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# TEST REPORT

**Report Number: 102570592LEX-003**
**Project Number: G102570592**

**Evaluation of the: Verifier Sentry (Model: SENTRY1)**
**With the following Modules Installed:**

**FCCID: Q9YSENTRY2 (WiFi/Bluetooth Module)**
**FCCID: Q9YSENTRY4 (CDMA Cell/PCS Module)**

**Tested to the SAR Criteria in**

**FCC Part 2.1093. Rss-102 Issue 5, per KDB447498 D01 v06**

**For**

**Cross Match Technologies**

| Test Performed by: | Test Authorized by: |
|---|---|
| Intertek<br>731 Enterprise Drive<br>Lexington, KY 40510 | Cross Match Technologies<br>3960 RCA Blvd Suite 6001<br>Palm Beach Gardens, FL 33410 |

**Prepared By:**________________ **Date:** 6/10/2016

Carmen Davis, Project Engineer

**Approved By:**________________ **Date:** 6/10/2016

Bryan Taylor, Team Leader

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**DOCUMENT HISTORY**

| Revision/ Project Number | Writer Initials | Date | Change |
|---|---|---|---|
| 1.0 /G102570592 | BCT | 6/10/2016 | Original document |
| | | | |
| | | | |

## 1.0 INTRODUCTION

At the request of Cross Match Technologies, Inc., the Verifier Sentry was evaluated for SAR in accordance with the requirements for FCC Part 2.1093 and RSS-102 Issue 5. Testing was performed in accordance with IEEE Std 1528:2013, IEC62209-2:2010, and the Office of Engineering and Technology KDB 447498. Testing was performed at the Intertek facility in Lexington, Kentucky.

For the evaluation, the dosimetric assessment system DASY52 was used. The total uncertainty for the evaluation of the spatial peak SAR values averaged over a cube of 1g tissue mass had been assessed for this system to be ±22.3%.

The SENTRY1 was tested at the maximum output power measured by Intertek. Maximum output power measurements are tabulated under Section 8.0 Test Results. The maximum spatial peak SAR value for the sample device averaged over 1g (for body worn mode) and 10g (for hand held mode) was found to be:

| Transmit Band (MHz) | Transmit Mode | Operating Mode | Channel | Frequency (MHz) | Conducted Output Power (dBm) | Reported $SAR_{1g}$ – Body Mode, $SAR_{10g}$ – Handheld Mode (W/kg) | Limit (W/kg) |
|---|---|---|---|---|---|---|---|
| 1850-1910 | CDMA PCS | Body | 1175 | 1908.75MHz | 23.47dBm | 1.2587 | 1.6W/kg |
| 824-849 | CDMA Cell | Body | 384 | 836.52MHz | 24.18dBm | 0.5275 | 1.6W/kg |
| 2390 – 2483.5 | WiFi | Body | 11 | 2462MHz | 21.0dBm | 0.0571 | 1.6W/kg |
| 1850-1910 | CDMA PCS | Handheld | 1175 | 1908.75MHz | 23.35dBm | 3.9025 | 4W/kg |
| 824-849 | CDMA Cell | Handheld | 384 | 836.52MHz | 24.18dBm | 0.8138 | 4W/kg |
| 2390 – 2483.5 | WiFi | Handheld | 6 | 2437MHz | 23.27dBm | 0.1109 | 4W/kg |

*Table 1: Maximum Measured SAR*

Based on the worst-case data presented above, the Verifier Sentry was found to be **compliant** with the 1.6 W/kg and 4W/kg requirements for general population / uncontrolled exposure.

## 2.0 TEST SITE DESCRIPTION

The SAR test site located at 731 Enterprise Drive, Lexington KY 40510 is comprised of the SPEAG model DASY 5.2 automated near-field scanning system, which is a package, optimized for dosimetric evaluation of mobile radios [3]. This system is installed in an ambient-free shielded chamber. The ambient temperature is controlled to 22.0 $\pm 2^{O}$C. During the SAR evaluations, the RF ambient conditions are monitored continuously for signals that might interfere with the test results. The tissue simulating liquid is also stored in this area in order to keep it at the same constant ambient temperature as the room.

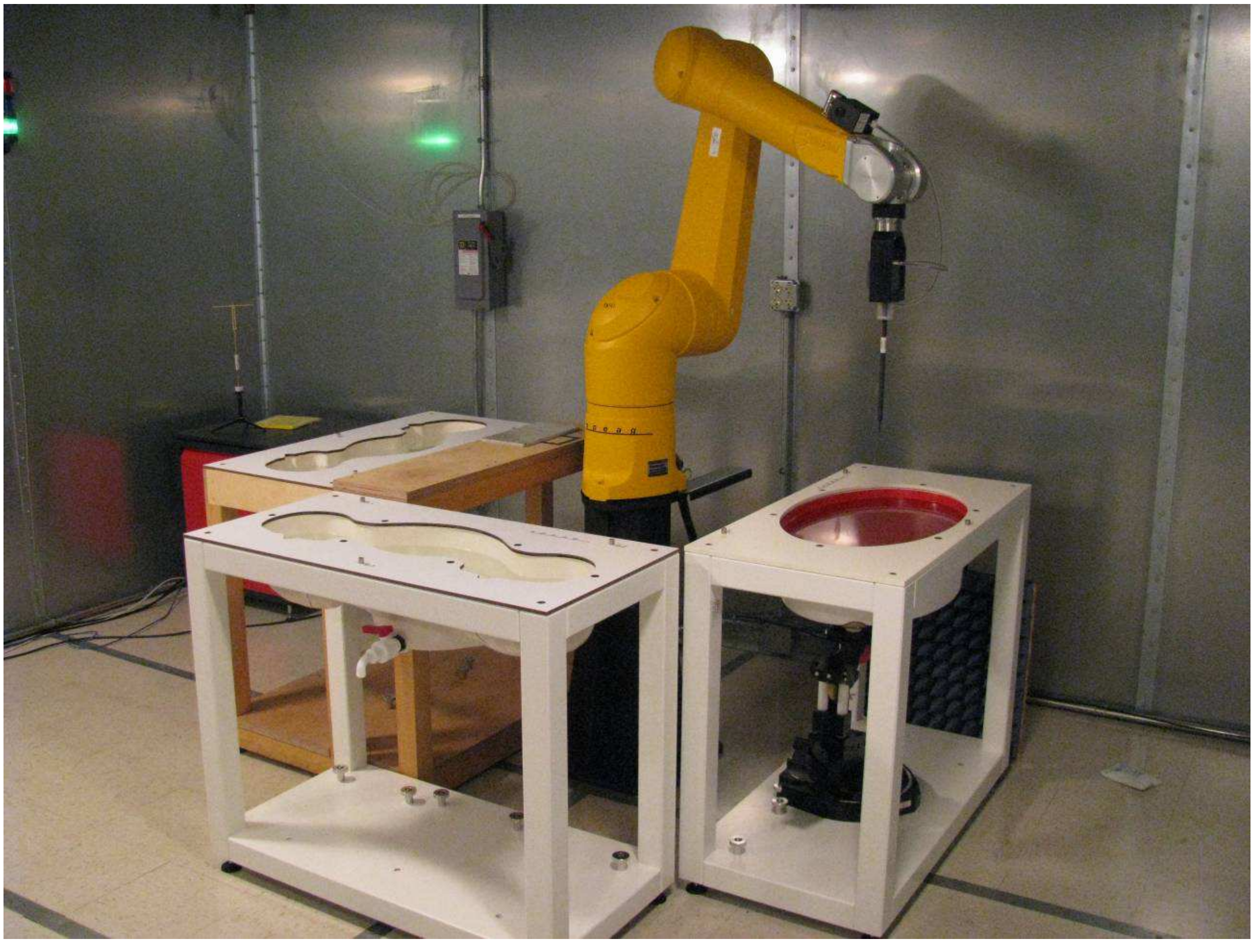

*Figure 1: Intertek SAR Test Site*

**Measurement Equipment**

The following major equipment/components were used for the SAR evaluation:

