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NEAR-FIELD POWER DENSITY EVALUATION REPORT

Applicant Name
Samsung Electronics Co., Ltd.
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Gyeonggi-do, 16677, Korea

Date of Testing
09/22/2023 – 10/11/2023
Test Site/Location
Element, Columbia, MD, USA
Document Serial No:
1M2308210092-22.A3L

FCC ID: **A3LSMS928U**

APPLICANT: **SAMSUNG ELECTRONICS CO., LTD.**

DUT Type: Portable Handset
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model: SM-S928U, SM-S928U1

Band & Mode	Tx Frequency	Measured psPD	Reported psPD
	MHz	mW/cm²	mW/cm²
n258	24250 - 24450; 24750 - 25250	0.526	0.851
n261	27500 - 28350	0.629	0.851
n260	37000 - 40000	0.620	0.851
Verdict		**PASS**	

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.

RJ Ortanez
Executive Vice President

ACCREDITED
CERTIFICATE # 2041.01

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1 DEVICE UNDER TEST

1.1 NR FR2 Checklist

NR FR2 Operations Information	
Form Factor	Portable Handset
Subcarrier Spacing (kHz)	120
Total Number of Supported Uplink CCs (SISO)	4
Total Number of Supported Uplink CCs (MIMO)	4
Total Number of Supported DL CCs	8
CP-OFDM Modulations Supported in UL	QPSK, 16QAM, 64QAM
DFT-s-OFDM Modulations Supported in UL	PI/2 BPSK, QPSK, 16QAM, 64QAM
LTE Anchor Bands	n258: 2/5/12/66/71, n261: 2/5/12/13/48/66, n260: 2/5/12/13/14/30/48/66
NR FR1 Anchor Bands	n258: 2/12/25/41/66/77, n261: 2/5/25/41/48/66/77, n260: 2/5/12/25/30/41/48/66/77
Duplex Type (mmWave)	TDD

NR FR2 Channels & Frequencies							
NR Band	Bandwidth (MHz)	Low		Mid		High	
		Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
n258	100	2018333	24350.04	2025833	24800.04	2032499	25200.00
n258	50	2018333	24350.04	2025833	24800.04	2032915	25224.96
n261	100	2071667	27550.08	2077915	27924.96	2084165	28299.96
n261	50	2071249	27525.00	2077915	27924.96	2084581	28324.92
n260	100	2229999	37050.00	2254165	38499.96	2278331	39949.92
n260	50	2229599	37026.00	2254165	38499.96	2278749	39975.00

1.2 Time-Averaging Algorithm for RF Exposure Compliance

The device is enabled with Qualcomm® Smart Transmit GEN2 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. Refer to Compliance Summary document for detailed description of Qualcomm® Smart Transmit.

The Smart Transmit 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., P_{limit} for sub-6 radio and WLAN radio, and *input.power.limit* for 5G mmW NR), for each characterized technology and band (see RF Exposure Part 0 Test Report).

Smart Transmit 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.*

1.3 Power Density Design Target and Uncertainty

Power Density Design Specifications	
PD_design_target **(mW/m^2)**	0.631
Design Related Total Uncertainty (dB)	1.4

1.4 Input Power Specifications

All power density measurements for this device were performed at the *input.power.limit* given in below tables. Input power is per antenna element and polarization for each antenna module. When input.power.limit is calculated to be above the maximum input power, the device is limited to the maximum input power.

