

# FCC SAR Test Report

**Equipment** : Digital Camera  
**Brand Name** : Polaroid  
**Model No.** : Cube Plus  
**FCC ID** : 2AD2WCUBEPLUS  
**Standard** : FCC 47 CFR Part 2 (2.1093)  
ANSI/IEEE C95.1-1992  
IEEE 1528-2003

**Applicant** : C & A Marketing Inc.  
**Manufacturer** : 2 Bergen Turnpike Ridgefield Park, NJ 07660,  
USA

**Chicony Electronics (Dong Guan ) Co.,Ltd.**  
San Zhong Guan Li Qu, Qingxi Town, Dongguan  
City Guangdong 523651 China

The product sample received on Aug. 14, 2015 and completely tested on Sep. 02, 2015. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the 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.

Reviewed by:



Kevin Liang / Assistant Manager



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**APPENDIX A. PLOTS OF SYSTEM PERFORMANCE CHECK**

**APPENDIX B. PLOTS OF SAR MEASUREMENT**

**APPENDIX C. DASY CALIBRATION CERTIFICATE**

**APPENDIX D. TEST SETUP PHOTOS**

## Revision History

[illegible]

## 1 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing as follows.

| Exposure Position | Frequency Band  | Reported 1g SAR (W/kg) | Equipment Class | Highest Reported 1g SAR (W/kg) |
|-------------------|-----------------|------------------------|-----------------|--------------------------------|
| Body              | WLAN2.4GHz Band | 1.29                   | DTS             | 1.29                           |

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) 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 1528-2003.

### 1.1 Guidance Standard

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 1528-2003
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r01
- FCC KDB 447498 D01 General RF Exposure Guidance v05r02
- FCC KDB 248227 D01 For IEEE802.11(Wi-Fi)Transmitters v02r01

### 1.2 Testing Location Information

| Testing Location |                                                                                                                                                      |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| HWA YA           | ADD : No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.<br>TEL : 886-3-327-3456 FAX : 886-3-327-0973 |

### 1.3 Device Category and SAR Limits

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6W/kg as averaged over any 1 gram of tissue.

#### 1.3.1 Test Conditions

|                     |             |
|---------------------|-------------|
| Ambient Temperature | 20 to 24 °C |
| Humidity            | < 60%       |

#### 1.3.2 Test Configuration

During WLAN SAR testing EUT is configured with the WLAN continuous TX tool, and the transmission duty factor was monitored on the spectrum analyzer with zero-span setting Duty factor observed as below:

- 802.11b, 1Mbps: 100%
- 802.11g, 6Mbps: 100%
- 802.11n, MCS0: 100%

For WLAN SAR testing, WLAN engineering testing software installed on the Support Notebook can provide continuous transmitting RF signal.

## 2 Equipment Under Test (EUT)

### 2.1 General Information

| Product Feature & Specification |                                       |
|---------------------------------|---------------------------------------|
| Equipment Name                  | Digital Camera                        |
| Brand Name                      | Polaroid                              |
| Model Name                      | Cube Plus                             |
| FCC ID                          | 2AD2WCUBEPLUS                         |
| Frequency Range                 | WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz |
| EUT Stage                       | Production Unit                       |

| Accessories<br>or 2nd<br>Source or<br>Key Part | Specification of Accessory |              |                                                   |            |                |
|------------------------------------------------|----------------------------|--------------|---------------------------------------------------|------------|----------------|
|                                                | Battery 1                  | Brand Name   | Fuji                                              | Model Name | 334045         |
|                                                |                            | Power Rating | 3.7 Vdc, 600 mAh                                  | Type       | Li-ion,        |
|                                                | Usb Cable                  | Brand Name   | UNEMAC                                            | Model Name | UAM5M-26CB-004 |
|                                                |                            | Signal Line  | 0.085 meter, non-shielded cable, w/o ferrite core |            |                |

## 2.2 Maximum Tune-up Limit & Conducted RF Output Power (Unit: dBm)

| WLAN 2.4GHz 802.11b Average Power (dBm) |                    |           | Tune up Limit<br>(dBm) |
|-----------------------------------------|--------------------|-----------|------------------------|
| Power vs. Channel                       |                    |           |                        |
| Channel                                 | Frequency<br>(MHz) | Data Rate |                        |
|                                         |                    | 1Mbps     |                        |
| CH 1                                    | 2412               | 11.85     | 12.00                  |
| CH 6                                    | 2437               | 11.02     |                        |
| CH 11                                   | 2462               | 10.67     |                        |