| Description | Serial Number | Manufacture | Model | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| SAR Probe | 3516 | Speag | EXDV3 | 12/16/15 | 12/16/16 |
| System Verification Dipole | 4d122 | Speag | D835V2 | 9/17/15 | 9/17/16 |
| System Verification Dipole | 5d154 | Speag | D1900V2 | 9/21/15 | 9/21/16 |
| System Verification Dipole | 718 | Speag | D2450V2 | 12/10/15 | 12/10/16 |
| DAE | 358 | Speag | DAE4 | 9/16/15 | 9/16/16 |
| Vector Signal Generator | 257708 | Rohde & Schwarz | SMBV100A | 9/18/15 | 9/18/16 |
| Network Analyzer | US39173983 | Agilent | 8753ES | 3/18/15 | 3/18/16 |
| USB Power Sensor | 100155 | Rohde & Schwarz | NRP-Z81 | 9/20/15 | 9/20/16 |
| USB Power Sensor | 100705 | Rohde & Schwarz | NRP-Z51 | 12/17/15 | 12/17/16 |
| Dielectric Probe Kit | 1111 | Speag | DAK-3.5 | NCR | NCR |
| Spectrum Analyzer | 3099 | Rohde & Schwarz | FSP7 | 9/18/15 | 9/18/16 |
| Base Station Simulator | 119981 | Rohde & Schwarz | CMU200 | 9/22/15 | 9/22/16 |
| SAM Twin Phantom | 1663 | Speag | QD 000 P40 C | NCR | NCR |
| Oval Flat Phantom ELI 5.0 | 1108 | Speag | QD OVA 002 A | NCR | NCR |
| 6-axis robot | F11/5H1Y A/A/01 | Staubli | RX-90 | NCR | NCR |

NCR – No Calibration Required

*Table 2: Test Equipment Used for SAR Evaluation*

## Measurement Uncertainty

The Table below includes the uncertainty budget suggested by the IEEE Std 1528-2013 and determined by SPEAG for the DASY5 measurement System.

| Error Description | Uncertainty Value | Prob. Dist. | Div. | $c_i$ (1g) | $c_i$ (10g) | Std.Unc. (1g) | Std.Unc. (10g) | ($v_i$) $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | ±6.0% | N | 1 | 1 | 1 | ±6.0% | ±6.0% | ∞ |
| Axial Isotropy | ±4.7% | R | √3 | 0.7 | 0.7 | ±1.9% | ±1.9% | ∞ |
| Hemispherical Isotropy | ±9.6% | R | √3 | 0.7 | 0.7 | ±3.9% | ±3.9% | ∞ |
| Boundary Effect | ±1.0% | R | √3 | 1 | 1 | ±0.6% | ±0.6% | ∞ |
| Linearity | ±4.7% | R | √3 | 1 | 1 | ±2.7% | ±2.7% | ∞ |
| System Detection Limits | ±1.0% | R | √3 | 1 | 1 | ±0.6% | ±0.6% | ∞ |
| Modulation Response | ±2.4% | R | √3 | 1 | 1 | ±1.4% | ±1.4% | ∞ |
| Readout Electronics | ±0.3% | N | 1 | 1 | 1 | ±0.3% | ±0.3% | ∞ |
| Response Time | ±0.8% | R | √3 | 1 | 1 | ±0.5% | ±0.5% | ∞ |
| Integration Time | ±2.6% | R | √3 | 1 | 1 | ±1.5% | ±1.5% | ∞ |
| RF Ambient Noise | ±3.0% | R | √3 | 1 | 1 | ±1.7% | ±1.7% | ∞ |
| RF Ambient Reflections | ±3.0% | R | √3 | 1 | 1 | ±1.7% | ±1.7% | ∞ |
| Probe Positioner | ±0.4% | R | √3 | 1 | 1 | ±0.2% | ±0.2% | ∞ |
| Probe Positioning | ±2.9% | R | √3 | 1 | 1 | ±1.7% | ±1.7% | ∞ |
| Max. SAR Eval. | ±2.0% | R | √3 | 1 | 1 | ±1.2% | ±1.2% | ∞ |
| **Test sample Related** | | | | | | | | |
| Device Positioning | ±2.9% | N | 1 | 1 | 1 | ±2.9% | ±2.9% | 145 |
| Device Holder | ±3.6% | N | 1 | 1 | 1 | ±3.6% | ±3.6% | 5 |
| Power Drift | ±5.0% | R | √3 | 1 | 1 | ±2.9% | ±2.9% | ∞ |
| Power Scaling | ±0.0% | R | √3 | 1 | 1 | ±0% | ±0% | ∞ |
| **Phantom and Setup** | | | | | | | | |
| Phantom Uncertainty | ±6.1% | R | √3 | 1 | 1 | ±3.5% | ±3.5% | ∞ |
| SAR Correction | ±1.9% | R | √3 | 1 | 0.84 | ±1.1% | ±0.9% | ∞ |
| Liquid Conductivity (mea.) | ±2.5% | R | √3 | 0.78 | 0.71 | ±1.1% | ±1.0% | ∞ |
| Liquid Permittivity(mea.) | ±2.5% | R | √3 | 0.26 | 0.26 | ±0.3% | ±0.4% | ∞ |
| Temp unc. - Conductivity | ±3.4% | R | √3 | 0.78 | 0.71 | ±1.5% | ±1.4% | ∞ |
| Temp unc. - Permittivity | ±0.4% | R | √3 | 0.23 | 0.26 | ±0.1% | ±0.1% | ∞ |
| **Combined Standard Uncertainty** | | | | | | ±11.2% | ±11.1% | 361 |
| **Expanded STD Uncertainty** | | | | | | **±22.3%** | **±22.2%** | |

Notes.

1. Worst Case uncertainty budget for DASY5 assessed according to IEEE 1528-2013. The budget is valid for the frequency range 300 MHz – 3 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerably smaller.