Table 1-1
5G mmWave NR n258 Antenna M Patch input.power.limit

Band	Beam ID 1	Beam ID 2	input.power.limit
n258	0		16.2
n258	2		11.2
n258	4		11.3
n258	6		12.9
n258	8		11.0
n258	10		9.2
n258	11		9.4
n258	12		8.4
n258	13		10.1
n258	18		8.9
n258	19		9.3
n258	20		9.7
n258	24		6.8
n258	25		5.8
n258	26		3.9
n258	27		4.3
n258	28		6.7
n258	34		6.7
n258	35		4.4
n258	36		3.8
n258	37		5.4
n258		256	10.0
n258		258	9.7
n258		260	9.7
n258		262	10.4
n258		264	10.1
n258		266	7.6
n258		267	6.2
n258		268	6.1
n258		269	7.3
n258		274	6.6
n258		275	6.0
n258		276	6.2
n258		280	3.0
n258		281	2.1
n258		282	2.7
n258		283	2.5
n258		284	1.7
n258		290	2.0
n258		291	2.5
n258		292	2.5
n258		293	2.2
n258	0	256	8.0
n258	2	258	7.1
n258	4	260	7.1
n258	6	262	7.8
n258	8	264	7.3
n258	10	266	4.4
n258	11	267	3.9
n258	12	268	4.3
n258	13	269	5.3
n258	18	274	3.8
n258	19	275	3.8
n258	20	276	5.4
n258	24	280	-0.1
n258	25	281	0.2
n258	26	282	-0.1
n258	27	283	0.1
n258	28	284	0.2
n258	34	290	-0.4
n258	35	291	0.1
n258	36	292	-0.1
n258	37	293	0.5

Table 1-2
5G mmWave NR n261 Antenna M Patch input.power.limit

Band	Beam ID 1	Beam ID 2	input.power.limit
n261	0		14.6
n261	2		11.5
n261	4		11.4
n261	6		11.5
n261	8		12.2
n261	10		9.2
n261	11		8.4
n261	12		8.5
n261	13		9.1
n261	18		9.2
n261	19		7.1
n261	20		10.8
n261	24		7.1
n261	25		4.9
n261	26		4.1
n261	27		5.0
n261	28		6.1
n261	34		5.8
n261	35		4.4
n261	36		4.4
n261	37		5.4
n261		256	9.9
n261		258	10.0
n261		260	10.3
n261		262	9.8
n261		264	10.3
n261		266	7.1
n261		267	6.3
n261		268	6.2
n261		269	6.7
n261		274	6.8
n261		275	6.2
n261		276	7.0
n261		280	2.0
n261		281	3.2
n261		282	3.2
n261		283	2.9
n261		284	2.0
n261		290	2.3
n261		291	3.3
n261		292	3.2
n261		293	2.2
n261	0	256	7.8
n261	2	258	7.4
n261	4	260	7.7
n261	6	262	7.1
n261	8	264	8.0
n261	10	266	4.8
n261	11	267	4.7
n261	12	268	4.3
n261	13	269	5.1
n261	18	274	4.6
n261	19	275	3.5
n261	20	276	4.9
n261	24	280	0.1
n261	25	281	0.6
n261	26	282	0.4
n261	27	283	0.3
n261	28	284	0.0
n261	34	290	0.0
n261	35	291	0.5
n261	36	292	0.5
n261	37	293	0.3

Table 1-3
5G mmWave NR n260 Antenna M Patch input.power.limit

Band	Beam ID 1	Beam ID 2	input.power.limit
n260	0		11.4
n260	2		11.5
n260	4		11.2
n260	6		11.3
n260	8		12.3
n260	10		8.4
n260	11		8.0
n260	12		9.4
n260	13		8.7
n260	18		7.8
n260	19		9.5
n260	20		8.7
n260	24		4.5
n260	25		4.4
n260	26		4.9
n260	27		5.9
n260	28		5.5
n260	34		4.4
n260	35		4.9
n260	36		5.8
n260	37		5.6
n260		256	11.3
n260		258	11.0
n260		260	10.4
n260		262	10.2
n260		264	11.3
n260		266	7.5
n260		267	7.9
n260		268	7.7
n260		269	7.7
n260		274	8.5
n260		275	7.9
n260		276	7.2
n260		280	5.2
n260		281	4.0
n260		282	3.9
n260		283	4.5
n260		284	4.1
n260		290	4.1
n260		291	4.7
n260		292	3.9
n260		293	4.0
n260	0	256	8.2
n260	2	258	7.9
n260	4	260	7.6
n260	6	262	7.0
n260	8	264	8.4
n260	10	266	4.0
n260	11	267	5.4
n260	12	268	5.2
n260	13	269	4.6
n260	18	274	4.7
n260	19	275	5.5
n260	20	276	4.8
n260	24	280	1.0
n260	25	281	0.6
n260	26	282	0.9
n260	27	283	1.3
n260	28	284	1.1
n260	34	290	0.4
n260	35	291	0.9
n260	36	292	1.1
n260	37	293	1.0

