

# ELEMENT MATERIALS TECHNOLOGY

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## PART 0 SAR CHAR REPORT

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**Date of Testing:**

2/27/23

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Element, Columbia, MD, USA

**Document Serial No.:**

1M2302220014-02.A3L

**FCC ID:**

**A3LSMS918U**

**APPLICANT:**

**SAMSUNG ELECTRONICS CO., LTD**

**Report Type:**

Part 0 SAR Characterization

**DUT Type:**

Portable Handset

**Model(s):**

SM-S918U, SM-S918U1

Only operations relevant to this permissive change were evaluated for compliance. Please see the original compliance evaluation in RF Exposure Technical Report S/N: 1M2209010098-29.A3L for complete evaluation of all other operating modes. The operation description includes a description of all changed items.

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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# 1 DEVICE UNDER TEST

## 1.1 Device Overview

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/NFC/UWB 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/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
UMTS 1750	Voice/Data	1712.4 - 1752.6 MHz
UMTS 1900	Voice/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 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 38	Voice/Data	2572.5 - 2617.5 MHz
LTE Band 48	Voice/Data	3552.5 - 3697.5 MHz
NR Band n71	Voice/Data	665.5 - 695.5 MHz
NR Band n12	Voice/Data	701.5 - 713.5 MHz
NR Band n26	Voice/Data	816.5 - 846.5 MHz
NR Band n5	Voice/Data	826.5 - 846.5 MHz
NR Band n66	Voice/Data	1712.5 - 1777.5 MHz
NR Band n25	Voice/Data	1852.5 - 1912.5 MHz
NR Band n2	Voice/Data	1852.5 - 1907.5 MHz
NR Band n30	Voice/Data	2307.5 - 2312.5 MHz
NR Band n7	Voice/Data	2502.5 - 2567.5 MHz
NR Band n41	Voice/Data	2501.01 - 2685 MHz
NR Band n38	Voice/Data	2575 - 2615 MHz
NR Band n48	Voice/Data	3555 - 3694.98 MHz
NR Band n77 DoD	Voice/Data	3455.01 - 3544.98 MHz
NR Band n77	Voice/Data	3705 - 3975 MHz
2.4 GHz WLAN	Voice/Data	2412 - 2462 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-4	Voice/Data	5845 - 5885 MHz
U-NII-5	Voice/Data	5935 - 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
NFC	Data	13.56 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
UWB	Data	6489.6 - 7987.2 MHz

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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  $P_{Limit}$  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., 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.

## 1.3 Nomenclature for Part 0 Report

Technology	Term	Description
2G/3G/4G/5G Sub-6 NR	$P_{limit}$	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>P<sub>limit</sub></i> for all technologies and bands

## 1.4 Bibliography

Report Type	Report Serial Number
RF Exposure Part 0 Original Filing Test Report	Original Filing
RF Exposure Part 1 Test Report	1M2302220014-01.A3L
Compliance Summary	1M2302220014-03.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:

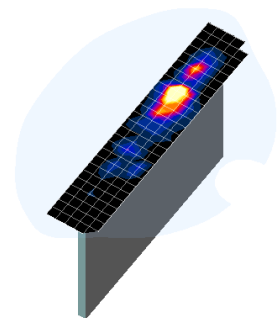
$\sigma$	=	conductivity of the tissue-simulating material (S/m)
$\rho$	=	mass density of the tissue-simulating material (kg/m <sup>3</sup> )
$E$	=	Total RMS electric field strength (V/m)

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) ( $\Delta x_{area}, \Delta y_{area}$ )	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 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 3-1 represent different exposure scenarios.

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

Scenario	Description	SAR Test Cases
Head (DSI = 2)	<ul style="list-style-type: none"> <li>Device positioned next to head</li> <li>Receiver Active</li> </ul>	Head SAR per KDB Publication 648474 D04
Hotspot mode (DSI = 3)	<ul style="list-style-type: none"> <li>Device transmits in hotspot mode near body</li> <li>Hotspot Mode Active</li> </ul>	Hotspot SAR per KDB Publication 941225 D06
Phablet (DSI = 0)	<ul style="list-style-type: none"> <li>Device is held with hand.</li> </ul>	Phablet SAR per KDB Publication 648474 D04 & KDB Publication 616217 D04
Body-worn (DSI = 0)	<ul style="list-style-type: none"> <li>Device being used with a body-worn accessory</li> </ul>	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>			
$SAR\_design\_target < SAR\_regulatory\_limit \times 10^{\frac{-Total\ Uncertainty}{10}}$			
1g SAR (W/kg)		10g SAR (W/kg)	
<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>	1.0 W/kg	<i>SAR_design_target</i>	2.5 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 in the Original RF Exposure Part 0 Test Report (Serial Number can be found in the bibliography).