| Error Description | Uncertainty Value | Prob. Dist. | Div. | $c_i$ (1g) | $c_i$ (10g) | Std.Unc. (1g) | Std.Unc. (10g) | ($v_i$) $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | ±6.55% | N | 1 | 1 | 1 | ±6.55% | ±6.55% | ∞ |
| Axial Isotropy | ±4.7% | R | √3 | 0.7 | 0.7 | ±1.9% | ±1.9% | ∞ |
| Hemispherical Isotropy | ±9.6% | R | √3 | 0.7 | 0.7 | ±3.9% | ±3.9% | ∞ |
| Boundary Effect | ±2.0% | R | √3 | 1 | 1 | ±1.2% | ±1.2% | ∞ |
| Linearity | ±4.7% | R | √3 | 1 | 1 | ±2.7% | ±2.7% | ∞ |
| System Detection Limits | ±1.0% | R | √3 | 1 | 1 | ±0.6% | ±0.6% | ∞ |
| Modulation Response | ±2.4% | R | √3 | 1 | 1 | ±1.4% | ±1.4% | ∞ |
| Readout Electronics | ±0.3% | N | 1 | 1 | 1 | ±0.3% | ±0.3% | ∞ |
| Response Time | ±0.8% | R | √3 | 1 | 1 | ±0.5% | ±0.5% | ∞ |
| Integration Time | ±2.6% | R | √3 | 1 | 1 | ±1.5% | ±1.5% | ∞ |
| RF Ambient Noise | ±3.0% | R | √3 | 1 | 1 | ±1.7% | ±1.7% | ∞ |
| RF Ambient Reflections | ±3.0% | R | √3 | 1 | 1 | ±1.7% | ±1.7% | ∞ |
| Probe Positioner | ±0.8% | R | √3 | 1 | 1 | ±0.5% | ±0.5% | ∞ |
| Probe Positioning | ±6.7% | R | √3 | 1 | 1 | ±3.9% | ±3.9% | ∞ |
| Max. SAR Eval. | ±4.0% | R | √3 | 1 | 1 | ±2.3% | ±2.3% | ∞ |
| **Test sample Related** | | | | | | | | |
| Device Positioning | ±2.9% | N | 1 | 1 | 1 | ±2.9% | ±2.9% | 145 |
| Device Holder | ±3.6% | N | 1 | 1 | 1 | ±3.6% | ±3.6% | 5 |
| Power Drift | ±5.0% | R | √3 | 1 | 1 | ±2.9% | ±2.9% | ∞ |
| Power Scaling | ±0.0% | R | √3 | 1 | 1 | ±0% | ±0% | ∞ |
| **Phantom and Setup** | | | | | | | | |
| Phantom Uncertainty | ±6.6% | R | √3 | 1 | 1 | ±3.8% | ±3.8% | ∞ |
| SAR Correction | ±1.9% | R | √3 | 1 | 0.84 | ±1.1% | ±0.9% | ∞ |
| Liquid Conductivity (mea.) | ±2.5% | R | √3 | 0.78 | 0.71 | ±1.1% | ±1.0% | ∞ |
| Liquid Permittivity(mea.) | ±2.5% | R | √3 | 0.26 | 0.26 | ±0.3% | ±0.4% | ∞ |
| Temp unc. - Conductivity | ±3.4% | R | √3 | 0.78 | 0.71 | ±1.5% | ±1.4% | ∞ |
| Temp unc. - Permittivity | ±0.4% | R | √3 | 0.23 | 0.26 | ±0.1% | ±0.1% | ∞ |
| **Combined Standard Uncertainty** | | | | | | ±12.3% | ±12.2% | 748 |
| **Expanded STD Uncertainty** | | | | | | **±24.6%** | **±24.5%** | |

Notes.

Worst Case uncertainty budget for DASY5 assessed according to IEEE 1528-2013. The budget is valid for the frequency range 3 GHz – 6 GHz and represents a worst-case analysis. Probe calibration error reflects uncertainty of the EX3D probe. For specific tests and configurations, the uncertainty could be considerably smaller.

## 3.0 JOB DESCRIPTION

At the request of Cross Match Technologies, SAR testing was performed on the SENTRY1.

| **Test sample** | |
|---|---|
| **Manufacturer** | Cross Match Technologies |
| **Product Name** | Verifier SentrySENTRY1 |
| **Serial Number** | Not Labeled |
| **Receive Date** | 5/12/2016 |
| **Device Received Condition** | Good |
| **Device Category** | Portable |
| **RF Exposure Category** | General Population/Uncontrolled Environment |
| **Antenna Type** | Internal |
| **Test sample Accessories** | |
| **Accessory** | Holster |

*Table 3: Product Information*

| Operating Bands | Frequency Range (MHz) | Maximum Output Power (declared by Manufacturer) | Duty Cycle |
|---|---|---|---|
| CDMA Cell | 824.2 – 848.31MHz | 24.5dBm | 1:1 |
| CDMA PCS | 1851.25 – 1908.75MHz | 23.5dBm | 1:1 |
| WiFi | 2390 – 2483.5MHz | 21dBm | 1:1 |
| Bluetooth | 2402 – 2480MHz | 7.73dBm | 1:1 |

*Table 4: Operating Bands*

## 4.0 SYSTEM VERIFICATION

### System Validation

Prior to the assessment, the system was verified to be within ±10% of the specifications by using the system validation kit. The system validation procedure tests the system against reference SAR values and the performance of probe, readout electronics and software. The test setup utilizes a phantom and reference dipole. The results from the system verifications with a dipole are shown in *Table 5*.

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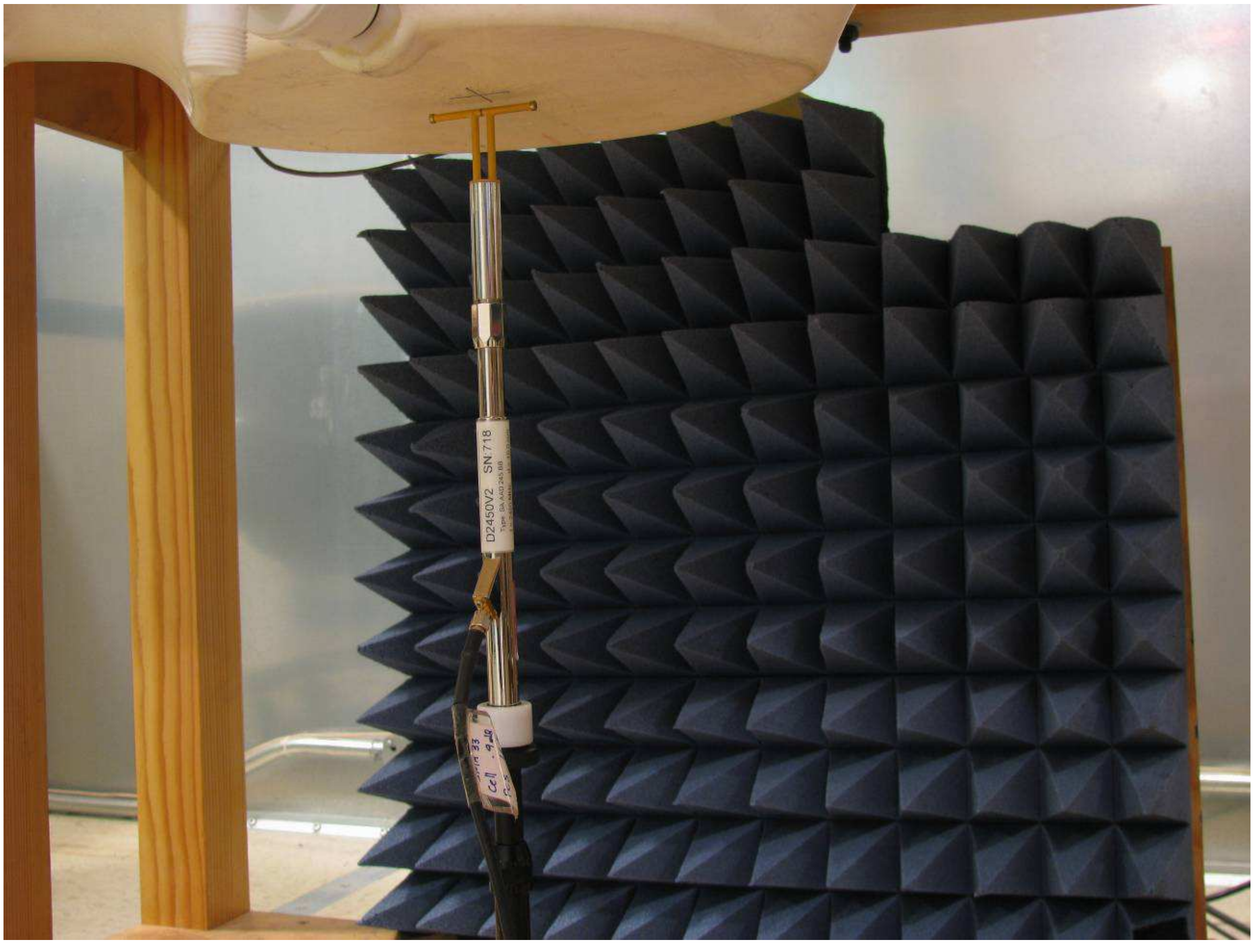



