# SAR Test Report

**FOR:**

**Manufacturer: Wi-MM Corporation**
**Model Number: BP100-2-2-1**
**FCC ID: 2ABUE-BP100-2-2-1**
**IC Certification Number: 11915A-BP100221**

**Test Report #: SAR_WIMML_002_14001**

**Date of Report: June 27, 2014**

ACCREDITED
TESTING LABORATORY
Certificate #2135.01

CTIA Authorized Test Lab
LAB CODE 20020328-00

**FCC Listed #:**
**A2LA Accredited**

**IC Recognized #**
**3462B-1**

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# 1. Assessment

The following device was evaluated against the limits for general population uncontrolled exposure specified in FCC 2.1093 and RSS 102, Issue 4 according to measurement procedures specified in FCC regulation as listed in chapter 5, IEEE 1528:2013, IEC 62209-1:2005, and IEC 62209-2:2010 and no deviations were ascertained during the course of the tests performed.

| Company | Description | Model # |
|---|---|---|
| Wi-MM Corporation | Bike computer with location, alarm and performance information | BP100-2-2-1 |

**Responsible for Testing Laboratory:**

| Date | Section | Name | Signature |
|---|---|---|---|
| June 27, 2014 | Compliance | Franz Engert (Compliance Manager) | Digitally signed by Franz Engert DN: cn=Franz Engert, c=US, o=CETECOM, ou=Complience, email=franz.engert@cetecom.com Date: 2014.06.27 20:12:22 -07'00' |

**Responsible for the Report:**

| Date | Section | Name | Signature |
|---|---|---|---|
| June 27, 2014 | Compliance | Josie Sabado (Test Lab Manager) | |

The test results of this test report relate exclusively to the test item specified in Section 3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

# 2. Administrative Data

## 2.1. Identification of the Testing Laboratory Issuing the SAR Test Report

| | |
|---|---|
| **Company Name:** | CETECOM Inc. |
| **Department:** | Compliance |
| **Address:** | 411 Dixon Landing Road<br>Milpitas, CA 95035<br>U.S.A. |
| **Telephone:** | +1 (408) 586 6200 |
| **Fax:** | +1 (408) 586 6299 |
| **Industry Canada Company Number:** | 3462B |
| **Test Lab Manager:** | Josie Sabado |
| **Responsible Project Leader:** | Cathy Palacios |

## 2.2. Identification of the Client

| | |
|---|---|
| **Applicant's Name:** | Wi-MM Corporation |
| **Street Address:** | 1885 De La Cruz Blvd |
| **City/Zip Code** | San Jose CA 95050 |
| **Country** | United States |
| **Contact Person:** | Les Levitt |
| **Phone No.** | (408) 373-6624 |
| **e-mail:** | llevitt@wi-mm.com |

## 2.3. Identification of the Manufacturer

Same as above client.

# 3. Equipment under Test (EUT)

## 3.1. General Specification of the Equipment under Test

| | |
|---|---|
| **Product Type:** | Portable |
| **Prototype/Production:** | Pre-Production |
| **RF Exposure Environment:** | General / Uncontrolled |
| **Dimensions:** | 43 x 254 x 17 mm |
| **Exposure Conditions:** | Near the Body |
| **Model No:** | BP100-2-2-1 |
| **FCC ID:** | 2ABUE-BP100-2-2-1 |
| **IC Certification Number:** | 11915A-BP100221 |
| **Antenna Information:** | **Cellular:**<br>Taoglas Part No. PA.25a<br>Hexa-Band Cellular SMD Antenna<br>Documented Max.Antenna Gain:<br>824 MHz: 1.5 dBi;<br>1880 MHz: 2.4 dBi<br>**Bluetooth:**<br>Monopole chip antenna<br>Documented Max Antenna Gain: 0.5 dBi |
| **Operating Voltage Range:** | Vmin: 3.3V/ Vnom: 3.7/ Vmax: 4.2V |
| **Operating Temperature Range:** | Tmin: 0°C/ Tmax: 50°C |
| **Supported Radios:** | CDMA<br>Bluetooth 4.0 |
| **Additional Radios[1]:** | GPS receiver at 1.575 MHz |
| **Power Back-Off Modes:** | None |
| **Simultaneous Transmission Configurations:** | Cellular + Bluetooth |
| **Date of Testing:** | May 30, 2014 to June 11, 2014 |

NOTES:
1. Additional radios are supported by the EUT, but are not addressed in this test report.

