FCC SAR Test Report

APPLICANT	:	Zebra Technologies Corporation
EQUIPMENT	:	Mobile Computer
BRAND NAME	:	Zebra
MODEL NAME	:	MC330M
FCC ID	:	UZ7MC330M
STANDARD	:	FCC 47 CFR Part 2 (2.1093) ANSI/IEEE C95.1-1992 IEEE 1528-2013

We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Eric Huang

Reviewed by: Eric Huang / Manager

Jones Tsai

Approved by: Jones Tsai / Manager

ilac-MRA

TAF
Testing Laboratory
1190

SPORTON INTERNATIONAL INC.
No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan (R.O.C.)

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA790120-02	Rev. 01	Initial issue of report	Nov. 02, 2017

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for Zebra Technologies Corporation, Mobile Computer, MC330M, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary		Highest Simultaneous Transmission	
		Body-worn (Separation 0mm)	Extremity (Separation 0mm)		
		1g SAR (W/kg)	10g SAR (W/kg)	1g SAR (W/kg)	10g SAR (W/kg)
DTS	2.4GHz WLAN	0.46	0.14	0.84	0.27
NII	5GHz WLAN	0.56	0.43	0.69	0.81
Date of Testing:		2017/9/28 ~ 2017/10/02			

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR, 4.0 W/kg for Extremity 10g SAR) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications

2. Administration Data

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190) and the FCC designation No. TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

Testing Laboratory	
Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978

Applicant	
Company Name	Zebra Technologies Corporation
Address	1 Zebra Plaza, Holtsville, NY 11742

Manufacturer	
Company Name	Zebra Technologies Corporation
Address	1 Zebra Plaza, Holtsville, NY 11742

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Mobile Computer
Brand Name	Zebra
Model Name	MC330M
FCC ID	UZ7MC330M
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	WLAN 2.4GHz : 802.11b/g/n HT20/HT40 WLAN 5GHz : 802.11a/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE
HW Version	EV1b
SW Version	Android Version 7.1.2
FW Version	W10: Aug 4 2017 12:57:11 version 7.35.205.8 (r) FWID 01-895bc792
Fusion Version	Fusion_BA_2.10.0.0.007_N-0809201717-N
MFD	30AUG17
EUT Stage	Engineering Sample

Remark:

1. The EUT is an EDA (Enterprise Digital Assistant) which has WLAN (802.11abgn), Bluetooth capability and support WLAN TX diversity and MIMO transmission, and this device has multiple terminals and accessories, detailed information are listed as below table.

1. **EUT and accessory list :**

<S/N of Test EUT>

EUT Type with scanner	S/N
1) Brick with scanner 1	172445230E5004
2) Brick with scanner 2	172425230E5049
3) Brick with scanner 4	172355230E5002
4) Turret Type with scanner 2	172345230E5114
5) Gun Type with scanner 3	172345230E5083
6) Gun Type with scanner 4	172345230E5081

< Accessory >

3 EUT Type	3 Keypads	3 Scanners	4 Batteries	Camera	3 Holster	2 Headset
1) Brick 2) Turret 3) Gun Type	1) 47 Key 2) 38 Key 3) 29 Key	1)SE4750SR (45 degrees) 2) SE965 3) SE4850 ERI 4) SE4750	1) MC32 1X 2) MC32 2X 3) Sentry 1X 4) Sentry 2X	2) W/o Camera	1) 11-69293-01R 2) 8710-050005-01R 3) SG-MC3021212-01R	1) Headset 1 2) Headset 2

2. **EUT and accessory combinations :**

Combinations		Keypad	Scanner	Battery	Camera	Holster	Headset
EUT Type	Brick	1,2,3	1,2,4	1,2,3,4	2	1,2	1,2
	Turret	1,2,3	2	1,2,3,4	2	1,2	1,2
	Gun Type	1,2,3	2,3,4	2,4	2	3	1,2

3. **Wireless Technology :**

Wireless Technology		Ant 1 (SISO Mode)	Ant 2 (SISO Mode)	Ant1+2 (MIMO Mode)	NFC Antenna
NFC 13.56 MHz		-	-	-	-
2.4GHz	802.11b	V	V	V	-
	802.11g	V	V	V	-
	802.11n-HT20	V	V	V	-
	802.11n-HT40	V	V	V	-
	BT2.1+EDR+ BT4.1 (LE)	V	-	-	-
5GHz	802.11a	V	V	V	-
	802.11n-HT20/VHT20	V	V	V	-
	802.11n-HT40/VHT40	V	V	V	-
	802.11ac-VHT80	V	V	V	-

5. RF Exposure Limits

5.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

5.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

1. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

6. Specific Absorption Rate (SAR)

6.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

6.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\mathbf{SAR} = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\mathbf{dm}}\right) = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\boldsymbol{\rho}\mathbf{dv}}\right)$$

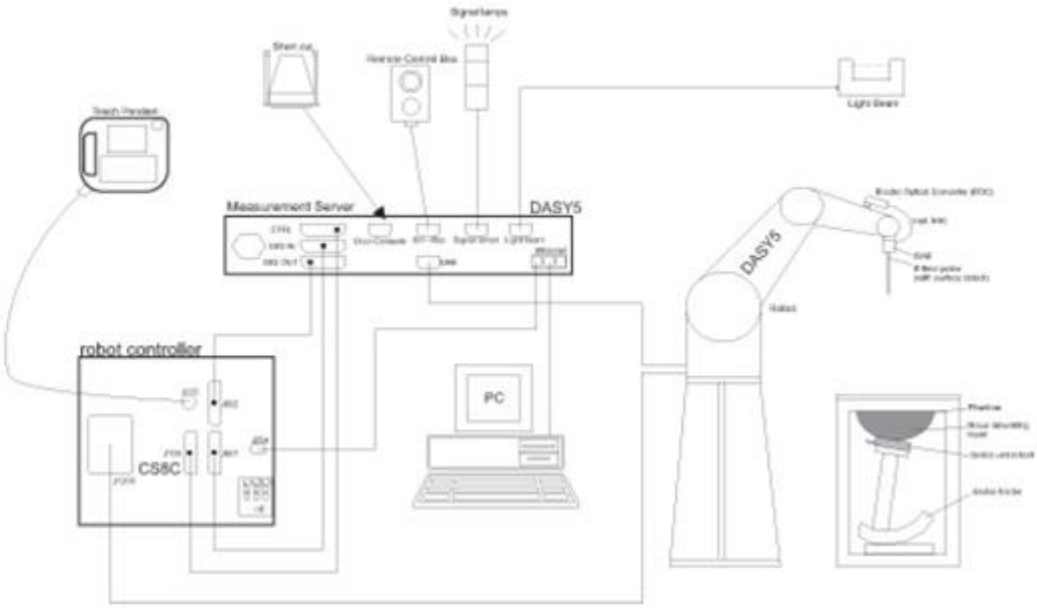
SAR is expressed in units of Watts per kilogram (W/kg)

$$\mathbf{SAR} = \frac{\boldsymbol{\sigma}|\mathbf{E}|^2}{\boldsymbol{\rho}}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