*Figure 2: System Verification Setup*

| Reference Dipole Validation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ambient Temp (°C) | Fluid Temp (°C) | Frequency (MHz) | Dipole | Fluid Type | Dipole Power Input | Cal. Lab SAR (1g) | Measured SAR (1g) | % Error SAR (1g) | Date |
| 23.1 | 22.1 | 2450 | D2450V2 | MSL2450 | 1W | 52.5 | 53.1 | 1.14 | 5/26/2016 |
| 23.1 | 22.1 | 835 | D835V2 | MSL900 | 1W | 9.49 | 10.1 | 6.43 | 5/17/2016 |
| 23.1 | 22.1 | 1900 | D1900V2 | MSL1900 | 1W | 39.9 | 41.4 | 3.76 | 5/18/2016 |
| 23.1 | 22.1 | 1900 | D1900V2 | MSL1900 | 1W | 39.9 | 41 | 2.76 | 6/6/2016 |
| 23.1 | 22.1 | 1900 | D1900V2 | MSL1900 | 1W | 39.9 | 40.9 | 2.51 | 6/28/2016 |
| 23.1 | 22.1 | 1900 | D1900V2 | MSL1900 | 1W | 39.9 | 42.1 | 5.51 | 7/6/2016 |
| 23.1 | 22.1 | 2450 | D2450V2 | MSL2450 | 1W | 52.5 | 56.7 | 8.00 | 7/1/2016 |

*Table 5: Dipole Validations (1g measurements)*

| Reference Dipole Validation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ambient Temp (°C) | Fluid Temp (°C) | Frequency (MHz) | Dipole | Fluid Type | Dipole Power Input | Cal. Lab SAR (10g) | Measured SAR (10g) | % Error SAR (10g) | Date |
| 23.1 | 22.1 | 2450 | D2450V2 | MSL2450 | 1W | 24.6 | 24.2 | 1.63 | 5/26/2016 |
| 23.1 | 22.1 | 835 | D835V2 | MSL900 | 1W | 6.22 | 6.68 | 7.40 | 5/17/2016 |
| 23.1 | 22.1 | 1900 | D1900V2 | MSL1900 | 1W | 21.1 | 21.4 | 1.42 | 5/18/2016 |
| 23.1 | 22.1 | 1900 | D1900V2 | MSL1900 | 1W | 21.1 | 21.2 | 0.47 | 6/6/2016 |
| 23.1 | 22.1 | 1900 | D1900V2 | MSL1900 | 1W | 21.1 | 21.4 | 1.42 | 6/28/2016 |
| 23.1 | 22.1 | 1900 | D1900V2 | MSL1900 | 1W | 21.1 | 21.9 | 3.79 | 7/6/2016 |
| 23.1 | 22.1 | 2450 | D2450V2 | MSL2450 | 1W | 24.6 | 26.2 | 6.50 | 7/1/2016 |

*Table 6: Dipole Validations (10g measurements)*

## Measurement Uncertainty for System Validation

| Source of Uncertainty | Value(dB) | Probability Distribution | Divisor | $c_i$ | $u_i(y)$ | $(u_i(y))$^2 |
|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | |
| Probe Calibration | 5.50 | n1 | 1 | 1 | 5.50 | 30.250 |
| Axial Isotropy | 4.70 | r | 1.732 | 0.7 | 2.71 | 7.364 |
| Hemispherical Isotropy | 9.60 | r | 1.732 | 0.7 | 5.54 | 30.722 |
| Boundary Effect | 1.00 | r | 1.732 | 1 | 0.58 | 0.333 |
| Linearity | 4.70 | r | 1.732 | 1 | 2.71 | 7.364 |
| System Detection Limits | 1.00 | r | 1.732 | 1 | 0.58 | 0.333 |
| Readout Electronics | 0.30 | n1 | 1 | 1 | 0.30 | 0.090 |
| Response Time | 0.80 | r | 1.732 | 1 | 0.46 | 0.213 |
| Integration Time | 2.60 | r | 1.732 | 1 | 1.50 | 2.253 |
| RF Ambient Noise | 3.00 | r | 1.732 | 1 | 1.73 | 3.000 |
| RF Ambient Reflections | 3.00 | r | 1.732 | 1 | 1.73 | 3.000 |
| Probe Positioner | 0.40 | r | 1.732 | 1 | 0.23 | 0.053 |
| Probe Positioning | 2.90 | r | 1.732 | 1 | 1.67 | 2.803 |
| Max. SAR Eval. | 1.00 | r | 1.732 | 1 | 0.58 | 0.333 |
| **Dipole / Generator / Power Meter Related** | | | | | | |
| Dipole positioning | 2.90 | n1 | 1 | 1 | 2.90 | 8.410 |
| Dipole Calibration Uncertainty | 0.68 | r | 1.732 | 1 | 0.39 | 0.154 |
| Power Meter 1 Uncertainty (+20C to +25C) | 0.13 | n1 | 1 | 2 | 0.13 | 0.017 |
| Power Meter 2 Uncertainty (+20C to +25C) | 0.04 | n1 | 1 | 3 | 0.04 | 0.002 |
| Sig Gen VSWR Mismatch Error | 1.80 | n1 | 1 | 5 | 1.80 | 3.240 |
| Sig Gen Resolution Error | 0.01 | n1 | 1 | 6 | 0.01 | 0.000 |
| Sig Gen Level Error | 0.90 | n1 | 1 | 1 | 0.90 | 0.810 |
| **Phantom and Setup** | | | | | | |
| Phantom Uncertainty | 4.00 | r | 1.732 | 1 | 2.31 | 5.334 |
| Liquid Conductivity (target) | 5.00 | r | 1.732 | 0.43 | 2.89 | 8.334 |
| Liquid Conductivity (meas.) | 2.50 | n1 | 1 | 0.43 | 2.50 | 6.250 |
| Liquid Permittivity (target) | 5.00 | r | 1.732 | 0.49 | 2.89 | 8.334 |
| Liquid Permittivity (meas.) | 2.50 | n1 | 1 | 0.49 | 2.50 | 6.250 |
| | | | | | | |
| Combined Standard Uncertainty | | N1 | 1 | 1 | 11.63 | 135.247 |
| Expanded Uncertainty | | Normal k= | 2 | | **23.26** | |
| | | | | | | |
| **Expanded Uncertainty** | **is** | **23.3** | **for** | **Normal** | **k=** | **2** |

## Tissue Simulating Liquid Description and Validation

The dielectric parameters were verified to be within 5% of the target values prior to assessment. The dielectric parameters ($\varepsilon_r$, $\sigma$) are shown in Table 7. A recipe for the tissue simulating fluid used is shown in Table 9.

