

# ELEMENT MATERIALS TECHNOLOGY

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## PART 0 SAR CHAR REPORT

**Applicant Name:**

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**Date of Testing:**

12/22/2023-02/01/2024

**Test Site/Location:**

Element, Columbia, MD, USA

**Document Serial No.:**

1M2312110124-05.A3L(R1)

**FCC ID:**

A3LSMS928JPN

**APPLICANT:**

SAMSUNG ELECTRONICS CO., LTD

**Report Type:**

Part 0 SAR Characterization

**DUT Type:**

Portable Handset

**Model(s):**

SC-52E, SCG26

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



|                                          |                               |                                   |
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## APPENDIX A: SAR TEST RESULTS FOR PLimit CALCULATIONS

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# 1 DEVICE UNDER TEST

## 1.1 Device Overview

This device uses the Qualcomm® Smart Transmit Gen2 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 and WLAN/BT operations. Additionally, this device supports NFC technologies, but the output power of these modems is not controlled by the Smart Transmit algorithm.

| Band & Mode       | Operating Modes | Tx Frequency                                                                                                                               |
|-------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| GSM/GPRS/EDGE 850 | Voice/Data      | 824.20 - 848.80 MHz                                                                                                                        |
| GSM/GPRS/EDGE1900 | Voice/Data      | 1850.20 - 1909.80 MHz                                                                                                                      |
| UMTS 850          | Voice/Data      | 826.40 - 846.60 MHz                                                                                                                        |
| LTE Band 12       | Data            | 699.7 - 715.3 MHz                                                                                                                          |
| LTE Band 13       | Data            | 779.5 - 784.5 MHz                                                                                                                          |
| LTE Band 5        | Data            | 824.7 - 848.3 MHz                                                                                                                          |
| LTE Band 66       | Data            | 1710.7 - 1779.3 MHz                                                                                                                        |
| LTE Band 4        | Data            | 1710.7 - 1754.3 MHz                                                                                                                        |
| LTE Band 2        | Data            | 1850.7 - 1909.3 MHz                                                                                                                        |
| LTE Band 41       | Data            | 2498.5 - 2687.5 MHz                                                                                                                        |
| NR Band n5        | Data            | 826.5 - 846.5 MHz                                                                                                                          |
| NR Band n66       | Data            | 1712.5 - 1777.5 MHz                                                                                                                        |
| NR Band n41       | Data            | 2501.01 - 2685 MHz                                                                                                                         |
| 2.4 GHz WIFI      | Data            | 2412 - 2462 MHz                                                                                                                            |
| 5 GHz WIFI        | Data            | U-NII-1: 5180 - 5240 MHz<br>U-NII-2A: 5260 - 5320 MHz<br>U-NII-2C: 5500 - 5720 MHz<br>U-NII-3: 5745 - 5825 MHz<br>U-NII-4: 5845 - 5885 MHz |
| 6 GHz WIFI        | Data            | U-NII-5: 5945 - 6415 MHz<br>U-NII-6: 6435 - 6515 MHz<br>U-NII-7: 6535 - 6875 MHz<br>U-NII-8: 6895 - 7115 MHz                               |
| 2.4 GHz Bluetooth | Data            | 2402 - 2480 MHz                                                                                                                            |
| NFC               | Data            | 13.56 MHz                                                                                                                                  |
| UWB               | Data            | 6489.6 - 7987.2 MHz                                                                                                                        |

## 1.2 Time-Averaging for SAR

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 and WLAN/BT are in compliance with FCC requirements. This Part 0 report shows SAR characterization of WWAN radios for 2G/3G/4G/5G Sub-6 NR, WLAN, and Bluetooth. Characterization is achieved by determining PLimit for 2G/3G/4G/5G Sub-6 NR, WLAN, and Bluetooth that corresponds to the exposure design targets after accounting for all device design related uncertainties, i.e., SAR\_design\_target (< 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)

