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PART 0 SAR CHAR REPORT

Applicant Name:
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Date of Testing:
10/25/21 - 11/1/21
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
1M2112090151-04.A3L

FCC ID: **A3LSMS906U**

APPLICANT: **SAMSUNG ELECTRONICS CO., LTD**

Report Type:	Part 0 SAR Characterization
Application Type:	Class II Permissive Change
DUT Type:	Portable Handset
Model(s):	SM-S906U, SM-S906U1
Permissive Change(s):	See FCC Change Document
Date of Original Certification:	12/07/21

Note: The following test data was evaluated for the current test report. Please refer to RF Exposure Technical Report S/N 1M2109090103-23 (Rev1).A3L for original compliance evaluation.

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.

Randy Ortanez
President

ACCREDITED
CERT #2041.01

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1 DEVICE UNDER TEST

1.1 Device Overview

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 48	Voice/Data	3552.5 - 3697.5 MHz
LTE Band 41	Voice/Data	2498.5 - 2687.5 MHz
LTE Band 38	Voice/Data	2572.5 - 2617.5 MHz
NR Band n71	Voice/Data	665.5 - 695.5 MHz
NR Band n12	Voice/Data	701.5 - 713.5 MHz
NR Band n5 (Cell)	Voice/Data	826.5 - 846.5 MHz
NR Band n66 (AWS)	Voice/Data	1712.5 - 1777.5 MHz
NR Band n25 (PCS)	Voice/Data	1852.5 - 1912.5 MHz
NR Band n2 (PCS)	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	2506.02 - 2679.99 MHz
NR Band n38	Voice/Data	2575 - 2615 MHz
NR Band n48	Voice/Data	3560.01 - 3690 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 - 6525 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

This device uses the Qualcomm® 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 technologies, but the output power of these modems is not controlled by the Smart Transmit algorithm.

1.2 Time-Averaging for SAR and Power Density

This device is enabled with Qualcomm® 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. 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_{limit}	Power level that corresponds to the exposure design target (*SAR_design_target)* after accounting for all device design related uncertainties
	P_{max}	Maximum tune up output power
	SAR_design_target	Target SAR level < FCC SAR limit after accounting for all device design related uncertainties
	SAR Char	Table containing *Plimit* for all technologies and bands

1.4 Bibliography

Report Type	Report Serial Number
RF Exposure Part 1 Test Report	1M2112090151-01.A3L
Original RF Exposure Part 1 Test Report	1M2109090103-01.A3L
Original RF Exposure Part 0 Test Report	1M2109090103-23.A3L

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 (ρ). 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:

σ	=	conductivity of the tissue-simulating material (S/m)
ρ	=	mass density of the tissue-simulating material (kg/m^3)
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.

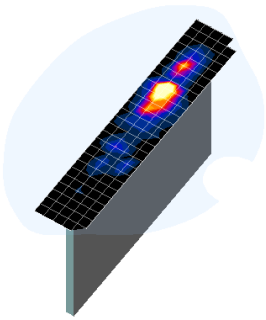

Figure 2-1
Sample SAR Area Scan

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 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) (Δx_{area}, Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom}, Δy_{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*Δz_{zoom}(n-1)	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*Δz_{zoom}(n-1)	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*Δz_{zoom}(n-1)	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*Δz_{zoom}(n-1)	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*Δz_{zoom}(n-1)	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

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)	▪ Device positioned next to head ▪ Receiver Active	*Head SAR per KDB Publication 648474 D04*
Hotspot mode (DSI = 3)	▪ Device transmits in hotspot mode near body ▪ Hotspot Mode Active	*Hotspot SAR per KDB Publication 941225 D06*
Phablet Grip (DSI=1 or 4)	▪ Device is held with hand and grip sensor is triggered ▪ Grip sensor triggered or earjack is active	*Phablet SAR per KDB Publication 648474 D04 & KDB Publication 616217 D04*
Phablet (DSI = 0)	▪ Device is held with hand and grip sensor is not triggered ▪ Distance grip sensor not triggered	*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**

SAR_design_target			
$SAR\_design\_target < SAR\_regulatory\_limit \times 10^{\frac{-Total\ Uncertainty}{10}}$			
1g SAR (W/kg)		**10g SAR (W/kg)**	
Total Uncertainty	1.0 dB	*Total Uncertainty*	1.0 dB
SAR_regulatory_limit	1.6 W/kg	*SAR_regulatory_limit*	4.0 W/kg
SAR_design_target	1.0 W/kg	*SAR_design_target*	2.5 W/kg

3.3 SAR Char

SAR test results corresponding to *Pmax* for each antenna/technology/band/DSI can be found in Appendix A.

