



## PART 0 SAR CHAR REPORT

**Applicant Name:**

Apple, Inc.  
One Apple Park Way  
Cupertino, CA 95014

**Date of Testing:**

06/22/2022 – 09/02/2022

**Test Site/Location:**Element Washington DC LLC,  
Morgan Hill, CA, USA**Document Serial No.:**

1C2205090028-25.BCG (Rev1)

**FCC ID:****BCGA2764****APPLICANT:****APPLE, INC.****Report Type:**

Part 0 SAR Characterization

**DUT Type:**

Tablet Device

**Model(s):**

A2764

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 Ortiz  
Executive Vice President



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APPENDIX A: SAR TEST RESULTS FOR $P_{Limit}$ CALCULATIONS		

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## 1 DEVICE UNDER TEST

### 1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
UMTS 850	Data	826.40 - 846.60 MHz
UMTS 1750	Data	1712.4 - 1752.6 MHz
UMTS 1900	Data	1852.4 - 1907.6 MHz
LTE Band 71	Voice/Data	665.5 - 695.5 MHz
LTE Band 12	Voice/Data	699.7 - 715.3 MHz
LTE Band 17	Voice/Data	706.5 - 713.5 MHz
LTE Band 13	Voice/Data	779.5 - 784.5 MHz
LTE Band 14	Voice/Data	790.5 - 795.5 MHz
LTE Band 26 (Cell)	Voice/Data	814.7 - 848.3 MHz
LTE Band 5 (Cell)	Voice/Data	824.7 - 848.3 MHz
LTE Band 66 (AWS)	Voice/Data	1710.7 - 1779.3 MHz
LTE Band 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 25 (PCS)	Voice/Data	1850.7 - 1914.3 MHz
LTE Band 2 (PCS)	Voice/Data	1850.7 - 1909.3 MHz
LTE Band 30	Voice/Data	2307.5 - 2312.5 MHz
LTE Band 7	Voice/Data	2502.5 - 2567.5 MHz
LTE Band 41	Voice/Data	2498.5 - 2687.5 MHz
LTE Band 48	Voice/Data	3552.5 - 3697.5 MHz
NR Band n71	Data	665.5 - 695.5 MHz
NR Band n12	Data	701.5 - 713.5 MHz
NR Band n14	Data	790.5 - 795.5 MHz
NR Band n26 (Cell)	Data	816.5 - 846.5 MHz
NR Band n5 (Cell)	Data	826.5 - 846.5 MHz
NR Band n70	Data	1697.5 - 1707.5 MHz
NR Band n66 (AWS)	Data	1712.5 - 1777.5 MHz
NR Band n25 (PCS)	Data	1852.5 - 1912.5 MHz
NR Band n2 (PCS)	Data	1852.5 - 1907.5 MHz
NR Band n30	Data	2307.5 - 2312.5 MHz
NR Band n7	Data	2502.5 - 2567.5 MHz
NR Band n41	Data	2506.02 - 2679.99 MHz
NR Band n77 DoD	Data	3455.01 - 3544.98 MHz
NR Band n77 C	Data	3705.00 - 3975.00 MHz
2.4 GHz WLAN	Voice/Data	2412 - 2472 MHz
U-NII-1	Voice/Data	5180 - 5240 MHz
U-NII-2A	Voice/Data	5260 - 5320 MHz
U-NII-2C	Voice/Data	5500 - 5720 MHz
U-NII-3	Voice/Data	5745 - 5825 MHz
U-NII-5	Voice/Data	5955 - 6415 MHz
U-NII-6	Voice/Data	6435 - 6515 MHz
U-NII-7	Voice/Data	6535 - 6875 MHz
U-NII-8	Voice/Data	6895 - 7115 MHz
Bluetooth	Data	2402 - 2480 MHz
NB UNII-1	Data	5162 - 5245 MHz
NB UNII-3	Data	5733 - 5844 MHz
NR Band n258	Data	24250 - 24450 MHz 24750 - 25250 MHz
NR Band n260	Data	37000 - 40000 MHz
NR Band n261	Data	27500 - 28350 MHz

This device uses the Qualcomm® Gen2 Smart Transmit feature to control and manage transmitting power in real time and to ensure the time-averaged RF exposure is in compliance with the FCC requirement at all times for 2G/3G/4G/5G WWAN operations. Additionally, this device supports WLAN/BT technologies, but the output power of these modems is not controlled by the Smart Transmit algorithm.