| WLAN 2.4GHz 802.11g Average Power (dBm) |                    |           | Tune up Limit<br>(dBm) |
|-----------------------------------------|--------------------|-----------|------------------------|
| Power vs. Channel                       |                    |           |                        |
| Channel                                 | Frequency<br>(MHz) | Data Rate |                        |
|                                         |                    | 6Mbps     |                        |
| CH 1                                    | 2412               | 10.84     | 11..00                 |
| CH 6                                    | 2437               | 10.10     |                        |
| CH 11                                   | 2462               | 10.63     |                        |

| WLAN 2.4GHz 802.11n_HT20 Average Power (dBm) |                    |           | Tune up Limit<br>(dBm) |
|----------------------------------------------|--------------------|-----------|------------------------|
| Power vs. Channel                            |                    |           |                        |
| Channel                                      | Frequency<br>(MHz) | Data Rate |                        |
|                                              |                    | MCS0      |                        |
| CH 1                                         | 2412               | 10.83     | 11.00                  |
| CH 6                                         | 2437               | 10.03     |                        |
| CH 11                                        | 2462               | 10.65     |                        |

### 3 RF Exposure Limits

#### 3.1 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.

#### 3.2 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                            |

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.

## 4 Specific Absorption Rate (SAR)

### 4.1 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.

### 4.2 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:

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

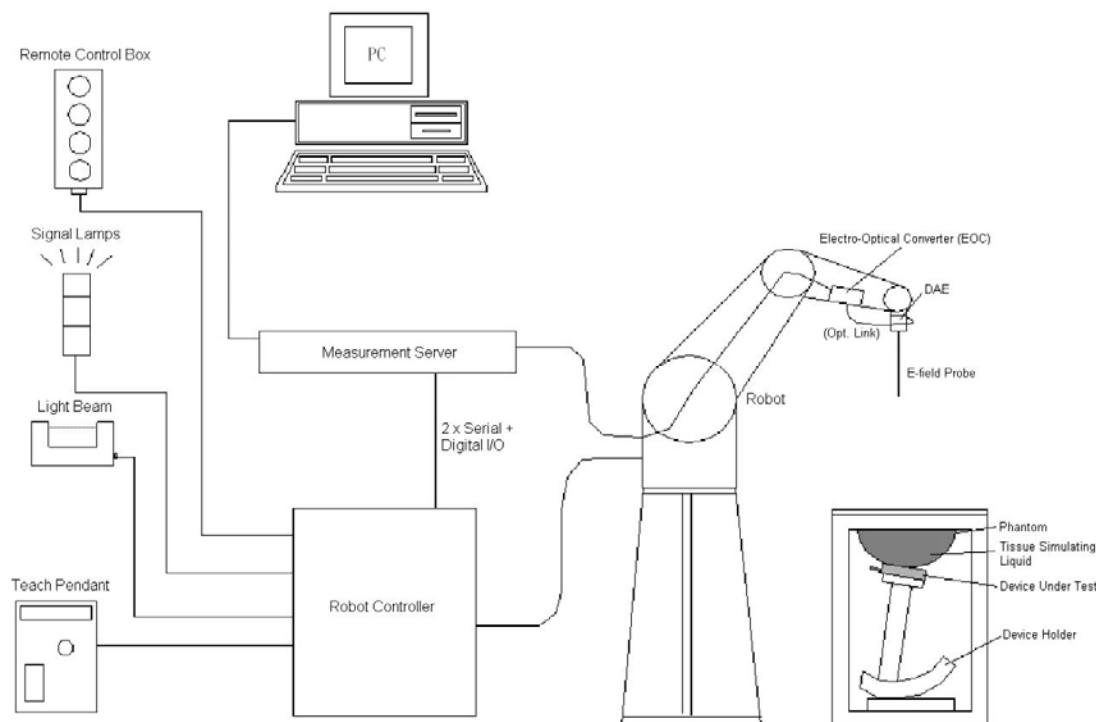
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

## 5 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.

## 5.1 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.

## 5.2 E-Field Probe Specification

### <EX3DV4 Probe>

|                                                                                     |                                                                                                                                                             |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Construction</b>                                                                 | Symmetrical design with triangular core<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| <b>Frequency</b>                                                                    | 10 MHz to 6 GHz; Linearity: $\pm 0.2$ dB                                                                                                                    |
| <b>Directivity</b>                                                                  | $\pm 0.3$ dB in HSL (rotation around probe axis)<br>$\pm 0.5$ dB in tissue material (rotation normal to probe axis)                                         |
| <b>Dynamic Range</b>                                                                | 10 $\mu$ W/g to 100 mW/g; Linearity: $\pm 0.2$ dB<br>(noise: typically $< 1$ $\mu$ W/g)                                                                     |
| <b>Dimensions</b>                                                                   | Overall length: 330 mm (Tip: 20 mm)<br>Tip diameter: 2.5 mm (Body: 12 mm)<br>Typical distance from probe tip to dipole centers: 1 mm                        |
|  |                                                                                                                                                             |

### 5.3 E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than  $\pm 10\%$ . The spherical isotropy shall be evaluated and within  $\pm 0.25\text{dB}$ . The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to appendix C of this report.