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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<br>Sub-6 NR<br>/WLAN/BT | $P_{limit}$              | Power level that corresponds to the exposure design target ( <i>SAR_design_target</i> ) after accounting for all device design related uncertainties |
|                                     | $P_{max}$                | Maximum tune up output power                                                                                                                         |
|                                     | <i>SAR_design_target</i> | Target SAR level < FCC SAR limit after accounting for all device design related uncertainties                                                        |
|                                     | <i>SAR Char</i>          | Table containing <i>Plimit</i> for all technologies and bands                                                                                        |

### 1.4 Bibliography

| Report Type                           | Report Serial Number |
|---------------------------------------|----------------------|
| RF Exposure Part 2 Test Report        | 1M2312110124-02.A3L  |
| RF Exposure Compliance Summary Report | 1M2312110124-03.A3L  |
| RF Exposure Part 1 Test Report        | 1M2312110124-01.A3L  |

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## 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:

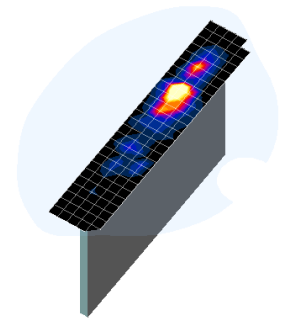
|          |   |                                                                     |
|----------|---|---------------------------------------------------------------------|
| $\sigma$ | = | conductivity of the tissue-simulating material (S/m)                |
| $\rho$   | = | mass density of the tissue-simulating 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 2-1) 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 2-1) 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 2-1. 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)<br>( $\Delta x_{\text{area}}, \Delta y_{\text{area}}$ ) | Maximum Zoom Scan Resolution (mm)<br>( $\Delta x_{\text{zoom}}, \Delta y_{\text{zoom}}$ ) | Maximum Zoom Scan Spatial Resolution (mm) |                             |                                      | Minimum Zoom Scan Volume (mm)<br>(x,y,z) |
|-----------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------|-----------------------------|--------------------------------------|------------------------------------------|
|           |                                                                                           |                                                                                           | Uniform Grid                              | Graded Grid                 |                                      |                                          |
|           |                                                                                           |                                                                                           |                                           | $\Delta z_{\text{zoom}}(n)$ | $\Delta z_{\text{zoom}}(1)^*$        |                                          |
| ≤ 2 GHz   | ≤ 15                                                                                      | ≤ 8                                                                                       | ≤ 5                                       | ≤ 4                         | ≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$ | ≥ 30                                     |
| 2-3 GHz   | ≤ 12                                                                                      | ≤ 5                                                                                       | ≤ 5                                       | ≤ 4                         | ≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$ | ≥ 30                                     |
| 3-4 GHz   | ≤ 12                                                                                      | ≤ 5                                                                                       | ≤ 4                                       | ≤ 3                         | ≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$ | ≥ 28                                     |
| 4-5 GHz   | ≤ 10                                                                                      | ≤ 4                                                                                       | ≤ 3                                       | ≤ 2.5                       | ≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$ | ≥ 25                                     |
| 5-6 GHz   | ≤ 10                                                                                      | ≤ 4                                                                                       | ≤ 2                                       | ≤ 2                         | ≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$ | ≥ 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 smartphone, 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.

When 1g SAR and 10g SAR exposure comparison is needed, the worst-case was determined from SAR normalized to 1g or 10g SAR limit.

The device state index (DSI) conditions used in Table 2-1 represent different exposure scenarios.

