SAR EVALUATION REPORT

FCC 47 CFR § 2.1093

For
AP20 AutoPole

FCC ID: RFD-AP20T
Model Name: AP20
Series Model: AP20 T

Report Number: 4791505014A-US-S0-V3
Issue Date: 2025/9/12

Prepared for
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3398

REVISION HISTORY

Rev.	Date	Revisions	Revised By
V0	2025/5/23	Initial Issue	Sally Lu
V1	2025/7/30	Addressed TCB 1st comment	Sally Lu
V2	2025/9/5	Addressed TCB 2nd comment	Sally Lu
V3	2025/9/12	Addressed TCB 3rd comment	Sally Lu

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1. Attestation of Test Results

Applicant Name	Leica Geosystems AG
FCC ID	RFD-AP20T
Model Name	AP20
Series Model	AP20 T
Exposure Category	General Population/Uncontrolled Exposure
Exposure Category	SAR Limits (W/Kg)
	Peak spatial-average(1g of tissue)
General population/Uncontrolled exposure	1.6
Occupational/Controlled exposure	8
RF Exposure Conditions	Equipment Class - Highest Reported SAR (W/kg)
	DSS
Body-worn	0.101
Simultaneous TX	0.101
Date Tested	2025/3/7
Test Results	Pass

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of any government. This report is written to support regulatory compliance of the applicable standards stated above.

For statement of conformity, simple acceptance (Section 8.2.1 of ISO/IEC Guide 98-4) was applied as decision rule for measurement in this test report.

- Pass - the measured value is below the acceptance limit, AL = TL.
- Fail - the measured value is above the acceptance limit, AL = TL.
- AL: Acceptance Limit.
- TL: Tolerance Limit (Specification Limit).
- Level of risk: PFA (Probability of False Accept) less than 50 %

Approved and Authorized By:	Prepared By:
	
Kent Liu Senior Laboratory Engineer Underwriters Laboratories Taiwan Co., Ltd.	Sally Lu Project Handler Underwriters Laboratories Taiwan Co., Ltd.

2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEC/IEEE 62209-1528, the following FCC Published RF exposure KDB procedures:

- KDB 447498 D04 Interim General RF Exposure Guidance v01
- KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- KDB 865664 D02 RF Exposure Reporting v01r02

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at:

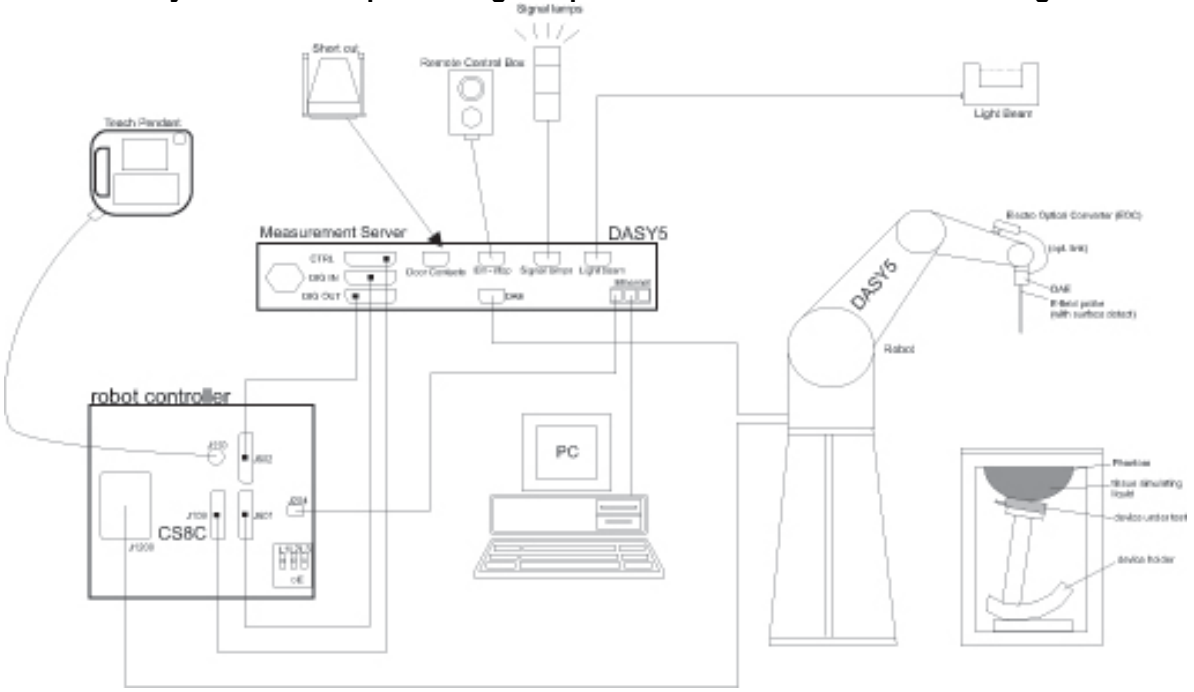
Underwriters Laboratories Taiwan Co., Ltd.,
SAR Room

Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

The DASY5 system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Win7 or Win10 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

4.2. SAR Scan Procedures

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEC/IEEE 62209-1528 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

4.3. Test Equipment

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Anritsu	MS46322B	1740002	2026/2/6
Dielectric Assessment Kit	SPEAG	DAK-3.5	1250	2025/9/16
Humidity/Temp meter	TECPEL	DTM-20	17020736	2025/5/13

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
EXG-B RF Vector Signal Generator	Keysight Technologies	N5172B	MY56200320	2025/4/15
Power Meter	Keysight Technologies	N1914A	MY56360007	2025/12/16
Power Sensor	Keysight Technologies	N8481H	MY56350009	2025/12/16
Power Meter	Anritsu	ML2495A	1645002	2025/11/24
Power Sensor	Anritsu	MA2411B	1531202	2025/11/24
Dosimetric E-Field Probe	SPEAG	EX3DV4	3901	2025/10/23
Data Acquisition Electronice	SPEAG	DAE4	1360	2025/7/8
System Validation Dipole	SPEAG	D2450V2	988	2025/9/10
Humidity/Temp meter	TECPEL	DTM-20	17020735	2026/2/25

UL Software

Software Version
DASY NEO52 D10.4 S14.6.14
SEMCAD-X-PostPro

5. Measurement Uncertainty

Measurement uncertainty for 300 MHz to 3 GHz

Source of Uncertainty	Tolerance (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (± %, 1g)	Standard Uncertainty (± %, 10g)	(Vi) Veff
Measurement System								
Probe Calibration	6	Normal	1	1	1	6.00	6.00	∞
Axial Isotropy	4.7	Rectangular	1.732	0.7	0.7	1.90	1.90	∞
Hemispherical Isotropy	9.6	Rectangular	1.732	0.7	0.7	3.88	3.88	∞
Boundary Effect	1	Rectangular	1.732	1	1	0.58	0.58	∞
Probe Linearity	4.7	Rectangular	1.732	1	1	2.71	2.71	∞
System Detection Limits	1	Rectangular	1.732	1	1	0.58	0.58	∞
Readout Electronics	0.3	Normal	1	1	1	0.30	0.30	∞
Probe Modulation Response	2.61	Rectangular	1.732	1	1	1.51	1.51	∞
Response Time	0.8	Rectangular	1.732	1	1	0.46	0.46	∞
Integration Time	2.6	Rectangular	1.732	1	1	1.50	1.50	∞
RF Ambient Conditions – Noise	3	Rectangular	1.732	1	1	1.73	1.73	∞
RF Ambient Conditions – Reflections	3	Rectangular	1.732	1	1	1.73	1.73	∞
Probe Positioner Mechanical Restrictions	0.4	Rectangular	1.732	1	1	0.23	0.23	∞
Probe Positioning with Respect to Phantom Shell	2.9	Rectangular	1.732	1	1	1.67	1.67	∞
Interpolation, Extrapolation and Averaged SAR calculation algorithms of the Postprocessor	2	Rectangular	1.732	1	1	1.15	1.15	∞
Test Sample Related								
Device Positioning	3	Normal	1	1	1	3.00	3.00	47
Device Holder Disturbance	3.6	Normal	1	1	1	3.60	3.60	2
DUT Power Drift of Measured SAR	5	Rectangular	1.732	1	1	2.89	2.89	∞
SAR Scaling	0	Rectangular	1.732	1	1	0.00	0.00	∞
Phantom and Setup								
Phantom Uncertainty - Shape,Thickness and Permittivity	6.1	Rectangular	1.732	1	1	3.52	3.52	∞
SAR Correction for Deviations in Permittivity and Conductivity	1.9	Normal	1	1	0.84	1.90	1.60	∞
Liquid Conductivity - measurement(DAK)	2.5	Normal	1	0.78	0.71	1.95	1.78	∞
Liquid Permittivity - measurement(DAK)	2.5	Normal	1	0.23	0.26	0.58	0.65	∞
Liquid Conductivity – Temperature Uncertainty	2.32	Rectangular	1.732	0.78	0.71	1.04	0.95	4
Liquid Permittivity – Temperature Uncertainty	0.85	Rectangular	1.732	0.23	0.26	0.11	0.13	4
Combined Standard Uncertainty (K=1)						11.37	11.29	185
Expanded Uncertainty U (K=2)						**22.74**	**22.58**	

