ELEMENT MATERIALS TECHNOLOGY

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NEAR-FIELD POWER DENSITY EVALUATION REPORT

Applicant Name
Microsoft Corporation
One Microsoft Way
Redmond, WA 98052 USA
Microsoft Corporation

Date of Testing
04/12/2022 – 05/12/2022
Test Site/Location
Element, Columbia, MD, USA
Document Serial No:
1M2204040049-25.C3K (Rev 1)

FCC ID: **C3K1997**

APPLICANT: **MICROSOFT CORPORATION**

DUT Type: Portable Computing Device
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model: 1997

Band & Mode	Tx Frequency	Measured psPD	Reported psPD
	MHz	mW/cm²	mW/cm²
n261	27500 - 28350	0.774	0.750
n260	37000 - 40000	0.585	0.750
Total Exposure Ratio		**0.984**	
Verdict		**PASS**	

Note: This revised Test Report supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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

ilac-MRA

ACCREDITED
CERTIFICATE # 2041.01

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1 DEVICE UNDER TEST

1.1 NR FR2 Checklist

NR FR2 Operations Information	
Form Factor	Portable Computing Device
Subcarrier Spacing (kHz)	120
Total Number of Supported Uplink CCs (SISO)	2
Total Number of Supported Uplink CCs (MIMO)	2
Total Number of Supported DL CCs	4
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	n261: 2/5/13/48/66, n260: 2/5/12/13/14/30/48/66
Duplex Type (mmWave)	TDD

NR FR2 Channels & Frequencies							
NR Band	Bandwidth (MHz)	Low		Mid		High	
		Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
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 GEN1 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. Note that WLAN operations are not enabled with 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 *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)**	0.6166
Design Related Total Uncertainty (dB)	2.1

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 n261 Antenna 0 input.power.limit

Band	Beam ID 1	Beam ID 2	input.power.limit
n261	0	-	7.5
n261	2	-	6.9
n261	4	-	6.9
n261	6	-	6.7
n261	8	-	4.0
n261	9	-	3.8
n261	10	-	4.3
n261	11	-	4.0
n261	16	-	3.8
n261	17	-	3.9
n261	18	-	3.9
n261	22	-	2.5
n261	23	-	1.7
n261	24	-	2.5
n261	25	-	2.4
n261	26	-	2.5
n261	32	-	2.2
n261	33	-	1.4
n261	34	-	2.1
n261	35	-	2.4
n261	-	128	7.6
n261	-	130	7.7
n261	-	132	7.9
n261	-	134	8.8
n261	-	136	5.6
n261	-	137	5.9
n261	-	138	5.1
n261	-	139	5.5
n261	-	144	4.9
n261	-	145	6.6
n261	-	146	5.3
n261	-	150	2.2
n261	-	151	2.6
n261	-	152	3.2
n261	-	153	3.4
n261	-	154	3.1
n261	-	160	2.5
n261	-	161	3.0
n261	-	162	2.9
n261	-	163	4.5
n261	0	128	4.5
n261	2	130	4.0
n261	4	132	4.2
n261	6	134	3.7
n261	8	136	1.7
n261	9	137	1.8
n261	10	138	1.5
n261	11	139	1.8
n261	16	144	1.1
n261	17	145	2.0
n261	18	146	3.0
n261	22	150	-0.9
n261	23	151	-0.8
n261	24	152	0.1
n261	25	153	0.3
n261	26	154	-0.1
n261	32	160	-0.7
n261	33	161	-0.8
n261	34	162	-0.1
n261	35	163	0.2

