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# PART 0 SAR CHAR REPORT

**Applicant Name:** Apple, Inc.

One Apple Park Way Cupertino, CA 95014 **Date of Testing:** 

02/16/2021 - 03/09/2021 **Test Site/Location:** 

PCTEST Lab, Morgan Hill, CA, USA

**Document Serial No.:** 1C2101020006-34.BCG

FCC ID: **BCGA2461** 

**APPLICANT:** APPLE, INC.

**Report Type:** Part 0 SAR Characterization

**DUT Type: Tablet Device** A2461, A2462 Model(s): Reference FCC ID: **BCGA2379** 

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





FCC ID: BCGA2461	Proud to be part of element	PART 0 SAR CHAR REPORT	Approved by:  Quality Manager
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APPENDIX A: SAR TEST RESULTS FOR PLimit CALCULATIONS

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2021 PCTEST RE'

# **DEVICE UNDER TEST**

#### 1.1 **Device Overview**

	T	
Band & Mode	Operating Modes	Tx Frequency
GPRS/EDGE 850	Data	824.20 - 848.80 MHz
GPRS/EDGE 1900	Data	1850.20 - 1909.80 MHz
UMTS 850	Data	826.40 - 846.60 MHz
UMTS 1750	Data	1712.4 - 1752.6 MHz
UMTS 1900	Data	1852.4 - 1907.6 MHz
LTE Band 71	Data	665.5 - 695.5 MHz
LTE Band 12	Data	699.7 - 715.3 MHz
LTE Band 17	Data	706.5 - 713.5 MHz
LTE Band 13	Data	779.5 - 784.5 MHz
LTE Band 14	Data	790.5 - 795.5 MHz
LTE Band 26 (Cell)	Data	814.7 - 848.3 MHz
LTE Band 5 (Cell)	Data	824.7 - 848.3 MHz
LTE Band 4 (AWS)	Data	1710.7 - 1754.3 MHz
LTE Band 66 (AWS)	Data	1710.7 - 1779.3 MHz
LTE Band 2 (PCS)	Data	1850.7 - 1909.3 MHz
LTE Band 25 (PCS)	Data	1850.7 - 1914.3 MHz
LTE Band 30	Data	2307.5 - 2312.5 MHz
LTE Band 7	Data	2502.5 - 2567.5 MHz
LTE Band 41	Data	2498.5 - 2687.5 MHz
LTE Band 48	Data	3552.5 - 3697.5 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 n41	Data	2506.02 - 2679.99 MHz
NR Band n77	Data	3710.01 - 3969.99 MHz
2.4 GHz WLAN	Voice/Data	2412 - 2472 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

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 technologies, but the output power of these modems is not controlled by the Smart Transmit algorithm.

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## 1.2 Data Referencing

GPRSEDGE 650 Ant 1 Fully Evaluated Referenced UMTS 850 Ant 1 Fully Evaluated Referenced UMTS 850 Ant 1 Fully Evaluated Referenced UMTS 1900 Ant 1 Fully Evaluated Referenced Referenced UMTS 1900 Ant 1 Fully Evaluated Referenced UMTS 1900 Ant 1 Fully Evaluated Referenced INT 1 Fully Evaluated Refer	Mode:	Reference Model Model - BCGA2379	Variant Model Model - BCGA2461
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NR Band n66 Ant 4b Fully Evaluated Referenced NR Band n62 And 4b Fully Evaluated Referenced NR Band n41 Ant 4b Fully Evaluated Referenced LTE Band 48 Ant 4a Fully Evaluated Fully Evaluated NR Band n77 Ant 4a Fully Evaluated Fully Evaluated		Fully Evaluated	
NR Band n25 Ant 4b Fully Evaluated Referenced NR Band n41 Ant 4b Fully Evaluated Referenced LTE Band 48 Ant 4a Fully Evaluated Fully Evaluated NR Band n77 Ant 4a Fully Evaluated Fully Evaluated		Fully Evaluated	
NR Band n41 Ant 4b         Fully Evaluated         Referenced           LTE Band 48 Ant 4a         Fully Evaluated         Fully Evaluated           NR Band n77 Ant 4a         Fully Evaluated         Fully Evaluated			
NR Band n77 Ant 4a Fully Evaluated Fully Evaluated	NR Band n41 Ant 4b		
2.4 GHz WLAN Ant 2a Fully Evaluated Referenced	NR Band n77 Ant 4a		
		Fully Evaluated	
2.4 GHz WLAN Ant 4a Fully Evaluated Fully Evaluated			
5 GHz WLAN Ant 4b Fully Evaluated Referenced			
5 GHz WLAN Ant 5b Fully Evaluated Referenced Bluetooth Ant 2a Fully Evaluated Referenced			
Bluetooth Ant 2a Fully Evaluated Referenced Bluetooth Ant 4a Fully Evaluated Fully Evaluated		Fully Evaluated	

Per manufacturer declaration, there are two tablet devices FCC ID: BCGA2379 and FCC ID: BCGA2461, with high degree of similarity, reference model FCC ID: BCGA2379 and variant model FCC ID: BCGA2461. The reference model supports mmWave operations, while the variant model has the mmWave components/antennas removed. Both models share the same material, form factor, circuit design, and components, including antennas and their locations. The reference and variant models use the same material, form factor, circuit design, and components, including antennas and their locations. The reference and variant models use the same power tables and have same tune-up tolerances.

Per FCC Approved Data Referencing Test Plan, testing was done fully on the reference model FCC ID: BCGA2379, while spot-check verification has been performed on variant model FCC ID: BCGA2461. Additionally, due to Antenna 4a location being close to the depopulated mmWave component, full testing has been done for all supported technologies on Antenna 4a. Please see RF exposure Technical report S/N 1C2101020005-34.BCG (Rev 1) for complete compliance evaluation for the reference model.

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#### 1.3 Time-Averaging for SAR

This device is enabled with Qualcomm<sup>®</sup> 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 PLimit 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).

#### 1.4 Nomenclature for Part 0 Report

Technology	Term	Description	
	P <sub>limit</sub>	Power level that corresponds to the exposure design	
20/20/40/50		target (SAR_design_target) after accounting for all device design related uncertainties	
2G/3G/4G/5G Sub-6 NR	<i>P<sub>max</sub></i> Maximum tune up output power		
Sub-o INK	SAR_design_target	Target SAR level < FCC SAR limit after accounting for all	
		device design related uncertainties	
	SAR Char	Table containing <i>Plimit</i> for all technologies and bands	

#### 1.5 **Bibliography**

Report Type	Report Serial Number
FCC SAR Evaluation Report (Part 1)	1C2101020006-01.BCG
RF Exposure Part 2 Test Report	1C2101020006-19.BCG
RF Exposure Compliance Summary	1C2101020006-20.BCG

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### 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 (o). 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:

conductivity of the tissue-simulating material (S/m) mass density of the tissue-simulating material (kg/m<sup>3</sup>) ρ

F 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
- 2. Table 2-1) and IEEE 1528-2013.
- 3. 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.