### 3.2. Technical Specification of Supported Radios

| Signal Type | Duty Cycle | Type(s) of Modulation | Band | Uplink Transmit Frequency Range (MHz) | Measured Maximum Conducted Output Power (dBm) |
|---|---|---|---|---|---|
| CDMA | 100% | QPSK, HPSK | Band Class 0 | 824 - 849 | 24.72 |
| | | | Band Class 1 | 1850 - 1910 | 24.18 |
| Bluetooth 4.0 | 61% | GFSK | N/A | 2400 – 2483.5 | 1.0 |
| GPS[1] | N/A | N/A | L1 | N/A | N/A |

NOTES:
1. Bands are supported by the EUT, but outside of the scope of this test report.

### 3.3. Identification of the Equipment Under Test (EUT)

| EUT # | MEID | HW Version | SW Version | Comments |
|---|---|---|---|---|
| 1 | A10000369F479F | BP100 2.2.1 | 1.0 | Radiated Unit |
| 2 | A10000369F46F4 | BP100 2.2.1 | 1.0 | Radiated Unit |
| 3 | A10000369F473A | BP100 2.2.1 | 1.0 | Conducted Unit |

### 3.4. Identification of Accessory equipment

No accessory equipment

### 3.5. Maximum SAR values

| Equipment Class | Exposure Condition | Measured 1g SAR (W/kg) | Maximum Reported 1g SAR (W/kg) |
|---|---|---|---|
| PCB | Near the Body | 0.232 | 0.356 |
| | Simultaneous Transmission | | 0.365 |
| DSS | Near the Body | 0.009 | 0.009 |
| | Simultaneous Transmission | | 0.365 |

## 4. Subject of Investigation

The objective of the measurements done by CETECOM Inc. was the dosimetric assessment of the EUT described in section 3. The tests were performed in configurations for devices operated next to a person's body. The examinations were carried out with the dosimetric assessment system DASY52 described in Section 6.

### 4.1. The IEEE Standard C95.1 , FCC Exposure Criteria, and IC Exposure Criteria

The FCC limits are set by CFR 47 FCC rule parts 1.1307 and 2.1093. The IC limits are set by RSS 102, Issue 4. The limits are derived from the recommendations in IEEE C95.1-1999 (ANSI/IEEE C95.1-1999), "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz."

### 4.2. SAR Limit

In this report the comparison between the exposure limits and the SAR data is made using the spatial peak SAR.

Having in mind a worst case consideration, the SAR limit is valid for uncontrolled environment and portable transmitters. The SAR values have to be averaged over a mass of 1g ($SAR_{1g}$) with the shape of a cube.

| Standard | Exposure Condition | Average SAR (W/kg) | Mass Average (g) |
|---|---|---|---|
| FCC CFR 47 Part 2.1093 (d)(2) | Partial-Body | 1.6 | 1 |
| RSS 102, Issue 4 | Localized Head and Trunk | 1.6 | 1 |

# 5. Measurement Procedure

The Federal Communications Commission (FCC) requires routine dosimetric assessment of mobile telecom-communications devices, either by laboratory measurement techniques or by computational modeling, prior to equipment authorization or use. The measurement procedure shall be performed according to IEEE 1528:2013. The following KDB publications have additionally been applied:

447498 D01 V05 – General RF Exposure Guidance
865664 D01V01 – SAR measurement 100 MHz to 6 GHz
941225 D01 V02 – SAR Measurement Procedures for 3G Devices

Industry Canada (IC) requirements and measurement techniques regarding RF exposure are described in RSS-102, Issue 4, which refers to the latest version of IEEE 1528 and IEC 62209. IC follows many of the same procedures as applied for compliance with FCC requirements regarding EUT specific technologies and form factors. IC allows the use of the above listed KDBs in most aspects as described in IC Notice 2012-DRS1203 regarding Applicability of Latest FCC RF Exposure KDB Procedures (Publication Date: October 24, 2012) and Other Procedures.

## 5.1. General Requirements

SAR evaluation was performed in a laboratory with an environment which avoids influence on SAR measurements by ambient EM sources and any reflection from the environment itself. The ambient temperature was in the range of 18°C to 25°C and 30-70% humidity. Simulating liquid temperature did not deviate more than 2°C throughout SAR evaluation.