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## 1.2 Time-Averaging for SAR and Power Density

This device is enabled with Qualcomm® Gen2 Smart Transmit algorithm to control and manage transmitting power in real time and to ensure that the time-averaged RF exposure from 2G/3G/4G/5G Sub-6 NR WWAN is in compliance with FCC requirements. This Part 0 report shows SAR characterization of WWAN radios for 2G/3G/4G/5G Sub-6 NR. Characterization is achieved by determining  $P_{\text{Limit}}$  for 2G/3G/4G/5G Sub-6 NR that corresponds to the exposure design targets after accounting for all device design related uncertainties, i.e.,  $\text{SAR}_{\text{design\_target}} < \text{FCC SAR limit}$  for sub-6 radio. The SAR characterization is denoted as SAR Char in this report. Section 1.3 includes a nomenclature of the specific terms used in this report.

The compliance test under the static transmission scenario and simultaneous transmission analysis are reported in Part 1 report. The validation of the time-averaging algorithm and compliance under the dynamic (time- varying) transmission scenario for WWAN technologies are reported in Part 2 report (report SN could be found in Section 1.4 – Bibliography).

## 1.3 Nomenclature for Part 0 Report

Technology	Term	Description
2G/3G/4G/5G Sub-6 NR	$P_{\text{limit}}$	Power level that corresponds to the exposure design target ( $\text{SAR}_{\text{design\_target}}$ ) after accounting for all device design related uncertainties
	$P_{\text{max}}$	Maximum tune up output power
	$\text{SAR}_{\text{design\_target}}$	Target SAR level < FCC SAR limit after accounting for all device design related uncertainties
	SAR Char	Table containing $P_{\text{limit}}$ for all technologies and bands

## 1.4 Bibliography

Report Type	Report Serial Number
FCC Part 0 PD Characterization Report	1C2205090028-28.BCG
FCC SAR Evaluation Report (Part 1)	1C2205090028-26.BCG
FCC PD Evaluation Report (Part 1)	1C2205090028-29.BCG
RF Exposure Part 2 Test Report	1C2205090028-27.BCG
RF Exposure Compliance Summary	1C2205090028-30.BCG
Wi-Fi 6 GHz RF Exposure Report	1C2205090028-33.BCG

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## 2 SAR AND POWER DENSITY MEASUREMENTS

### 2.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy ( $dU$ ) absorbed by (dissipated in) an incremental mass ( $dm$ ) contained in a volume element ( $dV$ ) of a given density ( $\rho$ ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 2-1).

**Equation 2-1**  
**SAR Mathematical Equation**

$$SAR = \frac{d}{dt} \left( \frac{dU}{dm} \right) = \frac{d}{dt} \left( \frac{dU}{\rho dV} \right)$$

**SAR is expressed in units of Watts per Kilogram (W/kg).**

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

where:

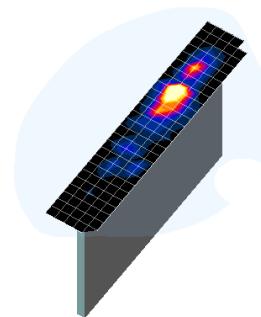
$\sigma$  = conductivity of the tissue-simulating material (S/m)  
 $\rho$  = mass density of the tissue-simulating material (kg/m<sup>3</sup>)  
 $E$  = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

### 2.2 SAR Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table ) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table ) and IEEE 1528-2013. On the



**Figure 2-1**  
**Sample SAR Area Scan**

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basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

- a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table . The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
- b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
- c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