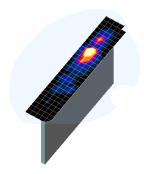


Figure 2-1 Sample SAR Area Scan

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- 4. 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
  - b. 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).
  - c. 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.
  - d. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
- 5. 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\*

_	Maximum Area Scan Maximum Zoom Sca		Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan
Frequency	Resolution (mm) (Δx <sub>area</sub> , Δy <sub>area</sub> )	Resolution (mm) (Δx <sub>200m</sub> , Δy <sub>200m</sub> )	Uniform Grid	G	raded Grid	Volume (mm) (x,y,z)
	uicu- yuicur	71000	Δz <sub>zoom</sub> (n)	Δz <sub>zoom</sub> (1)*	Δz <sub>zoom</sub> (n>1)*	
≤ 2 GHz	≤15	≤8	≤5	≤4	$\leq 1.5*\Delta z_{zoom}(n-1)$	≥30
2-3 GHz	≤12	≤5	≤5	≤4	$\leq 1.5*\Delta z_{zoom}(n-1)$	≥ 30
3-4 GHz	≤12	≤5	≤4	≤3	$\leq 1.5*\Delta z_{zoom}(n-1)$	≥28
4-5 GHz	≤ 10	≤4	≤3	≤ 2.5	$\leq 1.5*\Delta z_{zoom}(n-1)$	≥ 25
5-6 GHz	≤10	≤4	≤2	≤2	$\leq 1.5*\Delta z_{zoom}(n-1)$	≥22

<sup>\*</sup>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 tablet, 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.

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
(DSI = 1)	Detect Mode Activated	Tablet SAR per KDB Publication 616217 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_desi	gn_target			
SAR_design_target< SAR_regula	$tory\_limit  imes 10^{rac{-Total\ Uncertainty}{10}}$			
1g SAR (W/kg)				
Total Uncertainty	1.0 dB			
SAR_regulatory_limit	1.6 W/kg			
SAR_design_target	0.8 W/kg			

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#### 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
1	The worst-case SAR exposure is determined as maximum SAR normalized to the limit among:  1. Tablet SAR measured at 0 mm for Back, Top, Bottom, Right, Left surfaces

### Note:

For DSI = 1,  $P_{limit}$  is calculated by:

 $P_{limit}$  corresponding to 1g Tablet SAR evaluation at 0 mm for back, top, bottom, left and right surfaces

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Table 3-4 **SAR Characterizations** 

Exposure Scenario:	Ant 3 Body	Ant 3 Maximum	Ant 1 Body	Ant 1 Maximum	Ant 4a/4b Body	Ant 4a/4b Maximum	Ant 2a/2b Body	Ant 2a/2b Maximum
Averaging Volume:	1g	Tune-up	1g	Tune-up	1g	Tune-up	1g	Tune-up
Spacing:	0 mm	Output Power*	0 mm	Output Power*	0 mm	Output Power*	0 mm	Output Power*
DSI:	1		1		1		1	† ·
Technology/Band	Plimit corresponding to 0.8mW/g	Pmax	Plimit corresponding to 0.8mW/g	Pmax	Plimit corresponding to 0.8mW/g	Pmax	Plimit corresponding to 0.8mW/g	Pmax
GPRS/EDGE 850 MHz	18.01	24.81	18.61	23.31	N/A	N/A	N/A	N/A
GPRS/EDGE 1900 MHz	15.31	22.81	15.51	20.31	10.81	22.81	12.81	20.31
UMTS B5	18.20	24.70	18.00	22.90	N/A	N/A	N/A	N/A
UMTS B4	15.00	24.70	14.70	21.70	12.70	24.20	12.40	22.20
UMTS B2	14.90	24.70	16.10	21.70	11.00	24.20	12.70	22.20
LTE FDD B71	19.30	24.70	19.60	22.90	N/A	N/A	N/A	N/A
LTE FDD B12	18.60	24.70	19.20	22.90	N/A	N/A	N/A	N/A
LTE FDD B17	18.60	24.70	19.20	22.90	N/A	N/A	N/A	N/A
LTE FDD B13	18.70	24.70	19.80	22.90	N/A	N/A	N/A	N/A
LTE FDD B14	18.70	24.70	19.80	22.90	N/A	N/A	N/A	N/A
LTE FDD B26	18.20	24.70	18.00	22.90	N/A	N/A	N/A	N/A
LTE FDD B5	18.20	24.70	18.00	22.90	N/A	N/A	N/A	N/A
LTE FDD B66/4	15.00	24.70	14.70	21.70	12.70	24.20	12.40	22.20
LTE FDD B25/2	14.90	24.70	16.10	21.70	11.00	24.20	12.70	22.20
LTE FDD B30	14.30	22.70	12.80	19.20	11.50	22.20	13.30	19.70
LTE FDD B7	14.70	24.70	10.70	21.20	11.10	24.20	13.30	21.70
LTE TDD B48	9.71	17.80	10.81	15.52	10.41	16.92	10.81	17.72
LTE TDD B41 PC3	11.31	22.72	10.51	18.92	11.31	22.22	13.01	19.42
LTE TDD B41 ULCA PC3	11.31	22.72	10.51	19.22	11.31	22.22	13.01	19.72
LTE TDD B41 PC2	11.31	23.07	10.51	19.57	11.31	22.57	13.01	20.07
LTE TDD B41 ULCA PC2	11.31	23.37	10.51	19.87	11.31	22.87	13.01	20.37
NR FDD n71	19.30	24.70	20.10	22.90	N/A	N/A	N/A	N/A
NR FDD n12	18.60	24.70	19.20	22.90	N/A	N/A	N/A	N/A
NR FDD n5	18.20	24.70	18.00	22.90	N/A	N/A	N/A	N/A
NR FDD n66	15.00	24.70	14.70	21.70	12.70	24.20	12.40	22.20
NR FDD n25/n2	14.90	24.70	16.10	21.70	11.00	24.20	12.70	22.20
NR TDD n41 PC3	11.30	21.20	10.50	24.70	11.30	21.70	13.00	24.20
NR TDD n41 PC2	11.30	20.00	10.50	23.50	11.30	20.00	13.00	23.00
NR TDD n77 PC3	10.00	24.70	11.50	20.70	10.75	24.70	9.60	21.70
NR TDD n77 PC2	10.00	23.00	11.50	19.00	10.75	23.00	9.60	20.00