Plimit is calculated by linearly scaling with the measured SAR at the Ppart0 to correspond to the *SAR_design_target*. When *Plimit* < *Pmax*, *Ppart0* was used as Plimit in the Smart Transmit EFS. When *Plimit* > *Pmax* and *Ppart0*=Pmax, calculated *Plimit* 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 *Plimit* determination for each exposure scenario corresponding to *SAR_design_target* are shown in Table 3-3.

Table 3-3
***PLimit* Determination**

Device State Index (DSI)	*PLimit* Determination Scenarios
0	The worst-case SAR exposure is determined as maximum SAR normalized to the limit among: 1. Body Worn SAR 2. Extremity SAR measured at 8, 6 and 11 mm spacing for back, front, bottom respectively 3. Extremity SAR measured at 0 mm for top, left, and right surfaces
1 or 4	P_{limit} is calculated based on 10g Extremity SAR at 0 mm for back, front, and bottom surfaces
2	P_{limit} is calculated based on 1g Head SAR
3	P_{limit} is calculated based on 1g Hotspot SAR at 10 mm

Note:

For DSI = 0, P_{limit} is calculated by:

$$P_{limit} = \min\{ P_{limit} \text{ corresponding to 1g Body Worn SAR evaluation at 15 mm spacing},$$
$$P_{limit} \text{ corresponding to 10g Extremity SAR evaluation at 6}\sim\text{11 mm spacing},$$
$$P_{limit} \text{ corresponding to 10g Extremity SAR evaluation at 0 mm for top, left, \& right surfaces}\}$$

Table 3-4
SAR Characterizations

Exposure Senario			Body-Worn	Phablet Max	Phablet Reduced	Head	Hotspot	Earjack	Maximum Tune-Up Output Power*
Averaging Volume			1g	10g	10g	1g	1g	10g	
Spacing			15 mm	11, 8, 6, 0 mm	0 mm	0 mm	10 mm	0 mm	
DSI			0	0	1	2	3	4	
Technology/Band	Antenna	Antenna Group							Pmax
GSM 850	A	AG0	30.0		28.3	31.6	28.3	28.3	25.3
GSM 1900	A	AG0	26.4		18.8	32.4	18.8	18.8	22.1
UMTS 850	A	AG0	30.3		26.6	31.2	26.6	26.6	24.0
UMTS 1750	A	AG0	24.7		21.0	31.2	19.0	21.0	23.0
UMTS 1900	A	AG0	24.7		20.5	30.8	18.5	20.5	23.0
LTE Band 71	A	AG0	31.2		27.3	32.9	27.3	27.3	24.8
LTE Band 12	A	AG0	30.0		27.1	31.7	27.1	27.1	24.8
LTE Band 13	A	AG0	29.9		27.5	31.2	27.0	27.5	24.5
LTE Band 14	A	AG0	30.2		28.0	31.5	27.3	28.0	24.5
LTE Band 26 (Cell)	A	AG0	30.9		26.3	31.3	26.3	26.3	24.8
LTE Band 5 (Cell)	A	AG0	31.4		26.9	31.8	26.9	26.9	24.8
LTE Band 66/4 (AWS)	A	AG0	23.0		20.0	23.0	19.0	20.0	23.5
LTE Band 25/2 (PCS)	A	AG0	24.4		20.0	30.2	18.5	20.0	23.5