**Table 2-1**  
**Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04\***

Frequency	Maximum Area Scan Resolution (mm) ( $\Delta x_{area}, \Delta y_{area}$ )	Maximum Zoom Scan Resolution (mm) ( $\Delta x_{zoom}, \Delta y_{zoom}$ )	Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan Volume (mm) (x,y,z)
			Uniform Grid		Graded Grid	
			$\Delta z_{zoom}(n)$	$\Delta z_{zoom}(1)*$	$\Delta z_{zoom}(n>1)*$	
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤ 4	≤ 1.5* $\Delta z_{zoom}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5* $\Delta z_{zoom}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5* $\Delta z_{zoom}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5* $\Delta z_{zoom}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5* $\Delta z_{zoom}(n-1)$	≥ 22

\*Also compliant to IEEE 1528-2013 Table 6

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## 3 SAR CHARACTERIZATION

### 3.1 DSI and SAR Determination

This device uses different Device State Index (DSI) to configure different time averaged power levels based on certain exposure scenarios. Depending on the detection scheme implemented in the tablet, the worst-case SAR was determined by measurements for the relevant exposure conditions for that DSI. Detailed descriptions of the detection mechanisms are included in the operational description.

The device state index (DSI) conditions used in Table 3-1 represent different exposure scenarios.

**Table 3-1**  
**DSI and Corresponding Exposure Scenarios**

Scenario	Description	SAR Test Cases
(DSI = 1)	▪ Detect Mode Activated	<i>Tablet SAR per KDB Publication 616217 D04</i>

### 3.2 SAR Design Target

*SAR\_design\_target* is determined by ensuring that it is less than FCC SAR limit after accounting for total device designed related uncertainties specified by the manufacturer (see Table 3-2).

**Table 3-2**  
***SAR\_design\_target* Calculations**

<i>SAR_design_target</i>	
<i>SAR_design_target</i>	$< \frac{\text{SAR}_{\text{regulatory\_limit}} \times 10^{-\text{Total Uncertainty}}}{10}$
	1g SAR (W/kg)
<i>Total Uncertainty</i>	1.0 dB
<i>SAR_{regulatory\_limit}</i>	1.6 W/kg
<i>SAR_{design\_target}</i>	0.8 W/kg

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### 3.3 SAR Char

SAR test results corresponding to  $P_{max}$  for each antenna/technology/band/DSI can be found in Appendix A.

$P_{limit}$  is calculated by linearly scaling with the measured SAR at the  $P_{part0}$  to correspond to the  $SAR_{design\_target}$ . When  $P_{limit} < P_{max}$ ,  $P_{part0}$  was used as  $P_{limit}$  in the Smart Transmit EFS. When  $P_{limit} > P_{max}$  and  $P_{part0}=P_{max}$ , calculated  $P_{limit}$  was used in the Smart Transmit EFS. All reported SAR obtained from the  $P_{part0}$  SAR tests was less than  $SAR_{Design\_target} + 1$  dB Uncertainty. The final  $P_{limit}$  determination for each exposure scenario corresponding to  $SAR_{design\_target}$  are shown in Table 3-3.

**Table 3-3**  
 **$P_{limit}$  Determination**

Device State Index (DSI)	$P_{limit}$ Determination Scenarios
1	The worst-case SAR exposure is determined as maximum SAR normalized to the limit among: 1. Tablet SAR measured at 0 mm for Back, Top, Bottom, Right, Left surfaces

**Note:**

For DSI = 1,  $P_{limit}$  is calculated by:

$P_{limit}$  corresponding to 1g Tablet SAR evaluation at 0 mm for back, top, bottom, left and right surfaces

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**Table 3-4**  
**SAR Characterizations**