### Notes:

1. When  $P_{max} < P_{limit}$ , the DUT will operate at a power level up to  $P_{max}$ .

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## **EQUIPMENT LIST**

### For SAR measurements

Manufacturer         Model         Description         Cal Date         Cal Interval         Cal Due         Seriameter Network Analyzer         9/16/2021         MY40           Agilent         8753ES         S-Parameter Network Analyzer         9/16/2020         Annual         12/12/2021         MY42           Agilent         E551SC         Wireless Communications Test Set         12/21/2020         Annual         12/12/2021         G842           Agilent         NS182A         MXG Vector Signal Generator         9/25/2020         Annual         12/12/2021         US4           Agilent         NS182A         MXG Vector Signal Generator         12/11/2020         Annual         12/12/2021         US4           Agilent         NS920A         MXAS Signal Analyzer         12/11/2020         Annual         12/12/2021         MY4           Amplifier         CBT         NXA         CBT         ANA         CBT         NXA           Amplifier Research         150A10OC         Annifier         CBT         NXA         CBT         NXA           Amplifier Research         15SE1G6         Amplifier         CBT         NXA         CBT         NXA           Anritsu         MA24106A         USB Power Sensor         9/15/2020         Annual
Aglient         E438C         ESG Vector Signal Generator         12/2/2020         Annual         12/2/2021         MY42           Aglient         ES515C         Wireless Communications Test Set         12/15/2020         Annual         12/15/2021         GB42           Aglient         NS182A         MXG Vector Signal Generator         9/25/2020         Annual         12/15/2021         US46           Aglient         NS182A         MXG Vector Signal Generator         12/11/2020         Annual         12/12/2021         US4           Aglient         NS920A         MXA Signal Analyzer         12/11/2020         Annual         12/12/2021         MY4           Aglient         NS920A         MXA Signal Analyzer         12/11/2020         Annual         12/12/2021         MY4           Aglient         NS920A         MXA         CBT         NXA         CBT         NXA         CBT         ANA         CBT         NXA         CBT         NXA         CBT         NXA         CBT         NXA         CBT         NXA         CBT         XXA         CBT         NXA         CBT         NXA         CBT         XXA         XXA         CBT         XXA         XXA         XXA         XXA         XXA         XXA         XXA
Agilent   E5515C   Wireless Communications Test Set   12/15/2020   Annual   12/15/2021   G842   Agilent   N5182A   MXG Vector Signal Generator   9/25/2020   Annual   9/25/2021   MY67   Agilent   N5182A   MXG Vector Signal Generator   12/11/2020   Annual   12/11/2021   MY67   Agilent   N5182A   MXG Vector Signal Generator   12/11/2020   Annual   12/11/2021   MY67   Agilent   N9020A   MXA Signal Analyzer   12/21/2020   Annual   12/11/2021   MY67   Amplifier Research   150A100C   Armplifier   CBT   NVA   CBT   35   Amplifier Research   15510G   Armplifier   CBT   NVA   CBT   34   Amplifier Research   15510G   Amplifier   CBT   NVA   CBT   34   Amplifier Research   15510G   Amplifier   CBT   NVA   CBT   34   Amplifier   CBT   NVA   CBT   34   Amplifier   CBT   NVA   CBT   35   Amplifier   CBT   NVA   CBT   34   Amplifier   CBT   NVA   CBT   35   Amplifier   CBT   NVA   CBT   34   Amplifier   CBT   NVA   CBT   34   Amplifier   CBT   NVA   CBT   35   Amplifier   CBT   NVA   CBT   34   Amplifier   CBT   NVA   CBT   Amplifier   NVA   CBT   CBT   NVA   CBT
Agilent N5182A MXG Vector Signal Generator 9/25/2020 Annual 12/1/2021 US-66 Agilent N5182A MXG Vector Signal Generator 12/1/2020 Annual 12/1/2021 MY47 Agilent N9020A MXA Signal Annalyzer 12/21/2020 Annual 12/1/2021 MY47 Agilent N9020A MXA Signal Annalyzer 12/21/2020 Annual 12/1/2021 MY50 Amplifier Research 150A100C Amplifier CBT N/A CBT 35 Amplifier CBT N/A CBT 35 Amplifier CBT N/A CBT 34 Amritsu MA24106A USB Power Sensor 9/15/2020 Annual 9/15/2021 12/2 Anritsu MA24106A USB Power Sensor 9/15/2020 Annual 9/15/2021 12/2 Anritsu MA24106A USB Power Sensor 6/8/2020 Annual 6/8/2021 20/2 Anritsu MA24106A USB Power Sensor 6/8/2020 Annual 6/8/2021 20/2 Anritsu MA24106A USB Power Sensor 6/8/2020 Annual 12/18/2021 11/2 Anritsu MA24106A USB Power Sensor 9/2020 Annual 12/18/2021 11/2 Anritsu MA24106A USB Power Sensor 9/2020 Annual 12/18/2021 11/2 Anritsu MA24106A USB Power Sensor 9/2020 Annual 12/18/2021 11/2 Anritsu MA24106 Power Meter 11/3/2020 Annual 11/3/2021 11/2 Anritsu MX2495A Power Meter 11/3/2020 Annual 11/3/2021 11/2 Anritsu MX2495A Power Meter 11/3/2020 Annual 13/3/2021 6201 Anritsu MX821C Radio Communication Analyzer 9/30/2020 Annual 3/30/2021 6201 Anritsu MX821C Radio Communication Analyzer 5/21/2020 Annual 3/30/2021 6201 Control Company 4040 Therm/Clock/Humidity Monitor 6/29/2019 Biennial 6/29/2021 19/2 Control Company 4040 Therm/Clock/Humidity Monitor 6/29/2019 Biennial 6/29/2021 19/2 Control Company 4040 Therm/Clock/Humidity Monitor 6/29/2019 Biennial 6/29/2021 19/2 Control Company 4040 Therm/Clock/Humidity Monitor 6/29/2019 Biennial 6/29/2021 19/2 Control Company 4040 Therm/Clock/Humidity Monitor 6/29/2019 Biennial 6/29/2021 19/2 Control Company 4040 Therm/Clock/Humidity Monitor 6/29/2019 Biennial 6/29/2021 19/2 Control Company 4040 Therm/Clock/Humidity Monitor 6/29/2019 Biennial 6/29/2021 19/2 Control Company 4040 Therm/Clock/Humidity Monitor 6/29/2019 Bienni
Aglient         NS182A         MXG Vector Signal Generator         12/1/2020         Annual         12/1/2021         MY47           Aglient         N9020A         MXA Signal Analyzer         12/21/2020         Annual         12/21/2021         MY50           Amplifier Research         150A100C         Amplifier         CBT         N/A         CBT         N/A         CBT         AM         CBT         34           Amplifier Research         15S1G6         Amplifier         CBT         N/A         CBT         34           Annitsu         MA24106A         USB Power Sensor         9/15/2020         Annual         9/15/2021         124           Annitsu         MA24106A         USB Power Sensor         9/15/2020         Annual         9/15/2021         124           Annitsu         MA24106A         USB Power Sensor         6/8/2020         Annual         6/8/2021         201           Annitsu         MA24106A         USB Power Sensor         6/8/2020         Annual         12/18/2021         121           Annitsu         MA24106A         USB Power Sensor         12/18/2020         Annual         12/18/2021         122           Annitsu         MA24106A         USB Power Sensor         12/18/2020         Annual
Aglient         N9020A         MXA Signal Analyzer         12/21/2020         Annual         12/21/2021         MYSO           Amplifier Research         150A100C         Amplifier         CBT         N/A         CBT         35           Amplifier Research         15S1G8         Amplifier         CBT         N/A         CBT         34           Amritsu         MA24106A         USB Power Sensor         9/15/2020         Annual         9/15/2021         122           Anritsu         MA24106A         USB Power Sensor         9/15/2020         Annual         6/8/2021         20           Anritsu         MA24106A         USB Power Sensor         6/8/2020         Annual         6/8/2021         20           Anritsu         MA24106A         USB Power Sensor         6/8/2020         Annual         6/8/2021         20           Anritsu         MA24106A         USB Power Sensor         12/18/2020         Annual         12/18/2021         20           Anritsu         MA2410BA         Pulse Power Sensor         12/18/2020         Annual         11/3/2021         10           Anritsu         MISB20C         Radio Communication Analyzer         11/3/2020         Annual         11/3/2021         10           Anritsu
Amplifier Research