## 5.2. Body-worn and Other Configurations

**Phantom Requirements**
For body-worn and other configurations a flat phantom shall be used which is comprised of material with electrical properties similar to the corresponding tissues.

**Test Position**
The body-worn configurations shall be tested with the supplied accessories (belt-clips, holsters, etc.) attached to the device in normal use configuration. Devices with a headset output shall be tested with a connected headset.

**Test to be Performed**
For purpose of determining test requirements, accessories may be divided into two categories: those that do not contain metallic components and those that do. For multiple accessories that do not contain metallic components, the device may be tested only with that accessory which provides the closest spacing to the body. For multiple accessories that contain metallic components, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component, only the accessory that provides the closest spacing to the body must be tested. If the manufacturer provides none body-worn accessories a separation distance of 1.5 cm between the back of the device and the flat phantom is recommended. Other separation distances may be used, but they shall

not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

For devices with retractable antenna the SAR test shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure shall also be tested. For example, optional antennas or optional battery packs which may significantly change the volume, lengths, flip open/closed, etc. of the device, or any other accessories which might have the potential to considerably increase the peak spatial-average SAR value.

## 5.3. Procedure for assessing the peak spatial-average SAR

**Step 1*:* Power reference measurement:**

Prior to the SAR test, a local SAR measurement should be taken at a user-selected spatial reference point to monitor power variations during testing.

**Step 2: Area scan**

The measurement procedures for evaluating SAR associated with wireless handsets typically start with a coarse measurement grid in order to determine the approximate location of the local peak SAR values. This is referred to as the "area scan" procedure. The SAR distribution is scanned along the inside surface of typically half of the head of the phantom but at least larger than the areas projected (normal to the phantom's surface) by the handset and antenna. An example grid is given in Figure 4. The distance between the measured points and phantom surface should be less than 8 mm, and should remain constant (variation less than ± 1 mm) during the entire scan in order to determine the locations of the local peak SAR with sufficient precision. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. The approximate locations of the peak SARs should be determined from area scan. Since a given amplitude local peak with steep gradients may produce lower spatial-average SAR than slightly lower amplitude peaks with less steep gradients, it is necessary to evaluate the other peaks as well. However, since the spatial gradients of local SAR peaks are a function of wavelength inside the tissue simulating liquid and incident magnetic field strength, it is not necessary to evaluate peaks that are less than –2dB of the local maximum. Two-dimensional spline algorithms [Press, et al, 1996], [Brishoual, 2001] are typically used to determine the peaks and gradients within the scanned area. If the peak is closer than one-half of the linear dimension of the 1 g or 10 g tissue cube to the scan border, the measurement area should be enlarged if possible, e.g., by tilting the probe or the phantom (see Figure 5).

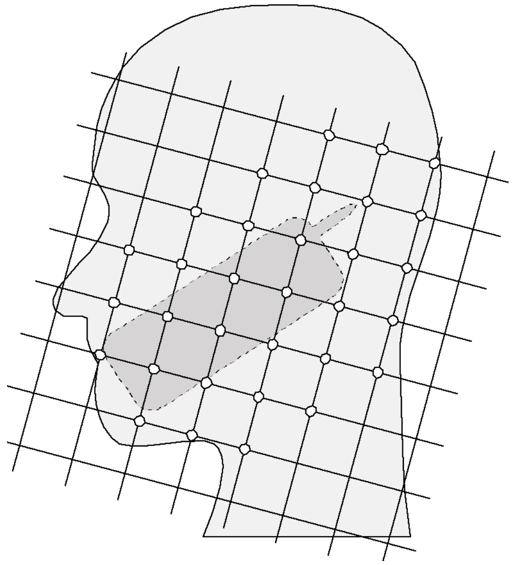


Figure 4 – Example of an area scan including the position of the handset. The scanned area (white dots) should be larger than the area projected by the handset and antenna.

The SPEAG DASY SAR system uses a mechanical sensor detection to find the phantom surface. To decrease test time, the DASY software allows the operator to choose an option where the SAR probe will reuse measurement locations from a previous identical area scan. With this option enabled, the DASY system will not use mechanical sensor detection to find the phantom surface. Locations of each measurement point of the area scan is taken at the same locations as an identical area scan if one is available. Area scans that reused location of measurement points is noted in the result plots under DASY Configuration > Sensor-Surface.