7. System Description and Setup

The DASY system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

7.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

<ES3DV3 Probe>

Construction	Symmetric design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz – 4 GHz; Linearity: ±0.2 dB (30 MHz – 4 GHz)
Directivity	±0.2 dB in TSL (rotation around probe axis) ±0.3 dB in TSL (rotation normal to probe axis)
Dynamic Range	5 μW/g – >100 mW/g; Linearity: ±0.2 dB
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 3.9 mm (body: 12 mm) Distance from probe tip to dipole centers: 3.0 mm

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 6 GHz)
Directivity	±0.3 dB in TSL (rotation around probe axis) ±0.5 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 μW/g – >100 mW/g Linearity: ±0.2 dB (noise: typically <1 μW/g)
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm

7.2 Data Acquisition Electronics (DAE)

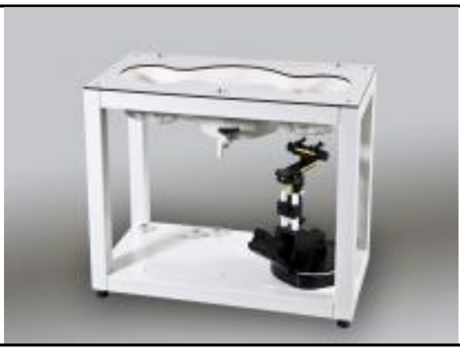
The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.1 Photo of DAE

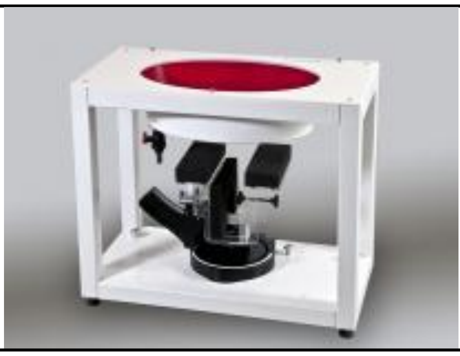
7.3 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm	
Filling Volume	Approx. 25 liters	
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet	
Measurement Areas	Left Hand, Right Hand, Flat Phantom	

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)	
Filling Volume	Approx. 30 liters	
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm	

The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

7.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters

Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

Mounting Device for Laptops

8. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b) Read the WWAN RF power level from the base station simulator.
(c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

8.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

8.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

8.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

<table>
<tr><th></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td>Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
</table>

8.4 Zoom Scan

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

<table>
<tr><th colspan="3"></th><th>$\leq$ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

8.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

8.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	735	Dec. 23, 2016	Dec. 22, 2017
SPEAG	5GHz System Validation Kit	D5GHzV2	1171	Jul. 18, 2017	Jul. 17, 2018
SPEAG	Data Acquisition Electronics	DAE3	495	May. 22, 2017	May. 21, 2018
SPEAG	Dosimetric E-Field Probe	EX3DV4	3925	May. 24, 2017	May. 23, 2018
WonDer	Thermometer	WD-5016	TM281-1	Mar. 17, 2017	Mar. 16, 2018
LINE SEIKI	Digital Thermometer	LKMelectronic	DTM3000SPEZIAL	Sep. 06, 2017	Sep. 05, 2018
SPEAG	Device Holder	N/A	N/A	N/A	N/A
R&S	Signal Generator	SMA100A	101091	Jul. 06, 2017	Jul. 05, 2018
Agilent	ENA Network Analyzer	E5071C	MY46316648	Jan. 04, 2017	Jan. 03, 2018
SPEAG	Dielectric Probe Kit	DAK-3.5	1146	Jul. 18, 2017	Jul. 17, 2018
Anritsu	Power Meter	ML2495A	1438002	Dec. 06, 2016	Dec. 05, 2017
Anritsu	Power Meter	ML2495A	1419002	May. 15, 2017	May. 14, 2018
Anritsu	Power Sensor	MA2411B	1339195	Dec. 06, 2016	Dec. 05, 2017
Anritsu	Power Sensor	MA2411B	1339124	May. 15, 2017	May. 14, 2018
Agilent	Spectrum Analyzer	E4408B	MY44211028	Aug. 23, 2017	Aug. 22, 2018
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jun. 26, 2017	Jun. 25, 2018
Mini-Circuits	Power Amplifier	ZVE-8G+	D120604	Mar. 09, 2017	Mar. 08, 2018
Mini-Circuits	Power Amplifier	ZHL-42W+	QA1344002	Mar. 09, 2017	Mar. 08, 2018
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
Woken	Attenuator 1	WK0602-XX	N/A	Note 1	
PE	Attenuator 2	PE7005-10	N/A	Note 1	
PE	Attenuator 3	PE7005- 3	N/A	Note 1	

General Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.

10. System Verification

10.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.2.

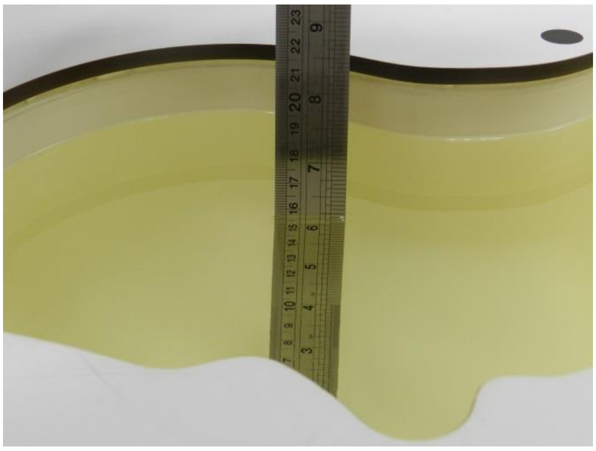


Fig 10.1Photo of Liquid Height for Head SAR

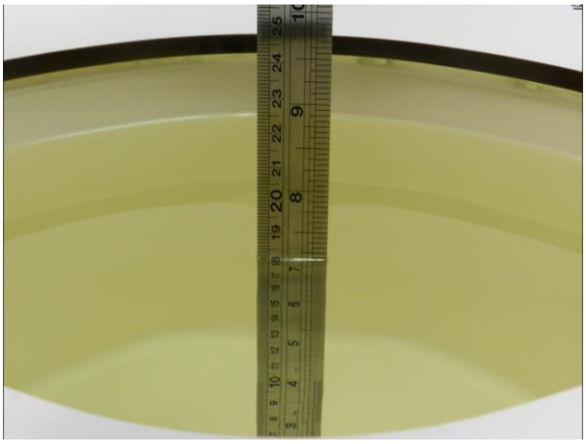


Fig 10.2 Photo of Liquid Height for Body SAR

10.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
For Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0
For Body								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7
2600	68.1	0	0	0.1	0	31.8	2.16	52.5