Amplifier Research         15S1G6         Amplifier         CBT         NA         CBT         34           Amplifier Research         15S1G6         Amplifier         CBT         NA         CBT         34           Anritsu         MA24106A         USB Power Sensor         9/15/2020         Annual         9/15/2021         122           Anritsu         MA24106A         USB Power Sensor         6/8/2020         Annual         6/8/2021         201           Anritsu         MA24106A         USB Power Sensor         6/8/2020         Annual         6/8/2021         201           Anritsu         MA2411B         Pulse Power Sensor         12/18/2020         Annual         12/18/2021         112           Anritsu         ML2495A         Power Meter         11/3/2020         Annual         11/3/2021         102           Anritsu         MT8820C         Radio Communication Analyzer         9/30/2020         Annual         19/30/2021         102           Annitsu         MT8821C         Radio Communication Analyzer         5/21/2020         Annual         5/21/2021         6201           Control Company         4040         Therm/Clock/Humidity Monitor         6/29/2019         Biennial         6/29/20201         1922 <tr< td=""></tr<>
Amplifier Research
Anritsu MA24106A USB Power Sensor 9/15/2020 Annual 9/15/2021 124 Anritsu MA24106A USB Power Sensor 9/15/2020 Annual 9/15/2021 124 Anritsu MA24106A USB Power Sensor 9/15/2020 Annual 9/15/2021 201 Anritsu MA24106A USB Power Sensor 6/8/2020 Annual 6/8/2021 201 Anritsu MA24106A USB Power Sensor 6/3/2020 Annual 6/8/2021 201 Anritsu MA2411B Pulse Power Sensor 12/18/2020 Annual 12/18/2021 112 Anritsu ML2495A Power Meter 11/3/2020 Annual 11/3/2021 102 Anritsu MI2495A Power Meter 11/3/2020 Annual 11/3/2021 102 Anritsu MT8820C Radio Communication Analyzer 9/30/2020 Annual 9/30/2021 6201 Anritsu MT8821C Radio Communication Analyzer 5/21/2020 Annual 9/30/2021 6201 Anritsu MT8821C Radio Communication Analyzer 5/21/2020 Annual 9/30/2021 6201 Control Company 4040 Therm/Clock/Humidity Monitor 6/29/2019 Biennial 6/29/2021 1922 Control Company 4040 Therm/Clock/Humidity Monitor 6/29/2019 Biennial 6/29/2021 1922 Control Company 4333 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Insize 1108-150 Digital Caliper 1/17/2020 Biennial 10/28/2022 2006 KEYSIGHT E438C VECTOR SIGNAL GENERATOR 6/2/2020 Annual 6/22/2021 MY45 MCL BW-N3W5+ 10dB Attenuator CBT N/A CBT 1 MCL BW-N3W5+ 3dB Attenuator CBT N/A CBT 1 MCL BW-N3W5+ 3dB Attenuator CBT N/A CBT 1 MINI-Circuits NLP-1000+ Low Pass Filter CBT N/A CBT 1 Mini-Circuits NLP-1000+ Low Pass Filter CBT N/A
Anritsu MA24106A USB Power Sensor 9/15/2020 Annual 9/15/2021 12/4 Anritsu MA24106A USB Power Sensor 6/8/2020 Annual 6/8/2021 20/1 Anritsu MA24106A USB Power Sensor 6/8/2020 Annual 6/8/2021 20/1 Anritsu MA2411B Pulse Power Sensor 12/18/2020 Annual 12/18/2021 11/2 Anritsu MA2411B Pulse Power Sensor 12/18/2020 Annual 12/18/2021 11/2 Anritsu ML2495A Power Meter 11/3/2020 Annual 12/18/2021 10/2 Anritsu MT8820C Radio Communication Analyzer 9/30/2020 Annual 11/3/2021 10/2 Anritsu MT8821C Radio Communication Analyzer 9/30/2020 Annual 9/30/2021 6201 Anritsu MT8821C Radio Communication Analyzer 5/21/2020 Annual 5/21/2021 6201 Control Company 40400 Therm/Clock/Humidity Monitor 6/29/2019 Biennial 6/29/2021 1922 Control Company 40400 Therm/Clock/Humidity Monitor 6/29/2019 Biennial 6/29/2021 1922 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Biennial 10/28/2022 2006 Control Company 4353 Long Stem Thermometer 10/28/2020 Annual 5/13/2
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Anritsu   MI2495A   Power Meter   11/3/2020   Annual   11/3/2021   103
Anritsu   MI2495A   Power Meter   11/3/2020   Annual   11/3/2021   103
Anritsu
Anritsu         MT8821C         Radio Communication Analyzer         5/21/2020         Annual         5/21/2021         6201           Control Company         4040         Therm./Clock/Humidity Monitor         6/29/2019         Biennial         6/29/2021         1922           Control Company         4040         Therm./Clock/Humidity Monitor         6/29/2019         Biennial         6/29/2021         1922           Control Company         4040         Therm./Clock/Humidity Monitor         6/29/2019         Biennial         6/29/2021         1922           Control Company         4353         Long Stem Thermometer         10/28/2020         Biennial         10/28/2022         2006           Insize         1108-150         Digtal Caliper         1/17/2020         Biennial         10/28/2022         4009           KEYSIGHT         E4438C         VECTOR SIGNAL GENERATOR         6/22/2020         Annual         6/22/2021         MY45           MCL         BW-N10W5+         10/38 Attenuator         CBT         N/A         CBT         1           MCL         BW-N8W5+         3dB Attenuator         CBT         N/A         CBT         1           Mini-Circuits         NIP-1200+         Low Pass Filter         CBT         N/A         CBT
Control Company         4040         Therm./Clock/Humidity Monitor         6/29/2019         Biennial         6/29/2021         1922           Control Company         4040         Therm./Clock/Humidity Monitor         6/29/2019         Biennial         6/29/2021         1922           Control Company         4040         Therm./Clock/Humidity Monitor         6/29/2019         Biennial         6/29/2021         1922           Control Company         4353         Long Stem Thermometer         10/28/2020         Biennial         10/28/2022         2006           Control Company         4353         Long Stem Thermometer         10/28/2020         Biennial         10/28/2022         2006           Insize         1108-150         Digital Caliper         1/17/2020         Biennial         1/17/2022         4091           KEYSIGHT         E4438C         VECTOR SIGNAL GENERATOR         6/22/2020         Annual         6/22/2021         MY45           MCL         BW-N10W5+         10dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N8W5+         6dB Attenuator         CBT         N/A         CBT         N           Mini-Circuits         NLP-1200+         Low Pass Filter         CBT         N/A         CBT
Control Company         4040         Therm./Clock/Humidity Monitor         6/29/2019         Biennial         6/29/2021         1922           Control Company         4040         Therm./Clock/Humidity Monitor         6/29/2019         Biennial         6/29/2021         1922           Control Company         4353         Long Stem Thermometer         10/28/2020         Biennial         10/28/2022         2006           Control Company         4353         Long Stem Thermometer         10/28/2020         Biennial         10/28/2022         2006           Insize         1108-150         Digital Caliper         1/17/2020         Biennial         11/28/2022         2006           KEYSIGHT         E4438C         VECTOR SIGNAL GENERATOR         6/22/2020         Annual         6/22/2021         MY45           MCL         BW-N10W5+         10dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N3W5+         3dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N3W5+         3dB Attenuator         CBT         N/A         CBT         1           Mini-Circuits         NLP-1000+         Low Pass Filter         CBT         N/A         CBT         N
Control Company         4040         Therm./Clock/Humidity Monitor         6/29/2019         Biennial         6/29/2021         1922           Control Company         4353         Long Stem Thermometer         10/28/2020         Biennial         10/28/2022         2006           Control Company         4353         Long Stem Thermometer         10/28/2020         Biennial         10/28/2022         2006           Insize         1108-150         Digital Caliper         1/17/2020         Biennial         1/17/2022         2006           KEYSIGHT         E4438C         VECTOR SIGNAL GENERATOR         6/22/2020         Annual         6/22/2021         MY45           MCL         BW-N10W5+         10dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N3W5+         3dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N6W5+         6dB Attenuator         CBT         N/A         CBT         1           Mini-Circuits         NLP-1000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-1200+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits
Control Company         4353         Long Stem Thermometer         10/28/2020         Biennial         10/28/2022         2006           Control Company         4353         Long Stem Thermometer         10/28/2020         Biennial         10/28/2022         2006           Insize         1108-150         Digital Caliper         1/17/2020         Biennial         1/17/2022         4091           KEYSIGHT         E4438C         VECTOR SIGNAL GENERATOR         6/22/2020         Annual         6/22/2021         MY45           MCL         BW-N10W5+         10dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N8W5+         3dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N6W5+         6dB Attenuator         CBT         N/A         CBT         1           Mini-Circuits         NLP-1000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+ <td< td=""></td<>
Control Company         4353         Long Stem Thermometer         10/28/2020         Biennial         10/28/2022         2006           Insize         1108-150         Digital Caliper         1/17/2020         Biennial         1/17/2022         4091           KEYSIGHT         E4438C         VECTOR SIGNAL GENERATOR         6/22/2020         Annual         6/22/2021         MY45           MCL         BW-N10W5+         10dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N3W5+         3dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N6W5+         6dB Attenuator         CBT         N/A         CBT         1           Mini-Circuits         NLP-1000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-1200+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+         Low Pass Filter
Insize
KEYSIGHT         E4438C         VECTOR SIGNAL GENERATOR         6/22/2020         Annual         6/22/2021         MY45           MCL         BW-N10W5+         10dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N3W5+         3dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N6W5+         6dB Attenuator         CBT         N/A         CBT         1           Mini-Circuits         NLP-1000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-1200+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         VLF-6000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         VLF-6000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         VLF-6000+         Low Pass Filter         CBT         N/A         CBT         N           Pasternack         PE2208-6         Bidirectional Coupler         CBT         N/A </td
MCL         BW-N10W5+         10dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N3W5+         3dB Attenuator         CBT         N/A         CBT         1           MCL         BW-N6W5+         6dB Attenuator         CBT         N/A         CBT         1           Mini-Circuits         NLP-1000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-1200+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         VLF-6000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         ZHDC-16-63-S+         50-6000MHz Bidirectional Coupler         CBT         N/A         CBT         N           Pasternack         PE2208-6         Bidirectional Coupler         CBT         N/A         CBT         N           Rohde & Schwarz         CMW500         Radio Communication Tester         5/13/2020         Annual         5/13/2021         16           Rohde & Schwarz         CMW500         Radio Communication Tester
MCL         BW-N3W5+         3dB Attenuator         CBT         N/A         CBT         1.           MCL         BW-N6W5+         6dB Attenuator         CBT         N/A         CBT         1           Mini-Circuits         NLP-1000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-1200+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         VLP-6000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         ZHDC-16-63-5+         50-6000MHz Bidirectional Coupler         CBT         N/A         CBT         N           Pasternack         PE2208-6         Bidirectional Coupler         CBT         N/A         CBT         N           Rohde & Schwarz         CMW500         Radio Communication Tester         5/13/2020         Annual         5/13/2021         16           Rohde & Schwarz         CMW500         Radio Communication Tester         1/9/2020         Biennial         1/9/2022         10           Rohde & Schwarz         CMW500
MCL         BW-N6W5+         6dB Attenuator         CBT         N/A         CBT         1.           Mini-Circuits         NLP-1000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-1200+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         VLF-6000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         ZHDC-16-63-S+         50-6000MHz Bidirectional Coupler         CBT         N/A         CBT         N           Pasternack         PE2208-6         Bidirectional Coupler         CBT         N/A         CBT         N           Rohde & Schwarz         CMW500         Radio Communication Tester         5/13/2020         Annual         5/13/2021         16           Rohde & Schwarz         CMW500         Radio Communication Tester         4/28/2020         Annual         4/28/2021         16           Rohde & Schwarz         CMW500         Wideband Radio Communication Tester         9/17/2020         Annual         1/9/2022         10           Rohde
Mini-Circuits         NLP-1000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-1200+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         VLF-6000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         ZHDC-16-63-S+         50-6000MHz Bidirectional Coupler         CBT         N/A         CBT         N           Pasternack         PE2208-6         Bidirectional Coupler         CBT         N/A         CBT         N           Rohde & Schwarz         CMW500         Radio Communication Tester         5/13/2020         Annual         5/13/2021         16           Rohde & Schwarz         CMW500         Radio Communication Tester         4/28/2020         Annual         1/9/2022         10           Rohde & Schwarz         CMW500         Wideband Radio Communication Tester         9/17/2020         Annual         9/17/2021         14           Rohde & Schwarz         CMW500         Radio Communication Tester         9/17/2020         Annual         11/4/2021         10
Mini-Circuits         NLP-1200+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         NLP-2950+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         VLF-6000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         ZHDC-16-63-S+         50-6000MHz Bidirectional Coupler         CBT         N/A         CBT         N           Pasternack         PE2208-6         Bidirectional Coupler         CBT         N/A         CBT         N           Rohde & Schwarz         CMW500         Radio Communication Tester         5/13/2020         Annual         5/13/2021         16           Rohde & Schwarz         CMW500         Radio Communication Tester         4/28/2020         Annual         1/9/2022         10           Rohde & Schwarz         CMW500         Wideband Radio Communication Tester         9/17/2020         Annual         9/17/2021         14           Rohde & Schwarz         CMW500         Radio Communication Tester         9/17/2020         Annual         9/17/2021         14           Rohde & Schwarz         CMW500         Radio Communication Tester         11/4/2020         Annual         11/4/202
Mini-Circuits         NLP-2950+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         VLF-6000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         ZHDC-16-63-S+         50-6000MHz Bidirectional Coupler         CBT         N/A         CBT         N           Pasternack         PE2208-6         Bidirectional Coupler         CBT         N/A         CBT         N           Rohde & Schwarz         CMW500         Radio Communication Tester         5/13/2020         Annual         5/13/2021         16           Rohde & Schwarz         CMW500         Radio Communication Tester         4/28/2020         Annual         4/28/2021         16           Rohde & Schwarz         CMW500         Wideband Radio Communication Tester         1/9/2020         Biennial         1/9/2022         10           Rohde & Schwarz         CMW500         Wideband Radio Communication Tester         9/17/2020         Annual         9/17/2021         14           Rohde & Schwarz         CMW500         Radio Communication Tester         11/4/2020         Annual         11/4/2021         10           Rosenberger         32W1006-016         Torque Wrench         12/1/2020         Annual </td