Exposure Scenario:	Ant 1 Body	Ant 1 Maximum Tune-up Output Power*	Ant 2a/2b Body	Ant 2a/2b Maximum Tune-up Output Power*	Ant 3 Body	Ant 3 Maximum Tune-up Output Power*	Ant 4b Body	Ant 4b Maximum Tune-up Output Power*	Manufacturer's Smart Transmit Uncertainty (dB)	Low, Mid, High Band Pmax target Tolerance (dB)	Plimit target and UHB Pmax target Tolerance (dB)
Technology/Band	Plimit corresponding to 0.8 W/kg	Pmax	Plimit corresponding to 0.8 W/kg	Pmax	Plimit corresponding to 0.8 W/kg	Pmax	Plimit corresponding to 0.8 W/kg	Pmax			
UMTS 850	17.70	23.20	N/A	N/A	18.40	25.00	N/A	N/A			
UMTS 1750	16.10	22.00	14.30	22.00	16.00	24.50	13.30	25.00			
UMTS 1900	16.40	22.00	13.70	22.00	15.90	24.50	12.20	25.00			
LTE Band 71	20.30	23.20	N/A	N/A	20.50	25.00	N/A	N/A			
LTE Band 12	20.10	23.20	N/A	N/A	19.50	25.00	N/A	N/A			
LTE Band 17	20.10	23.20	N/A	N/A	19.50	25.00	N/A	N/A			
LTE Band 13	19.60	23.20	N/A	N/A	19.90	25.00	N/A	N/A			
LTE Band 14	19.60	23.20	N/A	N/A	19.90	25.00	N/A	N/A			
LTE Band 26 (Cell)	17.70	23.20	N/A	N/A	18.40	25.00	N/A	N/A			
LTE Band 5 (Cell)	17.70	23.20	N/A	N/A	18.40	25.00	N/A	N/A			
LTE Band 5 ULCA (Cell)	17.70	23.20	N/A	N/A	18.40	25.00	N/A	N/A			
LTE Band 66 (AWS)	16.10	25.00	14.30	24.50	16.00	23.50	13.30	24.00			
LTE Band 4 (AWS)	16.10	25.00	14.30	24.50	16.00	24.50	13.30	25.00			
LTE Band 25 (PCS)	16.40	22.00	13.70	22.00	15.90	24.50	12.20	25.00			
LTE Band 2 (PCS)	16.40	22.00	13.70	22.00	15.90	24.50	12.20	25.00			
LTE Band 30	13.60	21.50	13.60	21.50	14.90	24.50	12.10	21.80			
LTE Band 7	13.50	21.50	13.90	21.50	15.50	24.50	12.20	25.00			
LTE Band 7 ULCA	13.50	21.50	13.90	21.50	15.50	24.50	12.20	25.00			
LTE Band 41 PC3	12.7	23.0	14.0	23.0	13.1	23.0	11.8	23.0			
LTE Band 41 ULCA PC3	12.7	23.0	14.0	23.0	13.1	23.0	11.8	23.0			
LTE Band 41 PC2	12.7	24.4	14.0	23.9	13.1	22.9	11.8	23.4			
LTE Band 41 ULCA PC2	12.7	24.4	14.0	23.9	13.1	22.9	11.8	23.4			
LTE Band 48	11.2	17.6	11.4	18.0	11.8	16.7	10.9	19.0			
LTE Band 48 ULCA	11.2	17.6	11.4	18.0	11.8	16.7	10.9	19.0			
NR Band n71	20.30	23.20	N/A	N/A	20.50	25.00	N/A	N/A			
NR Band n12	20.10	23.20	N/A	N/A	19.50	25.00	N/A	N/A			
NR Band n14	19.60	23.20	N/A	N/A	19.90	25.00	N/A	N/A			
NR Band n26 (Cell)	17.70	23.20	N/A	N/A	18.40	25.00	N/A	N/A			
NR Band n5 (Cell)	17.70	23.20	N/A	N/A	18.40	25.00	N/A	N/A			
NR Band n70	16.10	25.00	14.30	24.50	16.00	24.50	13.30	25.00			
NR Band n66 (AWS)	16.10	25.00	14.30	24.50	16.00	23.50	13.30	24.00			
NR Band n25 (PCS)	16.40	22.00	13.70	22.00	15.90	24.50	12.20	25.00			
NR Band n2 (PCS)	16.40	22.00	13.70	22.00	15.90	24.50	12.20	25.00			
NR Band n30	13.60	21.50	13.60	21.50	14.90	24.50	12.10	21.80			
NR Band n7	13.50	21.50	13.90	21.50	15.50	24.50	12.20	25.00			
NR Band n41 PC3	12.70	25.00	14.00	25.00	13.10	25.00	11.80	25.00			
NR Band n41 PC2	12.70	28.00	14.00	27.50	13.10	26.50	11.80	27.00			
NR Band n77 PC3	11.20	22.50	11.00	22.50	11.20	24.70	10.80	24.70			
NR Band n77 PC2	11.20	22.50	11.00	22.50	11.20	26.50	10.80	26.50			