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	MSL	22.3	2.016	54.225	1.95	52.70	3.38	2.89	±5	2017/9/28
2450	MSL	22.6	1.988	54.052	1.95	52.70	1.95	2.57	±5	2017/10/18
5250	MSL	22.5	5.324	47.846	5.36	48.95	-0.67	-2.26	±5	2017/9/30
5250	MSL	22.5	5.187	46.716	5.36	48.95	-3.23	-4.56	±5	2017/10/2
5600	MSL	22.5	5.773	47.290	5.77	48.50	0.05	-2.49	±5	2017/9/30
5600	MSL	22.5	5.619	46.180	5.77	48.50	-2.62	-4.78	±5	2017/10/2
5750	MSL	22.5	5.981	47.046	5.94	48.28	0.69	-2.56	±5	2017/9/30
5750	MSL	22.5	5.817	45.948	5.94	48.28	-2.07	-4.83	±5	2017/10/2

10.3 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2017/9/28	2450	MSL	250	D2450V2-735	EX3DV4 - SN3925	DAE3 Sn495	13.50	50.60	54.00	6.72
2017/9/30	5250	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	7.94	78.10	79.40	1.66
2017/10/2	5250	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	7.80	78.10	78.00	-0.13
2017/9/30	5600	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	7.83	81.00	78.30	-3.33
2017/10/2	5600	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	8.42	81.00	84.20	3.95
2017/9/30	5750	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	7.99	78.70	79.90	1.52
2017/10/2	5750	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	7.77	78.70	77.70	-1.27

<System Verification for 1g SAR Results>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2017/9/28	2450	MSL	250	D2450V2-735	EX3DV4 - SN3925	DAE3 Sn495	6.36	23.80	25.44	6.89
2017/9/30	5250	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	2.18	21.80	21.80	0.00
2017/10/2	5250	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	2.15	21.80	21.50	-1.38
2017/9/30	5600	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	2.14	22.80	21.40	-6.14
2017/10/2	5600	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	2.25	22.80	22.50	-1.32
2017/9/30	5750	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	2.19	21.90	21.90	0.00
2017/10/2	5750	MSL	100	D5GHzV2-1171	EX3DV4 - SN3925	DAE3 Sn495	2.13	21.90	21.30	-2.74

<System Verification for 10g SAR Results>

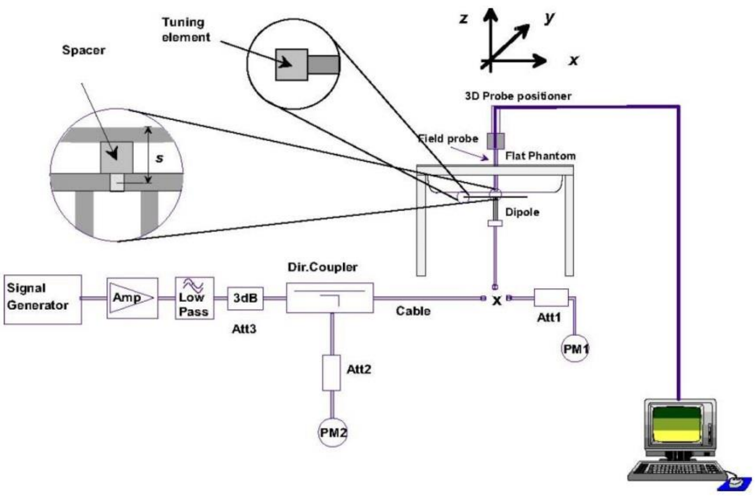


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

11. Conducted RF Output Power (Unit: dBm)

<WLAN Conducted Power>

General Note:

1. For each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode.
2. Per KDB 248227 D01v02r02, the simultaneous SAR provisions in KDB publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WiFi MIMO. If the sum of 1g single transmission chain SAR measurements is < 1.6W/kg and SAR peak to location ratio ≤ 0.04, no additional SAR measurements for MIMO.
3. Per KDB 248227 D01v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
4. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
5. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
6. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.18 The initial test position procedure is described in the following:
   a. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
   b. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
   c. For all positions/configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

<2.4GHz WLAN ANT 1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	18.10	18.50	100.00
		2	2417	18.12	18.50	
		6	2437	18.16	18.50	
		10	2457	18.13	18.50	
		11	2462	18.10	18.50	
	802.11g 6Mbps	1	2412	13.44	13.50	95.28
		2	2417	17.03	17.50	
		6	2437	17.13	17.50	
		10	2457	17.11	17.50	
		11	2462	13.21	13.50	
	802.11n-HT20 MCS0	1	2412	11.15	11.50	95.83
		2	2417	17.00	17.50	
		6	2437	17.03	17.50	
		10	2457	17.00	17.50	
		11	2462	12.13	12.50	
	802.11n-HT40 MCS0	3	2422	12.63	13.00	94.74
		6	2437	16.51	17.00	
		9	2452	14.38	14.50	

<2.4GHz WLAN ANT 2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	18.13	18.50	100.00
		2	2417	18.11	18.50	
		6	2437	18.15	18.50	
		10	2457	18.12	18.50	
		11	2462	18.18	18.50	
	802.11g 6Mbps	1	2412	13.03	13.50	96.06
		2	2417	17.23	17.50	
		6	2437	17.07	17.50	
		10	2457	17.13	17.50	
		11	2462	13.20	13.50	
	802.11n-HT20 MCS0	1	2412	11.04	11.50	95.00
		2	2417	17.19	17.50	
		6	2437	17.02	17.50	
		10	2457	17.02	17.50	
		11	2462	12.49	12.50	
	802.11n-HT40 MCS0	3	2422	12.53	13.00	94.74
		6	2437	16.99	17.00	
		9	2452	14.16	14.50	

<2.4GHz WLAN ANT 1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	20.64	21.00	100.00
		2	2417	20.83	21.50	
		6	2437	20.83	21.50	
		10	2457	20.60	21.50	
		11	2462	20.31	21.00	
	802.11g 6Mbps	1	2412	16.50	17.00	95.28
		2	2417	20.17	20.50	
		6	2437	20.17	20.50	
		10	2457	18.51	19.00	
		11	2462	18.08	18.50	
	802.11n-HT20 MCS0	1	2412	14.88	15.00	95.04
		2	2417	20.09	20.50	
		6	2437	20.09	20.50	
		10	2457	17.70	18.00	
		11	2462	16.73	17.00	
	802.11n-HT40 MCS0	3	2422	11.81	12.00	95.56
		6	2437	17.81	18.00	
		9	2452	12.86	13.00	

<TXBF Mode 2.4GHz WLAN ANT 1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11n-HT20 MCS0	1	2412	16.56	17.00	100.00
		2	2417	21.46	21.50	
		6	2437	21.46	21.50	
		10	2457	21.36	21.50	
		11	2462	17.51	18.00	
	802.11n-HT40 MCS0	3	2422	15.76	16.00	100.00
		6	2437	19.56	20.00	
		9	2452	19.52	20.00	

<u><5GHz WLAN ANT1></u>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	15.03	15.50	96.00
		40	5200	17.32	17.50	
		44	5220	17.37	17.50	
		48	5240	17.20	17.50	
	802.11n-HT20 MCS0	36	5180	14.40	14.50	95.83
		40	5200	17.01	17.50	
		44	5220	17.02	17.50	
		48	5240	17.22	17.50	
	802.11n-HT40 MCS0	38	5190	9.01	9.50	91.58
		46	5230	16.00	16.50	
	802.11ac-VHT20 MCS0	36	5180	14.46	14.50	95.87
		40	5200	17.06	17.50	
		44	5220	17.08	17.50	
		48	5240	17.26	17.50	
	802.11ac-VHT40 MCS0	38	5190	9.06	9.50	91.84
		46	5230	16.10	16.50	
	802.11ac-VHT80 MCS0	42	5210	8.37	8.50	85.32

