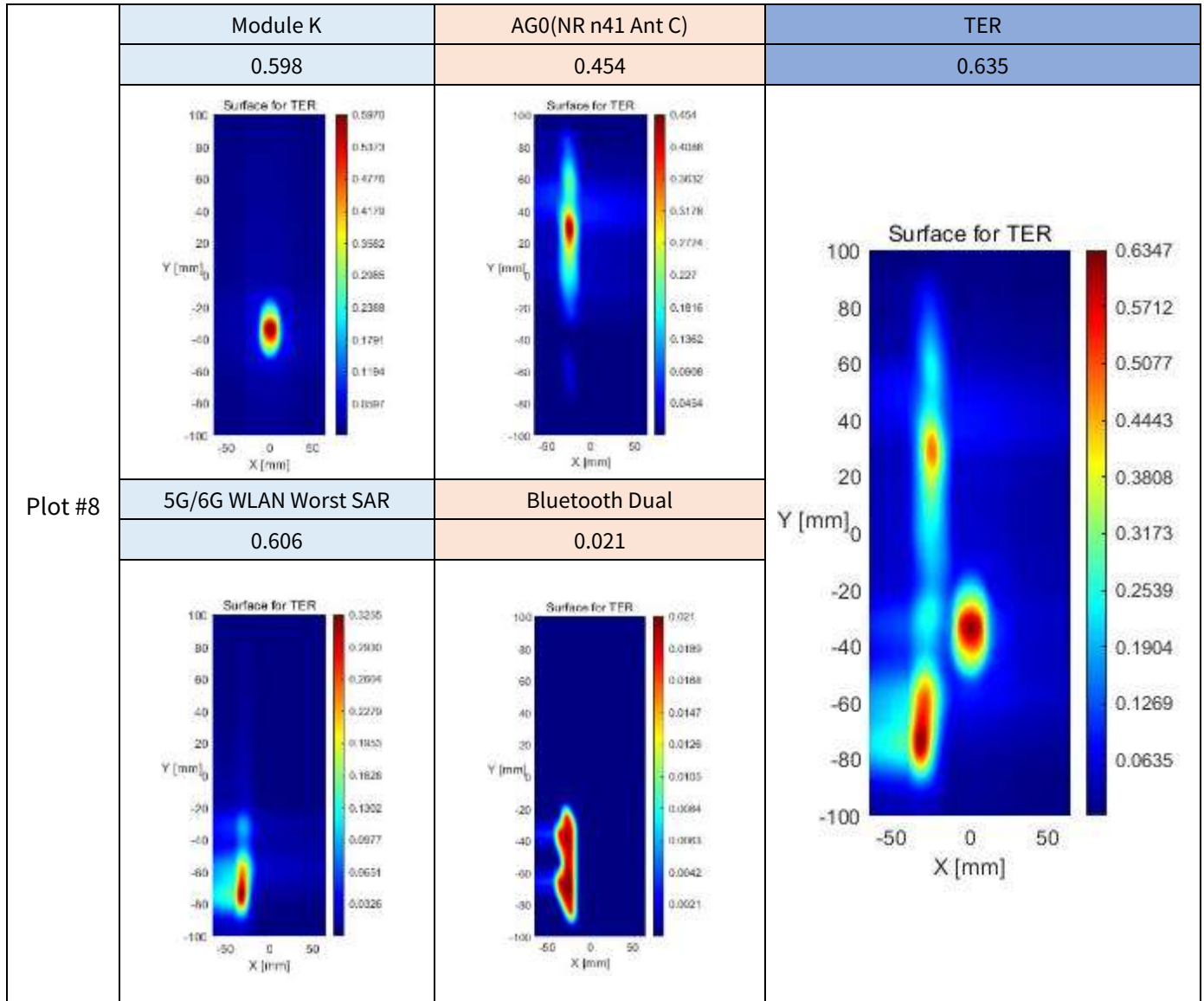




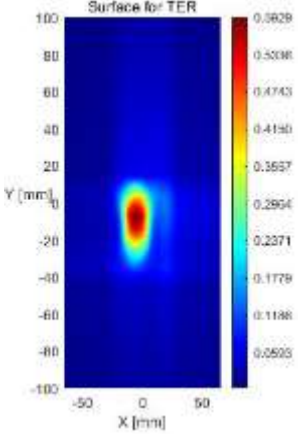
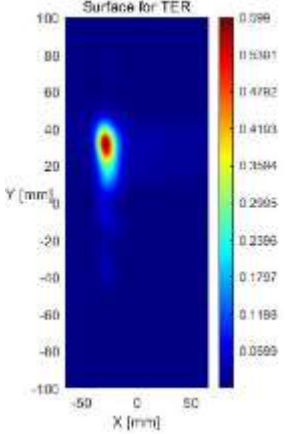
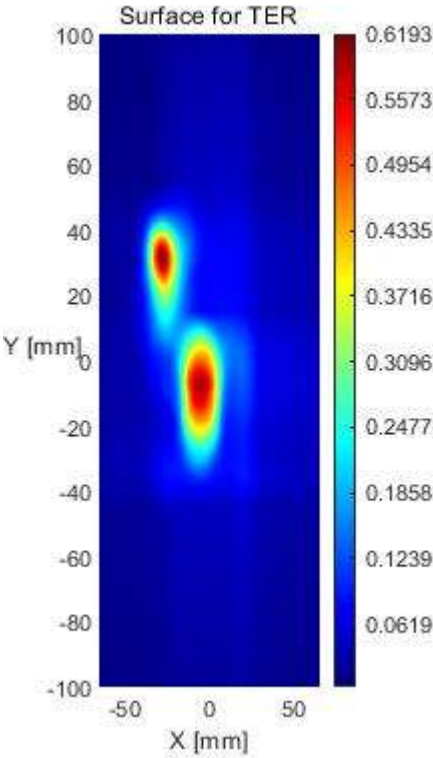
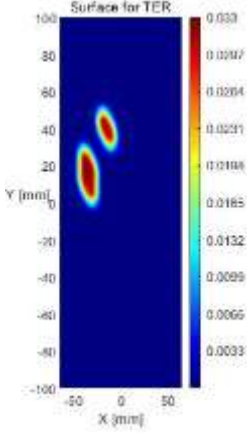


8.2.3 Body Open Left Postion





8.2.4 Body Closed Left Postion

Plot #8	Module K	5G/6G WLAN Worst SAR	TER
	0.593	0.599	0.619
			
	Bluetooth Dual		
	0.033		
			

Note:

1. Worst case Power density results for each test configuration among all antenna arrays and among all supported bands were considered for TER Analysis.
2. For Power density measurements, a test separation distance of 2mm was used for phablet configuration and Head SAR Configuration due to mmWave probe restraints.
3. The worst-case between Adjusted Reported_psPD and Measured Total psPD was chosen for TER analysis.
4. The maximum SAR measurement results of the rear and left sides of AG0 and the TER evaluation of mmWave FR2 [AG1] were performed, and it was confirmed that AG0 and mmWave antenna (AG1) are decoupled from each other, and the FCC's TER limit is also complied with.
5. The simultaneous transmission evaluation of mmWave FR2 [AG1] and LTE/NR [AG1] between the same antenna group was verified in the part 2 TAS test report.

The above numerical summed PD and SAR for all the worst case simultaneous transmission conditions were Total Exposure Ratio.

Therefore, the above analysis is sufficient to determine no further test cases are required and that simultaneous transmission is compliant to the FCC RF exposure limit.

