

**ELEMENT MATERIALS TECHNOLOGY** 

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## PART 0 SAR CHAR REPORT

#### **Applicant Name:**

Samsung Electronics Co., Ltd. 129, Samsung-ro, Maetan dong, Yeongtong-gu, Suwon-si Gyeonggi-do, 16677, Korea Date of Testing: 11/08/2023-01/08/2024 Test Site/Location: Element, Columbia, MD, USA Document Serial No.: 1M2311010111-22.A3L(R1)

# FCC ID:

# A3LSMA356U

**APPLICANT:** 

# SAMSUNG ELECTRONICS CO., LTD

Report Type: DUT Type: Model(s): Part 0 SAR Characterization Portable Handset SM-A356U, SM-A356U1, SM-S356V

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.

RJ Ortanez Executive Vice President



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04/08/2022



## 1 DEVICE UNDER TEST

#### 1.1 Device Overview

This device uses time-averaged SAR (TAS) feature to control and manage transmitting power in real time and to ensure at all times the time-averaged RF exposure is in compliance with the FCC requirement for WWAN operations via S.LSI TAS. Additionally, this device supports WLAN/BT/NFC technologies, but the output power of these modems is not controlled by the TAS algorithm.

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	Band & Mode	Operating Modes	Tx Frequency	
(	GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz	
G	SWGPRS/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	Voice/Data	814.7 - 848.3 MHz	
	LTE Band 5	Voice/Data	824.7 - 848.3 MHz	
	LTE Band 66	Voice/Data	1710.7 - 1779.3 MHz	
	LTE Band 4	Voice/Data	1710.7 - 1754.3 MHz	
	LTE Band 25	Voice/Data	1850.7 - 1914.3 MHz	
	LTE Band 2	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 n5	Voice/Data	826.5 - 846.5 MHz	
	NR Band n70	Voice/Data	1697.5 - 1707.5 MHz	
	NR Band n66	Voice/Data	1712.5 - 1777.5 MHz	
	NR Band n25	Voice/Data	1852.5 - 1912.5 MHz	
	NR Band n2	Voice/Data	1852.5 - 1907.5 MHz	
	NR Band n30	Voice/Data	2307.5 - 2312.5 MHz	
	NR Band n41	Voice/Data	2501.01 - 2685 MHz	
	NR Band n48	Voice/Data	3555 - 3694.98 MHz	
		Vaia a /Data	3455.01 - 3544.98 MHz;	
	NR Band n78	Voice/Data	3705 - 3795 MHz	
	NR Band n77	Voice/Data	3455.01 - 3544.98 MHz;	
	The Band III I	10100/10414	3705 - 3975 MHz	
	2.4 GHz WIFI	Voice/Data	2412 - 2472 MHz	
	5 GHz WIFI	Voice/Data	U-NII-1: 5180 - 5240 MHz U-NII-2A: 5260 - 5320 MHz U-NII-2C: 5500 - 5720 MHz U-NII-3: 5745 - 5825 MHz	
	2.4 GHz Bluetooth	Data	2402 - 2480 MHz	
	NFC	Data	13.56 MHz	
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### 1.2 Time-Averaging for SAR

This device is enabled with S.LSI TAS algorithm to control and manage transmitting power in real time and to ensure that the time-averaged RF exposure from WWAN is in compliance with FCC requirements. This Part 0 report shows SAR characterization of WWAN radios. Characterization is achieved by determining P<sub>Limit</sub> for WWAN that corresponds to the exposure design targets after accounting for all device design related uncertainties, i.e., SAR\_design\_target (< FCC SAR limit) for WWAN radios. 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	
	Plimit	Power level that corresponds to the exposure design target (SAR_design_target) after accounting for all device design related uncertainties	
WWAN,	P <sub>max</sub>	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 <i>Plimit</i> for all technologies and bands	

#### 1.4 Bibliography

Report Type	Report Serial Number
RF Exposure Part 2 Test Report	1M2311010111-23.A3L
RF Exposure Compliance Summary Report	1M2311010111-18.A3L
RF Exposure Part 1 Test Report	1M2311010111-17.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 ( $\rho$ ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 2-1).

Equation 2-1 SAR Mathematical Equation

$SAR = \frac{d}{d}$	$\int \frac{dU}{dU}$	$=\frac{d}{d}$	$\frac{dU}{dU}$
$SAR = \frac{d}{dt}$	dm	$\int dt$	$\langle \rho dv \rangle$

#### 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 <sup>3</sup> )
Е	=	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.

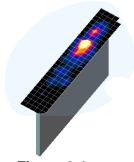


Figure 2-1 Sample SAR Area Scan

 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

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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 ( $10 \times 10 \times 10$ ) 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.

	Maximum Area Scan	Maximum Zoom Scan	Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan	
Frequency	Resolution (mm) (Δx <sub>area</sub> , Δy <sub>area</sub> )	Resolution (mm) (Δx <sub>zoom</sub> , Δy <sub>zoom</sub> )	Uniform Grid	Graded Grid		Volume (mm) (x,y,z)	
			∆z <sub>zoom</sub> (n)	$\Delta z_{zoom}(1)^*$	Δz <sub>zoom</sub> (n>1)*		
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤4	≤ 1.5*Δz <sub>zoom</sub> (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	≤ 1.5*Δz <sub>zoom</sub> (n-1)	≥ 25	
5-6 GHz	≤ 10	≤ 4	≤2	≤2	≤ 1.5*Δz <sub>zoom</sub> (n-1)	≥ 22	
	*Also compliant to IEEE 1528-2013 Table 6						

 Table 2-1

 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04\*

\*Also compliant to IEEE 1528-2013 Table 6

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## **3** SAR CHARACTERIZATION

#### 3.1 RSI and SAR Determination

For WWAN operations this device uses different Radio State Index (RSI) via S.LSI TAS 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 RSI. 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 radio state index (RSI) conditions used in Table 3-1 represent different exposure scenarios.