### 5.4 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.



## 5.5 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90BL; DASY5: TX90XL) type from Stäubli SA (France). The Stäubli robot series have many features that are important for our application:

- High precision (repeatability  $\pm 0.035$  mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)



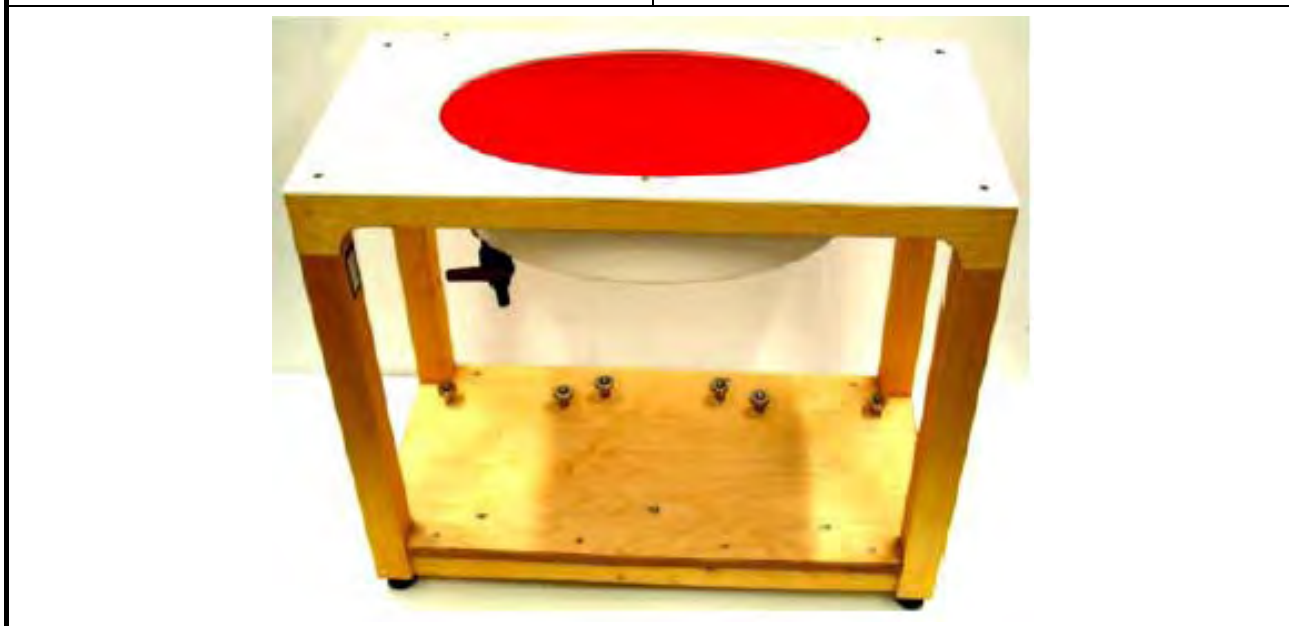
## 5.6 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY5: 400 MHz, Intel Celeron), chipdisk (DASY5: 128 MB), RAM (DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board. The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.



## 5.7 Phantom

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



The ELI4 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.

## 6 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) Area scan
- (b) Power reference measurement
- (c) Zoom scan
- (d) Power drift measurement

### 6.1 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
- (g) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- (b) Generation of a high-resolution mesh within the measured volume
- (c) Interpolation of all measured values from the measurement grid to the high-resolution grid
- (d) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (e) Calculation of the averaged SAR within masses of 1g and 10g

## 6.2 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.

## 6.3 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 dB) 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 SAR measurement 100 MHz to 6 GHz

|                                                                                                        | $\leq 3$ GHz                                                                                                                                                                                                                                                           | $> 3$ GHz                                              |
|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | $5 \pm 1$ mm                                                                                                                                                                                                                                                           | $\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm     |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location              | $30^\circ \pm 1^\circ$                                                                                                                                                                                                                                                 | $20^\circ \pm 1^\circ$                                 |
| Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$                 | $\leq 2$ GHz: $\leq 15$ mm<br>$2 - 3$ GHz: $\leq 12$ mm                                                                                                                                                                                                                | $3 - 4$ GHz: $\leq 12$ mm<br>$4 - 6$ GHz: $\leq 10$ mm |
|                                                                                                        | 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 $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device. |                                                        |