$P_{limit}$  is calculated by linearly scaling with the measured SAR at the Ppart0 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 Ppart0 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<sub>Limit</sub> Determination**

Device State Index (DSI)	P <sub>Limit</sub> Determination Scenarios
0	The worst-case SAR exposure is determined as maximum SAR normalized to the limit (i.e. lowest $P_{limit}$ ) among: 1. Body Worn SAR 2. Extremity SAR measured at 0 mm spacing for all edges.
2	$P_{limit}$ is calculated based on 1g Head SAR
3	$P_{limit}$ is calculated based on 1g Hotspot SAR at 10 mm

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**Table 3-4  
SAR Characterizations**

Exposure Scenario			Body-Worn	Extremity	Head	Hotspot	Maximum Tune-Up Output Power*
Averaging Volume			1g	10g	1g	1g	
Spacing			15 mm	0 mm	0 mm	10 mm	
DSI			0	0	2	3	
Technology/Band	Antenna	Antenna Group					Pmax
GSM 850	A	AGO	28.5		31.4	25.6	25.3
GSM 1900	A	AGO	20.0		33.2	18.0	22.1
UMTS 850	A	AGO	27.4		31.3	26.2	24.0
UMTS 1750	A	AGO	19.0		31.8	19.0	23.0
UMTS 1900	A	AGO	19.5		32.2	17.5	23.0
LTE Band 71	A	AGO	27.8		34.3	27.8	24.5
LTE Band 12	A	AGO	27.5		33.4	27.5	24.5
LTE Band 13	A	AGO	28.6		31.9	27.6	24.5
LTE Band 14	A	AGO	27.9		31.7	27.9	24.5
LTE Band 26 (Cell)	A	AGO	27.6		31.1	26.7	24.5
LTE Band 5 (Cell)	A	AGO	27.8		30.9	26.6	24.5
LTE Band 66/4 (AWS)	A	AGO	20.0		31.4	19.5	23.5
LTE Band 66/4 (AWS)	F	AGI	20.0		18.0	20.0	23.5
LTE Band 25/2 (PCS)	A	AGO	20.0		33.9	17.5	23.5
LTE Band 25/2 (PCS)	F	AGI	18.0		17.0	18.0	23.5
LTE Band 30	A	AGO	21.5		33.2	19.0	22.5
LTE Band 30	F	AGI	20.0		17.0	20.0	22.5
LTE Band 7	B	AGO	20.0		37.7	20.0	23.0
LTE Band 7	F	AGI	18.5		16.0	18.5	23.0
LTE Band 48	G	AGI	18.0		16.0	18.0	20.5
LTE Band 41/38 (PC3)	B	AGO	20.0		22.0	20.0	22.0
LTE Band 41 (PC2)	B	AGO	20.0		22.0	20.0	22.1
LTE Band 41/38 (PC3)	F	AGI	19.0		17.0	19.0	22.0
LTE Band 41 (PC2)	F	AGI	19.0		17.0	19.0	22.1
NR Band n71	A	AGO	27.3		33.7	27.3	24.5
NR Band n12	A	AGO	27.0		32.8	27.0	24.5
NR Band n26/n5	A	AGO	27.4		31.6	25.8	24.5
NR Band n66	A	AGO	20.0		32.3	19.5	23.5
NR Band n66	F	AGI	20.0		18.0	20.0	23.5
NR Band n25/n2 (PCS)	A	AGO	20.0		33.6	17.5	23.5
NR Band n25/n2 (PCS)	F	AGI	20.0		17.0	20.0	23.5
NR Band n30	A	AGO	21.5		35.4	19.0	22.5
NR Band n30	F	AGI	20.0		17.0	20.0	22.5
NR Band n7	B	AGO	20.0		36.7	20.0	23.0
NR Band n7	F	AGI	18.5		16.0	18.5	23.0
NR Band n41 Path 1 (PC2)	F	AGI	19.0		17.0	19.0	26.0
NR Band n41 Path 1 (PC2)	B	AGO	17.0		15.0	17.0	22.0
NR Band n41 Path 1 (PC2)	E	AGI	15.0		13.0	15.0	20.0
NR Band n41 Path 1 (PC2)	D	AGO	16.5		15.5	16.5	21.0
NR Band n41 Path 2 (PC2)	B	AGO	19.0		17.0	19.0	26.0
NR Band n41 Path 2 (PC2)	F	AGI	17.0		16.0	17.0	22.0
NR Band n41 Path 2 (PC2)	D	AGO	16.0		14.5	16.0	19.0
NR Band n41 Path 2 (PC2)	E	AGI	14.0		12.5	14.0	20.0
NR Band n38	F	AGI	19.0		17.0	19.0	24.0
NR Band n38	B	AGO	19.0		17.0	19.0	24.0
NR Band n48	G	AGI	18.0		16.0	18.0	22.5
NR Band n48	C	AGO	13.5		11.5	13.5	18.5
NR Band n48	I	AGI	15.5		13.5	15.5	21.0
NR Band n48	D	AGO	13.5		11.5	13.5	19.0
NR Band n77 DoD (PC2)	G	AGI	18.0		17.0	18.0	26.0
NR Band n77 DoD (PC2)	C	AGO	14.0		14.0	14.0	20.5
NR Band n77 DoD (PC2)	I	AGI	17.0		17.0	17.0	23.0
NR Band n77 DoD (PC2)	D	AGO	14.5		14.5	14.5	21.0
NR Band n77 (PC2)	G	AGI	18.0		17.0	18.0	26.0
NR Band n77 (PC2)	C	AGO	14.0		14.0	14.0	20.5
NR Band n77 (PC2)	I	AGI	17.0		17.0	17.0	23.0
NR Band n77 (PC2)	D	AGO	14.5		14.5	14.5	21.0