Table 1-4
5G mmWave NR n258 Antenna N Patch input.power.limit

Band	Beam ID 1	Beam ID 2	input.power.limit
n258	1		11.2
n258	3		10.1
n258	5		10.4
n258	7		10.6
n258	9		11.8
n258	14		7.8
n258	15		6.7
n258	16		7.2
n258	17		8.3
n258	21		7.0
n258	22		6.2
n258	23		7.5
n258	29		3.4
n258	30		2.6
n258	31		2.4
n258	32		2.6
n258	33		4.3
n258	38		3.0
n258	39		2.4
n258	40		2.3
n258	41		3.5
n258		257	13.1
n258		259	13.3
n258		261	13.5
n258		263	13.4
n258		265	13.0
n258		270	10.2
n258		271	9.2
n258		272	9.2
n258		273	9.8
n258		277	9.6
n258		278	9.0
n258		279	10.6
n258		285	5.5
n258		286	4.8
n258		287	5.0
n258		288	5.4
n258		289	6.6
n258		294	5.0
n258		295	4.8
n258		296	5.2
n258		297	5.9
n258	1	257	8.5
n258	3	259	7.6
n258	5	261	7.7
n258	7	263	8.0
n258	9	265	8.2
n258	14	270	5.7
n258	15	271	4.0
n258	16	272	4.5
n258	17	273	5.2
n258	21	277	4.3
n258	22	278	3.6
n258	23	279	5.5
n258	29	285	0.6
n258	30	286	-0.3
n258	31	287	-0.3
n258	32	288	0.2
n258	33	289	1.6
n258	38	294	0.2
n258	39	295	-0.4
n258	40	296	-0.1
n258	41	297	1.1

Table 1-5
5G mmWave NR n261 Antenna N Patch input.power.limit

Band	Beam ID 1	Beam ID 2	input.power.limit
n261	1		10.9
n261	3		10.8
n261	5		10.5
n261	7		10.1
n261	9		10.8
n261	14		7.8
n261	15		6.7
n261	16		7.4
n261	17		7.8
n261	21		7.5
n261	22		7.5
n261	23		7.6
n261	29		3.8
n261	30		2.8
n261	31		3.0
n261	32		3.1
n261	33		3.7
n261	38		3.2
n261	39		3.1
n261	40		3.0
n261	41		3.2
n261		257	10.8
n261		259	10.1
n261		261	10.0
n261		263	10.2
n261		265	10.8
n261		270	6.6
n261		271	5.9
n261		272	6.3
n261		273	7.5
n261		277	6.8
n261		278	6.0
n261		279	6.7
n261		285	3.2
n261		286	2.5
n261		287	2.1
n261		288	2.1
n261		289	2.8
n261		294	2.7
n261		295	2.3
n261		296	2.1
n261		297	2.3
n261	1	257	7.4
n261	3	259	6.9
n261	5	261	6.8
n261	7	263	6.9
n261	9	265	7.2
n261	14	270	3.8
n261	15	271	3.1
n261	16	272	3.4
n261	17	273	4.3
n261	21	277	4.2
n261	22	278	3.2
n261	23	279	3.9
n261	29	285	-0.2
n261	30	286	-0.9
n261	31	287	-0.8
n261	32	288	-0.8
n261	33	289	-0.2
n261	38	294	-0.7
n261	39	295	-0.8
n261	40	296	-0.8
n261	41	297	-0.7