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	17.46	17.50	96.00
		56	5280	17.37	17.50	
		60	5300	17.40	17.50	
		64	5320	14.63	15.00	
	802.11n-HT20 MCS0	52	5260	17.26	17.50	95.83
		56	5280	17.20	17.50	
		60	5300	17.24	17.50	
		64	5320	15.02	15.50	
	802.11n-HT40 MCS0	54	5270	16.51	17.00	91.58
		62	5310	11.25	11.50	
	802.11ac-VHT20 MCS0	52	5260	17.28	17.50	95.87
		56	5280	17.22	17.50	
		60	5300	17.25	17.50	
		64	5320	15.07	15.50	
	802.11ac-VHT40 MCS0	54	5270	16.52	17.00	91.84
		62	5310	11.26	11.50	
	802.11ac-VHT80 MCS0	58	5290	11.02	11.50	85.32

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	17.17	17.50	96.00
		116	5580	17.23	17.50	
		124	5620	17.25	17.50	
		132	5660	17.28	17.50	
		140	5700	15.70	16.00	
		144	5720	17.21	17.50	
	802.11n-HT20 MCS0	100	5500	16.08	16.50	95.83
		116	5580	17.02	17.50	
		124	5620	17.18	17.50	
		132	5660	17.22	17.50	
		140	5700	14.55	15.00	
		144	5720	17.18	17.50	
	802.11n-HT40 MCS0	102	5510	10.69	11.00	91.58
		110	5550	16.09	16.50	
		126	5630	16.27	16.50	
		134	5670	16.05	16.50	
		142	5710	16.57	17.00	
	802.11ac-VHT20 MCS0	100	5500	16.29	16.50	95.87
		116	5580	17.18	17.50	
		124	5620	17.22	17.50	
		132	5660	17.25	17.50	
		140	5700	14.59	15.00	
		144	5720	17.20	17.50	
	802.11ac-VHT40 MCS0	102	5510	10.71	11.00	91.84
		110	5550	16.10	16.50	
		126	5630	16.36	16.50	
		134	5670	16.23	16.50	
		142	5710	16.58	17.00	
	802.11ac-VHT80 MCS0	106	5530	7.61	8.00	85.32
		122	5610	13.89	14.00	
		138	5690	16.69	17.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	17.23	17.50	96.00
		157	5785	17.02	17.50	
		165	5825	17.01	17.50	
	802.11n-HT20 MCS0	149	5745	17.00	17.50	95.83
		157	5785	17.16	17.50	
		165	5825	17.47	17.50	
	802.11n-HT40 MCS0	151	5755	16.57	17.00	91.58
		159	5795	16.75	17.00	
	802.11ac-VHT20 MCS0	149	5745	17.01	17.50	95.87
		157	5785	17.48	17.50	
		165	5825	17.49	17.50	
	802.11ac-VHT40 MCS0	151	5755	16.79	17.00	91.84
		159	5795	16.77	17.00	
	802.11ac-VHT80 MCS0	155	5775	14.86	15.00	85.32

<5GHz WLAN ANT2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	15.41	15.50	95.28
		40	5200	17.33	17.50	
		44	5220	17.14	17.50	
		48	5240	17.09	17.50	
	802.11n-HT20 MCS0	36	5180	14.45	14.50	95.83
		40	5200	17.04	17.50	
		44	5220	17.04	17.50	
		48	5240	17.01	17.50	
	802.11n-HT40 MCS0	38	5190	9.39	9.50	91.58
		46	5230	16.09	16.50	
	802.11ac-VHT20 MCS0	36	5180	14.47	14.50	95.08
		40	5200	17.22	17.50	
		44	5220	17.19	17.50	
		48	5240	17.05	17.50	
	802.11ac-VHT40 MCS0	38	5190	9.48	9.50	91.75
		46	5230	16.11	16.50	
	802.11ac-VHT80 MCS0	42	5210	8.07	8.50	86.11

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	17.44	17.50	95.28
		56	5280	17.25	17.50	
		60	5300	17.21	17.50	
		64	5320	14.51	15.00	
	802.11n-HT20 MCS0	52	5260	17.14	17.50	95.83
		56	5280	17.03	17.50	
		60	5300	17.01	17.50	
		64	5320	15.00	15.50	
	802.11n-HT40 MCS0	54	5270	16.51	17.00	91.58
		62	5310	11.12	11.50	
	802.11ac-VHT20 MCS0	52	5260	17.28	17.50	95.08
		56	5280	17.22	17.50	
		60	5300	17.12	17.50	
		64	5320	15.03	15.50	
	802.11ac-VHT40 MCS0	54	5270	16.56	17.00	91.75
		62	5310	11.13	11.50	
	802.11ac-VHT80 MCS0	58	5290	11.32	11.50	86.11

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	17.01	17.50	95.28
		116	5580	17.16	17.50	
		124	5620	17.25	17.50	
		132	5660	17.29	17.50	
		140	5700	15.69	16.00	
		144	5720	17.18	17.50	
	802.11n-HT20 MCS0	100	5500	16.24	16.50	95.83
		116	5580	17.07	17.50	
		124	5620	17.23	17.50	
		132	5660	17.20	17.50	
		140	5700	14.51	15.00	
		144	5720	17.01	17.50	
	802.11n-HT40 MCS0	102	5510	10.94	11.00	91.58
		110	5550	16.00	16.50	
		126	5630	16.03	16.50	
		134	5670	16.02	16.50	
		142	5710	16.68	17.00	
	802.11ac-VHT20 MCS0	100	5500	16.34	16.50	95.08
		116	5580	17.14	17.50	
		124	5620	17.27	17.50	
		132	5660	17.24	17.50	
		140	5700	14.55	15.00	
		144	5720	17.04	17.50	
	802.11ac-VHT40 MCS0	102	5510	10.95	11.00	91.75
		110	5550	16.04	16.50	
		126	5630	16.07	16.50	
		134	5670	16.08	16.50	
		142	5710	16.77	17.00	
	802.11ac-VHT80 MCS0	106	5530	7.95	8.00	86.11
		122	5610	13.66	14.00	
		138	5690	16.71	17.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	17.23	17.50	95.28
		157	5785	17.03	17.50	
		165	5825	17.02	17.50	
	802.11n-HT20 MCS0	149	5745	17.18	17.50	85.83
		157	5785	17.35	17.50	
		165	5825	17.26	17.50	
	802.11n-HT40 MCS0	151	5755	16.91	17.00	91.58
		159	5795	16.97	17.00	
	802.11ac-VHT20 MCS0	149	5745	17.30	17.50	95.08
		157	5785	17.39	17.50	
		165	5825	17.32	17.50	
	802.11ac-VHT40 MCS0	151	5755	16.98	17.00	91.75
		159	5795	16.97	17.00	
	802.11ac-VHT80 MCS0	155	5775	14.52	15.00	86.11