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

Band	Beam ID 1	Beam ID 2	input.power.limit
n261	1	-	8.8
n261	3	-	7.3
n261	5	-	7.1
n261	7	-	7.4
n261	12	-	4.7
n261	13	-	3.9
n261	14	-	4.2
n261	15	-	4.9
n261	19	-	4.9
n261	20	-	4.0
n261	21	-	4.1
n261	27	-	3.9
n261	28	-	2.4
n261	29	-	2.3
n261	30	-	2.7
n261	31	-	3.1
n261	36	-	3.1
n261	37	-	2.2
n261	38	-	2.6
n261	39	-	2.9
n261	-	129	7.2
n261	-	131	7.6
n261	-	133	7.6
n261	-	135	7.4
n261	-	140	4.9
n261	-	141	5.0
n261	-	142	4.7
n261	-	143	5.1
n261	-	147	5.0
n261	-	148	4.8
n261	-	149	4.8
n261	-	155	2.5
n261	-	156	2.5
n261	-	157	2.8
n261	-	158	2.9
n261	-	159	2.6
n261	-	164	2.2
n261	-	165	2.5
n261	-	166	2.7
n261	-	167	2.6
n261	1	129	4.2
n261	3	131	4.4
n261	5	133	4.2
n261	7	135	4.3
n261	12	140	1.4
n261	13	141	1.2
n261	14	142	1.2
n261	15	143	1.5
n261	19	147	2.2
n261	20	148	1.5
n261	21	149	1.6
n261	27	155	-0.5
n261	28	156	-1.0
n261	29	157	-0.7
n261	30	158	-0.6
n261	31	159	-0.4
n261	36	164	-0.6
n261	37	165	-0.9
n261	38	166	-0.6
n261	39	167	-0.5

Table 1-3
5G mmWave NR n260 Antenna 0 input.power.limit

Band	Beam ID 1	Beam ID 2	input.power.limit
n260	0	-	5.4
n260	2	-	5.4
n260	4	-	5.5
n260	6	-	5.7
n260	8	-	2.8
n260	9	-	2.9
n260	10	-	3.1
n260	11	-	2.9
n260	16	-	2.2
n260	17	-	2.4
n260	18	-	3.1
n260	22	-	1.2
n260	23	-	0.2
n260	24	-	0.6
n260	25	-	0.1
n260	26	-	1.2
n260	32	-	0.1
n260	33	-	0.5
n260	34	-	1.7
n260	35	-	0.1
n260	-	128	5.4
n260	-	130	5.4
n260	-	132	5.2
n260	-	134	5.7
n260	-	136	2.6
n260	-	137	2.6
n260	-	138	2.7
n260	-	139	2.8
n260	-	144	2.6
n260	-	145	3.1
n260	-	146	2.6
n260	-	150	-0.1
n260	-	151	0.1
n260	-	152	0.3
n260	-	153	-0.1
n260	-	154	0.2
n260	-	160	0.2
n260	-	161	0.6
n260	-	162	1.2
n260	-	163	0.4
n260	0	128	1.8
n260	2	130	2.4
n260	4	132	1.9
n260	6	134	2.1
n260	8	136	-0.5
n260	9	137	-1.0
n260	10	138	0.4
n260	11	139	-0.3
n260	16	144	-0.7
n260	17	145	0.5
n260	18	146	0.8
n260	22	150	-2.4
n260	23	151	-3.4
n260	24	152	-2.3
n260	25	153	-2.9
n260	26	154	-1.9
n260	32	160	-3.2
n260	33	161	-2.6
n260	34	162	-1.8
n260	35	163	-3.3

Table 1-4
5G mmWave NR n260 Antenna 1 input.power.limit

Band	Beam ID 1	Beam ID 2	input.power.limit
n260	1	-	8.2
n260	3	-	8.1
n260	5	-	7.9
n260	7	-	7.7
n260	12	-	5.3
n260	13	-	5.6
n260	14	-	5.3
n260	15	-	4.9
n260	19	-	5.5
n260	20	-	5.7
n260	21	-	5.1
n260	27	-	3.1
n260	28	-	3.7
n260	29	-	3.2
n260	30	-	3.4
n260	31	-	4.0
n260	36	-	2.6
n260	37	-	3.4
n260	38	-	3.2
n260	39	-	3.6
n260	-	129	8.1
n260	-	131	8.8
n260	-	133	8.5
n260	-	135	8.8
n260	-	140	6.1
n260	-	141	5.4
n260	-	142	5.0
n260	-	143	5.5
n260	-	147	7.0
n260	-	148	6.2
n260	-	149	5.0
n260	-	155	4.2
n260	-	156	3.3
n260	-	157	4.4
n260	-	158	3.7
n260	-	159	3.9
n260	-	164	3.0
n260	-	165	3.7
n260	-	166	3.8
n260	-	167	3.9
n260	1	129	5.0
n260	3	131	5.3
n260	5	133	5.1
n260	7	135	4.9
n260	12	140	2.6
n260	13	141	2.4
n260	14	142	2.2
n260	15	143	2.3
n260	19	147	3.4
n260	20	148	2.7
n260	21	149	2.2
n260	27	155	1.9
n260	28	156	1.1
n260	29	157	0.5
n260	30	158	0.5
n260	31	159	0.4
n260	36	164	0.7
n260	37	165	1.0
n260	38	166	0.6
n260	39	167	1.0