6. Device Under Test (DUT) Information

6.1. DUT Description

Product	AP20 AutoPole
Brand Name	Leica Geosystem
Model Name	AP20
Series Model	AP20 T
Operating Frequency	Bluetooth : 2402MHz ~ 2480MHz NFC:13.56MHz
Modulation	GFSK ASK
S/N	574781
Sample ID	7899110
Software Version	N/A
Received Date	2025/2/19

Notes:

1. The models difference as below:
   - Electronically identical, use the same module of NINAB301.
   - AP20 T disables the Target ID function (Search and lock onto the target by verifying a specify ID on the fly.), which is available in AP20.

2. Disclaimer: The EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual. The laboratory is not responsible when the information is supplied by the customer and can affect the validity of results.

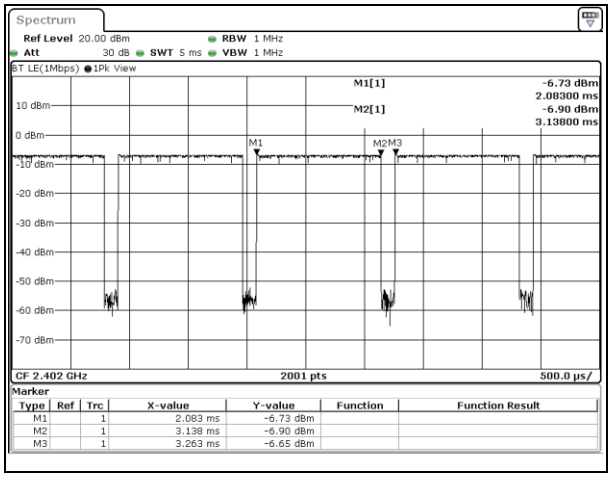
3. The antennas provided to the EUT, we select the highest gain on each frequency band for calculation and testing, please refer to the following table:

Ant. No.	Transmitter Circuit	Frequency Range	Brand Name	Model Name	Maximum Gain (dBi)	Ant. Type	Connector Type
BT	Chain0	2402~2480MHz	uBlox	NINA-B301	3.5	Dipole	R-SMA
NFC	Chain0	13.56MHz	NXP	CLRC66303HN	0	PCB	N/A

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
Bluetooth	2.4 GHz	LE	89.41%
NFC	13.56MHz	-	-

Mode	On Time (ms)	On+Off Time (ms)	Duty Cycle
BT LE(1Mbps)	1.055	1.180	0.8941



7. RF Exposure Conditions (Test Configurations)

Refer to Appendix B for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

7.1. Standalone SAR Test Exclusion Considerations

Since the Dedicated Host Approach is applied, the standalone SAR test exclusion procedure in KDB 447498 Appendix B table B.2 is applied to determine the minimum test separation distance:

- When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.
- When the separation distance from the antenna to an adjacent edge is > 5 mm, the actual antenna-to-edge separation distance is applied to determine SAR test exclusion.

Table B.2—Example Power Thresholds (mW)

Frequency (MHz)	Distance (mm)										
	5	10	15	20	25	30	35	40	45	50
300	39	65	88	110	129	148	166	184	201	217
450	22	44	67	89	112	135	158	180	203	226
835	9	25	44	66	90	116	145	175	207	240
1900	3	12	26	44	66	92	122	157	195	236
2450	3	10	22	38	59	83	111	143	179	219
3600	2	8	18	32	49	71	96	125	158	195
5800	1	6	14	25	40	58	80	106	136	169

Band	Test Position	separation distance(mm)	Max. ERP power(dBm)	Max. ERP power(mW)	Exemption Limits(mW)	Test Require
Bluetooth	Front Side	4.00	10.5	11.22	3.00	Yes
	Back Side	46.00			179.00	No
	Left Side	5.00			3.00	Yes
	Right Side	68.00			219.00	No
	Top Side	0.00			3.00	Yes
	Bottom Side	135.00			219.00	No
NFC	Front Side	17	-11	0.079	38	No
	Back Side	17			38	No
	Left Side	26			83	No
	Right Side	26			83	No
	Top Side	25			59	No
	Bottom Side	110			219	No

Note(s):

According to KDB 447498, if the calculated Power threshold is less than the output power then SAR testing is required.