## 6.4 Zoom Scan

Zoom scans are used to 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 whose 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 SAR measurement 100 MHz to 6 GHz.

|                                                                                                                                                                                                                                                                                                             |                                           |                                                                                             | $\leq 3$ GHz                                           | $> 3$ GHz                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------------------------------------|
| Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$                                                                                                                                                                                                                      |                                           |                                                                                             | $\leq 2$ GHz: $\leq 8$ mm<br>$2 - 3$ GHz: $\leq 5$ mm* | $3 - 4$ GHz: $\leq 5$ mm*<br>$4 - 6$ GHz: $\leq 4$ mm*                              |
| Maximum zoom scan spatial resolution, normal to phantom surface                                                                                                                                                                                                                                             | uniform grid: $\Delta z_{\text{Zoom}}(n)$ |                                                                                             | $\leq 5$ mm                                            | $3 - 4$ GHz: $\leq 4$ mm<br>$4 - 5$ GHz: $\leq 3$ mm<br>$5 - 6$ GHz: $\leq 2$ mm    |
|                                                                                                                                                                                                                                                                                                             | graded grid                               | $\Delta z_{\text{Zoom}}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface | $\leq 4$ mm                                            | $3 - 4$ GHz: $\leq 3$ mm<br>$4 - 5$ GHz: $\leq 2.5$ mm<br>$5 - 6$ GHz: $\leq 2$ mm  |
|                                                                                                                                                                                                                                                                                                             |                                           | $\Delta z_{\text{Zoom}}(n>1)$ : between subsequent points                                   | $\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$           |                                                                                     |
| Minimum zoom scan volume                                                                                                                                                                                                                                                                                    | x, y, z                                   |                                                                                             | $\geq 30$ mm                                           | $3 - 4$ GHz: $\geq 28$ mm<br>$4 - 5$ GHz: $\geq 25$ mm<br>$5 - 6$ GHz: $\geq 22$ mm |
| Note: $\delta$ 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 <u>reported</u> SAR from the <u>area scan based 1-g SAR estimation</u> 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. |                                           |                                                                                             |                                                        |                                                                                     |

## 6.5 Volume Scan Procedures

The volume scan is used to 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.

## 6.6 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.

## 7 Test Equipment List

| Manufacturer  | Name of Equipment                | Type/Model    | Serial Number | Calibration |            |
|---------------|----------------------------------|---------------|---------------|-------------|------------|
|               |                                  |               |               | Last Cal.   | Due Date   |
| SPEAG         | Data Acquisition Electronics     | DAE4          | 1424          | 2015/2/20   | 2016/2/19  |
| SPEAG         | Dosimetric E-Field Probe         | EX3DV4        | 3976          | 2015/2/26   | 2016/2/25  |
| SPEAG         | 2450MHz System Validation Kit    | D2450V2       | 929           | 2015/2/25   | 2016/2/24  |
| SPEAG         | Device Holder                    | N/A           | N/A           | NCR         | NCR        |
| Mini-Circuits | Power Amplifier                  | ZHL-42W+      | 15542         | NCR         | NCR        |
| Mini-Circuits | Power Amplifier                  | ZVE-8G+       | 605601404     | NCR         | NCR        |
| Agilent       | ENA Series Network Analyzer      | E5071C        | MY46419201    | 2015/1/21   | 2016/1/20  |
| Agilent       | EXA Signal Analyzer              | N9010A        | MY54200432    | 2015/8/12   | 2016/8/11  |
| Agilent       | MXG-B RF Vector Signal Generator | N5182B        | MY53050081    | 2015/3/30   | 2016/3/28  |
| SPEAG         | Dielectric Probe Kit             | SM DAK 040CA  | 1146          | NCR         | NCR        |
| Anritsu       | Power Meter                      | ML2495A       | 1124009       | 2015/1/29   | 2016/1/28  |
| Anritsu       | Power sensor                     | MA2411B       | 1027452       | 2015/1/29   | 2016/1/28  |
| Anritsu       | Power Meter                      | ML2495A       | 1241002       | 2014/9/29   | 2015/9/28  |
| Anritsu       | Power sensor                     | MA2411B       | 1207366       | 2014/9/29   | 2015/9/28  |
| SPEAG         | Flat Phantom ELI5.0              | QD OVA 002 AA | 1238          | NCR         | NCR        |
| Wisewind      | Thermometer                      | HTC1          | HTC1          | 2014/12/25  | 2015/12/24 |
| Wisewind      | Thermometer                      | YF-160A       | 130504609     | 2014/12/25  | 2015/12/24 |

**General Note:**

1. The calibration certificate of DASY can be referred to appendix C of this report.
2. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
3. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1W input power according to the ratio of 1W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it
4. Attenuator 1 insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.
5. NCR: No calibration request.