Table 1-6
5G mmWave NR n260 Antenna N Patch input.power.limit

Band	Beam ID 1	Beam ID 2	input.power.limit
n260	1		10.9
n260	3		10.4
n260	5		9.9
n260	7		10.2
n260	9		10.6
n260	14		6.6
n260	15		7.5
n260	16		7.9
n260	17		7.1
n260	21		6.5
n260	22		8.0
n260	23		7.0
n260	29		3.1
n260	30		3.1
n260	31		4.9
n260	32		3.5
n260	33		2.8
n260	38		3.1
n260	39		4.6
n260	40		4.5
n260	41		3.6
n260		257	11.4
n260		259	11.3
n260		261	11.0
n260		263	10.8
n260		265	11.3
n260		270	8.1
n260		271	7.5
n260		272	8.1
n260		273	7.7
n260		277	8.3
n260		278	8.0
n260		279	7.9
n260		285	5.4
n260		286	4.9
n260		287	4.7
n260		288	5.0
n260		289	5.1
n260		294	5.5
n260		295	4.9
n260		296	4.8
n260		297	5.5
n260	1	257	7.7
n260	3	259	7.2
n260	5	261	7.2
n260	7	263	6.9
n260	9	265	7.3
n260	14	270	3.9
n260	15	271	4.0
n260	16	272	4.4
n260	17	273	4.0
n260	21	277	4.0
n260	22	278	4.9
n260	23	279	3.9
n260	29	285	0.8
n260	30	286	0.4
n260	31	287	1.2
n260	32	288	0.8
n260	33	289	0.5
n260	38	294	0.6
n260	39	295	0.6
n260	40	296	1.0
n260	41	297	0.4

1.5 DUT Antenna Locations

The table below indicates the surfaces evaluated for near field power density (part 1) evaluation. Refer to RF Exposure Part 0 Test Report for justification of these worst-surfaces.

Table 1-7
Device Surfaces

Band	Antenna	Back	Front	Top	Bottom	Right	Left
n258	M	Yes	No	No	No	No	No
n261	M	Yes	No	No	No	No	No
n260	M	Yes	No	No	No	No	No
n258	N	No	No	No	No	Yes	No
n261	N	No	No	No	No	Yes	No
n260	N	No	No	No	No	Yes	No

1.6 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.

This 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 Multi-TX and Antenna SAR Considerations Appendix for simultaneous transmission analysis.

1.7 Guidance Applied

- November 2017, October 2018, April 2019, November 2019 TCBC Workshop Notes
- SPEAG DASY6 System Handbook
- IEC/IEEE 63195-1:2022
- FCC KDB 865664 D02 v01r04
- FCC KDB 447498 D01 v02r01

1.8 Bibliography

Table 1-8
Bibliography

Report Type	Report Serial Number
FCC SAR Evaluation Report (Part 1)	1M2308210092-24.A3L
Power Density Part 0 Test Report	
RF Exposure Part 2 Test Report	1M2308210092-23.A3L
RF Exposure Compliance Summary Report	1M2308210092-25.A3L
Power Density Simulation Report	

2 MEASUREMENT SYSTEM

2.1 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).

2.2 SPEAG EUmmWVx Probe / E-Field 5G Probe

The EUmmWVx 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

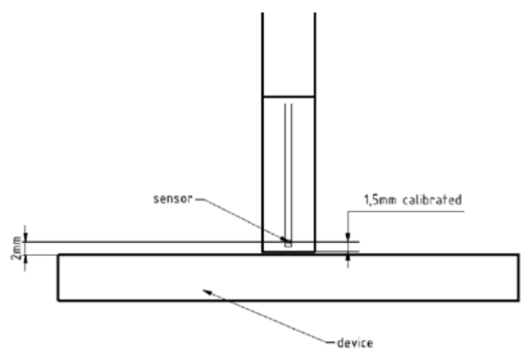

Figure 2-1
EUmmWVx Probe

2.3 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 fields. 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 characterize the total E-field and H-field distributions. Nevertheless, solutions based on direct measurement of 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 λ/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 λ/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*, 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.

2.4 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 equations. 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 EUmmWVx probe.

3 RF EXPOSURE LIMITS FOR POWER DENSITY

3.1 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.

3.2 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. 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.

3.3 RF Exposure Limits for Frequencies Above 6 GHz

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.

Table 3-1
Human Exposure Limits Specified in FCC 47 CFR §1.1310

Human Exposure to Radiofrequency (RF) Radiation Limits		
Frequency Range [MHz]	**Power Density** [mW/cm^2]	**Average Time** [Minutes]
(A) Limits For Occupational / Controlled Environments		
1,500 – 100,000	5.0	6
(B) Limits For General Population / Uncontrolled Environments		
1,500 – 100,000	1.0	30

Note: 1.0 mW/cm^2 is 10 W/m^2

4 SYSTEM VERIFICATION

4.1 Test 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 provided by the manufacturer, per November 2017 TCBC Workshop Notes.

