



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-F711U1, SM-F711U

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.


Randy Ortanez
President



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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
Cell. CDMA/EVDO	Voice/Data	824.70 - 848.31 MHz
PCS CDMA/EVDO	Voice/Data	1851.25 - 1908.75 MHz
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	Data	665.5 - 695.5 MHz
NR Band n12	Data	701.5 - 713.5 MHz
NR Band n5 (Cell)	Data	826.5 - 846.5 MHz
NR Band n66 (AWS)	Data	1712.5 - 1777.5 MHz
NR Band n25 (PCS)	Data	1852.5 - 1912.5 MHz
NR Band n2 (PCS)	Data	1852.5 - 1907.5 MHz
NR Band n30	Data	2307.5 - 2312.5 MHz
NR Band n41	Data	2506.02 - 2679.99 MHz
NR Band n77 DoD	Data	3460.02 - 3540 MHz
NR Band n77	Data	3710.01 - 3969.99 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
Bluetooth	Data	2402 - 2480 MHz
NR Band n260	Data	37000 - 40000 MHz
NR Band n261	Data	27500 - 28350 MHz
NFC	Data	13.56 MHz

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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 P_{limit} for all technologies and bands

1.4 Bibliography

Report Type	Report Serial Number
FCC Part 0 PD Characterization Report	
Near Field PD Report (Part 1)	1M2107290086-22.A3L
RF Exposure Part 1 Test Report	1M2107290086-21.A3L
RF Exposure Part 2 Test Report	1M2107290086-23.A3L
RF Exposure Compliance Summary Report	1M2107290086-24.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 (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.

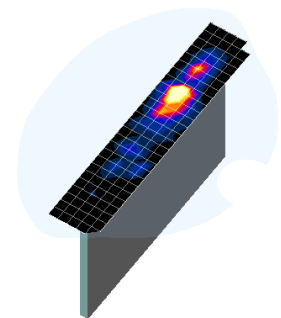


Figure 2-1
Sample SAR Area Scan

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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) ($\Delta x_{\text{area}}, \Delta y_{\text{area}}$)	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 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 5 mm in the closed configuration or 10 mm in the open configuration

Note:

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

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

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Table 3-4
SAR Characterizations

Exposure Scenario:		Body-Worn	Phablet Max	Phablet	Head	Hotspot	Earjack	Maximum Tune-Up Output Power*
Averaging Volume:		1g	10g	10g	1g	1g	10g	
Spacing:		15 mm	8, 6, 11 mm	0 mm	0 mm	10, 5 mm	0 mm	
DSI:		0	0	1	2	3	4	
Technology/Band	Antenna							Pmax
CDMA BC0	A	29.5		28.1	29.9	23.0	28.1	24.0
EVDO BC0	A	29.5		28.1	29.9	23.0	28.1	23.5
CDMA/EVDO BC1	A	25.1		21.0	34.1	18.0	21.0	23.0
GSM/GPRS/EDGE 850 MHz	A	29.1		29.2	31.5	21.8	29.2	24.3
GSM/GPRS/EDGE 1900 MHz	A	26.3		18.8	33.9	18.8	18.8	21.3
UMTS B5	A	29.3		29.0	32.2	23.0	29.0	24.0
UMTS B4	A	26.3		20.0	34.9	18.0	20.0	23.0
UMTS B2	A	26.6		21.0	34.5	18.0	21.0	23.0
LTE FDD B71	A	30.0		29.7	32.0	23.0	29.7	24.5
LTE FDD B12	A	29.5		28.9	32.3	23.0	28.9	24.5
LTE FDD B13	A	30.8		29.0	32.0	23.0	29.0	24.5
LTE FDD B14	A	30.8		28.0	31.6	23.0	28.0	24.5
LTE FDD B26	A	29.5		28.8	30.9	23.0	28.8	24.3
LTE FDD B5	A	30.1		28.5	31.1	23.0	28.5	24.3
LTE FDD B66/4	A	24.5		20.4	35.5	18.0	20.4	24.0
LTE FDD B25/2	A	26.0		21.0	35.1	18.0	21.0	24.0
LTE FDD B30	A	28.0		21.0	35.5	17.5	21.0	23.0
LTE FDD B7	B	27.4		21.0	34.6	17.5	21.0	24.0
LTE TDD B48	F	19.5		19.5	15.0	15.0	19.5	21.5
LTE TDD B41/38	B	26.4		21.0	31.6	17.5	21.0	22.5
LTE TDD B41 (PC2)	B	26.4		21.0	31.6	17.5	21.0	23.4
NR FDD n71	A	27.4		28.5	32.2	23.0	28.5	24.5
NR FDD n12	A	27.4		27.4	32.2	23.0	27.4	24.5
NR FDD n5	A	29.2		29.2	31.0	23.0	29.2	24.3
NR FDD n66 Ant A	A	26.0		19.5	35.7	17.5	19.5	23.5
NR FDD n66 Ant I	I	21.0		21.0	17.0	18.0	21.0	23.5
NR FDD n25/2 Ant A	A	26.4		21.0	34.4	17.5	21.0	23.5
NR FDD n25/2 Ant I	I	23.7		23.7	18.0	18.0	23.7	23.5
NR FDD n30	A	29.2		21.0	40.4	17.5	21.0	22.5
NR TDD n41	I	21.0		21.0	15.0	19.0	21.0	24.3
NR TDD n41 (PC2)	I	21.0		21.0	15.0	19.0	21.0	26.8
NR TDD n77 Ant F	F	18.5		18.5	15.0	17.5	18.5	24.0
NR TDD n77 (PC2) Ant F	F	18.5		18.5	15.0	17.5	18.5	25.5
NR TDD n77 Ant I	I	16.5		16.5	13.0	15.5	16.5	20.0
NR TDD n77 (PC2) Ant I	I	16.5		16.5	13.0	15.5	16.5	21.5
NR TDD n77 Ant E	E	16.5		16.5	13.0	15.5	16.5	20.0
NR TDD n77 (PC2) Ant E	E	16.5		16.5	13.0	15.5	16.5	21.5
NR TDD n77 Ant C	C	12.5		12.5	9.0	11.0	12.5	16.0
NR TDD n77 (PC2) Ant C	C	12.5		12.5	9.0	11.0	12.5	17.5