	Exposure Scenarios for S.LSI TAS							
Scenario	Description	SAR Test Cases						
Head (RSI =4)	<ul> <li>RSI = RCV</li> <li>Device positioned next to head</li> <li>Receiver Active</li> </ul>	Head SAR per KDB Publication 648474 D04						
Hotspot mode (RSI =3)	<ul> <li>RSI = Hotspot</li> <li>Device transmits in hotspot mode near body</li> <li>Hotspot Mode Active</li> </ul>	Hotspot SAR per KDB Publication 941225 D06						
Phablet (RSI = 0)	<ul> <li>RSI = Free</li> <li>Device is held with hand</li> </ul>	Phablet SAR per KDB Publication 648474 D04 & KDB Publication 616217 D04						
Body-worn (RSI = 0)	<ul> <li>RSI = Free</li> <li>Device being used with a body-worn accessory</li> </ul>	Body-worn SAR per KDB Publication 648474 D04						

Table 3-1 Exposure Scenarios for S.LSI TAS

### 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 for WWAN Operations

SAR_design_target						
$SAR\_design\_target < SAR\_regulatory\_limit \times 10^{\frac{-Total Uncertainty}{10}}$						
1g SAR (W/kg)		10g SAR (W/kg)				
Total Uncertainty	1.0 dB	Total Uncertainty	1.0 dB			
SAR_regulatory_limit	SAR_regulatory_limit 1.6 W/kg		4.0 W/kg			
SAR_design_target	0.8 W/kg	SAR_design_target	2.0 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.

Radio State Index (RSI)	PLimit Determination Scenarios
0	<ul> <li>The worst-case SAR exposure is determined as maximum SAR normalized to the limit (i.e. lowest <i>P</i><sub>limit</sub>) among:</li> <li>1. Body Worn SAR</li> <li>2. Extremity SAR measured at 0 mm spacing</li> </ul>
4	Plimit is calculated based on 1g Head SAR
3	Plimit is calculated based on 1g Hotspot SAR at 10 mm

Table 3-3
PLimit Determination for S.LSI TAS

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Exposure Scenario			Maximum	Body-Worn or Phablet	Hotspot	Head	
Averaging Volume			Tune-Up	1g/10g	1g	lg	
			Output	15mm, 0mm	10mm	0mm	
Spacing			Power*	0	3		
RSI		Antenna		0	3	4	
Technology/Band	Antenna	Group	Pmax				
GSM 850	А	AG1	24.3	28.0	28.0	31.4	
GSM 1900	В	AG1	22.6	19.0	19.0	31.3	
UMTS 850	А	AG1	24.0	27.5	27.5	32.9	
UMTS 1750	В	AG1	23.0	21.0	19.5	32.4	
UMTS 1900	В	AG1	23.0	20.5	19.5	30.7	
LTE Band 71	А	AG1	24.5	28.4	28.4	32.5	
LTE Band 12	А	AG1	24.5	29.1	29.1	32.4	
LTE Band 13	А	AG1	24.5	29.2	28.8	31.1	
LTE Band 14	А	AG1	24.5	27.9	27.9	31.4	
LTE Band 26	А	AG1	24.5	27.0	27.0	32.1	
LTE Band 5	А	AG1	24.5	27.4	27.4	31.8	
LTE Band 66/4	В	AG1	23.5	21.0	18.5	30.6	
LTE Band 66/4	F	AG2	22.2	20.0	18.5	18.5	
LTE Band 25/2	В	AG1	23.0	21.0	18.5	30.5	
LTE Band 25/2	F	AG2	22.2	21.0	18.5	18.5	
LTE Band 30	В	AG1	22.0	20.0	18.5	31.5	
LTE Band 30	F	AG2	21.2	19.0	18.5	18.5	
LTE Band 7	В	AG1	23.3	20.0	18.5	39.1	
LTE Band 7	F	AG2	22.0	21.0	18.5	18.5	
LTE Band 41 PC2	В	AG1	22.4	20.0	18.5	29.6	
LTE Band 41 PC2	F	AG2	20.7	19.0	17.5	17.5	
LTE Band 38	В	AG1	22.0	20.0	18.5	29.6	
LTE Band 38	F	AG2	20.0	19.0	17.5	17.5	
LTE Band 48	G	AG2	19.5	18.5	18.5	17.5	
NR Band n71	A	AG1	24.5	29.0	28.6	32.6	
NR Band n5	A	AG1	24.5	26.5	26.5	32.5	
NR Band n70	В	AG1	23.0	20.0	18.5	30.2	
NR Band n66	В	AG1	23.5	21.0	18.5	30.9	
NR Band n66	F	AG2	22.2	20.0	18.5	18.5	
NR Band n25/n2	В	AG2 AG1	23.0	21.0	18.5	29.9	
NR Band n25/n2	F	AG1 AG2	22.2	21.0	18.5	18.5	
NR Band n30	В	AG2 AG1	22.2	20.0	18.5	31.8	
NR Band n30	F	AG1 AG2	22.0	19.0	18.5	18.5	
NR Band n41 PC3	В	AG1	24.0	20.0	16.5	24.0	
NR Band n41 PC3	F	AG1 AG2	24.0	19.0	17.5	17.5	
NR Band n41 PC2	В	AG2 AG1	22.0	20.0	16.5	24.0	
NR Band n41 PC2	F	AG1 AG2	26.0	19.0	17.5	17.5	
NR Band n48	G	AG2 AG2	24.0	17.5	17.5	17.5	
NR Band n48	B	AG2 AG1	17.5	13.0	13.0	13.0	
NR Band n48	К	AG1 AG2	19.0	14.5	14.5	13.0	
NR Band n48	L	AG2 AG2	17.0	14.5	14.5	14.5	
NR Band n78 PC2	G	AG2 AG2	26.0	17.5	17.5	12.0	
NR Band n78 PC2	B	AG2 AG1	28.0	17.5	12.5	12.5	
	K						
NR Band n78 PC2 NR Band n78 PC2	L	AG2 AG2	24.0 21.5	15.0	15.0	15.0	
	G			13.0	13.0	13.0	
NR Band n77 PC2	B	AG2	26.0 22.5	17.5 12.5	17.5	16.5	
NR Band n77 PC2	_	AG1			12.5	12.5	
NR Band n77 PC2 NR Band n77 PC2	K	AG2 AG2	24.0 21.5	15.0 13.0	15.0 13.0	15.0 13.0	