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 1-5
Device Surfaces

Band	Antenna	Antenna Type	Back	Front	Top	Bottom	Right	Left
n261	0	Patch	No	No	No	No	Yes	No
n261	1	Patch	No	Yes	Yes	No	No	No
n260	0	Patch	No	No	No	No	Yes	No
n260	1	Patch	No	Yes	Yes	No	No	No

1.6 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D04v01, 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 D04v01 4.3.2 procedures.

Table 1-6
Simultaneous Transmission

No.	Capable Transmit Configuration	Body
1	LTE + 5G NR FR2	Yes
2	LTE + 2.4 GHz WLAN Ant 1 + 2.4 GHz WLAN Ant 2 + 5G NR FR2	Yes
3	LTE + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 + 5G NR FR2	Yes
4	LTE + 2.4 GHz WLAN Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 + 5G NR FR2	Yes
5	LTE + 2.4 GHz WLAN Ant 1 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 + 5G NR FR2	Yes
6	LTE + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 + 5G NR FR2	Yes
7	LTE + Bluetooth + 2.4 GHz WLAN Ant 2 + 5G NR FR2	Yes
8	LTE + Bluetooth + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 2 + 5G NR FR2	Yes
9	LTE + Bluetooth + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 + 5G NR FR2	Yes
10	LTE + Bluetooth + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 + 5G NR FR2	Yes

NOTE:

1. 5G NR mmW Operations are limited to Non-Standalone (EN-DC) operations only.
2. NR antenna arrays cannot transmit simultaneously.
3. LTE + 5G NR FR2 scenarios are limited to EN-DC combinations with anchor bands as shown in the NR FR2 checklist.
4. 2.4 GHz WLAN antenna 1 and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
5. All non-5G NR licensed modes share the same antenna path and cannot transmit simultaneously.
6. 5G NR bands cannot transmit simultaneously.
7. This device supports time averaging smart transmit algorithm in WWAN. Smart transmit adds directly the time-averaged RF exposure from 4G and time-averaged RF exposure from 5G mmW NR to ensure that the normalized RF exposure from both 4G and 5G mmW NR does not exceed FCC limit.

1.7 Guidance Applied

- November 2017, October 2018, April 2019, November 2019 TCBC Workshop Notes
- SPEAG DASY6 System Handbook
- IEC TR 63170:2018
- FCC KDB 865664 D01 v01r04
- FCC KDB 447498 D04 v01

1.8 Bibliography

Table 1-7
Bibliography

Report Type	Report Serial Number
FCC SAR Evaluation Report (Part 1)	1M2204040049-02.C3K
PD Char Report	
RF Exposure Part 2 Test Report	1M2204040049-21.C3K
RF Exposure Compliance Summary Report	1M2204040049-27.C3K
Power Density Simulation Report	
6 - 8 GHz RF Exposure Report	1M2204040049-26.C3K

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

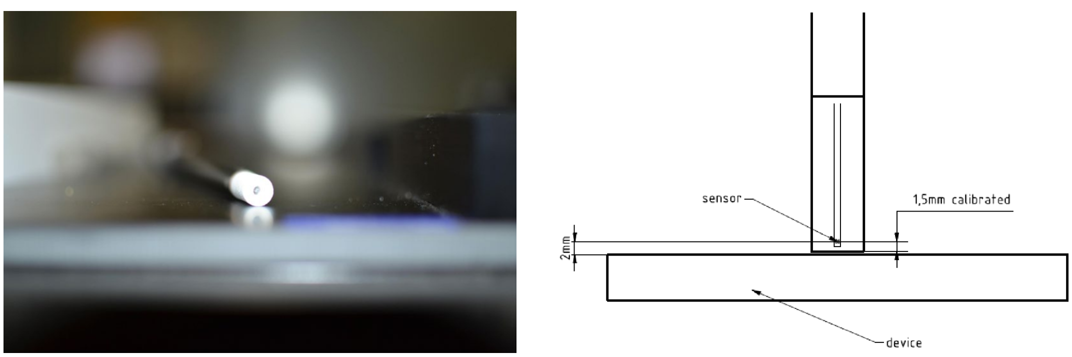

Figure 2-1
EUmmWVx Probe

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.