9. Measurement Uncertainty

Measurement Uncertainty for CDASY6 mmWave module						
a	b	c	d	e	f = b x e / d	g
Source of uncertainty	Uncertainty Value (± dB)	Probability distribution	Div.	ci	Standard Uncertainty (± dB)	vi
Probe calibration	0.49	N	1	1	0.49	∞
Probe correction	0.00	R	1.73	1	0.00	∞
Frequency Response(BW ≤ 1 GHz)	0.20	R	1.73	1	0.12	∞
Sensor cross coupling	0.00	R	1.73	1	0.00	∞
Istropy	0.50	R	1.73	1	0.29	∞
Linearity	0.20	R	1.73	1	0.12	∞
Probe scattering	0.00	R	1.73	1	0.00	∞
Probe positioning offset	0.30	R	1.73	1	0.17	∞
Probe positioning Repeatability	0.04	R	1.73	1	0.02	∞
Probe spatial Resolution	0.00	R	1.73	1	0.00	∞
Field Impedence Dependence	0.00	R	1.73	1	0.00	∞
Sensor Mechanical Offset	0.00	R	1.73	1	0.00	∞
Amplitude and Phase noise	0.04	R	1.73	1	0.02	∞
Measurement area truncation	0.00	R	1.73	1	0.00	∞
Data acquisition	0.03	N	1	1	0.03	∞
Field Reconstruction	0.60	R	1.73	1	0.35	∞
Forward Transformation	0.00	R	1.73	1	0.00	∞
Power density Scaling	0.00	R	1.73	1	0.00	∞
Spatial Averaging	0.10	R	1.73	1	0.06	∞
Test sample and Environmental Factors						
Probe coupling with DUT	0.00	R	1.73	1	0.00	∞
Modulation Response	0.40	R	1.73	1	0.23	∞
Integration time	0.00	R	1.73	1	0.00	∞
Response time	0.00	R	1.73	1	0.00	∞
Device holder influence	0.10	R	1.73	1	0.06	∞
DUT alignment	0.00	R	1.73	1	0.00	∞
RF Ambient Conditions	0.04	R	1.73	1	0.02	∞
RF ambient - reflections	0.04	R	1.73	1	0.02	∞
Immunity/Secondary Reception	0.00	R	1.73	1	0.00	∞
Power Drif of DUT	0.21	R	1.73	1	0.12	∞
Combined standard uncertainty (k = 1)		RSS			0.76	∞
Expanded uncertainty (95% confidence level)		k = 2			1.52	

10 Power Density Test Equipment

Manufacturer	Type / Model	S/N	Calib. Date	Calib.Interval	Calib.Due
SPEAG	5G Module Phantom	-	N/A	N/A	N/A
HP	SAR System Control PC	-	N/A	N/A	N/A
Staubli	CS8Cspeag-TX60	F/20/0018446/C/001	N/A	N/A	N/A
Staubli	TX60 Lspeag	F/20/0018446/A/001	N/A	N/A	N/A
Staubli	D21142608A	020885	N/A	N/A	N/A
SPEAG	DAE4	868	09/19/2024	Annual	09/19/2025
SPEAG	E-Field Probe EUmmWV4	9528	05/17/2024	Annual	05/17/2025
SPEAG	Dipole 5G Verification Source 30 GHz	1011	07/09/2024	Annual	07/09/2025
TESTO	175-H1	44606611906	03/20/2025	Annual	03/20/2026

11. Conclusion

The Power density measurements and total exposure ratio analysis indicate that the DUT complies with the RF radiation exposure limits of the FCC, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the RF Exposure and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

12. References

- [1] ANSI/IEEE C95.1-1992, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, Sep. 1992.
- [2] IEC TR 63170:2018, Measurement Procedure for the Evaluation of Power Density Related to Human Exposure to Radiofrequency Fields from Wireless Communication Devices Operating between 6GHz and 100GHz.
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- [10] October 2018 Telecommunications Certification Body Council (TCBC) Workshop Notes
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- [13] SPEAG DASY6 System Handbook (September 2019)

Appendix A. – DUT Ant. Information & SETUP PHOTO

Please refer to test DUT Ant. Information & setup photo file no. as follows:

Report No.
HCT-SR-2504-FC005-P