## 8 System Verification

### 8.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. 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. 8.1.

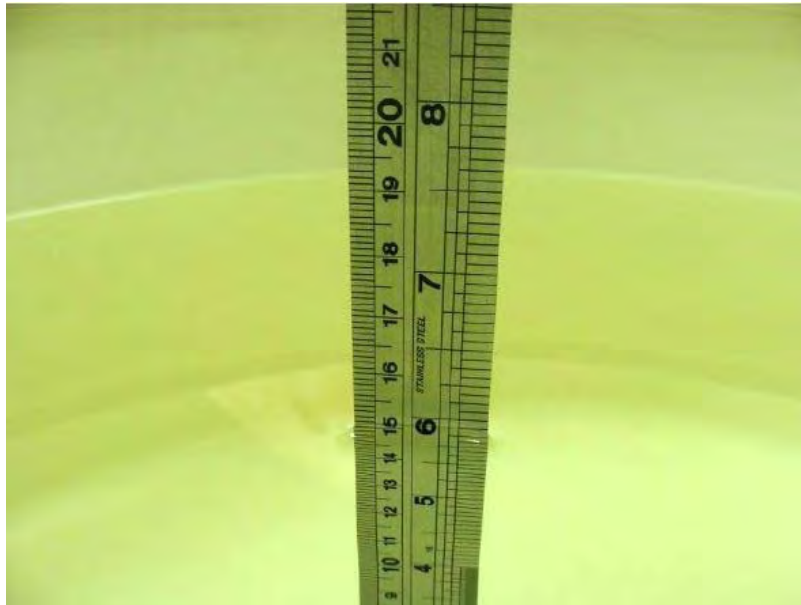


Fig 8.1 Photo of Liquid Height for Body SAR

## 8.2 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 ( $\sigma$ ) | Permittivity ( $\epsilon_r$ ) |
|-----------------|-----------|-----------|---------------|----------|---------------|----------|---------------------------|-------------------------------|
| For Body        |           |           |               |          |               |          |                           |                               |
| 2450            | 68.6      | 0         | 0             | 0.1      | 0             | 31.8     | 1.95                      | 52.7                          |

### <Tissue Dielectric Parameter Check Results>

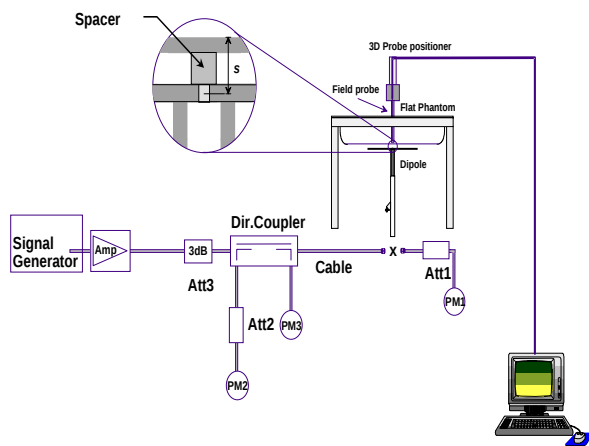
| Frequency (MHz) | Liquid Temp. (°C) | Conductivity ( $\sigma$ ) | Permittivity ( $\epsilon_r$ ) | Conductivity Target ( $\sigma$ ) | Permittivity Target ( $\epsilon_r$ ) | Delta ( $\sigma$ ) (%) | Delta ( $\epsilon_r$ ) (%) | Limit (%) | Date      |
|-----------------|-------------------|---------------------------|-------------------------------|----------------------------------|--------------------------------------|------------------------|----------------------------|-----------|-----------|
| 2450            | 22.3              | 2.002                     | 51.299                        | 1.95                             | 52.7                                 | 2.67                   | -2.66                      | ±5        | 2015/8/20 |

1. The dielectric properties of the tissue is within  $\pm 5\%$  of the target values.
2. Liquid temperature during dielectric property measurement by more than  $\pm 2^\circ\text{C}$
3. The dielectric properties of the tissue-equivalent liquids shall be measured within 24 h before the SAR measurements.