Table 3-4 SAR Characterizations for S.LSI TAS

- 1. For all modes/bands, when Hotspot Mode (RSI = 3) and Free (RSI = 0) are triggered at the same time, Hotspot Mode takes priority, thus the  $P_{limit}$  for Hotspot Mode is set to be less or equal to  $P_{limit}$  for Free.
- 2. When  $P_{max} < P_{limit}$ , the DUT will operate at a power level up to  $P_{max}$ .
- 3. For all bands RCV (RSI = 4) takes highest priority over all levels.

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## 4 EQUIPMENT LIST

#### For SAR measurements

Manufaoture r Agilent	Model E44048	De scription Seectrum Analyze r	Cal Date N/A	Cal Interval N/A	Cal Due N/A	Serial Numb MY4511324
Agilent	E4438C E4438C	EG Vector Sgnal Generator	10/10/2023	Annual	10/10/2024	MY4208263 MY4309207
Agilent		ESG Vector Signal Generator	11/15/2023	Annual	11/15/2024	U\$4624050
Agilent	N5182A	MIG Vector Signal Generator	11/14/2023	Annual	11/14/2024	
Agilent	N5182A	MKG Vector Signal Generator	7/4/2023	Annual	7/4/2024	MY4818039
Agilent	8753£5	5 Parameter Vector Network Analyzer	2/8/2023	Annual	2/8/2024	U\$3917012
Agilent	8753E5 8753E5	S-Parameter Vector Network Analyzer S-Parameter Vector Network Analyzer	7/21/2023	Annual	7/21/2024 1/12/2024	US39170111 MY4000147
Agilent						
Agilent	E3513C	Wireless Communications Test Set	4/24/2019	Triennial	CBT	GB4631079
Agilent	E3513C	Wireless Communications Test Set	1/12/2023	Annual	1/12/2024	MY5026213
Amplifier Research	135166	Amplifier	CBT	N/A	CBT	348972
Amplifier Research	1351G6 130A1000	Amplifier Amplifier	CBT	N/A	CBT	433971 350132
Amplitier Kese arch Anritsu	MN8110B	I/O Adaptor	CBT	N/A N/A	CBT	626174788
Anritsu	MI2495A	Power Meter	6/15/2023	Annual	6/15/2024	1138001
	ML2495A MA24118					133001
Anritsu		Pulse Power Sensor	1/10/2023	Annual	1/10/2024	
Anritsu	MA2411B	Pulse Power Sensor	6/15/2023	Annual	6/15/2024	1126066
Anritsu	MT8823C	Radi o Communication Analyzer MT8821C	7/5/2023	Annual	7/5/2024	626215000
Anritsu	MT882.1C	Radio Communication Analyzer MT8823C	3/31/2023	Annual	3/31/2024	620138179
Anritsu Anritsu	MT8821C	Radio Communication Analyzer MT8823C	1/10/2023	Annual	1/10/2024	620152463
Anritsu Anritsu	MTS000A MTS000A	Radio Communication Test Station Radio Communication Test Station	9/4/2023 10/17/2023	Annual Annual	9/4/2024 10/17/2024	627233740
Anritsu	MISCOA	Radio Communication lest station Radio Communication Test Station	3/20/2023	Annual	3/20/2024	626398798
Anritsu	MA24106A	USB Power Sensor	4/21/2023	Annual	4/21/2024	13495CB
Anritsu	MA24106A	USB Power Sensor	10/31/2023	Annual	10/31/2024	1248508
Anritsu	MA24306A	USB Power Sensor	7/4/2023	Annual	7/4/2024	1244512
Control Company	4040	Therm./ Clock/Humidity Monitor	1/17/2023	Annual	1/17/2024	160574418
Mitutoyo	500 196 30	CD 6 <sup>1</sup> ASX6Inch Digital Caliper	2/16/2022	Triennial	2/16/2025	A20238413
leysight Technologies	N67038	DE Power Analyze r	5/5/2021	Triennial	5/5/2024	MY5300403
(eysight Technologies	N9020A	MXA Signal Analyze r	3/15/2023	Annual	3/15/2024	U\$4647056
eysight Technologies	N902DA	MXA Signal Analyze r	4/6/2023	Annual	4/6/2024	MY4801023
Agilent	N902DA	MXA Signal Analyze r	10/17/2023	Annual	10/17/2024	MY5124047
Mini-Circuits	VLF-2930+	Low Pass Filter DC to 2700 MHz	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	VLF-6000+	Low Pass Filter DC to 6000 MHz	7/5/2023	Annual	7/5/2024	31684
Mini-Circuits	ZUDC10-83-5+	Directional Coupler	CBT	N/A	CBT	2050
Mini-Circuits	ZUDC10 83 S+	Directional Coupler	7/5/2023	Annual	7/5/2024	2111
See konk	TSF-100	Torque Wrench	6/30/2023	Annual	6/30/2024	47639-29
Rohde & Schwarz	CMW300	Wideband Radio Communication Tester	8/14/2023	Annual	8/14/2024	161662
Rohde & Schwarz	CMW300	Wideband Radio Communication Tester	6/1/2023	Annual	6/1/2024	108843
Rohde & Schwarz	CMW300	Wideband Radio Communication Tester	7/4/2023	Annual	7/4/2024	166818
Rohde & Schwarz	CMW300	Wideband Radio Communication Tester	8/10/2023	Annual	8/10/2024	140144
SPEAG	DAK-3.5	Die lectric Asses sment Kit	11/13/2023	Annual	11/13/2024	1277