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

| Scenario               | Description                                                       | SAR Test Cases                                                          |
|------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------------|
| Head (DSI = 1)         | Device positioned next to head<br>Receiver Active                 | Head SAR per KDB Publication 648474 D04                                 |
| Hotspot mode (DSI = 0) | Device transmits in hotspot mode near body<br>Hotspot Mode Active | Hotspot SAR per KDB Publication 941225 D06                              |
| Phablet (DSI = 0)      | Device is held with hand                                          | Phablet SAR per KDB Publication 648474 D04 & KDB Publication 616217 D04 |
| Body-worn (DSI = 0)    | Device being used with a body-worn accessory                      | Body-worn SAR per KDB Publication 648474 D04                            |

#### 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**

| <b><i>SAR_design_target</i></b>                                                           |          |                             |          |
|-------------------------------------------------------------------------------------------|----------|-----------------------------|----------|
| $SAR\_design\_target < SAR\_regulatory\_limit \times 10^{\frac{-Total\ Uncertainty}{10}}$ |          |                             |          |
| <b>1g SAR (W/kg)</b>                                                                      |          | <b>10g SAR (W/kg)</b>       |          |
| <i>Total Uncertainty</i>                                                                  | 1.0 dB   | <i>Total Uncertainty</i>    | 1.0 dB   |
| <i>SAR_regulatory_limit</i>                                                               | 1.6 W/kg | <i>SAR_regulatory_limit</i> | 4.0 W/kg |
| <i>SAR_design_target</i>                                                                  | 0.8 W/kg | <i>SAR_design_target</i>    | 2.0 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                                                                                                                                                                                      |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                        | The worst-case SAR exposure is determined as maximum SAR normalized to the limit (i.e. lowest $P_{limit}$ ) among:<br>1. Body Worn SAR<br>2. Extremity SAR measured at 0 mm for all surfaces.<br>3. Hotspot SAR at 10 mm |
| 1                        | $P_{limit}$ is calculated based on 1g Head SAR                                                                                                                                                                           |

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

| Exposure Scenario |         |                  | Maximum<br>Tune-Up<br>Output<br>Power* | Body-Worn, Hotspot,<br>or Phablet | Head |
|-------------------|---------|------------------|----------------------------------------|-----------------------------------|------|
| Averaging Volume  |         |                  |                                        | 1g/10g                            | 1g   |
| Spacing           |         |                  |                                        | 10mm, 0mm                         | 0mm  |
| DSI               |         |                  |                                        | 0                                 | 1    |
| Technology/Band   | Antenna | Antenna<br>Group | Pmax                                   |                                   |      |
| GSM 850           | A       | AG0              | 25.1                                   | 26.1                              | 29.6 |
| GSM 850           | E       | AG1              | 24.6                                   | 26.9                              | 21.8 |
| GSM 1900          | A       | AG0              | 21.8                                   | 18.8                              | 30.5 |
| UMTS 850          | A       | AG0              | 24.0                                   | 24.2                              | 27.7 |
| UMTS 850          | E       | AG1              | 23.5                                   | 25.7                              | 21.5 |
| LTE Band 12       | A       | AG0              | 23.0                                   | 26.8                              | 28.9 |
| LTE Band 12       | E       | AG1              | 22.5                                   | 26.1                              | 22.0 |
| LTE Band 13       | A       | AG0              | 23.0                                   | 24.6                              | 27.6 |
| LTE Band 13       | E       | AG1              | 22.5                                   | 26.8                              | 22.5 |
| LTE Band 5        | A       | AG0              | 24.0                                   | 24.9                              | 28.2 |
| LTE Band 5        | E       | AG1              | 23.5                                   | 26.4                              | 21.0 |
| LTE Band 66/4     | A       | AG0              | 23.0                                   | 18.5                              | 29.5 |
| LTE Band 2        | A       | AG0              | 23.0                                   | 18.0                              | 29.5 |
| LTE Band 41 PC3   | B       | AG0              | 22.0                                   | 19.0                              | 27.7 |
| LTE Band 41 PC3   | F       | AG1              | 22.0                                   | 19.5                              | 16.5 |
| NR Band n5        | A       | AG0              | 24.0                                   | 24.6                              | 27.5 |
| NR Band n5        | E       | AG1              | 23.5                                   | 25.9                              | 21.0 |
| NR Band n66       | A       | AG0              | 23.0                                   | 18.5                              | 28.7 |
| NR Band n66       | F       | AG1              | 23.0                                   | 20.5                              | 18.5 |
| NR Band n41 PC3   | B       | AG0              | 24.0                                   | 19.5                              | 21.0 |
| NR Band n41 PC3   | F       | AG1              | 24.0                                   | 19.0                              | 16.5 |
| 2.4 GHz WIFI      | H       | AG1              | 17.0                                   | 21.4                              | 16.0 |
| 2.4 GHz WIFI      | J       | AG1              | 17.0                                   | 23.5                              | 16.0 |
| 2.4 GHz WIFI      | MIMO    | AG1              | 17.0                                   | 19.5                              | 16.0 |
| 5 GHz WIFI        | H       | AG1              | 17.0                                   | 17.0                              | 15.0 |
| 5 GHz WIFI        | E       | AG1              | 17.0                                   | 20.5                              | 15.0 |
| 5 GHz WIFI        | MIMO    | AG1              | 17.0                                   | 17.1                              | 15.0 |
| 6 GHz WIFI        | H       | AG1              | 16.0                                   | 11.0                              | 11.0 |
| 6 GHz WIFI        | E       | AG1              | 16.0                                   | 11.0                              | 11.0 |
| 6 GHz WIFI        | MIMO    | AG1              | 16.0                                   | 11.0                              | 11.0 |
| 2.4 GHz Bluetooth | H       | AG1              | 15.9                                   | 23.9                              | 22.3 |
| 2.4 GHz Bluetooth | J       | AG1              | 15.0                                   | 31.0                              | 25.9 |
| 2.4 GHz Bluetooth | MIMO    | AG1              | 11.0                                   | 21.5                              | 21.1 |