### Step 3: Zoom scan

In order to assess the peak spatial SAR values averaged over a 1 g and 10 g cube, fine resolution volume scans, called "zoom scans", are performed at the peak SAR locations determined during the "area scan." The zoom scan volume should have at least 1.5 times the linear dimension of either a 1 g or a 10 g tissue cube for whichever peak spatial-average SAR is being evaluated. The peak local SAR locations that were determined in the area scan (interpolated value) should be on the centerline of the zoom scans. The centerline is the line that is normal to the surface and in the center of the volume scan. If this is not possible, the zoom scan can be shifted but not by more than half the dimension of the 1 g or a 10 g tissue cube.

The maximum spatial-average SAR is determined by a numerical analysis of the SAR values obtained in the volume of the zoom scan, whereby interpolation (between measured points) and extrapolation (between surface and closest measured points) routines should be applied. A 3-D-spline algorithm [Press, et al, 1996], [Kreyszig, 1983], [Brishoual, 2001] can be used for interpolation and a trapezoidal algorithm for the integration (averaging). Scan resolutions of larger than 2 mm can be used provided the uncertainty is evaluated according to E (see E.5).

In some areas of the phantom, such as the jaw and upper head region, the angle of the probe with respect to the line normal to the surface might become large, e.g., at angles larger than ± 30º (see Figure 5), which may increase the boundary effect to an unacceptable level. In these cases, a change in the orientation of the probe and/or the phantom is recommended during the zoom scan so that the angle between the probe housing tube and the line normal to the surface is significantly reduced (<30º).

**Step 4: Power reference measurement**

The local SAR should be measured at exactly the same location as in Step 1. The absolute value of the measurement drift (the difference between the SAR measured in Step 4 and Step 1) should be recorded in the uncertainty budget. It is recommended that the drift be kept within ± 5%. If this is not possible, even with repeat testing, additional information may be used to demonstrate the power stability during the test. Power reference measurements can be taken after each zoom scan, if more than one zoom scan is needed. However, the drift should always be referred to the initial state with fully charged battery.

## 5.4. Determination of the largest peak spatial-average SAR

In order to determine the largest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes should be tested for each frequency band according to steps 1 to 3 below.

**Step 1:** The tests of 6.4 should be conducted at the channel that is closest to the center of the transmit frequency band (*fc*) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom,
b) all configurations for each device position in (a), e.g. antenna extended and retracted, and
c) all operational modes for each device position in (a) and configuration in (b) in each frequency band, e.g. analog and digital.

If more than three frequencies need to be tested, (i.e., Nc > 3), then all frequencies, configurations and modes must be tested for all of the above positions.

**Step 2:** For the condition providing highest spatial peak SAR determined in Step 1 conduct all tests of 6.4 at all other test frequencies, e.g. lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the spatial peak SAR value determined in Step 1 is within 3dB of the applicable SAR limit, it is recommended that all other test frequencies should be tested as well[1].

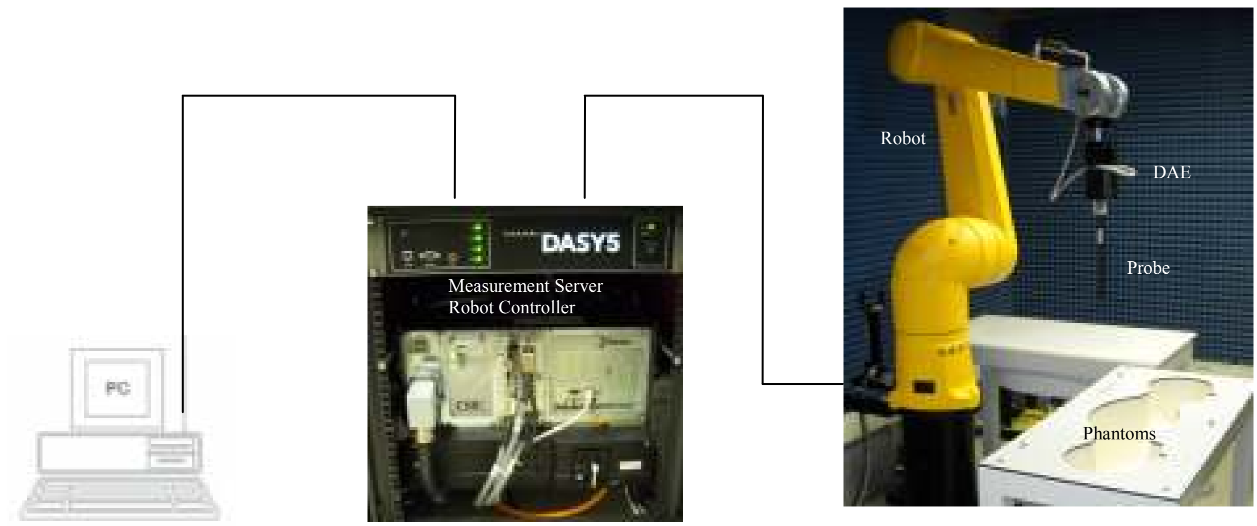
**Step 3:** Examine all data to determine the largest value of the peak spatial-average SAR found in Steps 1 to 2.