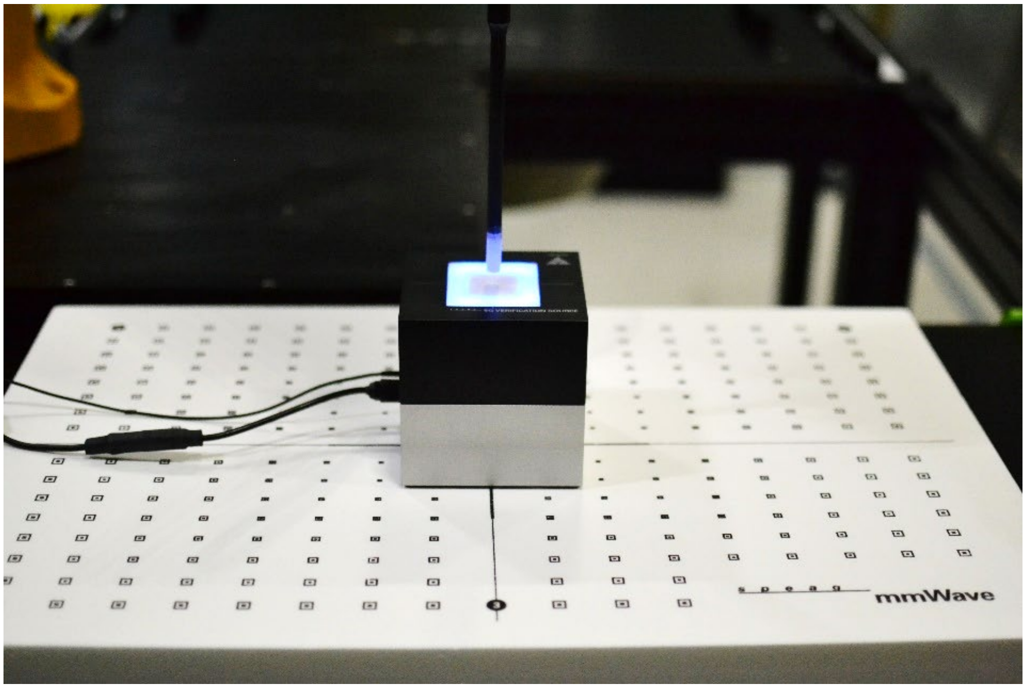

Figure 4-1
System Verification Setup Photo

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		
Q	30	04/12/2022	1045	9389	33.60	32.70	0.12	34.00	32.70	0.17	
R	30	04/12/2022	1035	9407	30.60	32.40	-0.25	31.10	32.40	-0.18	B1
Q	30	04/14/2022	1045	9389	33.70	32.70	0.13	34.10	32.70	0.18	B2
R	30	04/14/2022	1035	9407	32.70	32.40	0.04	33.20	32.40	0.11	
R	30	04/19/2022	1035	9407	32.40	32.40	0.00	32.90	32.40	0.07	
R	30	05/12/2022	1035	9407	31.50	32.40	-0.12	32.00	32.40	-0.05	

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 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	Accessory	Normal psPD	Total psPD	Plot #
			MHz		V	H	dBm			dB	mm			mW/cm^2	mW/cm^2	
n261	0	Patch	27924.96	Mid	33	-	1.4	CW	0F013JP220700E	0.09	2	Right	N/A	0.506	0.621	A1
n261	0	Patch	27924.96	Mid	33	-	1.4	CW	0F013JP220700E	-0.08	2	Right	Keyboard	0.482	0.545	
n261	0	Patch	27550.08	Low	-	150	2.2	CW	0F013JP220700E	0.03	2	Right	N/A	0.272	0.400	
n261	0	Patch	27550.08	Low	22	150	-0.9	CW	0F013JP220700E	0.06	2	Right	N/A	0.226	0.284	
n261	1	Patch	27550.08	Low	37	-	2.2	CW	0F00M7G220800E	-0.02	2	Front	N/A	0.512	0.588	
n261	1	Patch	27550.08	Low	-	164	2.2	CW	0F00M7G220800E	0.02	2	Front	N/A	0.408	0.456	
n261	1	Patch	27550.08	Low	28	156	-1.0	CW	0F00M7G220800E	0.09	2	Front	N/A	0.670	0.756	
n261	1	Patch	27550.08	Low	28	156	-1.0	CW	0F00M7G220800E	0.20	2	Front	Keyboard	0.682	0.774	A2
n261	1	Patch	27550.08	Low	37	-	2.2	CW	0F00M7G220800E	0.03	2	Top	N/A	0.106	0.148	
n261	1	Patch	27550.08	Low	-	157	2.8	CW	0F00M7G220800E	-0.20	2	Top	N/A	0.079	0.079	
n261	1	Patch	27550.08	Low	28	156	-1.0	CW	0F00M7G220800E	-0.14	2	Top	N/A	0.098	0.129	
47 CFR §1.1310 - SAFETY LIMIT Spatial Average Uncontrolled Exposure / General Population									Power Density 1 mW/cm^2 averaged over 4 cm^2							