**Notes:**

1. \*Maximum tune up output power Pmax is used to configure EUT during RF tune up procedure. The maximum allowed output power is equal to maximum Tune up output power +0.7/-1.0 dB tolerance and +1.0/-1.0 dB tolerance for UHB.
2. All  $P_{limit}$  EFS and maximum tune up output power  $P_{max}$  levels entered in above Table correspond to average power levels after accounting for duty cycle in the case of TDD modulation schemes (for e.g., LTE TDD).

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## 13 EQUIPMENT LIST

### For SAR measurements

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	E4404B	Spectrum Analyzer	N/A	N/A	N/A	MY45113242
Agilent	E4438C	ESG Vector Signal Generator	5/10/2022	Annual	5/10/2023	MY42082659
Agilent	E4438C	ESG Vector Signal Generator	2/14/2022	Annual	2/14/2023	MY42082385
Agilent	N5182A	MXG Vector Signal Generator	7/20/2022	Annual	7/20/2023	MY47420800
Agilent	N5182A	MXG Vector Signal Generator	6/21/2022	Annual	6/21/2023	MY47420651
Agilent	8753ES	S-Parameter Vector Network Analyzer	2/11/2022	Annual	2/11/2023	MY40003841
Agilent	8753ES	S-Parameter Vector Network Analyzer	12/17/2021	Annual	12/17/2022	MY40000670
Agilent	E5515C	Wireless Communications Test Set	5/12/2022	Annual	5/12/2023	GB43304278
Agilent	E5515C	Wireless Communications Test Set	1/14/2020	Triennial	1/14/2023	GB43304447
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Amplifier Research	15516G	Amplifier	CBT	N/A	CBT	433972
Amplifier Research	15516G	Amplifier	CBT	N/A	CBT	433974
Anritsu	ML2495A	Power Meter	3/17/2022	Annual	3/17/2023	941001
Anritsu	ML2496A	Power Meter	3/31/2022	Annual	3/31/2023	1138001
Anritsu	MA2411B	Pulse Power Sensor	4/29/2022	Annual	4/29/2023	1207470
Anritsu	MA2411B	Pulse Power Sensor	9/21/2021	Annual	9/21/2022	1315051
Anritsu	MT8821C	Radio Communication Analyzer MT8821C	6/27/2022	Annual	6/27/2023	6261895213
Anritsu	MT8821C	Radio Communication Analyzer MT8821C	5/24/2022	Annual	5/24/2023	6201144418
Anritsu	MT8821C	Radio Communication Analyzer MT8821C	3/31/2022	Annual	3/31/2023	6201664756
Anritsu	MT8821C	Radio Communication Analyzer MT8821C	9/26/2021	Annual	9/26/2022	6201524637
Anritsu	MT8800A	Radio Communication Test Station	8/2/2021	Annual	8/2/2022	6272337438
Anritsu	MT8800A	Radio Communication Test Station	8/2/2021	Annual	8/2/2022	6272337436
Anritsu	MT8800A	Radio Communication Test Station	3/30/2022	Annual	3/30/2023	6261914237
Anritsu	MA24106A	USB Power Sensor	8/12/2022	Annual	8/12/2023	1349513
Anritsu	MA24106A	USB Power Sensor	8/5/2022	Annual	8/5/2023	1344555
Control Company	4352	Long Stem Thermometer	9/10/2021	Biennial	9/10/2023	210774878
Control Company	4352	Long Stem Thermometer	9/10/2021	Biennial	9/10/2023	210774885
Control Company	4353	Long Stem Thermometer	10/28/2020	Biennial	10/28/2022	200670623
Control Company	4040	Therm./Clock/Humidity Monitor	1/21/2022	Annual	1/21/2023	160544418
Mitutoyo	500-196-30	CD-6 AXS Glinch Digital Caliper	2/16/2022	Triennial	2/16/2025	A20238413
Keysight Technologies	N6705B	DC Power Analyzer	5/5/2021	Triennial	5/5/2024	MY53004059
Keysight Technologies	N9020A	MXA Signal Analyzer	4/14/2022	Annual	4/14/2023	MY48010233
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Mini-Circuits	VLF-6000+	Low Pass Filter DC to 6000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	VLF-6000+	Low Pass Filter DC to 6000 MHz	7/6/2021	Annual	7/6/2022	31634