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 LTE Band 48, NR Band n77, and NR Band n66 , n25, n2, and n41 Ant I, 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	85033E	3.5mm Standard Calibration Kit	7/7/2021	Annual	7/7/2022	MY5342352
Agilent	8594A	(8kHc-2.5GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A000587
Agilent	8733ES	5-Parameter Vector Network Analyzer	12/15/2020	Annual	12/15/2021	MY40003841
Agilent	8733ES	5-Parameter Vector Network Analyzer	2/2/2021	Annual	2/2/2022	US8910242
Agilent	E4432B	ESG-D Series Signal Generator	2/24/2021	Annual	2/24/2022	US40053896
Agilent	E4438C	ESG Vector Signal Generator	9/29/2020	Annual	9/29/2021	MY45093852
Agilent	E4438C	ESG Vector Signal Generator	12/14/2020	Biennial	12/14/2022	MY42082385
Agilent	E4440A	PSA Series Spectrum Analyzer	1/29/2021	Annual	1/29/2022	MY46186272
Agilent	E5515C	Wireless Communications Test Set	12/15/2020	Annual	12/15/2021	GB42301079
Agilent	E5515C	Wireless Communications Test Set	2/4/2021	Annual	2/4/2022	GB41193563
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Agilent	N5182A	MMW Vector Signal Generator	6/15/2021	Annual	6/15/2022	MM47420800
Agilent	N5182A	MMW Vector Signal Generator	6/21/2021	Annual	6/21/2022	MM47420609
Agilent	N9020A	MMA Signal Analyzer	12/21/2020	Annual	12/21/2021	MY50000571
Amplifier Research	150A100C	Amplifier	CBT	N/A	CBT	500132
Amplifier Research	155166	Amplifier	CBT	N/A	CBT	343971
Anritsu	MA2410BA	USB Power Sensor	10/14/2020	Annual	10/14/2021	1827521
Anritsu	MA2410BA	USB Power Sensor	10/14/2020	Annual	10/14/2021	1827528
Anritsu	MA2411B	Pulse Power Sensor	12/18/2020	Annual	12/18/2021	1128066
Anritsu	MA2411B	Pulse Power Sensor	3/8/2021	Annual	3/8/2022	1339007
Anritsu	ML2455A	Power Meter	11/3/2020	Annual	11/3/2021	1039008
Anritsu	ML2455A	Power Meter	1/28/2021	Annual	1/18/2022	94105
Anritsu	MT8821C	Radio Communication Analyzer	2/1/2021	Annual	2/1/2022	620164756
Anritsu	MT8821C	Radio Communication Analyzer	3/2/2021	Annual	3/2/2022	6203044715
Anritsu	MT8821C	Radio Communication Analyzer	3/23/2021	Annual	3/23/2022	6201144418
Anritsu	MT8821C	Radio Communication Analyzer	4/14/2021	Annual	4/14/2022	620189211
Anritsu	MT8821C	Radio Communication Analyzer	4/16/2021	Annual	4/16/2022	6200901190
Anritsu	MT8821C	Radio Communication Analyzer	7/18/2021	Annual	7/18/2022	6202150047
Anritsu	MT8821C	Radio Communication Analyzer	5/21/2021	Annual	5/21/2022	6201144419
Control Company	4048	Therm / Clock / Humidity Monitor	2/17/2020	Biennial	2/17/2022	200113268
Control Company	4048	Therm / Clock / Humidity Monitor	2/17/2020	Biennial	2/17/2022	200113274
Control Company	4352	Long Stem Thermometer	1/24/2020	Biennial	1/24/2022	200043634
