



PART 0 SAR CHAR REPORT

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APPLICANT:

SAMSUNG ELECTRONICS CO., LTD

Report Type:

Part 0 SAR Characterization

DUT Type:

Portable Handset

Model(s):

SM-F721U

Additional Model:

SM-F721U1

Note: This revised Test Report (S/N: 1M2204080051-23.A3L (Rev1)) 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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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 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 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	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
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

This device uses the Qualcomm® Gen1 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® Gen1 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

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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 P_{limit} for all technologies and bands

1.4 Bibliography

Report Type	Report Serial Number
RF Exposure Part 2 Test Report	1M2204080051-22.A3L
PD Exposure Part 0 Test Report	
Near Field PD Report (Part 1)	1M2204080051-25.A3L
RF Exposure Compliance Summary Report	1M2204080051-24.A3L
RF Exposure Part 1 Test Report	1M2204080051-19.A3L

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2 SAR AND POWER DENSITY MEASUREMENTS

2.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (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.
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

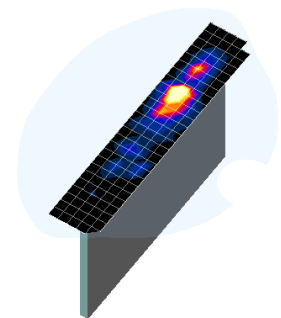


Figure 2-1
Sample SAR Area Scan

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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) ($\Delta x_{\text{area}}, \Delta y_{\text{area}}$)	Maximum Zoom Scan Resolution (mm) ($\Delta x_{\text{zoom}}, \Delta y_{\text{zoom}}$)	Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan Volume (mm) (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 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**

<i>SAR_design_target</i>			
$SAR_design_target < SAR_regulatory_limit \times 10^{\frac{-Total\ Uncertainty}{10}}$			
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.