# 6. The Measurement System

## 6.1. Robot system specification

The SAR measurement system being used is the SPEAG DASY52 system, which consists of a Stäubli TX90XL 6-axis robot arm and CS8c controller, SPEAG SAR Probe, Data Acquisition Electronics, and SAM Twin Phantom. The robot is used to articulate the probe to programmed positions inside the phantom to obtain the SAR readings from the EUT.

The system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.




*Schematic diagram of the SAR measurement system*

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. When the maximum SAR point has been found, the system will then carry out a 3D scan centered at that point to determine volume averaged SAR level.

### 6.2. Isotropic E-Field Probe for Dosimetric Measurements

The probes are constructed using three orthogonal dipole sensors arranged on an interlocking, triangular prism core. The probes have built-in shielding against static charges and are contained within a PEEK cylindrical enclosure material at the tip. Probe calibration is described in the probe's calibration certificate.

### 6.3. Data Acquisition Electronics

The DAE contains a signal amplifier, multiplexer, 16bit A/D converter and control logic. It uses an optical link for communication with the DASY5 system. The DAE has a dynamic range of -100 to 300 mV. It also contains a two step probe touch detector for mechanical surface detection and emergency robot stop.

### 6.4. Phantoms

The Twin SAM V4.0 Phantom is designed to specifications defined in IEEE 1528, and IEC/EN 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region.

Additionally, the Oval Flat ELI V4.0 Phantom is designed to specification defined in IEEE 1528, and IEC/EN 62209-2. It enables the dosimetric evaluation of body mounted usage.

### 6.5. Interpolation and Extrapolation schemes

The interpolation, extrapolation and maximum search routines are all based on the modifed Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation. The routines construct a once-continuously differentiable function that interpolates the measurement values.

# 7. Uncertainty Assessment

## 7.1. Measurement Uncertainty Budget According to IEEE 1528:2013

The uncertainty values for components specified were evaluated according to the procedures of *IEEE 1528-2013, NIST 1297 1994 edition and ISO Guide to the Expression of Uncertainty in Measurements (GUM).*