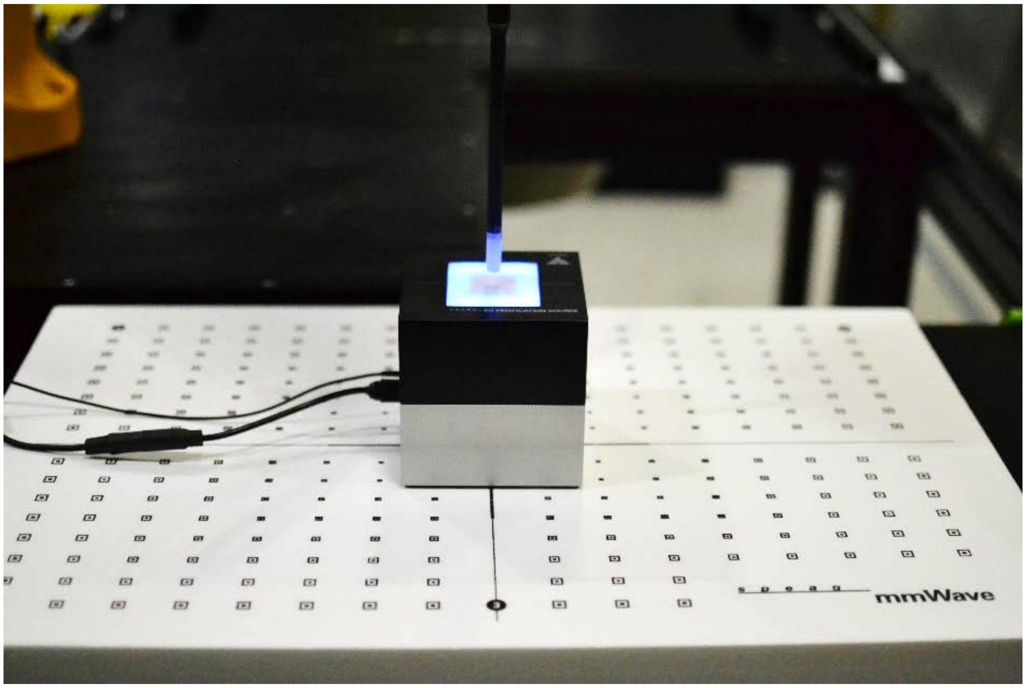

Figure 4-1
System Verification Setup Photo

Table 4-2
30 GHz Verifications

System Verification											
System	Frequency	Date	Source S/N	Probe S/N	Normal psPD (W/m² over 4 cm²)		Deviation (dB)	Total psPD (W/m² over 4 cm²)		Deviation (dB)	Plot #
					Measured	Target		Measured	Target		
R	30	09/22/2023	1035	9622	32.60	32.70	-0.01	33.00	32.70	0.04	B1
R	30	09/25/2023	1035	9622	33.10	32.70	0.05	33.50	32.70	0.10	B2
R	30	10/11/2023	1035	9622	33.60	32.70	0.12	34.00	32.70	0.17	B3

Note: A **10 mm 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 set up.

5 POWER DENSITY DATA @ INPUT.POWER.LIMIT

5.1 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-surface.

Table 5-1
5G mmWave NR Band n258

MEASUREMENT RESULTS															
Band	Module	Antenna Type	Frequency	Channel	Beam ID 1	Beam ID 2	input.power.limit	Signal Type	DUT S/N	Power Drift	Distance	DUT Surface	Normal psPD	Total psPD	Plot #
			MHz		V	H	dBm			dB	mm		mW/cm²	mW/cm²	
n258	M	Patch	25200.00	high	36		3.80	CW	WHV0054M	0.11	2	Back	0.260	0.311	
n258	M	Patch	25200.00	high		284	1.70	CW	WHV0054M	-0.01	2	Back	0.309	0.526	A1
n258	M	Patch	25200.00	high	34	290	-0.40	CW	WHV0054M	0.01	2	Back	0.146	0.197	
n258	N	Patch	24800.04	mid	40		2.3	CW	WHV0054M	-0.12	2	Right	0.296	0.355	
n258	N	Patch	25200.00	high		286	4.8	CW	WHV0054M	-0.13	2	Right	0.429	0.500	A2
n258	N	Patch	25200.00	high	39	295	-0.4	CW	WHV0054M	-0.03	2	Right	0.390	0.359	
47 CFR §1.1310 - SAFETY LIMIT Spatial Average Uncontrolled Exposure / General Population									Power Density 1 mW/cm² averaged over 4 cm²						