Mini-Circuits         VLF-6000+         Low Pass Filter         CBT         N/A         CBT         N           Mini-Circuits         ZHDC-16-63-S+         50-6000MHz Bidirectional Coupler         CBT         N/A         CBT         N           Pasternack         PE2208-6         Bidirectional Coupler         CBT         N/A         CBT         N           Rohde & Schwarz         CMW500         Radio Communication Tester         5/13/2020         Annual         5/13/2021         16           Rohde & Schwarz         CMW500         Radio Communication Tester         4/28/2020         Annual         4/28/2021         16           Rohde & Schwarz         FSP-7         Spectrum Analyzer         1/9/2020         Biennial         1/9/2022         10           Rohde & Schwarz         CMW500         Wideband Radio Communication Tester         9/17/2020         Annual         9/17/2021         14           Rohde & Schwarz         CMW500         Radio Communication Tester         11/4/2020         Annual         11/4/2021         10           Rosenberger         32W1006-016         Torque Wrench         12/1/2020         Annual         12/1/2021         N           SPEAG         D750V3         750 MHz SAR Dipole         5/18/2018         Triennial
Mini-Circuits         ZHDC-16-63-S+         50-6000MHz Bidirectional Coupler         CBT         N/A         CBT         N           Pasternack         PE2208-6         Bidirectional Coupler         CBT         N/A         CBT         N           Rohde & Schwarz         CMW500         Radio Communication Tester         5/13/2020         Annual         5/13/2021         16           Rohde & Schwarz         CMW500         Radio Communication Tester         4/28/2020         Annual         4/28/2021         16           Rohde & Schwarz         FSP-7         Spectrum Analyzer         1/9/2020         Biennial         1/9/2022         10           Rohde & Schwarz         CMW500         Wideband Radio Communication Tester         9/17/2020         Annual         9/17/2021         14           Rohde & Schwarz         CMW500         Radio Communication Tester         11/4/2020         Annual         11/4/2021         10           Rosenberger         32W1006-016         Torque Wrench         12/1/2020         Annual         12/1/2021         N           SPEAG         D750V3         750 MHz SAR Dipole         5/18/2018         Triennial         5/18/2021         10
Pasternack         PE2208-6         Bidirectional Coupler         CBT         N/A         CBT         N           Rohde & Schwarz         CMW500         Radio Communication Tester         5/13/2020         Annual         5/13/2021         16           Rohde & Schwarz         CMW500         Radio Communication Tester         4/28/2020         Annual         4/28/2021         16           Rohde & Schwarz         FSP-7         Spectrum Analyzer         1/9/2020         Biennial         1/9/2022         10           Rohde & Schwarz         CMW500         Wideband Radio Communication Tester         9/17/2020         Annual         9/17/2021         14           Rohde & Schwarz         CMW500         Radio Communication Tester         11/4/2020         Annual         11/4/2021         10           Rosenberger         32W1006-016         Torque Wrench         12/1/2020         Annual         12/1/2021         N           SPEAG         D750V3         750 MHz SAR Dipole         5/18/2018         Triennial         5/18/2021         10
Rohde & Schwarz         CMW500         Radio Communication Tester         5/13/2020         Annual         5/13/2021         16           Rohde & Schwarz         CMW500         Radio Communication Tester         4/28/2020         Annual         4/28/2021         16           Rohde & Schwarz         FSP-7         Spectrum Analyzer         1/9/2020         Biennial         1/9/2022         10           Rohde & Schwarz         CMW500         Wideband Radio Communication Tester         9/17/2020         Annual         9/17/2021         14           Rohde & Schwarz         CMW500         Radio Communication Tester         11/4/2020         Annual         11/4/2021         10           Rosenberger         32W1006-016         Torque Wrench         12/1/2020         Annual         12/1/2021         N           SPEAG         D750V3         750 MHz SAR Dipole         5/18/2018         Triennial         5/18/2021         10
Rohde & Schwarz         CMW500         Radio Communication Tester         4/28/2020         Annual         4/28/2021         16           Rohde & Schwarz         FSP-7         Spectrum Analyzer         1/9/2020         Biennial         1/9/2022         10           Rohde & Schwarz         CMW500         Wideband Radio Communication Tester         9/17/2020         Annual         9/17/2021         14           Rohde & Schwarz         CMW500         Radio Communication Tester         11/4/2020         Annual         11/4/2021         10           Rosenberger         32W1006-016         Torque Wrench         12/1/2020         Annual         12/1/2021         N           SPEAG         D750V3         750 MHz SAR Dipole         5/18/2018         Triennial         5/18/2021         10
Rohde & Schwarz         FSP-7         Spectrum Analyzer         1/9/2020         Biennial         1/9/2022         10           Rohde & Schwarz         CMW500         Wideband Radio Communication Tester         9/17/2020         Annual         9/17/2021         14           Rohde & Schwarz         CMW500         Radio Communication Tester         11/4/2020         Annual         11/4/2021         10           Rosenberger         32W1006-016         Torque Wrench         12/1/2020         Annual         12/1/2021         N           SPEAG         D750V3         750 MHz SAR Dipole         5/18/2018         Triennial         5/18/2021         10
Rohde& Schwarz         CMW500         Wideband Radio Communication Tester         9/17/2020         Annual         9/17/2021         14           Rohde & Schwarz         CMW500         Radio Communication Tester         11/4/2020         Annual         11/4/2021         10           Rosenberger         32W1006-016         Torque Wrench         12/1/2020         Annual         12/1/2021         N           SPEAG         D750V3         750 MHz SAR Dipole         5/18/2018         Triennial         5/18/2021         10
Rohde & Schwarz         CMW500         Radio Communication Tester         11/4/2020         Annual         11/4/2021         10           Rosenberger         32W1006-016         Torque Wrench         12/1/2020         Annual         12/1/2021         N           SPEAG         D750V3         750 MHz SAR Dipole         5/18/2018         Triennial         5/18/2021         10
Rosenberger         32W1006-016         Torque Wrench         12/1/2020         Annual         12/1/2021         N           SPEAG         D750V3         750 MHz SAR Dipole         5/18/2018         Triennial         5/18/2021         10
SPEAG         D750V3         750 MHz SAR Dipole         5/18/2018         Triennial         5/18/2021         1
SPEAG         D1750V2         1750 MHz SAR Dipole         5/15/2018         Triennial         5/15/2021         1/2
SPEAG         D2450V2         2450 MHz SAR Dipole         11/12/2018         Triennial         11/12/2021         9
SPEAG         D2450V2         2450 MHz SAR Dipole         5/16/2018         Triennial         5/16/2021         9
SPEAG         D2600V2         2600 MHz SAR Dipole         6/19/2018         Triennial         6/19/2021         1
SPEAG         D3500V2         3500 MHz SAR Dipole         8/16/2019         Biennial         8/16/2021         1
SPEAG         D3700V2         3700 MHz SAR Dipole         10/17/2019         Biennial         10/17/2021         1
SPEAG         D3900V2         3900 MHz SAR Dipole         11/13/2020         Annual         11/13/2021         1
SPEAG DAE4 Dasy Data Acquisition Electronics 10/12/2020 Annual 10/12/2021 1
SPEAG DAE4 Dasy Data Acquisition Electronics 1/13/2021 Annual 1/13/2022 7
SPEAG DAE4 Dasy Data Acquisition Electronics 4/14/2020 Annual 4/14/2021 1
SPEAG         EX3DV4         SAR Probe         10/21/2020         Annual         10/21/2021         75
SPEAG         EX3DV4         SAR Probe         7/16/2020         Annual         7/16/2021         7.
SPEAG         EX3DV4         SAR Probe         1/18/2021         Annual         1/18/2022         3:
SPEAG         EX3DV4         SAR Probe         1/18/2021         Annual         1/18/2022         33           SPEAG         EX3DV4         SAR Probe         6/22/2020         Annual         6/22/2021         70