Mini-Circuits	BW-N20WS+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20WS	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	ZUDC10-03-5+	Directional Coupler	CBT	N/A	CBT	2050
Narda	4722-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Huber + Suhner	742-0-0-21	Torque Wrench	4/6/2022	Biennial	6/4/2024	83881
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	5/3/2022	Annual	5/3/2023	128635
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	4/8/2022	Annual	4/8/2023	162125
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	4/7/2022	Annual	4/7/2023	167283
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	2/21/2022	Annual	2/21/2023	164948
SPEAG	DAK-3.5	Dielectric Assessment Kit	1/6/2022	Annual	1/6/2023	1278
SPEAG	DAK-3.5	Portable Dielectric Assessment Kit	8/18/2021	Annual	8/18/2022	1041
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1379
SPEAG	DAK-12	Dielectric Assessment Kit (10MHz - 3GHz)	3/21/2022	Annual	3/21/2023	1102
SPEAG	D750V3	750 MHz SAR Dipole	9/8/2021	Annual	9/8/2022	1097
SPEAG	D750V3	750 MHz SAR Dipole	5/16/2022	Annual	5/16/2023	1057
SPEAG	D750V3	750 MHz SAR Dipole	11/11/2019	Triennial	11/11/2022	1094
SPEAG	D835V2	835 MHz SAR Dipole	11/11/2019	Triennial	11/11/2022	4d108
SPEAG	D835V2	835 MHz SAR Dipole	5/16/2022	Annual	5/16/2023	4d040
SPEAG	D1750V2	1750 MHz SAR Dipole	9/9/2020	Biennial	9/9/2022	1104
SPEAG	D1900V2	1900 MHz SAR Dipole	9/10/2020	Biennial	9/10/2022	5d181
SPEAG	D1900V2	1900 MHz SAR Dipole	5/16/2022	Annual	5/16/2023	5d030
SPEAG	D2300V2	2300 MHz SAR Dipole	11/10/2020	Biennial	11/10/2022	1064
SPEAG	D2450V2	2450 MHz SAR Dipole	5/11/2022	Annual	5/11/2023	750
SPEAG	D2450V2	2450 MHz SAR Dipole	11/12/2019	Triennial	11/12/2022	855
SPEAG	D2600V2	2600 MHz SAR Dipole	9/9/2020	Biennial	9/9/2022	1069
SPEAG	D2600V2	2600 MHz SAR Dipole	5/11/2022	Annual	5/11/2023	1042
SPEAG	D3500V2	3500 MHz SAR Dipole	8/16/2019	Triennial	8/16/2022	1055
SPEAG	D3700V2	3700 MHz SAR Dipole	10/17/2019	Triennial	10/17/2022	1002
SPEAG	D3900V2	3900 MHz SAR Dipole	11/13/2020	Biennial	11/13/2022	1062
SPEAG	D5GHz2	5 GHz SAR Dipole	3/22/2022	Annual	3/22/2023	1123
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/20/2021	Annual	10/20/2022	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/13/2022	Annual	4/13/2023	1582
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/14/2022	Annual	4/14/2023	1402
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/13/2022	Annual	4/13/2023	501
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/13/2022	Annual	1/13/2023	793
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/16/2022	Annual	5/16/2023	701
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/21/2022	Annual	3/21/2023	1408
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/13/2022	Annual	4/13/2023	1465
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/18/2021	Annual	11/18/2022	1237
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/24/2022	Annual	2/24/2023	467
SPEAG	EX3DV4	SAR Probe	9/6/2021	Annual	9/6/2022	7674
SPEAG	EX3DV4	SAR Probe	4/22/2022	Annual	4/22/2023	7546
SPEAG	EX3DV4	SAR Probe	4/22/2022	Annual	4/22/2023	7532
SPEAG	EX3DV4	SAR Probe	1/19/2022	Annual	1/19/2023	3837
SPEAG	EX3DV4	SAR Probe	10/27/2021	Annual	10/27/2022	7420
SPEAG	EX3DV4	SAR Probe	2/21/2022	Annual	2/21/2023	7308
SPEAG	EX3DV4	SAR Probe	5/18/2022	Annual	5/18/2023	7416
SPEAG	EX3DV4	SAR Probe	3/22/2022	Annual	3/22/2023	7638
SPEAG	EX3DV4	SAR Probe	4/19/2022	Annual	4/19/2023	7499