| Measured Tissue Properties | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tissue Type | Frequency Measure (MHz) | Permittivity Target | Conductivity Target | Permittivity Measure | Imaginary Part | Conductivity Measure | Dielectric % Deviation | Conductivity % Deviation | Date |
| 2.4GHZ MSL | 2400 | 52.77 | 1.95 | 51.59 | 14.79 | 1.97 | 2.24 | 1.20 | 5/25/16 |
| | 2450 | 52.7 | 1.95 | 51.39 | 14.8 | 2.02 | 2.49 | 3.38 | |
| | 2462 | 52.66 | 1.95 | 51.33 | 14.92 | 2.04 | 2.53 | 4.73 | |

| Measured Tissue Properties | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tissue Type | Frequency Measure (MHz) | Permittivity Target | Conductivity Target | Permittivity Measure | Imaginary Part | Conductivity Measure | Dielectric % Deviation | Conductivity % Deviation | Date |
| 2.4GHZ MSL | 2400 | 52.77 | 1.95 | 51.87 | 14.86 | 1.98 | 1.71 | 1.68 | 6/28/2016 |
| | 2450 | 52.7 | 1.95 | 51.64 | 14.88 | 2.03 | 2.01 | 3.94 | |
| | 2462 | 52.66 | 1.95 | 51.45 | 14.91 | 2.04 | 2.30 | 4.66 | |

| Measured Tissue Properties | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tissue Type | Frequency Measure (MHz) | Permittivity Target | Conductivity Target | Permittivity Measure | Complex Permittivity | Conductivity Measure | Dielectric % Deviation | Conductivity % Deviation | Date |
| | 1850 | 53.3 | 1.52 | 53.2 | 14.91 | 1.53 | 0.19 | 0.89 | 5/17/16 |
| | 1880 | 53.3 | 1.52 | 52.92 | 14.96 | 1.56 | 0.71 | 2.87 | |
| MSL1900 | 1910 | 53.3 | 1.52 | 51.89 | 14.98 | 1.59 | 2.65 | 4.65 | |

| Measured Tissue Properties | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tissue Type | Frequency Measure (MHz) | Permittivity Target | Conductivity Target | Permittivity Measure | Complex Permittivity | Conductivity Measure | Dielectric % Deviation | Conductivity % Deviation | Date |
| | 824 | 55.2 | 0.97 | 53.02 | 21.31 | 0.98 | 3.95 | 0.64 | 5/17/16 |
| | 836 | 55.2 | 0.97 | 52.64 | 21.24 | 0.99 | 4.64 | 1.77 | |
| MSL835 | 850 | 55.2 | 0.98 | 52.53 | 21.18 | 1.00 | 4.84 | 2.13 | |

| Measured Tissue Properties | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tissue Type | Frequency Measure (MHz) | Permittivity Target | Conductivity Target | Permittivity Measure | Complex Permittivity | Conductivity Measure | Dielectric % Deviation | Conductivity % Deviation | Date |
| | 1850 | 53.3 | 1.52 | 52.89 | 14.86 | 1.53 | 0.77 | 0.55 | 6/6/16 |
| | 1880 | 53.3 | 1.52 | 52.81 | 14.92 | 1.56 | 0.92 | 2.59 | |
| MSL1900 | 1910 | 53.3 | 1.52 | 52.76 | 14.95 | 1.59 | 1.01 | 4.44 | |

| Measured Tissue Properties | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tissue Type | Frequency Measure (MHz) | Permittivity Target | Conductivity Target | Permittivity Measure | Complex Permittivity | Conductivity Measure | Dielectric % Deviation | Conductivity % Deviation | Date |
| | 1850 | 53.3 | 1.52 | 52.79 | 14.91 | 1.53 | 0.96 | 0.89 | 6/28/16 |
| | 1880 | 53.3 | 1.52 | 52.73 | 14.96 | 1.56 | 1.07 | 2.87 | |
| MSL1900 | 1910 | 53.3 | 1.52 | 52.7 | 14.98 | 1.59 | 1.13 | 4.65 | |

*Table 7: Dielectric Parameter Validations*

| Measured Tissue Properties | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tissue Type | Frequency Measure | Permittivity Target | Conductivity Target | Permittivity Measure | Complex Permittivity | Conductivity Measure | Dielectric % Deviation | Conductivity % Deviation | Date |
| | 1850 | 53.3 | 1.52 | 52.81 | 14.89 | 1.53 | 0.92 | 0.75 | 7/6/2016 |
| | 1880 | 53.3 | 1.52 | 52.76 | 14.92 | 1.56 | 1.01 | 2.59 | |
| MSL1900 | 1910 | 53.3 | 1.52 | 52.71 | 14.96 | 1.59 | 1.11 | 4.51 | |

*Table 8: Dielectric Parameter Validations (continued)*

| TYPICAL COMPOSITION OF INGREDIENTS FOR LIQUID TISSUE PHANTOMS. (450MHz to 2450 MHz data only) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ingredient (% by weight)** | f (MHz) | | | | | | | | | | | |
| | 450 | | 835 | | 915 | | 1900 | | 2450 | | 5500 | |
| Tissue Type | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body |
| Water | 38.56 | 51.16 | 41.45 | 52.4 | 41.05 | 56 | 54.9 | 70.45 | 62.7 | 68.64 | 65.53 | 78.67 |
| Salt (NaCl) | 3.95 | 1.49 | 1.45 | 1.4 | 1.35 | 0.76 | 0.18 | 0.36 | 0.5 | 0 | 0 | 0 |
| Sugar | 56.32 | 46.78 | 56 | 45 | 56.5 | 41.76 | 0 | 0 | 0 | 0 | 0 | 0 |
| HEC | 0.98 | 0.52 | 1 | 1 | 1 | 1.21 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bactericide | 0.19 | 0.05 | 0.1 | 0.1 | 0.1 | 0.27 | 0 | 0 | 0 | 0 | 0 | 0 |
| Triton X-100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 36.8 | 0 | 17.235 | 10.665 |
| DGBE | 0 | 0 | 0 | 0 | 0 | 0 | 44.92 | 29.18 | 0 | 31.37 | 0 | 0 |
| DGHE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17.235 | 10.665 |
| Dielectric Constant | 43.42 | 58 | 42.54 | 56.1 | 42 | 56.8 | 39.9 | 53.3 | 39.8 | 52.7 | | |
| Conductivity (S/m) | 0.85 | 0.83 | 0.91 | 0.95 | 1 | 1.07 | 1.42 | 1.52 | 1.88 | 1.95 | | |

*Table 9: Tissue Simulating Fluid Recipe*

Tissue Simulating Liquid for 5GHz, MBBL3500-5800V5 Manufactured by SPEAG (proprietary mixture)

| Ingredients | (% by weight) |
|---|---|
| Water | 78 |
| Mineral oil | 11 |
| Emulsifiers | 9 |
| Additives and Salt | 2 |

## 5.0 EVALUATION PROCEDURES

Prior to any testing, the appropriate fluid was used to fill the phantom to a depth of 15 cm $\pm$0.2cm. The fluid parameters were verified and the dipole validation was performed as described in the previous sections.

**Test Positions:**

The Device was positioned against the SAM and flat phantom using the exact procedure described in IEEE Std 1528:2013, IEC62209-2:2010, and the Office of Engineering and Technology KDB 447498.

**Reference Power Measurement:**

The measurement probe was positioned at a fixed location above the reference point. A power measurement was made with the probe above this reference position so it could used for the assessing the power drift later in the test procedure.