Table 5-2
5G mmWave NR Band n261

MEASUREMENT RESULTS															
Band	Module	Antenna Type	Frequency	Channel	Beam ID 1	Beam ID 2	input.power.limit	Signal Type	DUT S/N	Power Drift	Distance	DUT Surface	Normal psPD	Total psPD	Plot #
			MHz		V	H	dBm			dB	mm		mW/cm²	mW/cm²	
n261	M	Patch	27924.96	mid	26		4.10	CW	WHV0054M	-0.10	2	Back	0.511	0.580	A3
n261	M	Patch	27550.08	low		280	2.00	CW	WHV0054M	-0.02	2	Back	0.350	0.522	
n261	M	Patch	28299.96	high	34	290	0.00	CW	WHV0054M	0.04	2	Back	0.399	0.523	
n261	N	Patch	27924.96	mid	30		2.8	CW	WHV0054M	-0.02	2	Right	0.355	0.419	
n261	N	Patch	28299.96	high		296	2.1	CW	WHV0054M	-0.03	2	Right	0.589	0.629	A4
n261	N	Patch	28299.96	high	30	286	-0.9	CW	WHV0054M	0.04	2	Right	0.362	0.434	
47 CFR §1.1310 - SAFETY LIMIT Spatial Average Uncontrolled Exposure / General Population									Power Density 1 mW/cm² averaged over 4 cm²						

Table 5-3
5G mmWave NR Band n260

MEASUREMENT RESULTS															
Band	Module	Antenna Type	Frequency	Channel	Beam ID 1	Beam ID 2	input.power.limit	Signal Type	DUT S/N	Power Drift	Distance	DUT Surface	Normal psPD	Total psPD	Plot #
			MHz		V	H	dBm			dB	mm		mW/cm^2	mW/cm^2	
n260	M	Patch	39949.92	high	25		4.40	CW	WHV0054M	0.01	2	Back	0.374	0.475	
n260	M	Patch	38499.96	mid		282	3.90	CW	WHV0054M	0.02	2	Back	0.427	0.490	A5
n260	M	Patch	39949.92	high	34	290	0.40	CW	WHV0054M	0.05	2	Back	0.333	0.408	
n260	N	Patch	38499.96	mid	33		2.8	CW	WHV0054M	-0.06	2	Right	0.436	0.620	A6
n260	N	Patch	38499.96	mid		287	4.7	CW	WHV0054M	-0.08	2	Right	0.450	0.548	
n260	N	Patch	38499.96	mid	41	297	0.4	CW	WHV0054M	0.04	2	Right	0.359	0.436	
47 CFR §1.1310 - SAFETY LIMIT Spatial Average Uncontrolled Exposure / General Population									Power Density 1 mW/cm^2 averaged over 4 cm^2						

5.2 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 λ/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 RF Exposure Part 0 test report.
6. This device is enabled with Qualcomm® Smart Transmit feature to control and manage transmitting power in real time and to ensure that the time-averaged RF exposure from WWAN and WLAN is in compliance with FCC requirements. Per FCC guidance for devices enabled with Qualcomm® Smart Transmit feature, 4G LTE/5G NR FR1, WLAN/BT, 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 WLAN technologies are reported in Part 2 report.
7. Per FCC guidance for devices enabled with Qualcomm® Smart Transmit feature, simultaneous transmission analysis is evaluated by combining the exposure from each WWAN and WLAN antenna. 5G mmW NR and NFC/UWB simultaneous transmission scenario is evaluated under the SAR Part 1 Multi-TX and Antenna SAR Considerations Appendix.
8. The Beam IDs with one of the highest initial simulated power density for that surface and distance was selected for Part 1 Power Density measurements.
9. The device was configured to transmit CW wave signal for testing. Per FCC guidance for devices enabled with Qualcomm® Smart Transmit feature, additional testing was not required for different modulations (CP-OFDM: QPSK, 16QAM, 64QAM, DFT-s-OFDM: PI/2 BPSK, QPSK, 16QAM, 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.
10. The device was configured to MIMO configuration with H and V polarization beams transmitting together.