SPEAG	DAK-35	Die lectric Asses sment Kit	5/9/2023	Annual	5/9/2024	1070
SPEAG	DAKS 35	Portable Dielectric Assessment Kit	8/14/2023	Annual	8/14/2024	1041
SPEAG	DAK-12	Dielectric Assessment Kit (4MHz - 3GHz)	3/13/2023	Annual	3/13/2024	1102
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1379
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1243
SPEAG	D750V3	750 MHz SAR Dipole	3/14/2022	Biennial	3/14/2024	1054
SPEAG	D750V3	750 MHz SAR Dipole	2/13/2023	Annual	2/13/2024	1046
SPEAG	D750V3	750 MHz SAR Dipole	5/11/2023	Annual	5/11/2024	1008
SPEAG	D835V2	835 MHz SAR Dipole	1/21/2021	Triennial	1/21/2024	4d132
SPEAG	D835V2	835 MHz SAR Dipole	4/13/2023	Annual	4/13/2024	4d119
SPEAG	D835V2	835 MHz SAR Dipole	5/11/2023	Annual	5/11/2024	4d180
SPEAG	D1750V2	1750 MHz SAR Dipole	10/20/2021	Triennial	10/20/2024	1150
SPEAG	D1750V2	1750 MHz SAR Dipole	1/18/2022	Biennia	1/18/2024	1148
SPEAG	D1765V2	1750 MHz SAR Dipole	5/14/2021	Triennial	5/14/2024	1008
SPEAG	D1750V2	1750 MHz SAR Dipole	4/19/2023	Annual	4/19/2024	1051
SPEAG	D1900V2	1900 MHz SAR Dipole	2/21/2022	Biennial	2/21/2024	5d148
SPEAG	D1900V2	1900 MHz SAR Dipole	4/18/2023	Annual	4/18/2024	5d141
SPEAG	D1900V2	1900 MHz SAR Dipole	5/12/2023	Annual	5/12/2024	50026
SPEAG	02300V2	2300 MHz SAR Dipole	6/3/2021	Triennial	6/3/2024	1116
SPEAG	02300V2	2300 MHzSAR Dipole	6/12/2023	Annual	6/12/2024	1117
SPEAG	D2300V2	2300 MHz SAR Dipole	2/13/2023	Annual	2/13/2024	1008
SPEAG	D2450V2	2450 MHz SAR Dipole	11/25/2021	Triennial	11/25/2024	981
SPEAG						
	D2450V2	2450 MHz SAR Dipole	8/18/2021	Triennial	8/18/2024	719
SPEAG	D2450V2 D2450V2	2450 MHz SAR Dipole 2450 MHz SAR Dipole			8/18/2024 5/11/2024	719
SPEAG SPEAG		2450 MHz SAR Dipole	8/18/2021	Triennial		
SPEAG	D2450V2 D2600V2	2450 MHz SAR Dipole 2600 MHz SAR Dipole	8/18/2021 5/11/2023 4/14/2021	Triennial Annual Triennial	5/11/2024 4/14/2024	945 1004
at 67%a	D2450V2	2450 MH2 SAR Dipole 2600 MH2 SAR Dipole 2600 MH2 SAR Dipole 2600 MH2 SAR Dipole 2600 MH2 SAR Dipole	8/18/2021 5/11/2023	Triennial Annual	5/11/2024	945
SPEAG SPEAG	02430V2 02600V2 02600V2	2450 MHzSAR Dipole 2600 MHzSAR Dipole 2600 MHzSAR Dipole	8/18/2021 5/11/2023 4/14/2021 6/12/2023	Triennial Annual Triennial Annual	5/11/2024 4/14/2024 6/12/2024	945 1004 1009
SPEAG SPEAG SPEAG	02450V2 02600V2 02600V2 02600V2	2450 MH2 SAR Dipole 2600 MH2 SAR Dipole 2600 MH2 SAR Dipole 2600 MH2 SAR Dipole 2600 MH2 SAR Dipole	8/18/2021 5/11/2023 4/14/2021 6/12/2023 8/10/2023	Triennial Annual Triennial Annual Annual	5/11/2024 4/14/2024 6/12/2024 8/10/2024	945 1004 1009 1126
SPEAG SPEAG SPEAG SPEAG	02490V2 02600V2 02600V2 02600V2 02600V2 03500V2	2450 MH25AR Dipole 2600 MH25AR Dipole 2600 MH25AR Dipole 2600 MH25AR Dipole 2600 MH25AR Dipole 3300 MH25AR Dipole	8/18/2021 5/11/2023 4/14/2021 6/12/2023 8/10/2023 1/19/2021	Triennial Annual Triennial Annual Annual Triennial	5/11/2024 4/14/2024 6/12/2024 8/10/2024 1/19/2024	945 1004 1009 1126 1039
SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG	02430V2 02600V2 02600V2 02600V2 02600V2 03500V2 03500V2	2450 MH2 SAR Dipole 2600 MH2 SAR Dipole 2600 MH2 SAR Dipole 2600 MH2 SAR Dipole 3500 MH2 SAR Dipole 3500 MH2 SAR Dipole 3700 MH2 SAR Dipole	8/18/2021 5/11/2023 4/14/2021 6/12/2023 8/10/2023 1/19/2021 6/15/2023	Triennial Annual Triennial Annual Annual Triennial Annual	5/11/2024 4/14/2024 6/12/2024 8/10/2024 1/19/2024 6/15/2024	945 1004 1009 1126 1039 1127
SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG	02430/V2 02600/V2 02600/V2 02600/V2 02600/V2 03500/V2 03500/V2 03700/V2	2450 MHz SAR Dipole 2500 MHz SAR Dipole 2500 MHz SAR Dipole 2500 MHz SAR Dipole 3500 MHz SAR Dipole 3500 MHz SAR Dipole	8/18/2021 5/11/2023 4/14/2021 6/12/2023 8/10/2023 1/19/2021 6/15/2023 1/13/2023	Triennial Annual Triennial Annual Triennial Annual Annual	5/11/2024 4/14/2024 6/12/2024 8/10/2024 1/19/2024 6/15/2024 1/13/2024	945 1004 1009 1126 1039 1127 1067
SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG	02430V2 02600V2 02600V2 03500V2 03500V2 03500V2 03500V2 03500V2 03700V2	2460 MHz SAR Dipole 2800 MHz SAR Dipole 2800 MHz SAR Dipole 3800 MHz SAR Dipole 3800 MHz SAR Dipole 3800 MHz SAR Dipole 3700 MHz SAR Dipole 3700 MHz SAR Dipole	8/18/2021 5/11/2023 4/14/2021 6/12/2023 8/10/2023 1/19/2021 6/15/2023 6/15/2023 6/15/2023	Triennial Annual Triennial Annual Triennial Annual Annual Annual	5/11/2034 4/14/2034 6/12/2034 8/10/2034 1/19/2034 6/15/2034 6/15/2034 6/15/2034	945 1004 1009 1126 1039 1127 1067 1096
SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG	02450V2 02600V2 02600V2 02600V2 03500V2 03500V2 03700V2 03700V2 03900V2 03900V2	2400 MH2 SAR Dipole 2400 MH2 SAR Dipole 2400 MH2 SAR Dipole 2400 MH2 SAR Dipole 2400 MH2 SAR Dipole 3300 MH2 SAR Dipole 3300 MH2 SAR Dipole 3300 MH2 SAR Dipole 3400 MH2 SAR Dipole 3400 MH2 SAR Dipole	8/18/2021 5/11/2023 4/14/2021 6/12/2023 8/10/2023 1/19/2021 6/15/2023 6/15/2023 10/19/2023	Triennial Annual Triennial Annual Triennial Annual Annual Annual Annual	5/11/2024 4/14/2024 6/12/2024 8/10/2024 6/15/2024 6/15/2024 1/13/2024 6/15/2024 10/19/2024	945 1004 1009 1126 1099 1127 1067 1096 1056
SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG	22450V2 22660V2 22660V2 23560V2 23560V2 23560V2 23560V2 23570V2 23700V2 23700V2 23900V2 23900V2	2400 MH-5 XM Dipole 2100 MH-5 XM Dipole 5 SH S XM Dipole	8/18/2021 5/11/2023 4/14/2021 6/12/2023 8/10/2023 1/19/2021 6/15/2023 6/15/2023 10/19/2023 6/15/2023	Triennial Annual Triennial Annual Triennial Annual Annual Annual Annual	5/11/2024 4/14/2024 6/12/2024 8/10/2024 6/15/2024 6/15/2024 6/15/2024 6/15/2024 6/15/2024	945 1004 1009 1125 1099 1127 1067 1096 1036 1074
SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG	02450V2 0260V2 0260V2 03500V2 03500V2 03500V2 03500V2 03700V2 03700V2 03900V2 03900V2 03900V2 056H2V2	2400 MHz SAR Dipole 2400 MHz SAR Dipole 2400 MHz SAR Dipole 2400 MHz SAR Dipole 3300 MHz SAR Dipole 3300 MHz SAR Dipole 3300 MHz SAR Dipole 3300 MHz SAR Dipole 3800 MHz SAR Dipole 564 SAR Dipole 564 SAR Dipole 564 SAR Dipole	8/18/2021 5/11/2023 4/14/2021 6/12/2023 8/10/2023 8/10/2023 1/15/2023 6/15/2023 6/15/2023 6/15/2023 1/18/2023	Triennial Annual Triennial Annual Triennial Annual Annual Annual Annual Annual Annual Annual	5/11/2024 4/14/2024 6/12/2024 8/10/2024 9/19/2024 6/15/2024 6/15/2024 10/19/2024 6/15/2024 10/19/2024	945 1004 1009 1125 1039 1127 1067 1056 1056 1054 1054 1191
SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG	02450V2 02650V2 02650V2 02650V2 03500V2 03500V2 03700V2 03700V2 03700V2 03900V2 03900V2 03900V2 03947V2 0.564	2400 MH-5 XM Dipole 2100 MH-5 XM Dipole 5 SH S XM Dipole	\$\[18]\2021 \$\[11]\2023 4\[14]\2021 \$\[12]\2023 \$\[10]\2023 \$\[10]\2023 4\[15]\2023 4\[15]\2023 4\[15]\2023 4\[15]\2023 4\[15]\2023 1\[18]\2023 1\[17]\2023	Triennial Annual Triennial Annual Triennial Annual Annual Annual Annual Annual Annual	4,14/2024 4/14/2024 4/12/2024 4/12/2024 4/12/2024 4/12/2024 4/15/2024 4/15/2024 1/13/2024 4/15/2024 1/18/2024 1/17/2024	945 1004 1009 1126 1029 1127 1067 1096 1096 1096 1074 1191 1538
SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG SPEAG	02450V2 D2600V2 D2600V2 D2600V2 D3500V2 D3500V2 D3700V2 D3700V2 D3900V2 D3900V2 D390V2 D36HV2 DA54 DA54 DA54	2400 MHz 344 Dipole 2400 MHz 344 Dipole 2400 MHz 348 Dipole 2400 MHz 348 Dipole 3500 MHz 348 Dipole 3700 MHz 348 Dipole 3700 MHz 348 Dipole 3700 MHz 348 Dipole 3800 MHz 348 Dipole 564 546 Dipole 564 546 Dipole Dary Oba Acquisition Bir chorics Dary Oba Acquisition Bir chorics	\$\[\$\2021 \$\[11\]2023 4\[14\]2021 4\[14\]2021 4\[12\]2023 \$\[10\]2023 4\[12\]2023 4\[13\]2023 4\[15\]2023 4\[15\]2023 4\[15\]2023 4\[14\]2023 4\[14\]2023 4\[14\]2023 4\[14\]2023 4\[14\]2023	Triennial Annual Triennial Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual	4/14/2024 4/14/2024 4/12/2024 4/12/2024 4/12/2024 4/12/2024 4/15/2024 4/15/2024 4/15/2024 4/15/2024 4/14/2024 4/14/2024 4/14/2024	945 1004 1009 1126 1099 1127 1095 1096 1096 1096 1096 1094 1191 1538 1407 1334