**Area Scan:**

A coarse area scan was performed in order to find the approximate location of the peak SAR value. This scan was performed with the measurement probe at a constant height in the simulating fluid. A two dimensional spline interpolation algorithm was then used to determine the peaks and gradients within the scanned area. The area scan resolution conformed to the requirements of KDB 865664 as shown in Table 10.

**Zoom Scan:**

A zoom scan was performed around the approximate location of the peak SAR as determined from the area scan. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure. The zoom scan resolution conformed to the requirements of KDB 865664 as shown in Table 10.

<table>
<tr><td colspan="3"></td><td>$\le$ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">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 colspan="3">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 colspan="3" rowspan="2">Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$</td><td>$\le$ 2 GHz: $\le$ 15 mm<br>2 – 3 GHz: $\le$ 12 mm</td><td>3 – 4 GHz: $\le$ 12 mm<br>4 – 6 GHz: $\le$ 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 $\le$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$</td><td>$\le$ 2 GHz: $\le$ 8 mm<br>2 – 3 GHz: $\le$ 5 mm*</td><td>3 – 4 GHz: $\le$ 5 mm*<br>4 – 6 GHz: $\le$ 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>$\le$ 5 mm</td><td>3 – 4 GHz: $\le$ 4 mm<br>4 – 5 GHz: $\le$ 3 mm<br>5 – 6 GHz: $\le$ 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>$\le$ 4 mm</td><td>3 – 4 GHz: $\le$ 3 mm<br>4 – 5 GHz: $\le$ 2.5 mm<br>5 – 6 GHz: $\le$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\le 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\ge$ 30 mm</td><td>3 – 4 GHz: $\ge$ 28 mm<br>4 – 5 GHz: $\ge$ 25 mm<br>5 – 6 GHz: $\ge$ 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.<br>* When zoom scan is required and the <u>*reported*</u> SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is $\le$ 1.4 W/kg, $\le$ 8 mm, $\le$ 7 mm and $\le$ 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>

*Table 10: SAR Area and Zoom Scan Resolutions*

**Interpolation, Extrapolation and Detection of Maxima:**

The probe is calibrated at the center of the dipole sensors which is located 1 to 2.7 mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated.

In DASY5, the choice of the coordinate system defining the location of the measurement points has no influence on the uncertainty of the interpolation, Maxima Search and extrapolation routines. The interpolation, extrapolation and maximum search routines are all based on the modified Quadratic Shepard's method.

Thereby, 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 DASY5 routines construct a once-continuously differentiable function that interpolates the measurement values as follows:

- For each measurement point a trivariate (3-D) / bivariate (2-D) quadratic is computed. It interpolates the measurement values at the data point and forms a least-square fit to neighboring measurement values.
- The spatial location of the quadratic with respect to the measurement values is attenuated by an inverse distance weighting. This is performed since the calculated quadratic will fit measurement values at nearby points more accurate than at points located further away.
- After the quadratics are calculated for at all measurement points, the interpolating function is calculated as a weighted average of the quadratics.

There are two control parameters that govern the behavior of the interpolation method. One specifies the number of measurement points to be used in computing the least-square fits for the local quadratics. These measurement points are the ones nearest the input point for which the quadratic is being computed. The second parameter specifies the number of measurement points that will be used in calculating the weights for the quadratics to produce the final function. The input data points used there are the ones nearest the point at which the interpolation is desired. Appropriate defaults are chosen for each of the control parameters.

The trivariate quadratics that have been previously computed for the 3-D interpolation and whose input data are at the closest distance from the phantom surface, are used in order to extrapolate the fields to the surface of the phantom.

In order to determine all the field maxima in 2-D (Area Scan) and 3-D (Zoom Scan), the measurement grid is refined by a default factor of 10 and the interpolation function is used to evaluate all field values between corresponding measurement points. Subsequently, a linear search is applied to find all the candidate maxima. In a last step, non-physical maxima are removed and only those maxima which are within 2 dB of the global maximum value are retained.

**Averaging and Determination of Spatial Peak SAR**

The interpolated data is used to average the SAR over the 1g and 10g cubes by spatially discretizing the entire measured volume. The resolution of this spatial grid used to calculate the averaged SAR is 1mm or about 42875 interpolated points. The resulting volumes are defined as cubical volumes containing the appropriate tissue parameters that are centered at the location. The location is defined as the center of the incremental volume.

The spatial-peak SAR must be evaluated in cubical volumes containing a mass that is within 5% of the required mass. The cubical volume centered at each location, as defined above, should be expanded in all directions until the desired value for the mass is reached, with no surface boundaries of the averaging volume extending beyond the outermost surface of the considered region. In addition, the cubical volume should not consist of more than 10% of air. If these conditions are not satisfied then the center of the averaging volume is moved to the next location. Otherwise, the exact size of the final sampling cube is found using an inverse polynomial approximation algorithm, leading to results with improved accuracy. If one boundary of the averaging volume reaches the boundary of the measured volume during its expansion, it will not be evaluated at all. Reference is kept of all locations used and those not used for averaging the SAR. All average SAR values are finally assigned to the centered location in each valid averaging volume.

All locations included in an averaging volume are marked to indicate that they have been used at least once. If a location has been marked as used, but has never been assigned to the center of a cube, the highest averaged SAR value of all other cubical volumes which have used this location for averaging is assigned to this location. Only those locations that are not part of any valid averaging volume should be marked as unused. For the case of an unused location, a new averaging volume must be constructed which will have the unused location centered at one surface of the cube. The remaining five surfaces are expanded evenly in all directions until the required mass is enclosed, regardless of the amount of included air. Of the six possible cubes with one surface centered on the unused location, the smallest cube is used, which still contains the required mass.

If the final cube containing the highest averaged SAR touches the surface of the measured volume, an appropriate warning is issued within the post processing engine.

**Power Drift Measurement:**

The probe was positioned at precisely the same reference point and the reference power measurement was repeated. The difference between the initial reference power and the final one is referred to as the power drift. The power drift measurement was used to assess the output power stability of the test sample throughout the SAR scan.

**RF Ambient Activity:**

During the entire SAR evaluation, the RF ambient activity was monitored using a spectrum analyzer with an antenna connected to it. The spectrum analyzer was tuned to the frequency of measurement and with one trace set to max hold mode. In this way, it was possible to determine if at any point during the SAR measurement there was an interfering ambient signal. If an ambient signal was detected, then the SAR measurement was repeated.

## 6.0 CRITERIA

The following FCC limits for SAR apply to portable devices operating in the General Population/Uncontrolled Exposure environment:

| Exposure (General Population/Uncontrolled Exposure environment) | SAR (W/kg) |
|---|---|
| Average over the whole body | 0.08 |
| Spatial Peak (1g) | 1.60 |
| Spatial Peak for hands, wrists, feet and ankles (10g) | 4.00 |