### 8.3 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) | Input Power (mW) | Dipole S/N | Probe S/N | DAE S/N | Measured SAR (W/kg) | Targeted SAR (W/kg) | Normalized SAR (W/kg) | Deviation (%) |
|-----------|-----------------|------------------|------------|-----------|---------|---------------------|---------------------|-----------------------|---------------|
| 2015/8/20 | 2450            | 250mW            | 929        | 3976      | 1424    | 13.2                | 51.1                | 52.80                 | 3.327         |

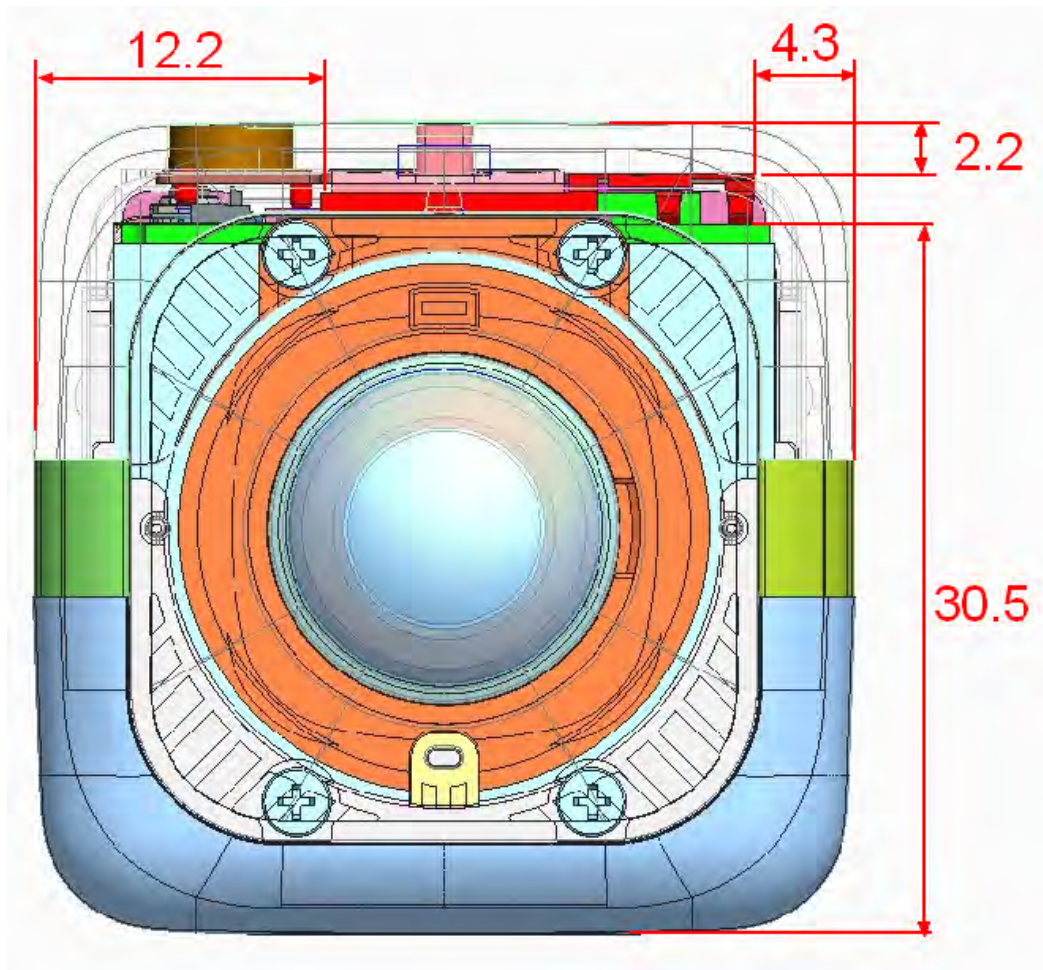


**System Performance Check Setup**



**Setup Photo**

## 9 Antenna Location



<EUT Rear View>

## 10 SAR Test Results

### General Note:

1. Per KDB 447498, 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. Reported SAR(W/kg)= Measured SAR(W/kg)\*Tune-up Scaling Factor
2. Per KDB 447498 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:
  - $\leq 0.8$  W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\leq 100$  MHz
  - $\leq 0.6$  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
  - $\leq 0.4$  W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\geq 200$  MHz
3. Per KDB 616217, the additional separation introduced by the contour against a flat phantom is  $< 5$  mm and reported SAR is  $< 1.2$  W/kg, a curved or contoured back surface or edge SAR is not required, more detail information please refer to the setup photo.
4. Per KDB 248227D01 v02, the Wi-Fi transmission modes include all channel bandwidth, modulation and data rate combinations for the 802.11a/g/n/ac OFDM configurations in a standalone or aggregated frequency band. For 2.4 GHz, 802.11b DSSS and 802.11g/n OFDM configurations are considered separately.
5. Per KDB 248227D01 v02 5.1.1 Initial Test Position SAR Test Reduction Procedure.
6. When the WLAN transmission was verified using a spectrum analyzer.