|                                          |                               |                                   |
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# 4 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        | MY45113282    |
| Agilent              | E4438C       | ESG Vector Signal Generator                   | 11/14/2023 | Annual       | 11/14/2024 | MY45093852    |
| Agilent              | E4438C       | ESG Vector Signal Generator                   | 11/15/2023 | Annual       | 11/15/2024 | MY45092078    |
| Agilent              | N5182A       | MXG Vector Signal Generator                   | 10/12/2023 | Annual       | 10/12/2024 | MY47400015    |
| Agilent              | N5182A       | MXG Vector Signal Generator                   | 7/4/2023   | Annual       | 7/4/2024   | MY48180366    |
| Agilent              | 8753ES       | S-Parameter Vector Network Analyzer           | 6/2/2023   | Annual       | 6/2/2024   | MY40003841    |
| Agilent              | 8753ES       | S-Parameter Vector Network Analyzer           | 2/8/2023   | Annual       | 2/8/2024   | US39170122    |
| Agilent              | E5515C       | Wireless Communications Test Set              | CBT        | N/A          | CBT        | US41140256    |
| Agilent              | E5515C       | Wireless Communications Test Set              | 1/12/2023  | Annual       | 1/12/2024  | MY5062130     |
| Agilent              | N4010A       | Wireless Connectivity Test Set                | N/A        | N/A          | N/A        | GB46170464    |
| Amplifier Research   | 1551G6       | Amplifier                                     | CBT        | N/A          | CBT        | 433973        |
| Amplifier Research   | 1551G6       | Amplifier                                     | CBT        | N/A          | CBT        | 433974        |
| Amplifier Research   | 150A100C     | Amplifier                                     | CBT        | N/A          | CBT        | 350132        |
| Anritsu              | MN8110B      | I/O Adaptor                                   | CBT        | N/A          | CBT        | 6261747881    |
| Anritsu              | ML2496A      | Power Meter                                   | 6/15/2023  | Annual       | 6/15/2024  | 1138001       |
| Anritsu              | ML2495A      | Power Meter                                   | 6/13/2023  | Annual       | 6/13/2024  | 1039008       |
| Anritsu              | MA2411B      | Pulse Power Sensor                            | 8/22/2023  | Annual       | 8/22/2024  | 1726262       |
| Anritsu              | MA2411B      | Pulse Power Sensor                            | 11/8/2023  | Annual       | 11/8/2024  | 1027293       |
| Anritsu              | MT8821C      | Radio Communication Analyzer MT8821C          | 12/15/2023 | Annual       | 12/15/2024 | 6200901190    |
| Anritsu              | MT8821C      | Radio Communication Analyzer MT8821C          | 7/7/2023   | Annual       | 7/7/2024   | 626204715     |
| Anritsu              | MT8821C      | Radio Communication Analyzer MT8821C          | 1/20/2023  | Annual       | 1/20/2024  | 6201144419    |
| Anritsu              | MT8821C      | Radio Communication Analyzer MT8821C          | 7/5/2023   | Annual       | 7/5/2024   | 6262150000    |
| Anritsu              | MT8000A      | Radio Communication Test Station              | 3/21/2023  | Annual       | 3/21/2024  | 6261987983    |
| Anritsu              | MT8000A      | Radio Communication Test Station              | 4/6/2023   | Annual       | 4/6/2024   | 6272337439    |
| Anritsu              | MT8000A      | Radio Communication Test Station              | 3/1/2023   | Annual       | 3/1/2024   | 6272337419    |
| Anritsu              | MA24106A     | USB Power Sensor                              | 6/15/2023  | Annual       | 6/15/2024  | 1827330       |
| Anritsu              | MA24106A     | USB Power Sensor                              | 12/4/2023  | Annual       | 12/4/2024  | 1520501       |