Note:

1. CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.
2. Each equipment item was used solely within its respective calibration period.

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## 14 MEASUREMENT UNCERTAINTIES

### For SAR Measurements

a	b	c	d	e = f(d, k)	f	g	h = c x f/e	i = c x g/e	k	
Uncertainty Component	IEEE 1528 Sec.	Tol. (± %)	Prob. Dist.	Div.	c <sub>i</sub> 1gm	c <sub>i</sub> 10 gms	1gm	10gms	v <sub>i</sub>	
<b>Measurement System</b>										
Probe Calibration	E.2.1	7	N	1	1	1	7.0	7.0	∞	
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞	
Hemispherical Isotropy	E.2.2	1.3	N	1	0.7	0.7	0.9	0.9	∞	
Boundary Effect	E.2.3	2	R	1.732	1	1	1.2	1.2	∞	
Linearity	E.2.4	0.3	N	1	1	1	0.3	0.3	∞	
System Detection Limits	E.2.4	0.25	R	1.732	1	1	0.1	0.1	∞	
Modulation Response	E.2.5	4.8	R	1.732	1	1	2.8	2.8	∞	
Readout Electronics	E.2.6	0.3	N	1	1	1	0.3	0.3	∞	
Response Time	E.2.7	0.8	R	1.732	1	1	0.5	0.5	∞	
Integration Time	E.2.8	2.6	R	1.732	1	1	1.5	1.5	∞	
RF Ambient Conditions - Noise	E.6.1	3	R	1.732	1	1	1.7	1.7	∞	
RF Ambient Conditions - Reflections	E.6.1	3	R	1.732	1	1	1.7	1.7	∞	
Probe Positioner Mechanical Tolerance	E.6.2	0.8	R	1.732	1	1	0.5	0.5	∞	
Probe Positioning w/ respect to Phantom	E.6.3	6.7	R	1.732	1	1	3.9	3.9	∞	
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	4	R	1.732	1	1	2.3	2.3	∞	
<b>Test Sample Related</b>										
Test Sample Positioning	E.4.2	3.12	N	1	1	1	3.1	3.1	35	
Device Holder Uncertainty	E.4.1	1.67	N	1	1	1	1.7	1.7	5	
Output Power Variation - SAR drift measurement	E.2.9	5	R	1.732	1	1	2.9	2.9	∞	
SAR Scaling	E.6.5	0	R	1.732	1	1	0.0	0.0	∞	
<b>Phantom &amp; Tissue Parameters</b>										
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	7.6	R	1.73	1.0	1.0	4.4	4.4	∞	
Liquid Conductivity - measurement uncertainty	E.3.3	4.3	N	1	0.78	0.71	3.3	3.0	76	
Liquid Permittivity - measurement uncertainty	E.3.3	4.2	N	1	0.23	0.26	1.0	1.1	75	
Liquid Conductivity - Temperature Uncertainty	E.3.4	3.4	R	1.732	0.78	0.71	1.5	1.4	∞	
Liquid Permittivity - Temperature Uncertainty	E.3.4	0.6	R	1.732	0.23	0.26	0.1	0.1	∞	
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞	
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞	
<b>Combined Standard Uncertainty (k=1)</b>						RSS		12.2	12.0	191
<b>Expanded Uncertainty</b>						k=2		24.4	24.0	
(95% CONFIDENCE LEVEL)										

The above measurement uncertainties are according to IEEE Std. 1528-2013

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