### Note:

- 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.
- Each equipment item was used solely within its respective calibration period.

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### **For SAR Measurements**

AR Measurements									
a	b	С	d	e=	f	g	h =	i =	k
				f(d,k)			c x f/e	c x g/e	
	IEEE	Tol.	Prob.		Ci	c <sub>i</sub>	1gm	10gms	
Uncertainty Component	1528 Sec.	(± %)	Dist.	Div.	1gm	10 gms	u <sub>i</sub>	u <sub>i</sub>	vi
	000.				0	J	(± %)	(± %)	
Measurement System									
Probe Calibration	E.2.1	6.55	Ν	1	1	1	6.6	6.6	∞
Axial Isotropy	E.2.2	0.25	Ν	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	Ν	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	Ν	1	1	1	0.3	0.3	∞
System Detection Limits	E.2.4	0.25	R	1.732	1	1	0.1	0.1	∞
Readout Electronics	E.2.6	0.3	Ν	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	∞
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	Ν	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	∞
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	1.732	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Unceritainty	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	∞
Combined Standard Uncertainty (k=1)			RSS				11.6	11.4	191
Expanded Uncertainty			k=2				23.2	22.8	
(95% CONFIDENCE LEVEL)									

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

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# APPENDIX A: SAR TEST RESULTS FOR PLIMIT CALCULATIONS

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Note: This device is depopulated version of the fully populated reference model FCC ID: BCGA2379. SAR characterization of antenna 1/2a/2b/3/4b/5b was referenced based on the reference model test results.