*P(mW)= $10^{(P(dBm)/10)}$.

8. Dielectric Property Measurements & System Check

8.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.
The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.
Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.
The dielectric constant (εr) and conductivity (σ) of typical tissue-equivalent media recipes are expected to
be within ± 5% of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEC/IEEE 62209-1528, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for εr and σ may be relaxed to ± 10%. This is limited to frequencies ≤ 3 GHz.

Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

Target Frequency (MHz)	Head	
	ε_r	σ (S/m)
150	52.3	0.76
300	45.3	0.87
450	43.5	0.87
835	41.5	0.90
900	41.5	0.97
915	41.5	0.98
1450	40.5	1.20
1610	40.3	1.29
1800 – 2000	40.0	1.40
2450	39.2	1.80
3000	38.5	2.40
5000	36.2	4.45
5100	36.1	4.55
5200	36.0	4.66
5300	35.9	4.76
5400	35.8	4.86
5500	35.6	4.96
5600	35.5	5.07
5700	35.4	5.17
5800	35.3	5.27

Dielectric Property Measurements Results

SAR Lab.	Date	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
				Measured	Target	Delta (%)	Measured	Target	Delta (%)
SAR Lab.	2025/3/7	Head	2402	39.36	39.27	0.22	1.82	1.76	3.87
			2440	39.31	39.21	0.24	1.86	1.79	4.05
			2441	39.30	39.21	0.23	1.86	1.79	4.05
			2450	39.25	39.20	0.14	1.87	1.80	3.96
			2480	39.17	39.16	0.02	1.91	1.83	4.28

8.2. System Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are re-measured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within 10% of the manufacturer calibrated dipole SAR target.

Date	Tissue Type	Dipole S/N	Input Power (mW)	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Delta 1g ±10 (%)	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Delta 10g ±10 (%)	Plot No.
2025/3/7	Head	D2450V2-988	250	13.5	51.90	54	4.05	6.14	24.60	24.56	-0.16	1

9. Conducted Output Power Measurements

9.1. Bluetooth

Average Power Measured Results

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Tune-up Limit (dBm)	SAR Test (Yes/No)
Bluetooth	BLE	1 Mbps	0	2402	4.85	5.0	Yes
			19	2440	6.44	7.0	
			39	2480	4.68	5.0	
		2 Mbps	0	2402	4.86	5.0	No
			19	2440	6.42	7.0	
			39	2480	4.67	5.0	

Note(s):

1. Disclaimer: The antenna gain specification is supplied by the customer.
2. The laboratory is not responsible when the information is supplied by the customer and can affect the validity of results.

10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

KDB 447498 D04 General RF Exposure Guidance:
Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

To determine the initial test position, Area Scans were performed to determine the position with the Maximum Value of SAR (measured). The position that produced the highest Maximum Value of SAR is considered the worst case position; thus used as the initial test position.

10.1. Test Condition

Test Item	Test Site No.	Test Date	Tested by
SAR	SAR1	2025/3/7	Edison Hu

10.2. Bluetooth

Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Power Drift	Plot No.
						Tune-up Limit	Meas.	Meas.	Scaled	Meas.	Scaled		
Bluetooth	0	Front	19	2440	89.41%	7.0	6.44	0.080	0.101	0.036	0.046	0.02	1
Bluetooth	0	Front	0	2402	89.41%	5.0	4.85	0.075	0.087	0.034	0.040	0.01	
Bluetooth	0	Front	39	2480	89.41%	5.0	4.68	0.052	0.062	0.023	0.028	0.02	
Bluetooth	0	Left side	19	2440	89.41%	7.0	6.44	0.032	0.041	0.016	0.020	-0.11	
Bluetooth	0	Top side	19	2440	89.41%	7.0	6.44	0.010	0.013	0.003	0.004	0.08	

10.3. Standalone SAR Test Exclusion Considerations & Estimated SAR

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√f(GHz)] ≤ 3.0, for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- $f_{(GHz)}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

When the standalone SAR test exclusion is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

- *(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√$f_{(GHz)}$/x]* W/kg for test separation distances ≤ 50 mm;
  where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
- 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.