**Notes:**

- When  $P_{max} < P_{limit}$ , the DUT will operate at a power level up to  $P_{max}$ .
- For all bands on AG1 when RCV is active, DSI=2 takes priority over all levels

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# 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	1/18/2023	Annual	1/18/2024	MY47270002
Agilent	E4438C	ESG Vector Signal Generator	5/10/2022	Annual	5/10/2023	MY42082659
Agilent	N5182A	MXG Vector Signal Generator	11/30/2022	Annual	11/30/2023	MY47420603
Agilent	N5182A	MXG Vector Signal Generator	7/20/2022	Annual	7/20/2023	MY47420800
Agilent	8753ES	S-Parameter Vector Network Analyzer	6/14/2022	Annual	6/14/2023	US39170118
Agilent	8753ES	S-Parameter Vector Network Analyzer	1/12/2023	Annual	1/12/2024	MY40001472
Agilent	E5515C	Wireless Communications Test Set	5/12/2022	Annual	5/12/2023	GB43304278
Agilent	E5515C	Wireless Communications Test Set	4/24/2019	Triennial	CBT	GB46310798
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433972
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433974
Amplifier Research	150A100C	Amplifier	CBT	N/A	CBT	350132
Anritsu	MN8110B	I/O Adaptor	N/A	N/A	N/A	6261747881
Anritsu	ML2496A	Power Meter	8/16/2022	Annual	8/16/2023	1351001
Anritsu	ML2495A	Power Meter	3/17/2022	Annual	3/17/2023	941001
Anritsu	MA2411B	Pulse Power Sensor	1/10/2023	Annual	1/10/2024	1315051
Anritsu	MA2411B	Pulse Power Sensor	10/21/2022	Annual	10/21/2023	1207364
Anritsu	MA24106A	USB Power Sensor	2/9/2023	Annual	2/9/2024	1520505
Anritsu	MA24106A	USB Power Sensor	2/9/2023	Annual	2/9/2024	2148505
Mini-Circuits	PWR-4GHS	USB Power Sensor	11/11/2022	Annual	11/11/2023	11710030062
Control Company	4352	Long Stem Thermometer	9/10/2021	Biennial	9/10/2023	210774678
Control Company	4352	Long Stem Thermometer	9/10/2021	Biennial	9/10/2023	210774685
Control Company	4040	Therm./ Clock/ Humidity Monitor	1/17/2023	Annual	1/17/2024	160574418
Mitutoyo	500-196-30	CD-6"ASX 6Inch 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	3/4/2022	Annual	3/4/2023	US46470561
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	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	ZUDC10-83-S+	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	TSF-100	Torque Wrench	7/11/2022	Annual	7/11/2023	47639-29
SPEAG	DAK-3.5	Dielectric Assessment Kit	12/15/2022	Annual	12/15/2023	1278
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/15/2022	Annual	8/15/2023	1041
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1379
SPEAG	D3500V2	3500 MHz SAR Dipole	1/19/2021	Triennial	1/19/2024	1059
SPEAG	D3700V2	3700 MHz SAR Dipole	1/13/2023	Annual	1/13/2024	1067
SPEAG	D3900V2	3900 MHz SAR Dipole	10/9/2020	Triennial	10/9/2023	1056
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/18/2022	Annual	7/18/2023	1583
SPEAG	EX3DV4	SAR Probe	7/19/2022	Annual	7/19/2023	7410

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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# 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> 1 gm	c <sub>i</sub> 10 gms	1 gm u <sub>i</sub> (± %)	10 gms u <sub>i</sub> (± %)	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	191
<b>Expanded Uncertainty</b> (95% CONFIDENCE LEVEL)	k=2						24.4	24.0	

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

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