SPEAG	02490V2 D260V/2 D260V/2 D260V/2 D260V/2 D350V/2 D350V/2 D350V/2 D350V/2 D350V/2 D350V/2 D350V/2 D350V/2 D350V/2 D350V/2 D354V/2 DA54 DA54 DA54	2800 MH-5 MR Dipole 2800 MH-5 MR Dipole 2800 MH-5 MR Dipole 2800 MH-5 MR Dipole 3800 MH-5 MR Dipole 3800 MH-5 MR Dipole 3700 MH-5 MR Dipole 3900 MH-5 MR Dipole 3900 MH-5 MR Dipole 3900 MH-5 MR Dipole 5 GH 5 SMR Dipole	8/18/2021 \$\frac{1}{11}2023 \$\frac{1}{2}2023 \$\frac{1}{2}2023 \$\frac{1}{2}2023 \$\frac{1}{2}2023 \$\frac{1}{2}52023 \$\frac	Triennial Annual Triennial Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual	4/14/2024 4/14/2024 6/12/2024 8/10/2024 1/19/2024 6/15/2024 6/15/2024 6/15/2024 6/15/2024 1/18/2024 1/17/2024 4/14/2024 4/14/2024 2/15/2024	945 1004 1009 1125 1099 1127 1095 1095 1095 1095 1095 1095 1094 1191 1558 1407 1334 665
5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG 5PEAG	03430/2 03600/2 03600/2 03600/2 03600/2 03600/2 03600/2 03700/2 03700/2 03900/2 03900/2 03604/2 0.6454/2 0.6454 0.645	2400 MHz SAR Dipole 2400 MHz SAR Dipole 2400 MHz SAR Dipole 2400 MHz SAR Dipole 3400 MHz SAR Dipole 549 SAR Dipole Dary Data Aquatistion Bit dronics Dary Data Aquatistion Bit dronics	8/18/2021 \$\frac{1}{12}2023 \$\frac{1}{12}2023 \$\frac{1}{2}22023 \$\frac{1}{2}2023 \$\frac{1}{2}2023 \$\frac{1}{2}52023 \$\fr	Triennial Annual Triennial Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual	4/11/2034 4/14/2034 6/12/2034 6/15/2034 6/15/2034 6/15/2034 6/15/2034 1/13/2034 6/15/2034 1/18/2034 4/14/2034 6/15/2034 4/14/2034 6/15/2034	945 1004 1009 1125 1097 1096 1096 1096 1096 1096 1096 1096 1096
5PEAG 5PEAG	03430V2 03450V2 03450V2 03500V2 03500V2 03500V2 03500V2 0370V2 0370V2 0370V2 0370V2 03645V2 03645V2 03645V2 03645 03645 03645 03645 03645 03645 03645	200 MH-5 xM Dipole     100 MH A Acquitation B -5 Chrolis     Day DBA Acquitation B -5 Chrols     Day DBA Acquitation B -5 Chrolis     Day DBA Acquitation B -	8/18/2021 \$\frac{1}{11/2028} \$\frac{1}{11/2028} \$\frac{1}{12/2028} \$\frac{1}{2028} \$\frac{1}{2028} \$\frac{1}{12/2028} \$	Triennial Annual Triennial Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual	\$111/2034 \$141/2034 \$12/2034 \$10/2034 \$19/2034 \$19/2034 \$132	945 2009 1125 2039 1127 2067 2036 2036 2037 1056 2037 1056 2037 1056 2037 2036 2037 2036 2037 2036 2037 2036 2037 2036 2037 2036 2036 2036 2036 2036 2039 2036 2039 2036 2039 2036 2039 2036 2039 2036 2039 2036 2039 2036 2039 2036 2039 2036 2039 2036 2039 2036 2039 2036 2036 2036 2036 2036 2036 2036 2036
594AG 594AG	03430V2 03430V2 03460V2 03460V2 03500V2 0350V2 0350V2 0370V2 0350V2 0350V2 0350V2 0350V2 0364V2 0344 0344 0344 0344 0344 0344 0344 034	2400 MHz SAR Dipole 2100 MHz SAR Dipole 2100 MHz SAR Dipole 2100 MHz SAR Dipole 2100 MHz SAR Dipole 3100 MHz SAR Dipole 3900 MHz SAR Dipole 5 GH SAR Dipole Dary Data Acquisition Bit dronics Dary Data Acquisition Bit dronics	8/18/2021 \$\frac{1}{11/2028} \$\frac{1}{12/2028} \$\frac{1}{21/2028}\\ \$\frac{1}{21/2028}\\ \$\frac{1}{21/2028}\\ \$\frac{1}{21/2028}\\ \$\frac{1}{21/2028}\\ \$\frac{1}{21/2028}\\ \$\frac{1}{21/20	Triennial Annual Triennial Annual Annual Triennial Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual	\$111/2034 414/2034 612/2034 810/2034 119/2034 415/2034 415/2034 413/2034 615/2034 413/2034 615/2034 414/2034 615/2034 118/2034 414/2034 615/2034 118/2034 615/2034 118/2	945 2004 2009 2009 2009 2009 2009 2009 2009
5PP.AG 5PP.AG	04450V2 04500V2 04500V2 04500V2 04500V2 04500V2 04500V2 04500V2 04500V2 04500V2 0450V2 0450V2 0450V2 0454 0454 0454 0454 0454 0454 0454	2800 MH-1540 Elipole 2800 MH-1540	8/18/2021 \$/11/2023 \$/11/2023 \$/12/2023 \$/19/2021 \$/19/2021 \$/19/2021 \$/19/2021 \$/19/2023 \$/15/2023 \$/15/2023 \$/17/2023 \$/15/2023	Tritonial Annual Tritonial Annual	\$(11)2034 4(14)7034 4(14)7034 4(12)7034 8(10)7034 4(15)7034	945 2004 2009 1125 2099 2057 2056 2056 2056 2054 1191 1334 407 1334 665 2530 2545 2545 2545 2545