6 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	WL25-1	Conducted Cable Set (25GHz)	N/A	N/A	N/A	WL25-1
-	WL40-1	Conducted Cable Set (40GHz)	N/A	N/A	N/A	WL40-1
Agilent	N9038A	MXE EMI Receiver	N/A	N/A	N/A	MY51210133
EMCO	3160-09	Small Horn (18 - 26.5GHz)	N/A	N/A	N/A	00135427
Emco	3116	Horn Antenna (18 - 40GHz)	N/A	N/A	N/A	9203-2178
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	N/A	N/A	N/A	102133
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	N/A	N/A	N/A	103200
SPEAG	EUmmWV4	EUmmWV4 Probe	02/15/2023	Annual	02/15/2024	9622
SPEAG	SM 003 100 AA	30GHz System Verification Ka- Band Source Antenna	02/07/2023	Annual	02/07/2024	1035
SPEAG	DAE4ip	Dasy Data Acquisition Electronics	11/16/2022	Annual	11/16/2023	1639
Agilent	N9030A	PXA Signal Analyzer (44GHz)	N/A	N/A	N/A	MY52350166
Emco	3115	Horn Antenna (1-18GHz)	N/A	N/A	N/A	9704-5182
Keysight Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	N/A	N/A	N/A	MY49430494
Rohde & Schwarz	180-442-KF	Horn (Small)	N/A	N/A	N/A	U157403-01
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	N/A	N/A	N/A	100342
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	N/A	N/A	N/A	102134
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	N/A	N/A	N/A	A051107
Virginia Diodes Inc	SAX252	Spectrum Analyzer Extension Module	N/A	N/A	N/A	SAX252
Virginia Diodes Inc	SAX253	Spectrum Analyzer Extension Module	N/A	N/A	N/A	SAX253
Virginia Diodes Inc	SAX254	Spectrum Analyzer Extension Module	N/A	N/A	N/A	SAX254

Note:
1. Each equipment item was used solely within its respective calibration period.

7 MEASUREMENT UNCERTAINTIES

a	b	c	d	e	f = c x f/e	g
Uncertainty Component	Unc. (± dB)	Prob. Dist.	Div.	c_i	u_i (± dB)	v_i
Measurement System						
Calibration	0.49	N	1	1	0.49	∞
Probe Correction	0.00	R	1.73	1	0.00	∞
Frequency Response	0.20	R	1.73	1	0.12	∞
Sensor Cross Coupling	0.00	R	1.73	1	0.00	∞
Isotropy	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	∞
Sensor MechanicalOffset	0.00	R	1.73	1	0.00	∞
Probe Spatial Resolution	0.00	R	1.73	1	0.00	∞
Field Impedence Dependance	0.00	R	1.73	1	0.00	∞
Amplitude and Phase Drift	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	∞
Sampling	0.00	R	1.73	1	0.00	∞
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	∞
System Detection Limit	0.04	R	1.73	1	0.02	∞
Test Sample Related						
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	∞
Ambient Reflections	0.04	R	1.73	1	0.02	∞
Immunity/Secondary Reception	0.00	R	1.73	1	0.00	∞
Drift 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	

8 CONCLUSION

8.1 Measurement 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.

9 REFERENCES

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[9] November 2017 Telecommunications Certification Body Council (TCBC) Workshop Notes

[10] October 2018 Telecommunications Certification Body Council (TCBC) Workshop Notes

[11] April 2019 Telecommunications Certification Body Council (TCBC) Workshop Notes

[12] November 2019 Telecommunications Certification Body Council (TCBC) Workshop Notes

[13] SPEAG DASY6 System Handbook (September 2019)