<5GHz WLAN ANT1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	16.63	17.00	95.28
		40	5200	18.42	18.50	
		44	5220	18.34	18.50	
		48	5240	18.40	18.50	
	802.11n-HT20 MCS0	36	5180	16.52	17.00	95.04
		40	5200	18.88	19.00	
		44	5220	18.90	19.00	
		48	5240	18.89	19.00	
	802.11n-HT40 MCS0	38	5190	9.54	10.00	91.58
		46	5230	17.05	17.50	
	802.11ac-VHT20 MCS0	36	5180	16.51	17.00	95.08
		40	5200	18.90	19.00	
		44	5220	18.92	19.00	
		48	5240	18.94	19.00	
	802.11ac-VHT40 MCS0	38	5190	9.64	10.00	91.84
		46	5230	17.07	17.50	
	802.11ac-VHT80 MCS0	42	5210	9.07	9.50	86.24

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	17.82	18.00	95.28
		56	5280	17.89	18.00	
		60	5300	17.89	18.00	
		64	5320	16.00	16.50	
	802.11n-HT20 MCS0	52	5260	17.72	18.00	95.04
		56	5280	17.69	18.00	
		60	5300	17.51	18.00	
		64	5320	16.26	16.50	
	802.11n-HT40 MCS0	54	5270	17.50	18.00	91.58
		62	5310	11.01	11.50	
	802.11ac-VHT20 MCS0	52	5260	17.74	18.00	95.08
		56	5280	17.73	18.00	
		60	5300	17.77	18.00	
		64	5320	16.27	16.50	
	802.11ac-VHT40 MCS0	54	5270	17.52	18.00	91.84
		62	5310	11.04	11.50	
	802.11ac-VHT80 MCS0	58	5290	10.11	10.50	86.24

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	17.20	17.50	95.28
		116	5580	19.11	19.50	
		124	5620	19.46	19.50	
		132	5660	19.37	19.50	
		140	5700	16.22	16.50	
		144	5720	19.34	19.50	
	802.11n-HT20 MCS0	100	5500	16.67	17.00	95.04
		116	5580	19.07	19.50	
		124	5620	19.33	19.50	
		132	5660	19.16	19.50	
		140	5700	16.11	16.50	
		144	5720	19.23	19.50	
	802.11n-HT40 MCS0	102	5510	12.50	13.00	91.58
		110	5550	17.66	18.00	
		126	5630	17.64	18.00	
		134	5670	17.51	18.00	
		142	5710	19.51	20.00	
	802.11ac-VHT20 MCS0	100	5500	16.71	17.00	95.08
		116	5580	19.09	19.50	
		124	5620	19.41	19.50	
		132	5660	19.20	19.50	
		140	5700	16.19	16.50	
		144	5720	19.28	19.50	
	802.11ac-VHT40 MCS0	102	5510	12.55	13.00	91.84
		110	5550	17.69	18.00	
		126	5630	17.68	18.00	
		134	5670	17.52	18.00	
		142	5710	19.62	20.00	
	802.11ac-VHT80 MCS0	106	5530	9.04	9.50	86.24
		122	5610	15.98	16.00	
		138	5690	18.70	19.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a MCS0	149	5745	20.01	20.50	95.28
		157	5785	20.10	20.50	
		165	5825	20.01	20.50	
	802.11n-HT20 MCS0	149	5745	20.17	20.50	95.04
		157	5785	20.10	20.50	
		165	5825	20.02	20.50	
	802.11n-HT40 MCS0	151	5755	19.56	20.00	91.58
		159	5795	19.53	20.00	
	802.11ac-VHT20 MCS0	149	5745	20.21	20.50	95.08
		157	5785	20.12	20.50	
		165	5825	20.20	20.50	
	802.11ac-VHT40 MCS0	151	5755	19.60	20.00	91.84
		159	5795	19.65	20.00	
	802.11ac-VHT80 MCS0	155	5775	18.62	19.00	86.24

<TXBF Mode 5GHz WLAN ANT 1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11n-HT20 MCS0	36	5180	17.50	18.00	100.00
		40	5200	20.11	20.50	
		44	5220	19.01	19.50	
		48	5240	20.41	20.50	
	802.11n-HT40 MCS0	38	5190	11.03	11.50	100.00
		46	5230	18.06	18.50	
	802.11ac-VHT20 MCS0	36	5180	17.54	18.00	100.00
		40	5200	20.19	20.50	
		44	5220	19.12	19.50	
		48	5240	20.46	20.50	
	802.11ac-VHT40 MCS0	38	5190	11.07	11.50	100.00
		46	5230	18.11	18.50	
	802.11ac-VHT80 MCS0	42	5210	10.57	11.00	100.00

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11n-HT20 MCS0	52	5260	19.62	20.00	100.00
		56	5280	19.69	20.00	
		60	5300	19.56	20.00	
		64	5320	18.16	18.50	
	802.11n-HT40 MCS0	54	5270	19.72	20.00	100.00
		62	5310	14.22	14.50	
	802.11ac-VHT20 MCS0	52	5260	19.67	20.00	100.00
		56	5280	19.75	20.00	
		60	5300	19.61	20.00	
		64	5320	18.06	18.50	
	802.11ac-VHT40 MCS0	54	5270	19.77	20.00	100.00
		62	5310	14.40	14.50	
	802.11ac-VHT80 MCS0	58	5290	12.01	12.50	100.00

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11n-HT20 MCS0	100	5500	19.04	19.50	100.00
		116	5580	18.67	19.00	
		124	5620	18.53	19.00	
		132	5660	18.51	19.00	
		140	5700	17.54	18.00	
		144	5720	19.52	20.00	
	802.11n-HT40 MCS0	102	5510	14.04	14.50	100.00
		110	5550	20.01	20.50	
		126	5630	20.00	20.50	
		134	5670	20.05	20.50	
		142	5710	20.22	20.50	
	802.11ac-VHT20 MCS0	100	5500	19.08	19.50	100.00
		116	5580	18.57	19.00	
		124	5620	18.69	19.00	
		132	5660	18.61	19.00	
		140	5700	17.56	18.00	
		144	5720	19.55	20.00	
	802.11ac-VHT40 MCS0	102	5510	14.14	14.50	100.00
		110	5550	20.11	20.50	
		126	5630	20.04	20.50	
		134	5670	20.17	20.50	
		142	5710	20.32	20.50	
	802.11ac-VHT80 MCS0	106	5530	11.11	11.50	100.00
		122	5610	18.90	19.00	
		138	5690	18.81	19.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11n-HT20 MCS0	149	5745	20.47	20.50	100.00
		157	5785	20.46	20.50	
		165	5825	20.50	20.50	
	802.11n-HT40 MCS0	151	5755	19.67	20.00	100.00
		159	5795	19.86	20.00	
	802.11ac-VHT20 MCS0	149	5745	20.47	20.50	100.00
		157	5785	20.46	20.50	
		165	5825	20.45	20.50	
	802.11ac-VHT40 MCS0	151	5755	19.67	20.00	100.00
		159	5795	19.96	20.00	
	802.11ac-VHT80 MCS0	155	5775	18.94	19.00	100.00