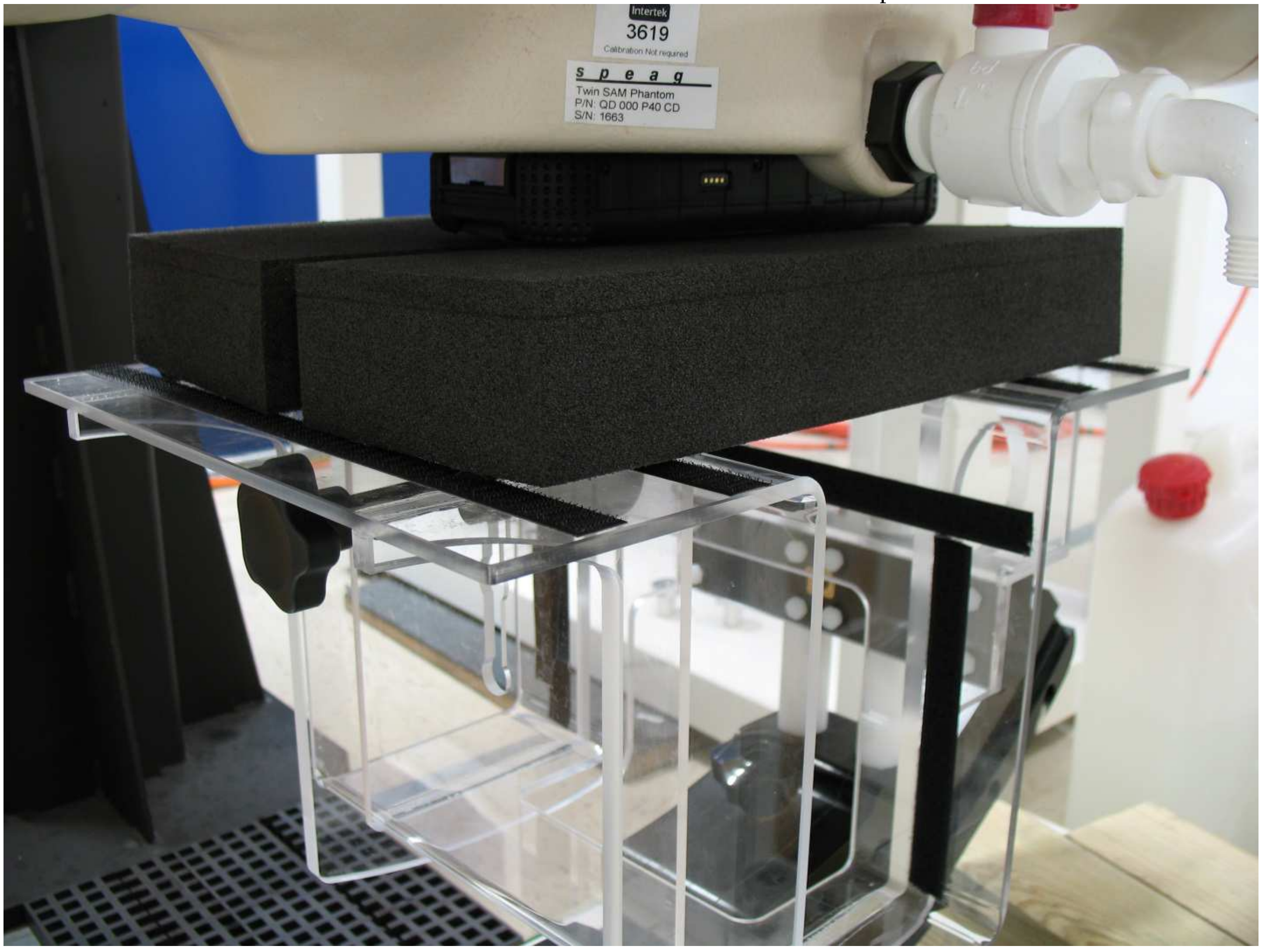
## 7.0 TEST CONFIGURATION

The Verifier Sentry can be operated and worn on the body using a pouch. The pouch is non-metallic and provides 14mm of separation between the device and the person. The pouch is formed such that the device can be positioned in one of two ways; with the screen facing toward the body or with the screen facing away from the body. Testing was performed with the sample installed in the pouch in both orientations. The test position is shown in the photographs below.

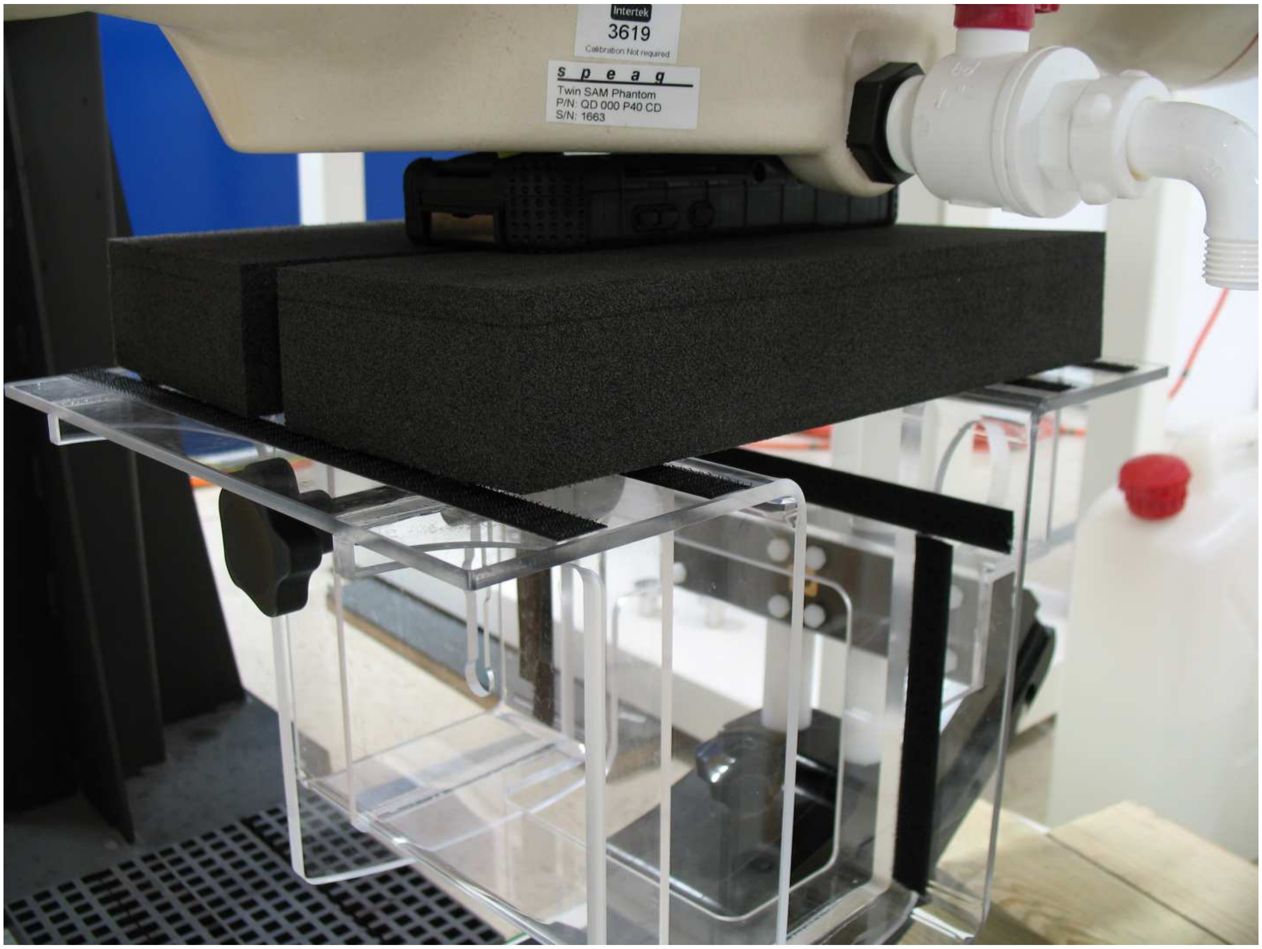
Testing was performed on the middle channel of each operating band first. When the 1g SAR exceeded 0.8W/kg on the middle channel, the low and high channels were also scanned.