LTE Band 30	A	AG0	26.3		21.0	33.1	19.0	21.0	22.5
LTE Band 7	B	AG0	22.0		20.0	22.0	20.0	20.0	23.0
LTE Band 41/38 (PC3)	B	AG0	21.5		20.0	21.5	20.0	20.0	22.0
LTE Band 41 (PC2)	B	AG0	21.5		20.0	21.5	20.0	20.0	22.9
LTE Band 48	F	AG1	18.5		18.5	16.0	18.5	18.5	21.0
NR Band n71	A	AG0	27.0		27.0	32.5	27.0	27.0	24.5
NR Band n12	A	AG0	29.5		27.5	30.8	27.4	27.5	24.5
NR Band n5 (Cell)	A	AG0	30.6		27.0	30.1	27.0	27.0	24.5
NR Band n66 (AWS)	A	AG0	22.5		20.0	22.5	18.5	20.0	23.5
NR Band n66 (AWS)	I	AG1	20.0		20.0	17.5	20.0	20.0	23.5
NR Band n25/2 (PCS)	A	AG0	22.5		19.0	22.5	18.5	19.0	23.5
NR Band n25/2 (PCS)	I	AG1	20.5		20.5	18.0	20.5	20.5	23.5
NR Band n30	A	AG0	26.0		21.0	32.8	19.0	21.0	22.0
NR Band n30	I	AG1	20.0		20.0	18.5	20.0	20.0	22.5
NR Band n7	B	AG0	22.0		20.0	22.0	20.0	20.0	23.0
NR Band n41 SRS 1 (PC3)/n38	I	AG1	19.5		19.5	17.0	19.5	19.5	24.0
NR Band n41 SRS 1 (PC2)	I	AG1	19.5		19.5	17.0	19.5	19.5	26.0
NR Band n41 SRS 2 (PC3)	B	AG0	16.0		16.0	16.0	16.0	16.0	18.7
NR Band n41 SRS 2 (PC2)	B	AG0	16.0		16.0	16.0	16.0	16.0	20.7
NR Band n41 SRS 3 (PC3)	E	AG1	15.0		15.0	15.0	15.0	15.0	18.5
NR Band n41 SRS 3 (PC2)	E	AG1	15.0		15.0	15.0	15.0	15.0	20.5
NR Band n41 SRS 4 (PC3)	D	AG0	13.0		13.0	13.0	13.0	13.0	16.0
NR Band n41 SRS 4 (PC2)	D	AG0	13.0		13.0	13.0	13.0	13.0	18.0
NR Band n48	F	AG1	17.0		17.0	15.5	17.0	17.0	23.0
NR Band n77 DoD SRS 1 (PC3)	F	AG1	17.0		17.0	15.5	17.0	17.0	24.0
NR Band n77 DoD SRS 1 (PC2)	F	AG1	17.0		17.0	15.5	17.0	17.0	26.0
NR Band n77 DoD SRS 2 (PC3)	C	AG0	11.0		11.0	11.0	11.0	11.0	18.0
NR Band n77 DoD SRS 2 (PC2)	C	AG0	11.0		11.0	11.0	11.0	11.0	20.0
NR Band n77 DoD SRS 3 (PC3)	K	AG1	15.0		15.0	15.0	15.0	15.0	23.0
NR Band n77 DoD SRS 3 (PC2)	K	AG1	15.0		15.0	15.0	15.0	15.0	25.0
NR Band n77 DoD SRS 4 (PC3)	D	AG0	11.5		11.5	11.5	11.5	11.5	18.3
NR Band n77 DoD SRS 4 (PC2)	D	AG0	11.5		11.5	11.5	11.5	11.5	20.3
NR Band n77 SRS 1 (PC3)	F	AG1	17.0		17.0	15.5	17.0	17.0	24.0
NR Band n77 SRS 1 (PC2)	F	AG1	17.0		17.0	15.5	17.0	17.0	26.0
NR Band n77 SRS 2 (PC3)	C	AG0	11.0		11.0	11.0	11.0	11.0	18.0
NR Band n77 SRS 2 (PC2)	C	AG0	11.0		11.0	11.0	11.0	11.0	20.0
NR Band n77 SRS 3 (PC3)	K	AG1	15.0		15.0	15.0	15.0	15.0	23.0
NR Band n77 SRS 3 (PC2)	K	AG1	15.0		15.0	15.0	15.0	15.0	25.0
NR Band n77 SRS 4 (PC3)	D	AG0	11.5		11.5	11.5	11.5	11.5	18.3
NR Band n77 SRS 4 (PC2)	D	AG0	11.5		11.5	11.5	11.5	11.5	20.3