## 10.1 Body SAR

### <DTS WLAN SAR>

| Plot No. | Band    | Mode | Test Position | Gap (cm) | Ch. | Freq. (MHz) | Data Rate | Average Power (dBm) | Tune-up Limit (dBm) | Tune-up Scaling Factor | Fast SAR 1g (W/kg) | Measured 1g (W/kg) | Reported 1g SAR (W/kg) | Note     |
|----------|---------|------|---------------|----------|-----|-------------|-----------|---------------------|---------------------|------------------------|--------------------|--------------------|------------------------|----------|
| 2        | 802.11b | -    | Front Face    | 0        | 1   | 2412        | 1M        | 11.85               | 12                  | 1.04                   | 0.293              | 0.339              | 0.35                   |          |
| 3        | 802.11b | -    | Rear Face     | 0        | 1   | 2412        | 1M        | 11.85               | 12                  | 1.04                   | 0.192              | 0.214              | 0.22                   |          |
| 4        | 802.11b | -    | Edge1         | 0        | 1   | 2412        | 1M        | 11.85               | 12                  | 1.04                   | 0.202              | 0.224              | 0.23                   |          |
| 5        | 802.11b | -    | Edge2         | 0        | 1   | 2412        | 1M        | 11.85               | 12                  | 1.04                   | 0.187              | 0.201              | 0.21                   |          |
| 6        | 802.11b | -    | Edge3         | 0        | 1   | 2412        | 1M        | 11.85               | 12                  | 1.04                   | 0.052              | 0.059              | 0.06                   |          |
| 8        | 802.11b | -    | Edge4         | 0        | 1   | 2412        | 1M        | 11.85               | 12                  | 1.04                   | 0.865              | 1.25               | 1.29                   |          |
| 10       | 802.11b | -    | Edge4         | 0        | 6   | 2437        | 1M        | 11.02               | 12                  | 1.25                   | 0.588              | 0.847              | 1.06                   |          |
| 11       | 802.11b | -    | Edge4         | 0        | 1   | 2412        | 1M        | 11.85               | 12                  | 1.04                   | 0.862              | 1.25               | 1.29                   | Repeated |

**Note:**

1. According to KDB248227 D01 V02r01, 5.2.1, 802.11b DSSS SAR Test Requirements.
2. According to KDB248227 D01 V02r01, 5.2.2, 2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements.

## 11 Uncertainty Assessment

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A 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 14.1

| Uncertainty Distributions          | Normal                     | Rectangular   | Triangular    | U-Shape       |
|------------------------------------|----------------------------|---------------|---------------|---------------|
| Multi-plying Factor <sup>(a)</sup> | 1/ $\kappa$ <sup>(b)</sup> | 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)  $\kappa$  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 Distribution | Divisor    | Ci (1g) | Standard Uncertainty (±%) (1g) |
|--------------------------------------|------------------------|--------------------------|------------|---------|--------------------------------|
| <b>Measurement System</b>            |                        |                          |            |         |                                |
| Probe Calibration                    | 6.0                    | Normal                   | 1.0        | 1.0     | 6.0                            |
| Axial Isotropy                       | 4.7                    | Rectangular              | $\sqrt{3}$ | 0.7     | 1.9                            |
| Hemispherical Isotropy               | 9.6                    | Rectangular              | $\sqrt{3}$ | 0.7     | 3.9                            |
| Boundary effects                     | 1.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 0.6                            |
| Linearity                            | 4.7                    | Rectangular              | $\sqrt{3}$ | 1.0     | 2.7                            |
| System Detection Limits              | 1.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 0.6                            |
| Modulation Response                  | 2.4                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.4                            |
| Readout Electronics                  | 0.3                    | Normal                   | 1.0        | 1.0     | 0.3                            |
| Response Time                        | 0.8                    | Rectangular              | $\sqrt{3}$ | 1.0     | 0.5                            |
| Integration Time                     | 2.6                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.5                            |
| RF Ambient Noise                     | 3.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.7                            |
| RF Ambient Reflections               | 3.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.7                            |
| Probe Positioner                     | 0.4                    | Rectangular              | $\sqrt{3}$ | 1.0     | 0.2                            |
| Probe Positioning                    | 2.9                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.7                            |
| Max. SAR Eval.                       | 2.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.2                            |
| <b>Dipole Related</b>                |                        |                          |            |         |                                |
| Device Positioning                   | 2.9                    | Normal                   | 1.0        | 1.0     | 2.9                            |
| Device Holder                        | 3.6                    | Normal                   | 1.0        | 1.0     | 3.6                            |
| Power Drift                          | 5.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 2.9                            |
| Power Scaling                        | 0.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 0.0                            |
| <b>Phantom and Tissue parameters</b> |                        |                          |            |         |                                |
| Phantom Uncertainty                  | 6.1                    | Rectangular              | $\sqrt{3}$ | 1.0     | 3.5                            |
| SAR correction                       | 1.9                    | Normal                   | 1.0        | 1.0     | 1.9                            |
| Liquid Conductivity (measurement)    | 2.0                    | Normal                   | 1.0        | 0.8     | 1.6                            |
| Liquid Permittivity (measurement)    | 2.1                    | Normal                   | 1.0        | 0.3     | 0.5                            |
| Temp. unc. - Conduct                 | 3.4                    | Rectangular              | $\sqrt{3}$ | 0.8     | 1.5                            |
| Temp. unc. - Permittivity            | 0.4                    | Rectangular              | $\sqrt{3}$ | 0.2     | 0.1                            |
| <b>Combined Standard Uncertainty</b> |                        |                          |            |         | 11.2                           |
| <b>Coverage Factor for 95 %</b>      |                        |                          |            |         | Kp=2                           |
| <b>Expanded Uncertainty</b>          |                        |                          |            |         | 22.4                           |