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: 1. Body Worn SAR 2. Extremity SAR measured at 8, 6 and 12 mm spacing for back, front, bottom respectively 3. Extremity SAR measured at 0 mm for all surfaces
1 or 4	P_{limit} is calculated based on 10g Extremity SAR at 0 mm for all surfaces
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	Phablet Max	Grip Sensor Active	Head	Hotspot	Earjack	Maximum
Averaging Volume		1g	10g	10g	1g	1g	10g	Tune-Up
Spacing		15 mm	8, 6, 12, 0 mm	0 mm	0 mm	10, 5 mm	0 mm	Output Power*
DSI		0	0	1	2	3	4	
Technology/Band	Antenna							Pmax
GSM 850	A	29.2		29.2	30.9	21.8	29.2	25.3
GSM 1900	A	27.3		18.8	36.1	18.8	18.8	22.1
UMTS 850	A	28.6		28.9	22.0	23.0	28.9	24.0
UMTS 1750	A	25.4		21.0	22.0	19.0	21.0	24.0
UMTS 1900	A	25.7		21.0	22.0	18.0	21.0	24.0
LTE Band 71	A	29.2		29.2	32.1	23.0	29.2	24.0
LTE Band 12	A	29.5		29.0	32.1	23.0	29.0	24.0
LTE Band 13	A	31.2		28.1	32.1	23.0	28.1	24.0
LTE Band 14	A	29.0		28.6	30.6	23.0	28.6	23.5
LTE Band 26 (Cell)	A	29.6		28.8	30.9	23.0	28.8	24.0
LTE Band 5 (Cell)	A	29.3		28.5	30.2	23.0	28.5	24.0
LTE Band 66 (AWS)	A	25.9		20.5	37.3	18.5	20.5	23.5
LTE Band 4 (AWS)	A	25.9		20.0	37.3	18.0	20.0	23.5
LTE Band 25/2 (PCS)	A	26.4		21.0	36.3	18.0	21.0	23.5
LTE Band 30	B	27.1		21.0	36.7	17.0	21.0	22.0
LTE Band 7	B	26.8		20.5	34.0	17.5	20.5	23.5
LTE Band 41 (PC3)	B	24.0		24.0	32.9	18.0	24.0	22.0
LTE Band 41 (PC2)	B	24.0		24.0	32.9	18.0	24.0	22.0
LTE Band 38	B	23.0		23.0	23.0	20.0	23.0	23.0
LTE Band 48	F	18.5		18.5	14.0	15.5	18.5	21.0
NR Band n71	A	27.9		27.6	30.7	23.0	27.6	24.0
NR Band n12	A	28.9		28.9	30.8	23.0	28.9	24.0
NR Band n5 (Cell)	A	29.5		26.8	30.8	23.0	26.8	24.0
NR Band n66 (AWS)	A	24.8		19.5	34.3	17.5	19.5	23.5
NR Band n66 (AWS)	I	21.0		21.0	15.0	15.0	21.0	23.0
NR Band n25/n2 (PCS)	A	25.4		21.0	34.9	17.5	21.0	23.5
NR Band n25/n2 (PCS)	I	21.0		21.0	15.5	15.5	21.0	23.5
NR Band n30	B	28.2		21.5	35.9	18.0	21.5	22.5
NR Band n30	I	21.0		21.0	16.0	18.5	21.0	23.0
NR Band n7	B	27.9		20.5	34.7	19.5	20.5	23.5
NR Band n41 (PC3)	I	20.0		20.0	15.0	17.0	20.0	24.5
NR Band n41 (PC2)	I	20.0		20.0	15.0	17.0	20.0	26.5
NR Band n38	I	19.5		19.5	15.0	17.0	19.5	24.0
NR Band n41 (PC3)	B	15.0		15.0	15.0	15.0	15.0	18.5
NR Band n41 (PC2)	B	15.0		15.0	15.0	15.0	15.0	20.5
NR Band n41 (PC3)	F	16.5		16.5	11.5	13.5	16.5	18.0
NR Band n41 (PC2)	F	16.5		16.5	11.5	13.5	16.5	20.0
NR Band n41 (PC3)	C	10.0		10.0	10.0	10.0	10.0	13.5
NR Band n41 (PC2)	C	10.0		10.0	10.0	10.0	10.0	15.5
NR Band n48	F	18.0		18.0	14.0	16.5	18.0	24.0
NR Band n48	I	18.0		18.0	14.0	16.5	18.0	20.0
NR Band n48	E	18.0		18.0	14.0	16.5	18.0	20.0
NR Band n48	C	14.0		14.0	14.0	14.0	14.0	18.0
NR Band n77 DoD (PC3)	F	18.0		18.0	14.0	15.5	18.0	24.0
NR Band n77 DoD (PC2)	F	18.0		18.0	14.0	15.5	18.0	26.0
NR Band n77 DoD (PC3)	I	18.0		18.0	14.0	15.5	18.0	20.0
NR Band n77 DoD (PC2)	I	18.0		18.0	14.0	15.5	18.0	22.0
NR Band n77 DoD (PC3)	E	18.0		18.0	14.0	15.5	18.0	20.0
NR Band n77 DoD (PC2)	E	18.0		18.0	14.0	15.5	18.0	22.0
NR Band n77 DoD (PC3)	C	14.0		14.0	14.0	14.0	14.0	18.0
NR Band n77 DoD (PC2)	C	14.0		14.0	14.0	14.0	14.0	20.0
NR Band n77 (PC3)	F	18.0		18.0	14.0	15.5	18.0	24.0
NR Band n77 (PC2)	F	18.0		18.0	14.0	15.5	18.0	26.0
NR Band n77 (PC3)	I	18.0		18.0	14.0	15.5	18.0	20.0
NR Band n77 (PC2)	I	18.0		18.0	14.0	15.5	18.0	22.0
NR Band n77 (PC3)	E	18.0		18.0	14.0	15.5	18.0	20.0
NR Band n77 (PC2)	E	18.0		18.0	14.0	15.5	18.0	22.0
NR Band n77 (PC3)	C	14.0		14.0	14.0	14.0	14.0	18.0
NR Band n77 (PC2)	C	14.0		14.0	14.0	14.0	14.0	20.0

Notes:

- 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
- When $P_{max} < P_{limit}$, the DUT will operate at a power level up to P_{max} .
- P_{limit} for DSI=1 and DSI =4 are the same.
- For all modes/bands, when RCV is active, DSI=2 takes priority over all levels.