<2.4GHz Bluetooth>

Mode	Channel	Frequency (MHz)	Average power (dBm)		
			1Mbps	2Mbps	3Mbps
BR / EDR	CH 00	2402	3.26	-0.53	-0.51
	CH 39	2441	3.46	0.81	0.87
	CH 78	2480	2.76	-0.01	0.00
Tune-up Limit			4	2	2

Mode	Channel	Frequency (MHz)	Average power (dBm)
			GFSK
LE	CH 00	2402	1.36
	CH 19	2440	2.87
	CH 39	2480	1.89
Tune-up Limit			4

Note:

1. Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:
   [(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR
   - f(GHz) is the RF channel transmit frequency in GHz
   - Power and distance are rounded to the nearest mW and mm before calculation
   - The result is rounded to one decimal place for comparison

Bluetooth Max Power (dBm)	Separation Distance (mm)	Frequency (GHz)	exclusion thresholds
4	< 5	2.48	0.94

Note:

Per KDB 447498 D01v06, when the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion. The test exclusion threshold is 0.94 which is <= 3, SAR testing is not required.

12. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
4. Per KDB 865664 D01v01r04, for extremity SAR is the same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

WLAN Note:

1. Per KDB 248227 D01v02r02, for 2.4GHz 802.11g/n SAR testing is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
2. Per KDB 248227 D01v02r02, U-NII-1 SAR testing is not required when the U-NII-2A band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band.
3. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
4. For all positions / configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
5. For WLAN SAR testing was performed on single antenna RF power in SISO mode is larger or equal to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode.
6. Per KDB 248227 D01v02r02, the simultaneous SAR provisions in KDB publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WiFi MIMO. If the sum of 1g single transmission chain SAR measurements is < 1.6W/kg and SAR peak to location ratio ≤ 0.04, no additional SAR measurements for MIMO.
7. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

SAR test proposal:

According to FCC KDB inquiry guidance, since there are many accessories and terminals for different combinations and configurations for this device, therefore our proposal is to identify each difference impact step by step and then follow KDB guidance test procedure at worst configuration to do full testing to reduce SAR testing numbers.

< Accessory >

2 WLAN Tx Antenna	3 Keypad	3 Scanner	4 Battery	Camera	3 EUT Type	3 Holster	2 Headset
1) WLAN Ant-1 2) WLAN Ant-2	1) 47 Key 2) 38 Key 3) 29 Key	1) SE4750SR(45degrees) 2) SE965 3) SE4850 ERI 4) SE4750SR	1) MC32 1X 2) MC32 2X 3) Sentry 1X 4) Sentry 2X	2) Without Camera	1) Brick 2) Turret 3) Gun	1) 11-69293-01R 2) 8710-050005-01R 3) SGMC3021212-01R	1) Headset 1 2) Headset 2

< EUT and accessory combinations >

Combinations		Keypad	Scanner	Battery	Camera	Holster	Headset
EUT Type	Brick	1,2,3	1,2,4	1,2,3,4	2	1,2	1,2
	Turret	1,2,3	2	1,2,3,4	2	1,2	1,2
	Gun Type	1,2,3	2,3,4	2,4	2	3	1,2

<WLAN2.4GHz test procedure>

(a) Brick type and Turret type:

Step 1. Identify worst antenna
Step 2. Identify worst position
Step 3. Identify Keypad impact
Step 4. Identify Scanner impact
Step 5. Identify Battery impact
Step 6. Identify Camera impact
Step 7. Identify EUT impact
Step 8. Identify Holster impact
Step 9. Full test follow KDB guidance

(b) Gun Type:

Step 1, select the identified worst configuration (keypad, battery, scanner) from WLAN5GHz pre-scan test results of Brick and Turret.
Step 2 Identify worst position / antenna
Step 3. Identify scanner 3 impact
Step 4. Full test follow KDB guidance

<WLAN 5GHz test procedure>

(a) Brick type and Turret type:

Step 1. Identify worst band/ antenna
Step 2. Identify worst position
Step 3. Identify Keypad impact
Step 4. Identify Scanner impact
Step 5. Identify Battery impact
Step 6. Identify Camera impact
Step 7. Identify EUT impact
Step 8. Identify Holster impact
Step 9. Full test follow KDB guidance

(b) Gun Type:

Step 1, select the identified worst configuration (keypad, battery, scanner) from WLAN5GHz pre-scan test results of Brick and Turret.
Step 2 Identify worst position / antenna
Step 3. Identify scanner 3 impact
Step 4. Full test follow KDB guidance

Remark:

1. The device does not support audio receiver, therefore the device would not be operated to close to ear for voice talk.
2. Since Gun type has the different exposure conditions, therefore we will base on identified worst configuration (Keypad, Battery, Scanner) to do additional SAR test reduction.
3. When Brick type and Turret type is placed into the holster 1, only front and back face of EUT will toward to the human body.
4. When Brick type and Turret type is placed into the holster 2, only front face of EUT will toward to the human body.
5. When Gun Type is placed into the holster 3, only Left and Right side of EUT will toward to the human body.
6. Since the Gun type has the pistol grip gets in the way of positioning, and it is close to front edge of phantom, the hotspot is unable to be captured, therefore according to FCC KDB inquiry guidance, the Gun type device was cut off pistol grip to perform Extremity SAR testing