| *a* | *b* | *c* | *d* | *e = f(d,k)* | *f* | *g = c x f / e* | *k* |
|---|---|---|---|---|---|---|---|
| **Uncertainty Component** | **Sec.** | **Tol. (± %)** | **Prob. Dist.** | **Div.** | $c_i$ **(1-g)** | **1-g** $u_i$ **(±%)** | $v_i$ |
| **Measurement System** | | | | | | | |
| Probe Calibration | E2.1 | 5.5 | N | 1 | 1 | 5.5 | ∞ |
| Axial Isotropy | E2.2 | 4.7 | R | √3 | 0.7 | 1.9 | ∞ |
| Hemispherical Isotropy | E2.2 | 9.6 | R | √3 | 0.7 | 3.9 | ∞ |
| Boundary Effect | E2.3 | 1.0 | R | √3 | 1 | 0.6 | ∞ |
| Linearity | E2.4 | 4.7 | R | √3 | 1 | 2.7 | ∞ |
| System Detection Limits | E2.5 | 1.0 | R | √3 | 1 | 0.6 | ∞ |
| Readout Electronics | E2.6 | 0.3 | N | 1 | 1 | 0.3 | ∞ |
| Response Time | E2.7 | 0.8 | R | √3 | 1 | 0.5 | ∞ |
| Integration Time | E2.8 | 2.6 | R | √3 | 1 | 1.5 | ∞ |
| RF Ambient Noise | E6.1 | 3.0 | R | √3 | 1 | 1.7 | ∞ |
| RF Ambient Reflections | E6.1 | 3.0 | R | √3 | 1 | 1.7 | ∞ |
| Probe Positioner Mechanical Tolerance | E6.2 | 0.4 | R | √3 | 1 | 0.2 | ∞ |
| Probe Positioning with respect to Phantom Shell | E6.3 | 2.9 | R | √3 | 1 | 1.7 | ∞ |
| Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation | E5.2 | 1.0 | R | √3 | 1 | 0.6 | ∞ |
| **Test sample Related** | | | | | | | |
| Test Sample Positioning | E4.2 | 2.9 | N | 1 | 1 | 2.9 | *145* |
| Device Holder Uncertainty | E4.1 | 3.6 | N | 1 | 1 | 3.6 | *5* |
| Output Power Variation - SAR drift measurement | 6.6.2 | 5.0 | R | √3 | 1 | 2.9 | ∞ |
| **Phantom and Tissue Parameters** | | | | | | | |
| Phantom Uncertainty (shape and thickness tolerances) | E3.1 | 4.0 | R | √3 | 1 | 2.3 | ∞ |
| Liquid Conductivity Target - tolerance | E3.2 | 5.0 | R | √3 | 0.7 | 1.8 | ∞ |
| Liquid Conductivity - measurement uncertainty | E3.3 | 2.5 | N | 1 | 0.7 | 1.6 | ∞ |
| Liquid Permittivity Target tolerance | E3.2 | 5.0 | R | √3 | 0.6 | 1.7 | ∞ |
| Liquid Permittivity - measurement uncertainty | E3.3 | 2.5 | N | 1 | 0.6 | 1.5 | ∞ |
| **Combined Standard Uncertainty** | | | RSS | | | **± 10.7%** | |
| **Expanded Uncertainty** (95% CONFIDENCE INTERVAL) | | | *k*= 2.00705 | | | **± 21.4%** | |

## 7.1. Measurement Uncertainty Budget According to EN 62209-1

A measurement uncertainty assessment has been undertaken following guidance given in IEC/EN-62209. Some of the uncertainty contributions are site-specific and, for these, CETECOM, Inc. has assessed the uncertainty contributions arising from local environmental and procedural factors. The resultant uncertainty budget, following the assessment template given IEC/EN-62209 is shown below:

| *a* | *b* | *c* | *d* | *e = f(d,k)* | *f* | *g = c x f / e* | *k* |
|---|---|---|---|---|---|---|---|
| **Uncertainty Component** | **Sec.** | **Tol. (± %)** | **Prob. Dist.** | **Div.** | **$c_i$ (1-g)** | **1-g $u_i$ (±%)** | **$v_i$** |
| **Measurement System** | | | | | | | |
| Probe Calibration | E2.1 | 5.5 | N | 1 | 1 | 5.5 | ∞ |
| Axial Isotropy | E2.2 | 4.7 | R | √3 | 0.7 | 1.9 | ∞ |
| Hemispherical Isotropy | E2.2 | 9.6 | R | √3 | 0.7 | 3.9 | ∞ |
| Boundary Effect | E2.3 | 1.0 | R | √3 | 1 | 0.6 | ∞ |
| Linearity | E2.4 | 4.7 | R | √3 | 1 | 2.7 | ∞ |
| System Detection Limits | E2.5 | 1.0 | R | √3 | 1 | 0.6 | ∞ |
| Readout Electronics | E2.6 | 0.3 | N | 1 | 1 | 0.3 | ∞ |
| Response Time | E2.7 | 0.8 | R | √3 | 1 | 0.5 | ∞ |
| Integration Time | E2.8 | 2.6 | R | √3 | 1 | 1.5 | ∞ |
| RF Ambient Noise | E6.1 | 3.0 | R | √3 | 1 | 1.7 | ∞ |
| RF Ambient Reflections | E6.1 | 3.0 | R | √3 | 1 | 1.7 | ∞ |
| Probe Positioner Mechanical Tolerance | E6.2 | 0.4 | R | √3 | 1 | 0.2 | ∞ |
| Probe Positioning with respect to Phantom Shell | E6.3 | 2.9 | R | √3 | 1 | 1.7 | ∞ |
| Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation | E5.2 | 1.0 | R | √3 | 1 | 0.6 | ∞ |
| **Test sample Related** | | | | | | | |
| Test Sample Positioning | E4.2 | 2.9 | N | 1 | 1 | 2.9 | *145* |
| Device Holder Uncertainty | E4.1 | 3.6 | N | 1 | 1 | 3.6 | *5* |
| Output Power Variation - SAR drift measurement | 6.6.2 | 5.0 | R | √3 | 1 | 2.9 | ∞ |
| **Phantom and Tissue Parameters** | | | | | | | |
| Phantom Uncertainty (shape and thickness tolerances) | E3.1 | 4.0 | R | √3 | 1 | 2.3 | ∞ |
| Liquid Conductivity Target - tolerance | E3.2 | 5.0 | R | √3 | 0.43 | 1.2 | ∞ |
| Liquid Conductivity - measurement uncertainty | E3.3 | 2.5 | N | 1 | 0.43 | 1.1 | ∞ |
| Liquid Permittivity Target tolerance | E3.2 | 5.0 | R | √3 | 0.49 | 1.4 | ∞ |
| Liquid Permittivity - measurement uncertainty | E3.3 | 2.5 | N | 1 | 0.49 | 1.2 | ∞ |
| **Combined Standard Uncertainty** | | | RSS | | | **± 10.5%** | |
| **Expanded Uncertainty** (95% CONFIDENCE INTERVAL) | | | *k*= 2.00705 | | | **± 21.0%** | |