Table 5-2
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	Accessory	Normal psPD	Total psPD	Plot #
			MHz		V	H	dBm			dB	mm			mW/cm^2	mW/cm^2	
n260	0	Patch	37050.00	Low	32	-	0.1	CW	0F013JP220700E	0.11	2	Right	N/A	0.212	0.265	
n260	0	Patch	37050.00	Low	-	150	-0.1	CW	0F013JP220700E	0.00	2	Right	N/A	0.329	0.439	A3
n260	0	Patch	37050.00	Low	-	150	-0.1	CW	0F013JP220700E	-0.20	2	Right	Keyboard	0.274	0.330	
n260	0	Patch	38499.96	Mid	23	151	-3.4	CW	0F013JP220700E	0.12	2	Right	N/A	0.214	0.253	
n260	1	Patch	39949.92	High	36	-	2.6	CW	0F00M7G220800E	-0.11	2	Front	N/A	0.245	0.320	
n260	1	Patch	37050.00	Low	-	164	3.0	CW	0F00M7G220800E	-0.05	2	Front	N/A	0.296	0.345	
n260	1	Patch	38499.96	Mid	31	159	0.4	CW	0F00M7G220800E	0.00	2	Front	N/A	0.425	0.559	
n260	1	Patch	38499.96	Mid	31	159	0.4	CW	0F00M7G220800E	0.07	2	Front	Keyboard	0.421	0.585	A4
n260	1	Patch	37050.00	Low	38	-	3.2	CW	0F00M7G220800E	-0.15	2	Top	N/A	0.085	0.114	
n260	1	Patch	37050.00	Low	-	158	3.7	CW	0F00M7G220800E	0.09	2	Top	N/A	0.061	0.068	
n260	1	Patch	37050.00	Low	27	155	1.9	CW	0F00M7G220800E	0.05	2	Top	N/A	0.078	0.111	
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 $\lambda/4$.
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. This device utilizes power reduction for some WLAN/BT wireless modes and technologies for simultaneous transmission compliance. These mechanisms are assessed in the SAR Test Report.
6. *Input.power.limit* parameter for 5G mmW NR radio was calculated in the PD Char Report.
7. 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 is in compliance with FCC requirements. Per FCC guidance for devices enabled with Qualcomm® Smart Transmit 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 technologies are reported in Part 2 report.
8. 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 WLAN simultaneous transmission scenario is evaluated under the Total Exposure Ratio (TER) Appendix.
9. 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.
10. 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.
11. 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
Agilent	N9030A	PXA Signal Analyzer (44GHz)	N/A	N/A	N/A	MY52350166
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	EUmmWV3	EUmmWV3 Probe	11/11/2021	Annual	11/11/2022	9389
SPEAG	EUmmWV3	EUmmWV3 Probe	12/13/2021	Annual	12/13/2022	9407
SPEAG	SM 003 100 AA	30GHz System Verification Ka- Band Source Antenna	12/07/2021	Annual	12/07/2022	1045
SPEAG	SM 003 100 AA	30GHz System Verification Ka- Band Source Antenna	02/22/2022	Annual	02/22/2023	1035
SPEAG	DAE4ip	Dasy Data Acquisition Electronics	11/11/2021	Annual	11/11/2022	1638
SPEAG	DAE4ip	Dasy Data Acquisition Electronics	01/21/2022	Annual	01/21/2023	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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[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 6 GHz and 100 GHz

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[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)