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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	MY45113242
Agilent	E4438C	ESG Vector Signal Generator	5/10/2022	Annual	5/10/2023	MY42082659
Agilent	E4438C	ESG Vector Signal Generator	2/14/2022	Annual	2/14/2023	MY42082385
Agilent	N5182A	MMG Vector Signal Generator	6/21/2022	Annual	6/21/2023	MY41620693
Agilent	N5182A	MMG Vector Signal Generator	7/6/2021	Annual	7/6/2022	MY48180366
Agilent	8753ES	S-Parameter Vector Network Analyzer	2/11/2022	Annual	2/11/2023	MY40063841
Agilent	8753ES	S-Parameter Vector Network Analyzer	12/17/2021	Annual	12/17/2022	MY40060670
Agilent	E5515C	Wireless Communications Test Set	5/12/2022	Annual	5/12/2023	GB44304778
Agilent	E5515C	Wireless Communications Test Set	5/6/2021	Annual	5/6/2022	GB44400860
Agilent	N4101A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Amplifier Research	155166	Amplifier	CBT	N/A	CBT	433974
Amplifier Research	155166	Amplifier	9/15/2021	Annual	9/15/2022	433975
Anritsu	ML2496A	Power Meter	4/21/2021	Annual	4/21/2022	1351001
Anritsu	ML2496A	Power Meter	3/31/2022	Annual	3/31/2023	1138001
Anritsu	MA2411B	Pulse Power Sensor	4/29/2022	Annual	4/29/2023	1207470
Anritsu	MA2411B	Pulse Power Sensor	9/21/2021	Annual	9/21/2022	1339008
Anritsu	MT8821C	Radio Communication Analyzer MT8821C	5/24/2022	Annual	5/24/2023	620144418
Anritsu	MT8821C	Radio Communication Analyzer MT8821C	3/31/2022	Annual	3/31/2023	6201664756
Anritsu	MT8821C	Radio Communication Analyzer MT8821C	9/26/2021	Annual	9/26/2022	6405148627
Anritsu	MT8821C	Radio Communication Analyzer MT8821C	8/20/2021	Annual	8/20/2022	6261150000
Anritsu	MT8800A	Radio Communication Test Station	8/2/2021	Annual	8/2/2022	6272337438
Anritsu	MT8800A	Radio Communication Test Station	8/2/2021	Annual	8/2/2022	6272337436
Anritsu	MT8800A	Radio Communication Test Station	8/2/2021	Annual	8/2/2022	6272337437
Anritsu	MA24106A	USB Power Sensor	6/1/2023	Annual	6/1/2024	1349514
Anritsu	MA24106A	USB Power Sensor	7/7/2021	Annual	7/7/2022	1244512
Control Company	4353	Long Stem Thermometer	10/28/2020	Biennial	10/28/2022	200670623
Control Company	4353	Long Stem Thermometer	10/28/2020	Biennial	10/28/2022	200670633
Control Company	4353	Long Stem Thermometer	10/28/2020	Biennial	10/28/2022	200670635
Control Company	4040	Therm / Clock/ Humidity Monitor	2/28/2018	Biennial	CBT	170515872
Control Company	4040	Therm / Clock/ Humidity Monitor	2/28/2018	Biennial	CBT	170515893
Midrange	S00-106-10	CD-6 GHz Clock-Digital	2/16/2022	Triennial	2/16/2025	A2023847
Keysight Technologies	N6705S	DC Power Analyzer	5/5/2021	Triennial	5/5/2024	MY53004059
Keysight Technologies	N8020A	MVA Signal Analyzer	4/14/2022	Annual	4/14/2023	MY48010233
NCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Mini-Circuits	VLF-6000+	Low Pass Filter DC to 6000 MHz	7/9/2021	Annual	7/9/2022	26189
Mini-Circuits	VLF-6000+	Low Pass Filter DC to 6000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	WV-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-1950	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
Mini-Circuits	ZUDC10-83-S+	Directional Coupler	9/15/2021	Annual	9/15/2022	2111
Narda	4722-3	Attenuator (3dB)	CBT	N/A	CBT	5426
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Seckond	TSF-100	Torque Wrench	7/8/2021	Annual	7/8/2022	47639-29
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	4/18/2022	Annual	4/18/2023	128633
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	3/29/2022	Annual	3/29/2023	171075
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	4/9/2022	Annual	4/9/2023	162125
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	4/7/2022	Annual	4/7/2023	167283
SPEAG	DAK-3.5	Dielectric Assessment Kit	1/6/2022	Annual	1/6/2023	1278
SPEAG	DAK-3.5	Dielectric Assessment Kit	10/20/2021	Annual	10/20/2022	1091
SPEAG	DAK3-3.5	Portable Dielectric Assessment Kit	8/28/2021	Annual	8/28/2022	1041
SPEAG	DAK3-3.5	Portable Dielectric Assessment Kit	7/15/2021	Annual	7/15/2022	1039
SPEAG	MA1A	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1379