# 8. Test results summary

## 8.1. Conducted Average Output Power

Measurement uncertainty for conducted measurements is ±0.5dB

**CDMA**

Average power measured using a Rhode and Schwarz CMU 200.

| Band | Channel | Frequency [MHz] | Average Power [dBm] | | | | Upper Power Tolerance Limit[1] |
|---|---|---|---|---|---|---|---|
| | | | RC1/1, SO55 | RC3/3, SO55 | SO32, SCH0 Disabled | SO32, SCH0 Enabled | |
| BC0 | 1013 | 824.7 | 24.5 | 24.48 | 24.49 | 24.48 | 26 |
| | 384 | 836.6 | 24.64 | 24.65 | 24.67 | 24.72 | |
| | 777 | 848.31 | 24.58 | 24.61 | 24.58 | 24.61 | |
| BC1 | 25 | 1851.25 | 24.04 | 24.18 | 24.16 | 24.17 | 26 |
| | 600 | 1880 | 24.02 | 24.12 | 24.14 | 24.14 | |
| | 1175 | 1908.75 | 23.9 | 24.04 | 23.98 | 23.99 | |

NOTES:

1. Upper power tolerance limit stated in the technical note titled "LISA-C200, Version 2xS-01 Tune Up Procedure" from u-blox, dated 31/10/2013.

## 8.2. Stand-Alone SAR Evaluation Exclusion

| Antenna | Operation Mode | SAR Evaluation Exclusion Reason |
|---|---|---|
| Bluetooth | GFSK | According to KDB 447498, SAR evaluation can be excluded if the following equation is satisfied:<br>[(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] ·[$\sqrt{f_{(GHz)}}$] ≤ 3.0<br><br>The maximum average output power is 1 dBm (1.26 mW)[1]. The user to device separation distance is at least 30 mm.<br><br>[(1.3 mW) / (30 mm)] x $\sqrt{2.44}$ = 0.1<br><br>SAR evaluation is excluded. |

NOTES:

1. Maximum average output power stated in the data sheet titled "BLE113 Data Sheet" from Bluegiga Technologies dated Monday, 10 March 2014.

## 8.3. Test Positions and Configurations

| Exposure Condition | Distance | Position | Positioning Photo (Appendix B) |
|---|---|---|---|
| **Body SAR** | 30 mm | Front | Photo 1 |
| | | Back | Photo 2 |
| | | Left Edge | Photo 3 |
| | | Right Edge | Photo 4 |

High and low channels are evaluated for the worst case positions at least once for each exposure condition regardless of the SAR value on the middle channel, according to guidance in Industry Canada Notice 2012-DRS1203. FCC only requires high and low channels be evaluated when the SAR value on the middle channel is more than 3 dB below the limit.

Measured SAR values are scaled up to the manufacturer's stated output power. These SAR values are the reported SAR values as described in FCC KDB 447498.

Configurations with multiple SAR values have at least one peak SAR within 2 dB of the primary peak.