**Uncertainty Budget for frequency range 30 MHz to 3 GHz**

| Error Description                    | Uncertainty Value (±%) | Probability Distribution | Divisor    | Ci (1g) | Standard Uncertainty (±%) (1g) |
|--------------------------------------|------------------------|--------------------------|------------|---------|--------------------------------|
| <b>Measurement System</b>            |                        |                          |            |         |                                |
| Probe Calibration                    | 6.0                    | Normal                   | 1.0        | 1.0     | 6.6                            |
| Axial Isotropy                       | 4.7                    | Rectangular              | $\sqrt{3}$ | 0.7     | 1.9                            |
| Hemispherical Isotropy               | 9.6                    | Rectangular              | $\sqrt{3}$ | 0.7     | 3.9                            |
| Boundary effects                     | 1.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 0.6                            |
| Linearity                            | 4.7                    | Rectangular              | $\sqrt{3}$ | 1.0     | 2.7                            |
| System Detection Limits              | 1.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 0.6                            |
| Modulation Response                  | 0.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 0.0                            |
| Readout Electronics                  | 0.3                    | Normal                   | 1.0        | 1.0     | 0.3                            |
| Response Time                        | 0.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 0.0                            |
| Integration Time                     | 2.6                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.5                            |
| RF Ambient Noise                     | 3.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.7                            |
| RF Ambient Reflections               | 3.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.7                            |
| Probe Positioner                     | 0.4                    | Rectangular              | $\sqrt{3}$ | 1.0     | 0.2                            |
| Probe Positioning                    | 2.9                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.7                            |
| Max. SAR Eval.                       | 2.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.2                            |
| <b>Dipole Related</b>                |                        |                          |            |         |                                |
| Device Of experimental dipole        | 5.5                    | Normal                   | 1.0        | 1.0     | 5.5                            |
| Dipole Axis to Liquid Distance       | 2.0                    | Rectangular              | $\sqrt{3}$ | 1.0     | 1.2                            |
| Input Power & SAR Drift              | 3.4                    | Rectangular              | $\sqrt{3}$ | 1.0     | 2.0                            |
| <b>Phantom and Tissue parameters</b> |                        |                          |            |         |                                |
| Phantom Uncertainty                  | 6.1                    | Rectangular              | $\sqrt{3}$ | 1.0     | 3.5                            |
| SAR correction                       | 1.9                    | Normal                   | $\sqrt{3}$ | 1.0     | 1.1                            |
| Liquid Conductivity (measurement)    | 2.0                    | Normal                   | 1.0        | 0.8     | 1.6                            |
| Liquid Permittivity (measurement)    | 2.1                    | Normal                   | 1.0        | 0.2     | 0.5                            |
| Temp. unc. - Conduct                 | 3.4                    | Rectangular              | $\sqrt{3}$ | 0.8     | 1.5                            |
| Temp. unc. - Permittivity            | 0.4                    | Rectangular              | $\sqrt{3}$ | 0.2     | 0.1                            |
| <b>Combined Standard Uncertainty</b> |                        |                          |            |         | 9.2                            |
| <b>Coverage Factor for 95 %</b>      |                        |                          |            |         | Kp=2                           |
| <b>Expanded Uncertainty</b>          |                        |                          |            |         | 18.4                           |

**Uncertainty Budget for System Validation for the 0.3-6 GHz range**

## 12 References

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