599.46 599.46	01460V2 02660V2 01460V2 01460V2 01500V2 01500V2 01500V2 0170V2 0170V2 0170V2 01900V2 01900V2 01900V2 01464 0146 0146 0146 0146 0146 0146 014	2 400 MHz SAR Dipole 2 100 MHz SAR Dipole 2 100 MHz SAR Dipole 2 100 MHz SAR Dipole 1 300 MHz SAR Dipole 1 300 MHz SAR Dipole 1 300 MHz SAR Dipole 3 300 MHz SAR Dipole 3 300 MHz SAR Dipole 3 900 MHz SAR Dipole 2 900 MHz SAR Dipole 2 900 MHz SAR Dipole 2 900 MHz SAR Dipole 2 900 MHz SAR Dipole 0 94 SAR Dipole 0 94	\$18/2021 \$11/2023 4/14/2021 4/14/2021 4/12/2023 8/10/2023 1/19/2023 4/15/2023 1/19/2023 4/15/2023 4/15/2023 1/18/2023 1/18/2023 2/15/2023 1/18/2023 2/15/2023 1/18/2023 2/15/2023 1/18/2023 2/15/2023 2/15/2023 1/12/2023 2/15/202	Triennial Annual Triennial Triennial Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual	\$/11/2024 4/14/2024 4/12/2024 8/10/2024 4/15/2024 4/15/2024 4/15/2024 4/15/2024 4/15/2024 4/14/2024 4/14/2024 4/14/2024 4/14/2024 4/14/2024 4/15/2024 4/15/2024 4/15/2024	945 1004 1009 1125 1077 1077 1077 1077 1077 1076 1074 1074 1074 1074 1074 1074 1055 1056 1056 1056 1056 1056 1056 1056
599.63 599.63 599.66	004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 00484 00484 00484 00484 00484 00484 00484 00484 00484 00484 00484 00484 00484 00484 00484 00484	1800 MH-1548 Dipole     1	¥11/2021 \$11/2021 \$11/2023 \$11/2023 \$14/4/2021 \$10/2023 \$10/	Triennial Annual Triennial Annual	9/11/2034 4/14/2034 4/12/2034 6/12/2034 8/10/2034 4/15/2034 4/15/2034 4/15/2034 4/15/2034 4/15/2034 4/14/2034 4/14/2034 4/15/2034 4/15/2034 4/15/2034 4/15/2034 4/15/2034 4/15/2034 4/15/2034 4/15/2034	945 1004 1009 1115 1027 1027 1027 1026 1027 1026 1027 1026 1027 1028 1028 1028 1028 1028 1028 1028 1028
599465 599465 599465 599465 599465 599465 599466 599466 599466 599466 599466 599466 599466 599466 599466 599466 599466 599466 599466 599466 599466 599466 599466 599466	C04630/2     C04630/2     C04630/2     C04630/2     C04630/2     C04630/2     C04630/2     C04630/2     C0463     C0464	2400 MH-5340 Dipole 2300 MH-5340 Dipole 2300 MH-5340 Dipole 2300 MH-5340 Dipole 1300 MH-5340 Dipole 1300 MH-5340 Dipole 1300 MH-5340 Dipole 1300 MH-5340 Dipole 1300 MH-5340 Dipole 3900 MH-5340 Dipole 5444 Saf0 Dipole Dary Data Acquisition Bic chronics Dary Data Acquisition Bic chronics	8/19/2021 9/11/2023 9/11/2023 9/11/2023 9/12/2	Triennial Annual Triennial Annual	9/11/2034 4/14/2024 6/12/2024 6/12/2024 6/12/2024 6/12/2024 6/15/2024 6/15/2024 4/13/2024 4/13/2024 4/13/2024 4/14/2024 4/14/2024 4/14/2024 4/14/2024 4/14/2024 4/15/2	945 1004 1009 1125 1097 1057 1057 1057 1057 1057 1057 1057 105
578.65 578.65 578.66 578.66 578.66 578.66 578.66 578.66 578.66 578.66 578.66 578.66 578.66 578.66 578.66 578.66 578.66 578.66 578.66	004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 00484 00480 00400000000	1800MH:ssR Dipole     1800MH:ssR Dipole     1800MH:ssR Dipole     1800MH:ssR Dipole     1800MH:ssR Dipole     1800MH:ssR Dipole     1700MH:ssR Dipole     170MH:ssR Dipole	\$19.2023 \$11.2023 \$11.2023 \$11.2023 \$10.20	Triennial Annual Triennial Annual	9/11/2034 4/14/2034 4/14/2034 4/12/2034 4/12/2034 4/12/2034 4/19/2034 4/19/2034 4/19/2034 4/15/2036 4/15/2	945 2004 2009 2009 2009 2005 2005 2005 2005 2005
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578.65 578.65 578.66	004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 004809/ 00480 00400000000	200 MH-1540 Elippide     200 MH-1540 Elippide     200 MH-1540 Elippide     200 MH-1540 Elippide     300 MH-1540 Elip	\$19.2023 \$11.2023 \$11.2023 \$11.2023 \$10.20	Triennial Annual Triennial Annual	211.2203 414.2203 814.2203 814.2203 814.2203 814.2203 814.2203 414	945 2004 2009 1125 2009 1127 2005 2004 1127 2005 2004 1129 1127 2005 2004 1129 1129 1129 1129 1129 1129 1129 112
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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.
- 2. Each equipment item was used solely within its respective calibration period.