| Control Company      | 4352         | Long Stem Thermometer                         | 1/26/2023  | Annual       | 1/26/2024  | 160508097     |
| Control Company      | 4040         | Therm/ Clock/ Humidity Monitor                | 1/17/2023  | Annual       | 1/17/2024  | 160574418     |
| Control Company      | 4040         | Digital Thermometer                           | 3/27/2023  | Biennial     | 3/27/2025  | 230208036     |
| Mitutoyo             | 500-196-30   | CD-6° ASX Ginch Digital Calliper              | 2/16/2022  | Triennial    | 2/16/2025  | A20238413     |
| Keyight Technologies | N6705B       | DC Power Analyzer                             | 5/5/2021   | Triennial    | 5/5/2024   | MY53004059    |
| Keyight Technologies | N9020A       | MXA Signal Analyzer                           | 4/6/2023   | Annual       | 4/6/2024   | MY48010233    |
| Agilent              | N9020A       | MXA Signal Analyzer                           | 4/26/2022  | Biennial     | 4/26/2024  | MY56470202    |
| 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                | 7/5/2023   | Annual       | 7/5/2024   | 31634         |
| Mini-Circuits        | BW-N20W5+    | 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-N20W5     | Power Attenuator                              | CBT        | N/A          | CBT        | 1226          |
| Mini-Circuits        | ZUDC18-83-5+ | Directional Coupler                           | CBT        | N/A          | CBT        | 2050          |
| Narda                | 4772-3       | Attenuator (3dB)                              | CBT        | N/A          | CBT        | 9406          |
| Narda                | BW-S3W2      | Attenuator (3dB)                              | CBT        | N/A          | CBT        | 120           |
| Seekonk              | NC-100       | Torque Wrench                                 | CBT        | N/A          | CBT        | 22217         |
| Seekonk              | NC-100       | Torque Wrench                                 | CBT        | N/A          | CBT        | 1262          |
| Rohde & Schwarz      | CMW500       | Wideband Radio Communication Tester           | 7/4/2023   | Annual       | 7/4/2024   | 166818        |
| Rohde & Schwarz      | CMW500       | Wideband Radio Communication Tester           | 2/9/2023   | Annual       | 2/9/2024   | 161617        |
| Rohde & Schwarz      | CMW500       | Wideband Radio Communication Tester           | 7/17/2023  | Annual       | 7/17/2024  | 171008        |
| Rohde & Schwarz      | CMW500       | Wideband Radio Communication Tester           | 10/16/2023 | Annual       | 10/16/2024 | 170999        |
| SPEAG                | DAK-3.5      | Dielectric Assessment Kit                     | 11/13/2023 | Annual       | 11/13/2024 | 1277          |
| SPEAG                | DAK3-3.5     | Portable Dielectric Assessment Kit            | 8/14/2023  | Annual       | 8/14/2024  | 1041          |
| SPEAG                | MAIA         | Modulation and Audio Interference Analyzer    | N/A        | N/A          | N/A        | 1237          |
| SPEAG                | MAIA         | Modulation and Audio Interference Analyzer    | N/A        | N/A          | N/A        | 1331          |
| SPEAG                | MAIA         | Modulation and Audio Interference Analyzer    | N/A        | N/A          | N/A        | 1390          |
| SPEAG                | DAK-12       | Dielectric Assessment Kit (4MHz - 3GHz)       | 3/13/2023  | Annual       | 3/13/2024  | 1102          |
| SPEAG                | CLA-13       | Confined Loop Antenna                         | 9/12/2023  | Annual       | 9/12/2024  | 1002          |
| SPEAG                | D750V3       | 750 Mhz SAR Dipole                            | 2/13/2023  | Annual       | 2/13/2024  | 1046          |
| SPEAG                | D835V2       | 835 Mhz SAR Dipole                            | 3/14/2022  | Biennial     | 3/14/2024  | 46047         |