Band	Frequency (MHz)	separation distance(mm)	Max. ERP* power(dBm)	Max. ERP power(mW)*	SAR test exclusion	SAR test exclusion Threshold	Test Require	Estimated 1-g SAR (W/kg)
NFC	13.56	5	-11	0.079	0.005	0.009	No	0

Note(s):

According to KDB 447498 D01V06 sect 4.3.1(c) exclusion

a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:

[(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] · [√$f_{(GHz)}$] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,[30] where

- $f_{(GHz)}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation[31]
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as *numeric thresholds* in step b) below

The test exclusions are applicable only when the minimum *test separation distance* is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

b) For 100 MHz to 6 GHz and *test separation distances* > 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following (also illustrated in Appendix B):[32]

1) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·($f_{(MHz)}$/150)]} mW, for 100 MHz to 1500 MHz
2) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW, for > 1500 MHz and ≤ 6 GHz

c) For frequencies below 100 MHz, the following may be considered for SAR test exclusion (also illustrated in Appendix C):[33]

1) For *test separation distances* > 50 mm and < 200 mm, the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by $[1 + \log(100/f_{(MHz)})]$

2) For *test separation distances* ≤ 50 mm, the power threshold determined by the equation in c) 1) for 50 mm and 100 MHz is multiplied by ½

3) SAR measurement procedures are not established below 100 MHz.

11. Simultaneous Transmission SAR Analysis

KDB 447498 D01 General RF Exposure Guidance explains how to calculate the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$$SPLSR = (SAR_1 + SAR_2)^{1.5} / Ri$$

Where:

SAR_1 is the highest measured or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

SAR_2 is the highest measured or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of $\mathbf{[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]}$

In order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$$(SAR_1 + SAR_2)^{1.5} / Ri \leq 0.04$$

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations
Standalone	1	BT + NFC
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	
	15	
	16	

Notes:

1. Bluetooth Radio can transmit simultaneously with NFC Radio.

Estimated SAR for Simultaneous Transmission SAR Analysis

Considerations for SAR estimation

1. When standalone SAR test exclusion applies, standalone SAR must also be estimated to determine simultaneous transmission SAR test exclusion.
2. Dedicated Host Approach criteria for SAR test exclusion is likewise applied to SAR estimation, with certain distinctions between test exclusion and SAR estimation:
   - When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied for SAR estimation; this is the same between test exclusion and SAR estimation calculations.
   - When the separation distance from the antenna to an adjacent edge is > 5 mm but ≤ 50 mm, the actual antenna-to-edge separation distance is applied for SAR estimation.
   - When the minimum test separation distance is > 50 mm, the estimated SAR value is 0.4 W/kg
3. Please refer to Estimated SAR Tables to see which test positions are inherently compliant as they consist of only estimated SAR values for all applicable transmitters and consequently will always have sum of SAR values < 1.2 W/kg. Simultaneous transmission SAR analysis was therefore not performed for these test positions.

Estimated SAR

Band	Test Position	separation distance(mm)	Max. ERP power(dBm)	Max. ERP power(mW)	Estimated 1-g SAR Value (W/kg)	Test Require
NFC	Front Side	17	-11	0.079	0	No
	Back Side	17			0	No
	Left Side	26			0	No
	Right Side	26			0	No
	Top Side	25			0	No
	Bottom Side	110			0	No

11.1 Sum of the SAR for BT & NFC

Test Position	1.Standalone SAR (W/kg) Bluetooth	2.Standalone SAR (W/kg) NFC	1-g SAR (W/kg) (1+2)
Front	0.101	0	0.101
Left Side	0.041	0	0.041
Top Side	0.013	0	0.013

Appendixes

Refer to separated files for the following appendixes.

4791505014A-US-S0-V1_Appendix A: SAR Setup Photos

4791505014A-US-S0-V1_Appendix B: Antenna Dimensions and Separation Distances

4791505014A-US-S0-V1_Appendix C: SAR System Check Plots

4791505014A-US-S0-V1_Appendix D: Highest SAR Test Plots

4791505014A-US-S0-V1_Appendix E: SAR Probe and Dipole Calibration Certificates

END OF REPORT