Control Company	4352	Long Stem Thermometer	1/24/2020	Biennial	1/24/2022	200043644
Control Company	4352	Ultra Long Stem Thermometer	3/2/2021	Annual	3/2/2022	140508987
Control Company	4352	Ultra Long Stem Thermometer	3/2/2021	Annual	3/2/2022	140508122
HEWLETT PACKARD	8733E	Network Analyzer	12/10/2020	Annual	12/10/2021	US38163081
Keylight	720	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	ATN1620B	DC Power Supply	CBT	N/A	CBT	MY5200131
Keysight Technologies	N6750B	DC Power Analyzer	5/5/2021	Triennial	5/5/2024	MY53004059
Keysight Technologies	N9020A	MMA Signal Analyzer	2/24/2021	Annual	2/24/2022	MY48010233
MCL	BW-N10W+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SAP-340+	Low Pass Filter	CBT	N/A	CBT	R897660063
MiniCircuits	VLF-600+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	VLF-600+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
MiniCircuits	BW-N20W5+	DC to 38 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
MiniCircuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
MiniCircuits	NLP-2950+	Low Pass Filter DC to 2900 MHz	CBT	N/A	CBT	N/A
Narda	4024C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-53W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	NC-100	Torque Wrench	12/1/2020	Annual	12/1/2021	N/A
Pasternack	NC-100	Torque Wrench	8/4/2020	Biennial	8/4/2022	N/A
Pasternack	PE2208-6	Bi-directional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bi-directional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMT500	Radio Communication Tester	10/16/2020	Annual	10/16/2021	101699
Rohde & Schwarz	CMT500	Radio Communication Tester	10/16/2020	Annual	10/16/2021	100178
Rohde & Schwarz	CMT500	Radio Communication Tester	10/27/2020	Annual	10/27/2021	100843
Rohde & Schwarz	NRK	Power Meter	12/7/2020	Annual	12/7/2021	102183
Rohde & Schwarz	NRK	Power Meter	12/7/2020	Annual	12/7/2021	102562
Rohde & Schwarz	ZNL6	Vector Network Analyzer	9/29/2020	Annual	9/29/2021	101307
SPEAG	D1750V2	1750 MHz SAR Dipole	10/23/2018	Triennial	10/23/2021	1150
SPEAG	D1800V2	1800 MHz SAR Dipole	10/23/2018	Triennial	10/23/2021	56580
SPEAG	D1800V2	1800 MHz SAR Dipole	10/23/2018	Triennial	10/23/2021	56149
SPEAG	D1800V2	1800 MHz SAR Dipole	2/12/2019	Triennial	2/12/2022	56148
SPEAG	D2300V2	2300 MHz SAR Dipole	8/13/2018	Triennial	8/13/2021	1073
SPEAG	D2300V2	2300 MHz SAR Dipole	6/3/2021	Annual	6/3/2022	1116
SPEAG	D2450V2	2450 MHz SAR Dipole	9/9/2020	Annual	9/9/2021	787
SPEAG	D2450V2	2450 MHz SAR Dipole	8/14/2020	Annual	8/14/2021	779
SPEAG	D2450V2	2450 MHz SAR Dipole	1/18/2021	Annual	1/18/2022	981
SPEAG	D2600V2	2600 MHz SAR Dipole	11/12/2019	Biennial	11/12/2021	1071
SPEAG	D3000V2	3000 MHz SAR Dipole	4/14/2021	Annual	4/14/2022	1004