SPEAG	CL413	13 MHz SAR Dipole	9/16/2021	Annual	9/16/2022	1002
SPEAG	D750V3	750 MHz SAR Dipole	5/11/2021	Annual	5/11/2022	1034
SPEAG	D750V3	750 MHz SAR Dipole	3/14/2022	Annual	3/14/2023	1054
SPEAG	D750V3	750 MHz SAR Dipole	2/14/2022	Annual	2/14/2023	1046
SPEAG	D750V3	750 MHz SAR Dipole	10/19/2021	Annual	10/19/2022	1161
SPEAG	D835V2	835 MHz SAR Dipole	5/11/2021	Annual	5/11/2022	46186
SPEAG	D835V2	835 MHz SAR Dipole	3/14/2022	Annual	3/14/2023	46047
SPEAG	D835V2	835 MHz SAR Dipole	4/14/2022	Annual	4/14/2023	46119
SPEAG	D835V2	835 MHz SAR Dipole	10/19/2021	Annual	10/19/2022	46116
SPEAG	D1750V2	1750 MHz SAR Dipole	5/14/2021	Biennial	5/14/2023	1008
SPEAG	D1750V2	1750 MHz SAR Dipole	10/22/2021	Annual	10/22/2022	1150
SPEAG	D1900V2	1900 MHz SAR Dipole	9/21/2021	Annual	9/21/2022	56148
SPEAG	D1900V2	1900 MHz SAR Dipole	10/22/2021	Annual	10/22/2022	56098
SPEAG	D1900V2	1900 MHz SAR Dipole	2/21/2022	Annual	2/21/2023	56148
SPEAG	D2300V2	2300 MHz SAR Dipole	6/3/2021	Annual	6/3/2022	1116
SPEAG	D3900V2	3900 MHz SAR Dipole	6/10/2021	Annual	6/10/2022	1073
SPEAG	D2450V2	2450 MHz SAR Dipole	8/18/2021	Annual	8/18/2022	719
SPEAG	D2450V2	2450 MHz SAR Dipole	9/20/2020	Biennial	9/20/2022	797
SPEAG	D2450V2	2450 MHz SAR Dipole	11/25/2021	Annual	11/25/2022	981
SPEAG	D2600V2	2600 MHz SAR Dipole	4/14/2021	Biennial	4/14/2023	1004
SPEAG	D2600V2	2600 MHz SAR Dipole	6/24/2019	Triennial	6/24/2022	1064
SPEAG	D3500V2	3500 MHz SAR Dipole	1/19/2021	Biennial	1/19/2023	1059
SPEAG	D3500V2	3500 MHz SAR Dipole	1/21/2020	Triennial	1/21/2023	1097
SPEAG	D3700V2	3700 MHz SAR Dipole	1/22/2020	Triennial	1/22/2023	1097
SPEAG	D3700V2	3700 MHz SAR Dipole	1/28/2021	Biennial	1/28/2023	1018
SPEAG	D3900V2	3900 MHz SAR Dipole	10/9/2020	Biennial	10/9/2022	1056
SPEAG	D3900V2	3900 MHz SAR Dipole	6/10/2021	Annual	6/10/2022	1073
SPEAG	D5604V2	5 GHz SAR Dipole	1/10/2022	Annual	1/10/2023	1057
SPEAG	DAE4	Dasys Data Acquisition Electronics	3/14/2022	Annual	3/14/2023	1463
SPEAG	DAE4	Dasys Data Acquisition Electronics	8/1/2021	Annual	8/1/2022	1481
SPEAG	DAE4	Dasys Data Acquisition Electronics	12/8/2021	Annual	12/8/2022	809
SPEAG	DAE4	Dasys Data Acquisition Electronics	5/12/2022	Annual	5/12/2023	728
SPEAG	DAE4	Dasys Data Acquisition Electronics	11/10/2021	Annual	11/10/2022	1323
SPEAG	DAE4	Dasys Data Acquisition Electronics	3/16/2022	Annual	3/16/2023	1272
SPEAG	DAE4	Dasys Data Acquisition Electronics	7/13/2021	Annual	7/13/2022	1583
SPEAG	DAE4	Dasys Data Acquisition Electronics	1/14/2022	Annual	1/14/2023	1558
SPEAG	DAE4	Dasys Data Acquisition Electronics	9/13/2021	Annual	9/13/2022	1364
SPEAG	DAE4	Dasys Data Acquisition Electronics	8/16/2021	Annual	8/16/2022	1450
SPEAG	DAE4	Dasys Data Acquisition Electronics	6/15/2021	Annual	6/15/2022	1532
SPEAG	DAE4	Dasys Data Acquisition Electronics	6/21/2021	Annual	6/21/2022	1676
SPEAG	DAE4	Dasys Data Acquisition Electronics	6/15/2021	Annual	6/15/2022	1334
SPEAG	DAE4	Dasys Data Acquisition Electronics	2/22/2022	Annual	2/22/2023	665
SPEAG	DAE4	Dasys Data Acquisition Electronics	8/4/2021	Annual	8/4/2022	1680
SPEAG	DAE4	Dasys Data Acquisition Electronics	4/13/2022	Annual	4/13/2023	1407
SPEAG	EK3DV4	SAR Probe	3/22/2022	Annual	3/22/2023	7637
SPEAG	EK3DV4	SAR Probe	8/5/2021	Annual	8/5/2022	7670
SPEAG	EK3DV4	SAR Probe	1/10/2022	Annual	1/10/2023	7571
SPEAG	EK3DV4	SAR Probe	5/18/2021	Annual	5/17/2022	3914
SPEAG	EK3DV4	SAR Probe	11/16/2021	Annual	11/16/2022	7538
SPEAG	EK3DV4	SAR Probe	3/21/2022	Annual	3/21/2023	7527
SPEAG	EK3DV4	SAR Probe	7/28/2021	Annual	7/28/2022	7418
SPEAG	EK3DV4	SAR Probe	1/19/2022	Annual	1/19/2023	7570
SPEAG	EK3DV4	SAR Probe	9/17/2021	Annual	9/17/2022	7558
SPEAG	EK3DV4	SAR Probe	6/28/2021	Annual	6/28/2022	7661
SPEAG	EK3DV4	SAR Probe	6/21/2021	Annual	6/21/2022	7691
SPEAG	EK3DV4	SAR Probe	7/20/2021	Annual	7/20/2022	7406
SPEAG	EK3DV4	SAR Probe	6/21/2021	Annual	6/21/2022	7409
SPEAG	EK3DV4	SAR Probe	2/12/2022	Annual	2/12/2023	7417
SPEAG	EK3DV4	SAR Probe	9/20/2021	Annual	9/20/2022	7553
SPEAG	EK3DV4	SAR Probe	4/20/2022	Annual	4/20/2023	7659