Notes:

1. For all modes/bands, when Hotspot Mode (DSI=3) and Extremity sensor (DSI=1) are triggered at the same time, DSI=3 takes priority, thus the P_{limit} for DSI=3 is set to be less or equal to P_{limit} for DSI=1.
2. When $P_{max} < P_{limit}$, the DUT will operate at a power level up to P_{max}.
3. P_{limit} for DSI=1 and DSI =4 are the same.
4. For all bands on AG1, when RCV is active, DSI=2 takes priority over all levels.

4 EQUIPMENT LIST

For SAR measurements

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	CBT	N/A	CBT	3051A00187
Agilent	85033E	3.5mm Standard Calibration Kit	7/7/2021	Annual	7/7/2022	MY53402352
Agilent	E4438C	ESG Vector Signal Generator	12/14/2020	Biennial	12/14/2022	MY42082385
Agilent	E4432B	ESG-D Series Signal Generator	2/24/2021	Annual	2/24/2022	US40053896
Agilent	N5182A	MXG Vector Signal Generator	6/21/2021	Annual	6/21/2022	MY47420603
Agilent	N5182A	MXG Vector Signal Generator	6/15/2021	Annual	6/15/2022	MY47420800
Agilent	8753ES	S-Parameter Vector Network Analyzer	2/2/2021	Annual	2/2/2022	US39170122
Agilent	E5515C	Wireless Communications Test Set	2/4/2021	Annual	2/4/2022	GB43193563
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	353317
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433978
Anritsu	MN8110B	I/O Adaptor	CBT	N/A	CBT	6261747881
Anritsu	ML2496A	Power Meter	3/3/2021	Annual	3/3/2022	1306009
Anritsu	ML2496A	Power Meter	44307	Annual	44672	1351001
Anritsu	MA2411B	Pulse Power Sensor	44183	Annual	44548	1126066
Anritsu	MA2411B	Pulse Power Sensor	44264	Annual	44629	1207470
Anritsu	MT8821C	Radio Communication Analyzer	44302	Annual	44667	6200901190
Anritsu	MT8821C	Radio Communication Analyzer	44395	Annual	44760	6262150047
Anritsu	MA24106A	USB Power Sensor	44257	Annual	44622	1349509
Anritsu	MA24106A	USB Power Sensor	44376	Annual	44741	1349513
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
Control Company	4352	Long Stem Thermometer	1/24/2020	Biennial	1/24/2022	200043588
Control Company	4352	Long Stem Thermometer	5/16/2020	Biennial	5/16/2022	200294604
Control Company	4040	Therm./ Clock/ Humidity Monitor	3/6/2020	Biennial	3/6/2022	200170296
Control Company	4040	Therm./ Clock/ Humidity Monitor	3/6/2020	Biennial	3/6/2022	200170313
Insize	1108-150	Digital Caliper	1/17/2020	Biennial	1/17/2022	409193536
Intelligent Weigh	PD-3000	Electronic Balance	CBT	N/A	CBT	11081534
Intelligent Weighing	PD-3000	Electronic Balance	CBT	N/A	CBT	120405017
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	N6705B	DC Power Analyzer	5/5/2021	Triennial	5/5/2024	MY53004059
Keysight Technologies	N9020A	MXA Signal Analyzer	2/24/2021	Annual	2/24/2022	MY48010233
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	VLF-6000+	Low Pass Filter	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	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	TVA-11-422	RF Power Amp	CBT	N/A	CBT	QA1303002
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	NC-100	Torque Wrench	44166	Annual	44531	N/A
Pasternack	NC-100	Torque Wrench	8/4/2020	Biennial	8/4/2022	N/A
Pasternack	NC-100	Torque Wrench (8in-lbs)	8/5/2020	Biennial	8/5/2022	47639-47
Rohde & Schwarz	CMX500	Radio Communication Tester	CBT	N/A	CBT	100298
Rohde & Schwarz	CMW500	Radio Communication Tester	2/18/2021	Annual	2/18/2022	101767
Rohde & Schwarz	CMW500	Radio Communication Tester	1/19/2021	Annual	1/19/2022	111427
Rohde & Schwarz	CMW500	Radio Communication Tester	3/22/2021	Annual	3/22/2022	167283
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	2/10/2021	Annual	2/10/2022	161662
Seekonk	NC-100	Torque Wrench	8/5/2020	Biennial	8/5/2022	N/A
Seekonk	NC-100	Torque Wrench (8" lb)	8/4/2020	Biennial	8/4/2022	21053
Seekonk Inc	NC-100	Torque Wrench	8/4/2020	Biennial	8/4/2022	N/A
SPEAG	D3500V2	3500 MHz SAR Dipole	01/19/21	Annual	01/19/2022	1059
SPEAG	D3500V2	3500 MHz SAR Dipole	01/21/20	Biennial	01/21/2022	1097
SPEAG	D3700V2	3700 MHz SAR Dipole	01/19/21	Annual	01/19/2022	1018
SPEAG	D3700V2	3700 MHz SAR Dipole	01/21/20	Biennial	01/21/2022	1067
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/16/2021	Annual	8/16/2022	1450
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/3/2021	Annual	8/3/2022	1681
SPEAG	DAK-3.5	Dielectric Parameter Probes	12/9/2020	Annual	12/9/2021	1278
SPEAG	EX3DV4	SAR Probe	6/28/2021	Annual	6/28/2022	7661
SPEAG	EX3DV4	SAR Probe	8/5/2021	Annual	8/5/2022	7670

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.

5 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_i 1gm	c_i 10 gms	1gm u_i (± %)	10gms u_i (± %)	v_i
Measurement System									
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	1.73	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	1.73	1	1	0.1	0.1	∞
Modulation Response	E.2.5	4.8	R	1.73	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	1.73	1	1	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1	1	1.5	1.5	∞
RF Ambient Conditions - Noise	E.6.1	3	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	3	R	1.73	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.8	R	1.73	1	1	0.5	0.5	∞
Probe Positioning w/ respect to Phantom	E.6.3	6.7	R	1.73	1	1	3.9	3.9	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	4	R	1.73	1	1	2.3	2.3	∞
Test Sample Related									
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	1.73	1	1	2.9	2.9	∞
SAR Scaling	E.6.5	0	R	1.73	1	1	0.0	0.0	∞
Phantom & Tissue Parameters									
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	1.73	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Unceritainty	E.3.4	0.6	R	1.73	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	∞
Combined Standard Uncertainty (k=1)			RSS				12.2	12.0	191
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				24.4	24.0	