| SPEAG                | D835V2       | 835 Mhz SAR Dipole                            | 4/13/2023  | Annual       | 4/13/2024  | 46119         |
| SPEAG                | D835V2       | 835 Mhz SAR Dipole                            | 5/11/2023  | Annual       | 5/11/2024  | 46180         |
| SPEAG                | D1750V2      | 1750 Mhz SAR Dipole                           | 4/19/2023  | Annual       | 4/19/2024  | 1051          |
| SPEAG                | D1750V2      | 1750 Mhz SAR Dipole                           | 5/17/2023  | Annual       | 5/17/2024  | 1092          |
| SPEAG                | D1750V2      | 1750 Mhz SAR Dipole                           | 10/20/2021 | Triennial    | 10/20/2024 | 1150          |
| SPEAG                | D1900V2      | 1900 Mhz SAR Dipole                           | 5/12/2023  | Annual       | 5/12/2024  | 58026         |
| SPEAG                | D1900V2      | 1900 Mhz SAR Dipole                           | 4/18/2023  | Annual       | 4/18/2024  | 5d141         |
| SPEAG                | D2450V2      | 2450 Mhz SAR Dipole                           | 11/25/2021 | Triennial    | 11/25/2024 | 981           |
| SPEAG                | D2600V2      | 2600 Mhz SAR Dipole                           | 4/14/2021  | Triennial    | 4/14/2024  | 1004          |
| SPEAG                | D2600V2      | 2600 Mhz SAR Dipole                           | 8/10/2023  | Annual       | 8/10/2024  | 1126          |
| SPEAG                | D5GHV2       | 5 GHz SAR Dipole                              | 1/10/2022  | Triennial    | 1/10/2025  | 1057          |
| SPEAG                | D6.5GHV2     | 6.5 GHz SAR Dipole                            | 10/11/2023 | Annual       | 10/11/2024 | 1019          |
| SPEAG                | DAE4         | Dasy Data Acquisition Electronics             | 6/15/2023  | Annual       | 6/15/2024  | 1334          |
| SPEAG                | DAE4         | Dasy Data Acquisition Electronics             | 6/15/2023  | Annual       | 6/15/2024  | 1532          |
| SPEAG                | DAE4         | Dasy Data Acquisition Electronics             | 4/14/2023  | Annual       | 4/14/2024  | 1407          |
| SPEAG                | DAE4         | Dasy Data Acquisition Electronics             | 9/6/2023   | Annual       | 9/6/2024   | 1364          |
| SPEAG                | DAE4         | Dasy Data Acquisition Electronics             | 4/14/2023  | Annual       | 4/14/2024  | 1368          |
| SPEAG                | DAE4         | Dasy Data Acquisition Electronics             | 2/15/2023  | Annual       | 2/15/2024  | 665           |
| SPEAG                | DAE4         | Dasy Data Acquisition Electronics             | 2/16/2023  | Annual       | 2/16/2024  | 1645          |
| SPEAG                | DAE4         | Dasy Data Acquisition Electronics             | 10/18/2023 | Annual       | 10/18/2024 | 1322          |
| SPEAG                | EX3DV4       | SAR Probe                                     | 9/13/2023  | Annual       | 9/13/2024  | 7558          |
| SPEAG                | EX3DV4       | SAR Probe                                     | 6/15/2023  | Annual       | 6/15/2024  | 7409          |
| SPEAG                | EX3DV4       | SAR Probe                                     | 4/14/2023  | Annual       | 4/14/2024  | 7659          |
| SPEAG                | EX3DV4       | SAR Probe                                     | 4/18/2023  | Annual       | 4/18/2024  | 7718          |
| SPEAG                | EX3DV4       | SAR Probe                                     | 2/8/2023   | Annual       | 2/8/2024   | 7417          |
| SPEAG                | EX3DV4       | SAR Probe                                     | 6/8/2023   | Annual       | 6/8/2024   | 7491          |
| SPEAG                | EX3DV4       | SAR Probe                                     | 2/10/2023  | Annual       | 2/10/2024  | 7640          |
| SPEAG                | EX3DV4       | SAR Probe                                     | 10/23/2023 | Annual       | 10/23/2024 | 7547          |