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## 5 MEASUREMENT UNCERTAINTIES

#### **For SAR Measurements**

a	b	с	d	e=	f	8	h =	i =	k
				f(d, k)			cx f/e	c x g/e	
	IEEE	Tol.	Prob.		c,	q	lgm	10gms	
Uncertainty Component	1528 Sec.	(± %)	D ist.	Div.	1gm	10 gms	u,	u,	vi
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	
Bound ary Effect	E.2.3	2	R	1.732	1	1	1.2	1.2	
Linearity	E.2.4	0.3	N	1	1	1	0.3	0.3	
System Detection Limits	E.2.4	0.25	R	1.732	1	1	0.1	0.1	
Modulation Response	E.2.5	4.8	R	1.732	1	1	2.8	2.8	- 00
Readout Electronics	E.2.6	0.3	N	1	1	1	0.3	0.3	
Response Time	E.2.7	0.8	R	1.732	1	1	0.5	0.5	
Integration Time	E.2.8	2.6	R	1.732	1	1	1.5	1.5	
RF Ambient Conditions - Noise	E.6.1	3	R	1.732	1	1	1.7	1.7	
RF Ambient Conditions - Reflections	E.6.1	3	R	1.732	1	1	1.7	1.7	
Probe Positioner Mechanical Tolerance	E.6.2	0.8	R	1.732	1	1	0.5	0.5	
Probe Positioning w/ respect to Phantom	E.6.3	6.7	R	1.732	1	1	3.9	3.9	
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	4	R	1.732	1	1	2.3	2.3	
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	1.732	1	1	2.9	2.9	
SAR Scaling	E.6.5	0	R	1.732	1	1	0.0	0.0	00
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	7.6	R	1.73	1.0	1.0	4.4	4.4	8
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)	1	l	RSS	1	l	1	12.2	12.0	191
Expanded Uncertainty			k=2				24.4	24.0	
(95% CONFIDENCE LEVEL)									

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

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