## 8.4. SAR Results for Body

| Band | Operation Mode | Channel | Frequency (MHz) | Position | Measured SAR 1g (W/kg) | Reported SAR 1g (W/kg) | Results (Appendix A) |
|---|---|---|---|---|---|---|---|
| **BC0** | **RC 3/3, SO32** | **384** | **836.52** | Front | 0.103 | 0.140 | Plot 1 |
| | | | | Back | 0.107 | 0.145 | Plot 2 |
| | | | | Left Edge | 0.070 | 0.096 | Plot 3 |
| | | | | Right Edge | 0.080 | 0.109 | Plot 4 |
| **BC1** | **RC 3/3, SO32** | **600** | **1880** | Front | 0.232 | 0.356 | Plot 5 |
| | | | | Back | 0.182 | 0.279 | Plot 6 |
| | | | | Left Edge | 0.185 | 0.284 | Plot 7 |
| | | | | Right Edge | 0.199 | 0.305 | Plot 8 |
| | | **25** | **1851.25** | Front | 0.132 | 0.202 | Plot 9 |
| | | **1175** | **1908.75** | Front | 0.105 | 0.167 | Plot 10 |

## 8.5. Simultaneous Transmission SAR Evaluation Consideration

According to KDB 648474, SAR evaluation for simultaneous transmission can be excluded when specific requirements are satisfied.

When standalone SAR evaluation is excluded, the estimated SAR value is calculated as:
(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)]·[$\sqrt{f_{(GHz)}}/x$] W/kg
where x=7.5. Bluetooth for body positions is calculated as 0.009 W/kg

| Position | Highest Reported 1g SAR (W/kg) | |
|---|---|---|
| | Bluetooth | Cellular |
| Front | 0.009 | 0.356 |
| Back | 0.009 | 0.279 |
| Left Edge | 0.009 | 0.284 |
| Right Edge | 0.009 | 0.305 |

| Position | Sum of 1g SAR (W/kg) | SAR to Peak Location Separation Ratio[1] | Simultaneous Transmission Evaluation Exclusion Reason |
|---|---|---|---|
| Front | 0.365 | -- | Sum of 1g SAR less than 1.6 W/kg |
| Back | 0.288 | -- | Sum of 1g SAR less than 1.6 W/kg |
| Left Edge | 0.293 | -- | Sum of 1g SAR less than 1.6 W/kg |
| Right Edge | 0.314 | -- | Sum of 1g SAR less than 1.6 W/kg |

1. SAR to Peak Location Separation Ratio is only calculated if the sum of 1g SAR (W/kg) is equal to or greater than 1.6 W/kg.

### 8.6. Dipole verification

Prior to formal testing at each frequency a system verification was performed in accordance with IEEE 1528. The 1 Watt reference SAR value is taken from the SPEAG dipole calibration report. All of the testing described in this report was performed within 24 hours of the system verification. The following results were obtained:

| Date | Liquid Type | Frequency (MHz) | CW input at dipole feed (Watts) | 1g SAR (W/kg)[1] | 1 Watt reference SAR value (W/kg) | Difference reference SAR value to normalized SAR | Results (Appendix A) |
|---|---|---|---|---|---|---|---|
| 5/30/2014 | MSL | 835 | 1 | 9.98 | 9.55 | 4.5% | Plot 11 |
| 5/30/2014 | MSL | 1900 | 1 | 38.4 | 40.3 | -4.7% | Plot 12 |
| 6/11/2014 | MSL | 1900 | 1 | 36.8 | 40.3 | -8.7% | Plot 13 |

## 9. References

1. [IEEE 1999] IEEE Std C95.1-1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Inst. of Electrical and Electronics Engineers, Inc., December 1998.

2. [IEEE 2013] 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. Inst. of Electrical and Electronics Engineers, Inc., June 2013.

3. [NIST 1994] NIST: Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results, Technical Note 1297 (TN1297), United States Department of Commerce Technology Administration, National Institute of Standards and Technology, September 1994.

4. [FCC 20XX] Various FCC KDB Publications, < http://transition.fcc.gov/oet/ea/eameasurements.html#sar>

5. [IC 2010] RSS-102: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), Industry Canada, Issue 4, March 2010.

6. [IC 2012] Notice 2012-DRS1203: RE: APPLICABILITY OF LATEST FCC RF EXPOSURE KDB PROCEDURES (PUBLICATION DATE: OCTOBER 24, 2012) AND OTHER PROCEDURES, Industry Canada, December 2012

7. BS EN 62209-2:2010, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)

## 10. Report History

| Date | Report Name – Changes to Report | Report prepared by |
|---|---|---|
| June 27, 2014 | SAR_WIMML_002_14001<br>1. First Version | J. Sabado |
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