SPEAG	D2600V2	2600 MHz SAR Dipole	6/14/2019	Triennial	6/14/2022	1064
SPEAG	D3500V2	3500 MHz SAR Dipole	1/19/2021	Annual	1/19/2022	1059
SPEAG	D3500V2	3500 MHz SAR Dipole	1/21/2020	Biennial	1/21/2022	1087
SPEAG	D3700V2	3700 MHz SAR Dipole	1/19/2021	Annual	1/19/2022	1018
SPEAG	D3700V2	3700 MHz SAR Dipole	1/21/2020	Biennial	1/21/2022	1067
SPEAG	D3800V2	3800 MHz SAR Dipole	10/9/2020	Annual	10/9/2021	1056
SPEAG	D3800V2	3800 MHz SAR Dipole	6/10/2021	Annual	6/10/2022	1073
SPEAG	D500V2	5 GHz SAR Dipole	9/10/2020	Annual	9/10/2021	1181
SPEAG	D500V2	5 GHz SAR Dipole	1/20/2021	Annual	1/20/2022	1057
SPEAG	D750V3	750 MHz SAR Dipole	10/19/2018	Triennial	10/19/2021	1161
SPEAG	D750V3	750 MHz SAR Dipole	3/16/2020	Biennial	3/16/2022	1003
SPEAG	D850V2	850 MHz SAR Dipole	10/19/2018	Triennial	10/19/2021	46133
SPEAG	D850V2	850 MHz SAR Dipole	1/21/2021	Annual	1/21/2022	46132
SPEAG	DAE4	Day Data Acquisition Electronics	6/21/2021	Annual	6/21/2022	1676
SPEAG	DAE4	Day Data Acquisition Electronics	6/22/2021	Annual	6/22/2022	1677
SPEAG	DAE4	Day Data Acquisition Electronics	9/10/2020	Annual	9/10/2021	1449
SPEAG	DAE4	Day Data Acquisition Electronics	7/13/2021	Annual	7/13/2022	1583
SPEAG	DAE4	Day Data Acquisition Electronics	10/16/2020	Annual	10/16/2021	1333
SPEAG	DAE4	Day Data Acquisition Electronics	1/13/2021	Annual	1/13/2022	1558
SPEAG	DAE4	Day Data Acquisition Electronics	3/10/2021	Annual	3/10/2022	1415
SPEAG	DAE4	Day Data Acquisition Electronics	3/18/2021	Annual	3/18/2022	1272
SPEAG	DAE4	Day Data Acquisition Electronics	4/7/2021	Annual	4/7/2022	1407
SPEAG	DAE4	Day Data Acquisition Electronics	6/15/2021	Annual	6/15/2022	1334
SPEAG	DAE4	Day Data Acquisition Electronics	12/7/2020	Annual	12/7/2021	1533
SPEAG	EX30V4	SAR Probe	10/20/2020	Annual	10/20/2021	7951
SPEAG	EX30V4	SAR Probe	10/20/2020	Annual	10/20/2021	7939
SPEAG	EX30V4	SAR Probe	11/23/2020	Annual	11/23/2021	7938
SPEAG	EX30V4	SAR Probe	12/11/2020	Annual	12/11/2021	7971
SPEAG	EX30V4	SAR Probe	1/20/2021	Annual	1/20/2022	3589
SPEAG	EX30V4	SAR Probe	3/16/2021	Annual	3/16/2022	7926
SPEAG	EX30V4	SAR Probe	4/19/2021	Annual	4/19/2022	7957
SPEAG	EX30V4	SAR Probe	6/21/2021	Annual	6/21/2022	7409
SPEAG	EX30V4	SAR Probe	7/20/2021	Annual	7/20/2022	7406
SPEAG	EX30V4	SAR Probe	6/28/2021	Annual	6/28/2022	7460
SPEAG	EX30V4	SAR Probe	7/20/2021	Annual	7/20/2022	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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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 Uncertainty	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
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.4	24.0

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