12.1 Body Worn Accessory SAR

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Keypad	Scanner	Battery	Camera	EUT Type	Holster	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 1	Keypad 1	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	6	2437	18.16	18.50	1.081	100	1.000	-0.01	0.356	0.385
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	11	2462	18.18	18.50	1.076	100	1.000	0.02	0.404	0.435
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 2	Keypad 1	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	11	2462	18.18	18.50	1.076	100	1.000	-0.02	0.004	0.004
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 2	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	11	2462	18.18	18.50	1.076	100	1.000	0.06	0.365	0.393
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 3	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	11	2462	18.18	18.50	1.076	100	1.000	0.11	0.365	0.393
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 2	Battery 1	Camera 2	Type 1	Holster 1	11	2462	18.18	18.50	1.076	100	1.000	0.15	0.358	0.385
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 4	Battery 1	Camera 2	Type 1	Holster 1	11	2462	18.18	18.50	1.076	100	1.000	0.11	0.361	0.389
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 1	Battery 2	Camera 2	Type 1	Holster 1	11	2462	18.18	18.50	1.076	100	1.000	-0.09	0.400	0.431
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 1	Battery 3	Camera 2	Type 1	Holster 1	11	2462	18.18	18.50	1.076	100	1.000	0.16	0.399	0.430
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 1	Battery 4	Camera 2	Type 1	Holster 1	11	2462	18.18	18.50	1.076	100	1.000	0.18	0.375	0.404
01	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 2	Battery 1	Camera 2	Type 2	Holster 1	11	2462	18.18	18.50	1.076	100	1.000	0.08	0.424	0.456
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 2	Battery 1	Camera 2	Type 2	Holster 1	1	2412	18.13	18.50	1.089	100	1.000	0.08	0.411	0.448
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 2	Battery 1	Camera 2	Type 2	Holster 1	6	2437	18.15	18.50	1.084	100	1.000	-0.13	0.349	0.378
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 2	Keypad 1	Scanner 2	Battery 1	Camera 2	Type 2	Holster 2	11	2462	18.18	18.50	1.076	100	1.000	-0.06	0.002	0.002
	WLAN2.4GHz	802.11b 1Mbps	Right Side	0mm	Ant 1	Keypad 1	Scanner 4	Battery 2	Camera 2	Type 3	Holster 3	6	2437	18.16	18.50	1.081	100	1.000	-0.12	0.105	0.114
	WLAN2.4GHz	802.11b 1Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 4	Battery 2	Camera 2	Type 3	Holster 3	11	2462	18.18	18.50	1.076	100	1.000	0.17	0.125	0.135
	WLAN2.4GHz	802.11b 1Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	11	2462	18.18	18.50	1.076	100	1.000	-0.13	0.129	0.139
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	Keypad 1	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	52	5260	17.46	17.50	1.010	96	1.042	-0.12	0.142	0.149
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	52	5260	17.44	17.50	1.014	95.28	1.050	-0.11	0.145	0.154
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	Keypad 1	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	132	5660	17.28	17.50	1.052	96	1.042	0.01	0.132	0.145
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	132	5660	17.29	17.50	1.050	95.28	1.050	-0.08	0.152	0.168
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	Keypad 1	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	149	5745	17.23	17.50	1.065	96	1.042	-0.01	0.145	0.161
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	149	5745	17.23	17.50	1.064	95.28	1.050	0	0.149	0.166
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	Keypad 1	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	132	5660	17.29	17.50	1.050	95.28	1.050	0.09	0.007	0.008
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 2	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	132	5660	17.29	17.50	1.050	95.28	1.050	-0.11	0.138	0.152
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 3	Scanner 1	Battery 1	Camera 2	Type 1	Holster 1	132	5660	17.29	17.50	1.050	95.28	1.050	-0.16	0.129	0.142
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 2	Battery 1	Camera 2	Type 1	Holster 1	132	5660	17.29	17.50	1.050	95.28	1.050	-0.01	0.129	0.142
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 4	Battery 1	Camera 2	Type 1	Holster 1	132	5660	17.29	17.50	1.050	95.28	1.050	-0.14	0.130	0.143
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 1	Battery 2	Camera 2	Type 1	Holster 1	132	5660	17.29	17.50	1.050	95.28	1.050	0.01	0.129	0.142
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 1	Battery 3	Camera 2	Type 1	Holster 1	132	5660	17.29	17.50	1.050	95.28	1.050	0	0.130	0.143
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 1	Battery 4	Camera 2	Type 1	Holster 1	132	5660	17.29	17.50	1.050	95.28	1.050	0.02	0.128	0.141
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 2	Battery 1	Camera 2	Type 2	Holster 1	132	5660	17.29	17.50	1.050	95.28	1.050	-0.11	0.116	0.128
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	Keypad 1	Scanner 1	Battery 1	Camera 2	Type 1	Holster 2	132	5660	17.29	17.50	1.050	95.28	1.050	0.08	0.012	0.013
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Ant 1	Keypad 1	Scanner 4	Battery 2	Camera 2	Type 3	Holster 3	52	5260	17.46	17.50	1.010	96	1.042	-0.08	0.448	0.472
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 4	Battery 2	Camera 2	Type 3	Holster 3	52	5260	17.44	17.50	1.014	95.28	1.050	-0.05	0.467	0.497
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	52	5260	17.44	17.50	1.014	95.28	1.050	-0.01	0.478	0.509
02	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	60	5300	17.21	17.50	1.069	95.28	1.050	-0.1	0.497	0.558
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Ant 1	Keypad 1	Scanner 4	Battery 2	Camera 2	Type 3	Holster 3	132	5660	17.28	17.50	1.052	96	1.042	-0.01	0.457	0.501
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 4	Battery 2	Camera 2	Type 3	Holster 3	132	5660	17.29	17.50	1.050	95.28	1.050	0.15	0.486	0.536
03	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	132	5660	17.29	17.50	1.050	95.28	1.050	0.01	0.509	0.561
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	100	5500	17.01	17.50	1.119	95.28	1.050	-0.13	0.429	0.504
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	116	5580	17.16	17.50	1.081	95.28	1.050	0.1	0.421	0.478
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	124	5620	17.25	17.50	1.059	95.28	1.050	-0.05	0.449	0.499
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	140	5700	15.69	16.00	1.074	95.28	1.050	-0.14	0.379	0.427
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	144	5720	17.18	17.50	1.076	95.28	1.050	-0.01	0.461	0.521
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Ant 1	Keypad 1	Scanner 4	Battery 2	Camera 2	Type 3	Holster 3	149	5745	17.23	17.50	1.065	96	1.042	-0.07	0.446	0.495
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 4	Battery 2	Camera 2	Type 3	Holster 3	149	5745	17.23	17.50	1.064	95.28	1.050	0.03	0.457	0.511
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	149	5745	17.23	17.50	1.064	95.28	1.050	-0.03	0.473	0.529
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	157	5785	17.03	17.50	1.114	95.28	1.050	-0.14	0.414	0.484
04	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	Holster 3	165	5825	17.02	17.50	1.117	95.28	1.050	-0.09	0.462	0.542

12.2 Extremity SAR

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Keypad	Scanner	Battery	Camera	EUT Type	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 1	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	6	2437	18.16	18.50	1.081	100	1.000	-0.02	0.124	0.134
05	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	11	2462	18.18	18.50	1.076	100	1.000	-0.1	0.125	0.135
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	1	2412	18.13	18.50	1.089	100	1.000	-0.1	0.119	0.130
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	6	2437	18.15	18.50	1.084	100	1.000	-0.1	0.122	0.132
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	52	5260	17.46	17.50	1.010	96	1.042	0.13	0.240	0.253
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	52	5260	17.44	17.50	1.014	95.28	1.050	-0.15	0.331	0.352
06	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	60	5300	17.21	17.50	1.069	95.28	1.050	0.08	0.332	0.373
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	132	5660	17.28	17.50	1.052	96	1.042	-0.06	0.350	0.384
07	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	132	5660	17.29	17.50	1.050	95.28	1.050	0.06	0.363	0.400
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	100	5500	17.01	17.50	1.119	95.28	1.050	-0.1	0.316	0.371
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	116	5580	17.16	17.50	1.081	95.28	1.050	-0.04	0.334	0.379
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	124	5620	17.25	17.50	1.059	95.28	1.050	0.12	0.341	0.379
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	140	5700	15.69	16.00	1.074	95.28	1.050	-0.1	0.266	0.300
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	144	5720	17.18	17.50	1.076	95.28	1.050	-0.1	0.351	0.397
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	149	5745	17.23	17.50	1.065	96	1.042	0.02	0.311	0.345
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	149	5745	17.23	17.50	1.064	95.28	1.050	0.11	0.365	0.408
08	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	157	5785	17.03	17.50	1.114	95.28	1.050	-0.15	0.363	0.425
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	Keypad 1	Scanner 3	Battery 2	Camera 2	Type 3	165	5825	17.02	17.50	1.117	95.28	1.050	0.03	0.297	0.348

13. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Body-worn	Extremity
1.	WLAN ANT 1 + WLAN ANT 2	Yes	Yes
2.	BT ANT 1 + WLAN ANT 2	Yes	Yes

General Note:

1. For SAR testing was performed on single antenna RF power in SISO mode is larger or equal to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode.
2. WLAN and Bluetooth share the same antenna 1, and cannot transmit simultaneously.
3. The worst case WLAN reported SAR for each configuration was used for SAR summation. Therefore, the following summations represent the absolute worst cases for simultaneous transmission with WLAN.
4. EUT will choose either WLAN 2.4GHz or WLAN 5GHz according to the network signal condition; therefore, 2.4GHz WLAN and 5GHz WLAN will not operate simultaneously at any moment.
5. The Scaled SAR summation is calculated based on the same configuration and test position.
6. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/kg.
   ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
   iii) If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.
   iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.
7. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v06 based on the formula below.
   i) (*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)]·[√f(GHz)/*x*] W/kg for *test separation distances* ≤ 50 mm; where *x* = 7.5 for 1-g SAR, and *x* = 18.75 for 10-g SAR.
   ii) When the minimum separation distance is < 5mm, the distance is used 5mm to determine SAR test exclusion.
   iii) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the *test separation distances* is > 50 mm.

<For Body-worn>

Bluetooth Max Power	Exposure Position	Body worn
	Test separation	< 5 mm
4 dBm	Estimated 1g SAR (W/kg)	0.126 W/kg

<For Extremity>

Bluetooth Max Power	Exposure Position	Extremity
	Test separation	< 5 mm
4 dBm	Estimated 10g SAR (W/kg)	0.050 W/kg

13.1 Body-Worn Accessory Exposure Conditions

Exposure Position	1 2.4GHz WLAN Ant 1 1g SAR (W/kg)	2 2.4GHz WLAN Ant 2 1g SAR (W/kg)	3 5GHz WLAN Ant 1 1g SAR (W/kg)	4 5GHz WLAN Ant 2 1g SAR (W/kg)	5 BT Ant 1 Estimated 1g SAR (W/kg)	1+2 Summed 1g SAR (W/kg)	3+4 Summed 1g SAR (W/kg)	2+5 Summed 1g SAR (W/kg)	4+5 Summed 1g SAR (W/kg)
Front		0.004		0.013	0.126	**0.004**	**0.013**	**0.130**	**0.139**
Back	0.385	0.456	0.161	0.168	0.126	**0.841**	**0.329**	**0.582**	**0.294**
Left side		0.139		0.561	0.126	**0.139**	**0.561**	**0.265**	**0.687**
Right side	0.114		0.501		0.126	**0.114**	**0.501**	**0.126**	**0.126**

13.2 Extremity Conditions

Exposure Position	1 2.4GHz WLAN Ant 1 10g SAR (W/kg)	2 2.4GHz WLAN Ant 2 10g SAR (W/kg)	3 5GHz WLAN Ant 1 10g SAR (W/kg)	4 5GHz WLAN Ant 2 10g SAR (W/kg)	5 BT Ant 1 Estimated 10g SAR (W/kg)	1+2 Summed 10g SAR (W/kg)	3+4 Summed 10g SAR (W/kg)	2+5 Summed 10g SAR (W/kg)	4+5 Summed 10g SAR (W/kg)
Back	0.134	0.135	0.384	0.425	0.050	**0.269**	**0.809**	**0.185**	**0.475**

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14. Uncertainty Assessment

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor[(a)]	1/k[(b)]	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	6.00	N	1	1	1	6.0	6.0
Axial Isotropy	4.70	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.60	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	1.00	R	1.732	1	1	0.6	0.6
Linearity	4.70	R	1.732	1	1	2.7	2.7
System Detection Limits	1.00	R	1.732	1	1	0.6	0.6
Modulation Response	4.68	R	1.732	1	1	2.7	2.7
Readout Electronics	0.30	N	1	1	1	0.3	0.3
Response Time	0.00	R	1.732	1	1	0.0	0.0
Integration Time	2.60	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.00	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.00	R	1.732	1	1	1.7	1.7
Probe Positioner	0.40	R	1.732	1	1	0.2	0.2
Probe Positioning	2.90	R	1.732	1	1	1.7	1.7
Max. SAR Eval.	2.00	R	1.732	1	1	1.2	1.2
Test Sample Related							
Device Positioning	3.03	N	1	1	1	3.0	3.0
Device Holder	3.60	N	1	1	1	3.6	3.6
Power Drift	5.00	R	1.732	1	1	2.9	2.9
Power Scaling	0.00	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.10	R	1.732	1	1	3.5	3.5
SAR correction	0.00	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.03	N	1	0.78	0.71	0.0	0.0
Liquid Conductivity (target)	5.00	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.50	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.68	R	1.732	0.78	0.71	1.7	1.5
Liquid Permittivity Repeatability	0.02	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.00	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.50	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.84	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						11.6%	11.6%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						23.2%	23.1%

Uncertainty Budget for frequency range 300 MHz to 3 GHz

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	6.55	N	1	1	1	6.6	6.6
Axial Isotropy	4.70	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.60	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	2.00	R	1.732	1	1	1.2	1.2
Linearity	4.70	R	1.732	1	1	2.7	2.7
System Detection Limits	1.00	R	1.732	1	1	0.6	0.6
Modulation Response	4.68	R	1.732	1	1	2.7	2.7
Readout Electronics	0.30	N	1	1	1	0.3	0.3
Response Time	0.00	R	1.732	1	1	0.0	0.0
Integration Time	2.60	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.00	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.00	R	1.732	1	1	1.7	1.7
Probe Positioner	0.40	R	1.732	1	1	0.2	0.2
Probe Positioning	6.70	R	1.732	1	1	3.9	3.9
Max. SAR Eval.	4.00	R	1.732	1	1	2.3	2.3
Test Sample Related							
Device Positioning	3.03	N	1	1	1	3.0	3.0
Device Holder	3.60	N	1	1	1	3.6	3.6
Power Drift	5.00	R	1.732	1	1	2.9	2.9
Power Scaling	0.00	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.60	R	1.732	1	1	3.8	3.8
SAR correction	0.00	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.03	N	1	0.78	0.71	0.0	0.0
Liquid Conductivity (target)	5.00	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.50	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.68	R	1.732	0.78	0.71	1.7	1.5
Liquid Permittivity Repeatability	0.02	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.00	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.50	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.84	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						12.7%	12.6%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						25.4%	25.3%

Uncertainty Budget for frequency range 3 GHz to 6 GHz

15. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

[3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013

[4] SPEAG DASY System Handbook

[5] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

[6] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[7] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[8] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.