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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## 5 MEASUREMENT UNCERTAINTIES

Applicable for SAR measurements < 6GHz:

| a                                                                             | b                    | c            | d              | e=<br>f(d,k) | f                     | g                        | h =<br>c x f/e                 | i =<br>c x g/e                   | k              |
|-------------------------------------------------------------------------------|----------------------|--------------|----------------|--------------|-----------------------|--------------------------|--------------------------------|----------------------------------|----------------|
| Uncertainty Component                                                         | IEEE<br>1528<br>Sec. | ToL<br>(± %) | Prob.<br>Dist. | Div.         | c <sub>i</sub><br>1gm | c <sub>i</sub><br>10 gms | 1gm<br>u <sub>i</sub><br>(± %) | 10gms<br>u <sub>i</sub><br>(± %) | 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                              | ∞              |
| Hemishperical 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           |
| <b>Expanded Uncertainty</b><br>(95% CONFIDENCE LEVEL)                         |                      |              |                |              |                       |                          | k=2                            | 24.4                             | 24.0           |

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

|                                          |                               |                                   |
|------------------------------------------|-------------------------------|-----------------------------------|
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Applicable for SAR measurements > 6GHz:

|                                                                               |                |            |             | f(d,k) |                    |                       | c x f/e                  | c x g/e                    |                |
|-------------------------------------------------------------------------------|----------------|------------|-------------|--------|--------------------|-----------------------|--------------------------|----------------------------|----------------|
| Uncertainty Component                                                         | IEEE 1528 Sec. | Tol. (± %) | Prob. Dist. | Div.   | c <sub>i</sub> 1gm | c <sub>i</sub> 10 gms | 1gm u <sub>i</sub> (± %) | 10gms u <sub>i</sub> (± %) | v <sub>i</sub> |
| <b>Measurement System</b>                                                     |                |            |             |        |                    |                       |                          |                            |                |
| Probe Calibration                                                             | E.2.1          | 9.3        | N           | 1      | 1                  | 1                     | 9.3                      | 9.3                        | ∞              |
| Axial Isotropy                                                                | E.2.2          | 0.25       | N           | 1      | 0.7                | 0.7                   | 0.2                      | 0.2                        | ∞              |
| Hemishperical 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                      | 13.8                       | 13.6           |
| <b>Expanded Uncertainty</b><br>(95% CONFIDENCE LEVEL)                         |                |            |             |        |                    |                       | k=2                      | 27.6                       | 27.1           |

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

|                                          |                               |                                   |
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