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

For SAR Measurements

a	c	d	e = f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	Tol. (± %)	Prob. Dist.	Div.	c _i 1gm	c _i 10 gms	1gm u _i (± %)	10gms u _i (± %)	v _i
Measurement System								
Probe Calibration	6.55	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	1.3	N	1	0.7	0.7	0.9	0.9	∞
Boundary Effect	2.0	R	1.73	1.0	1.0	1.2	1.2	∞
Linearity	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	0.25	R	1.73	1.0	1.0	0.1	0.1	∞
Readout Electronics	0.3	N	1	1.0	1.0	0.3	0.3	∞
Response Time	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions - Noise	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
RF Ambient Conditions - Reflections	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	6.7	R	1.73	1.0	1.0	3.9	3.9	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Test Sample Related								
Test Sample Positioning	2.7	N	1	1.0	1.0	2.7	2.7	35
Device Holder Uncertainty	1.67	N	1	1.0	1.0	1.7	1.7	5
Output Power Variation - SAR drift measurement	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
SAR Scaling	0.0	R	1.73	1.0	1.0	0.0	0.0	∞
Phantom & Tissue Parameters								
Phantom Uncertainty (Shape & Thickness tolerances)	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
Liquid Conductivity - measurement uncertainty	4.2	N	1	0.78	0.71	3.3	3.0	10
Liquid Permittivity - measurement uncertainty	4.1	N	1	0.23	0.26	1.0	1.1	10
Liquid Conductivity - Temperature Uncertainty	3.4	R	1.73	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Uncertainty	0.6	R	1.73	0.23	0.26	0.1	0.1	∞
Liquid Conductivity - deviation from target values	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Permittivity - deviation from target values	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Combined Standard Uncertainty (k=1)	RSS					11.5	11.3	60
Expanded Uncertainty (95% CONFIDENCE LEVEL)	k=2					23.0	22.6	

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