Table A-1
DSI = 1 *P<sub>Limit</sub>* Calculations – Ant 4a LTE Band 48

	MEASUREMENT RESULTS															
F	REQUENCY		Mode	Bandwidth	Conducted	MPR [dB]	Antenna	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Plimit	Minimum Plimit
MHz	Ch.		Wode	[MHz]	Power [dBm]	WFK [UB]	Config.	Modulation	RD SIZE	RB Oliset	Spacing	Side	Duty Cycle	(W/kg)	[dBm]	[dBm]
3560.00	55340	Low	LTE Band 48	20	12.40	0	Ant 4a	QPSK	1	0	0 mm	back	1:1.58	0.649	11.32	
3603.30	55773	Low- Mid	LTE Band 48	20	12.26	0	Ant 4a	QPSK	1	0	0 mm	back	1:1.58	0.597	11.55	
3646.70	56207	Mid- High	LTE Band 48	20	12.51	0	Ant 4a	QPSK	1	0	0 mm	back	1:1.58	0.599	11.78	
3690.00	56640	High	LTE Band 48	20	12.24	0	Ant 4a	QPSK	1	0	0 mm	back	1:1.58	0.610	11.43	
3560.00	55340	Low	LTE Band 48	20	12.48	0	Ant 4a	QPSK	50	25	0 mm	back	1:1.58	0.644	11.44	
3603.30	55773	Low- Mid	LTE Band 48	20	12.40	0	Ant 4a	QPSK	50	25	0 mm	back	1:1.58	0.593	11.71	
3646.70	56207	Mid- High	LTE Band 48	20	12.57	0	Ant 4a	QPSK	50	25	0 mm	back	1:1.58	0.601	11.83	
3690.00	56640	High	LTE Band 48	20	12.15	0	Ant 4a	QPSK	50	25	0 mm	back	1:1.58	0.626	11.23	
3646.70	56207	Mid- High	LTE Band 48	20	12.50	0	Ant 4a	QPSK	100	0	0 mm	back	1:1.58	0.625	11.59	
3646.70	56207	Mid- High	LTE Band 48	20	12.51	0	Ant 4a	QPSK	1	0	0 mm	top	1:1.58	0.128	18.48	
3646.70	56207	Mid- High	LTE Band 48	20	12.57	0	Ant 4a	QPSK	50	25	0 mm	top	1:1.58	0.133	18.38	
3646.70	56207	Mid- High	LTE Band 48	20	12.51	0	Ant 4a	QPSK	1	0	0 mm	bottom	1:1.58	0.001	39.55	10.68
3646.70	56207	Mid- High	LTE Band 48	20	12.57	0	Ant 4a	QPSK	50	25	0 mm	bottom	1:1.58	0.001	39.61	10.00
3646.70	56207	Mid- High	LTE Band 48	20	12.51	0	Ant 4a	QPSK	1	0	0 mm	right	1:1.58	0.000	39.55	
3646.70	56207	Mid- High	LTE Band 48	20	12.57	0	Ant 4a	QPSK	50	25	0 mm	right	1:1.58	0.000	39.61	
3560.00	55340	Low	LTE Band 48	20	12.40	0	Ant 4a	QPSK	1	0	0 mm	left	1:1.58	0.657	11.27	
3603.30	55773	Low- Mid	LTE Band 48	20	12.26	0	Ant 4a	QPSK	1	0	0 mm	left	1:1.58	0.626	11.34	
3646.70	56207	Mid- High	LTE Band 48	20	12.51	0	Ant 4a	QPSK	1	0	0 mm	left	1:1.58	0.625	11.60	
3690.00	56640	High	LTE Band 48	20	12.24	0	Ant 4a	QPSK	1	0	0 mm	left	1:1.58	0.667	11.04	
3560.00	55340	Low	LTE Band 48	20	12.48	0	Ant 4a	QPSK	50	25	0 mm	left	1:1.58	0.655	11.36	
3603.30	55773	Low- Mid	LTE Band 48	20	12.40	0	Ant 4a	QPSK	50	25	0 mm	left	1:1.58	0.626	11.48	
3646.70	56207	Mid- High	LTE Band 48	20	12.57	0	Ant 4a	QPSK	50	25	0 mm	left	1:1.58	0.650	11.49	
3690.00	56640	High	LTE Band 48	20	12.15	0	Ant 4a	QPSK	50	25	0 mm	left	1:1.58	0.711	10.68	]
3646.70	56207	Mid- High	LTE Band 48	20	12.50	0	Ant 4a	QPSK	100	0	0 mm	left	1:1.58	0.721	10.97	
	ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram									

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# Table A-2 DSI = 1 P<sub>Limit</sub> Calculations – Ant 4a NR Band n77

	DSI - 1 Plimit Calculations - Ant 4a NK Band III I																
	MEASUREMENT RESULTS																
FR	REQUENCY		Mode	Bandwidth	Conducted	Antenna	MPR [dB]	Waveform	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Plimit	Minimum Plimit
MHz	Ch.			[MHz]	Power [dBm]	Config									(W/kg)	[dBm]	[dBm]
3750.00	650000	Low	NR Band n77	100	10.54	Ant 4a	0.0	DFT-S-OFDM	QPSK	1	137	0 mm	back	1:1	0.650	11.44	
3930.00	662000	High	NR Band n77	100	10.22	Ant 4a	0.0	DFT-S-OFDM	QPSK	1	271	0 mm	back	1:1	0.457	12.65	
3750.00	650000	Low	NR Band n77	100	10.50	Ant 4a	0.0	DFT-S-OFDM	QPSK	135	138	0 mm	back	1:1	0.623	11.59	
3930.00	662000	High	NR Band n77	100	10.18	Ant 4a	0.0	DFT-S-OFDM	QPSK	135	138	0 mm	back	1:1	0.458	12.60	
3750.00	650000	Low	NR Band n77	100	10.33	Ant 4a	0.0	DFT-S-OFDM	QPSK	270	0	0 mm	back	1:1	0.616	11.46	
3750.00	650000	Low	NR Band n77	100	10.18	Ant 4a	0.0	CP-OFDM	QPSK	1	1	0 mm	back	1:1	0.494	12.27	
3750.00	650000	Low	NR Band n77	100	10.54	Ant 4a	0.0	DFT-S-OFDM	QPSK	1	137	0 mm	top	1:1	0.205	16.45	
3750.00	650000	Low	NR Band n77	100	10.50	Ant 4a	0.0	DFT-S-OFDM	QPSK	135	138	0 mm	top	1:1	0.190	16.74	
3750.00	650000	Low	NR Band n77	100	10.54	Ant 4a	0.0	DFT-S-OFDM	QPSK	1	137	0 mm	bottom	1:1	0.010	29.57	11.44
3750.00	650000	Low	NR Band n77	100	10.50	Ant 4a	0.0	DFT-S-OFDM	QPSK	135	138	0 mm	bottom	1:1	0.009	29.99	
3750.00	650000	Low	NR Band n77	100	10.54	Ant 4a	0.0	DFT-S-OFDM	QPSK	1	137	0 mm	right	1:1	0.000	39.57	
3750.00	650000	Low	NR Band n77	100	10.50	Ant 4a	0.0	DFT-S-OFDM	QPSK	135	138	0 mm	right	1:1	0.000	39.53	
3750.00	650000	Low	NR Band n77	100	10.54	Ant 4a	0.0	DFT-S-OFDM	QPSK	1	137	0 mm	left	1:1	0.630	11.58	
3930.00	662000	High	NR Band n77	100	10.22	Ant 4a	0.0	DFT-S-OFDM	QPSK	1	271	0 mm	left	1:1	0.520	12.09	
3750.00	650000	Low	NR Band n77	100	10.50	Ant 4a	0.0	DFT-S-OFDM	QPSK	135	138	0 mm	left	1:1	0.581	11.89	
3930.00	662000	High	NR Band n77	100	10.18	Ant 4a	0.0	DFT-S-OFDM	QPSK	135	138	0 mm	left	1:1	0.514	12.10	
3750.00	650000	Low	NR Band n77	100	10.33	Ant 4a	0.0	DFT-S-OFDM	QPSK	270	0	0 mm	left	1:1	0.595	11.62	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT							Body										
			Spatial Pe				1.6 W/kg (mW/g)										
	Ur	contro	lled Exposure/G	eneral Popu	ilation						averaç	ged over 1	gram				

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