The Verifier Sentry can also be operated in handheld mode outside of the pouch. Therefore testing was also performed with the device in direct contact with the phantom on each of the four sides using the spatial limit for hands, feet, wrists and ankles over a 10g cube.

Testing was performed on the middle channel of each operating band first. When the 10g SAR exceeded 2W/kg on the middle channel, the low and high channels were also scanned.


Intertek
3619
Calibration Not required
s p e a g
Twin SAM Phantom
P/N: QD 000 P40 CD
S/N: 1663

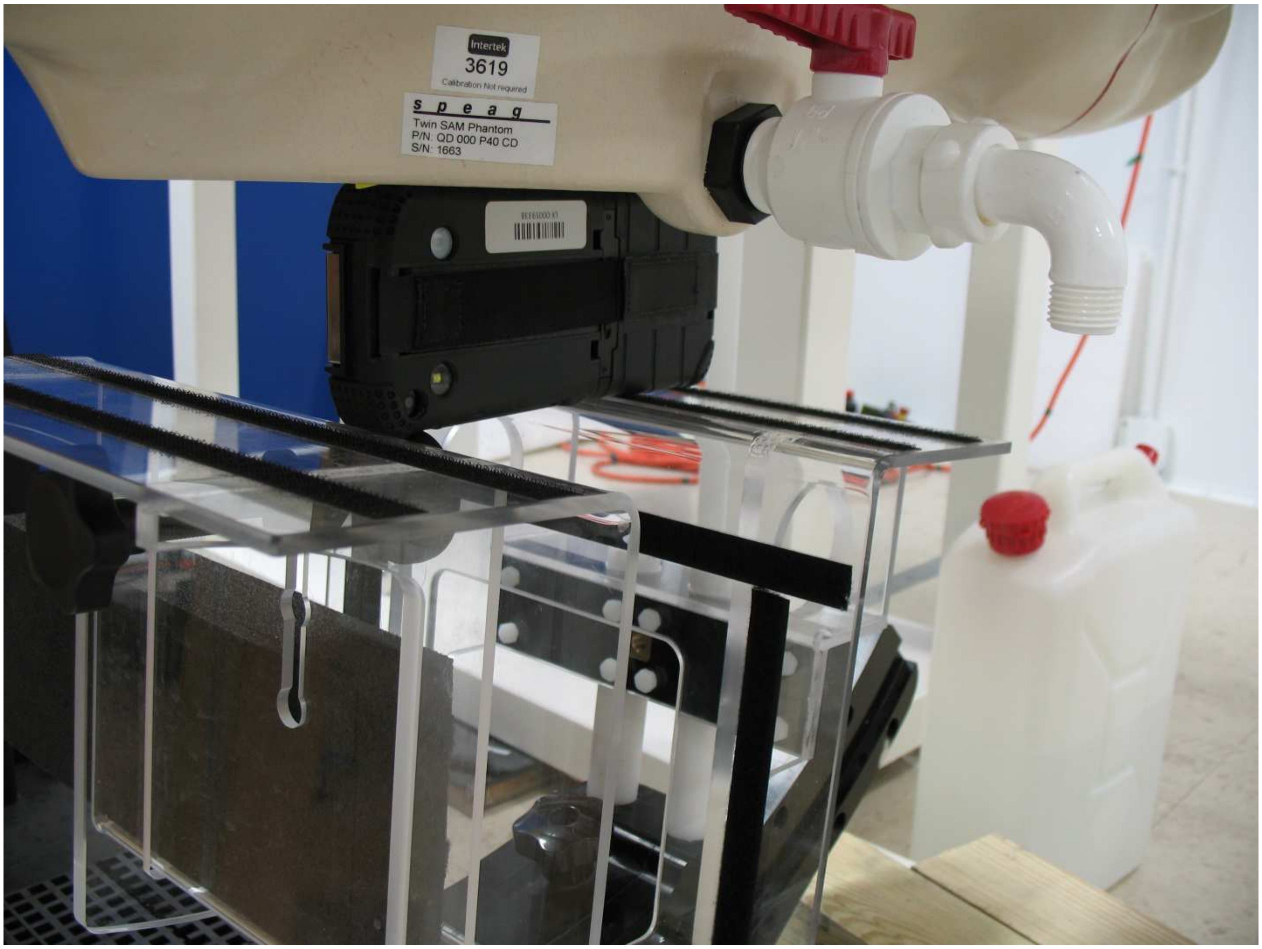
Front Side


Intertek
3619
Calibration Not required
s p e a g
Twin SAM Phantom
P/N: QD 000 P40 CD
S/N: 1663

Back Side


Intertek
3619
Calibration Not required
s p e a g
Twin SAM Phantom
P/N: QD 000 P40 CD
S/N: 1663
SENTRY 1.1

Right Side


Intertek
3619
Calibration Not required
s p e a g
Twin SAM Phantom
P/N: QD 000 P40 CD
S/N: 1663

Left Side


Front Side, In pouch


Back Side, In Pouch

## 8.0 TEST RESULTS

The results on the following page(s) were obtained when the device was transmitting at maximum output power. Detailed measurement data and plots, which reveal information about the location of the maximum SAR with respect to the device, are referenced are shown in separate exhibits presented with this application. The measured conducted output power was compared to the power declared by the manufacturer and used for scaling the measured SAR values.

The device was evaluated according to the specific requirements found in FCC KDB 447498[9]. The worst case 1-g SAR value was less than the 1.6W/kg limit. Also the worst case 10-g SAR value was less than the 4W/kg limit for extremity use conditions.

**Standalone SAR Measurements (Body Worn Mode in Pouch):**

| | Body Mode SAR Results Using 900MHz MSL. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date** | **TX Mode** | | **Position** | **Power Drift (dB)** | **Measured SAR 1g (W/kg)** | **Reported SAR 1g (W/kg)** | **Measured Conducted Output Power (dBm)** | **Maximum Conducted Output Power (dBm)** |
| 5/17/2016 | CDMA Cell Band, Low Channel (1013) | Pouch | Back | 0.18 | 0.3880 | **0.4611** | 23.75 | 24.50 |
| | | | Front | | | **0.0000** | 23.75 | 24.50 |
| 5/17/2016 | CDMA Cell Band, Mid Channel (384) | Pouch | Back | -0.08 | 0.4900 | **0.5275** | 24.18 | 24.50 |
| | | | Front | -0.08 | 0.4650 | **0.5006** | 24.18 | 24.50 |
| 5/17/2016 | CDMA Cell Band, High Channel (777) | Pouch | Back | -0.20 | 0.3010 | **0.3816** | 23.47 | 24.50 |
| | | | Front | | | **0.0000** | 23.47 | 24.50 |
| 1g SAR Limit (Head & Body) = 1.6W/kg | | | | | | | | |

*Table 11: CDMA Cell SAR Results*

| | Body Mode SAR Results Using 1900MHz MSL. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date** | **TX Mode** | | **Position** | **Power Drift (dB)** | **Measured SAR 1g (W/kg)** | **Reported SAR 1g (W/kg)** | **Measured Conducted Output Power (dBm)** | **Maximum Conducted Output Power (dBm)** |
| 5/18/2016 | CDMA PCS Band, Low Channel (25) | Pouch | Back | 0.30 | 1.1300 | **1.0668** | 23.75 | 23.50 |
| | | | Front | | | **0.0000** | 23.75 | 23.50 |
| 5/18/2016 | CDMA PCS Band, Mid Channel (600) | Pouch | Back | -0.21 | 0.8680 | **0.7422** | 24.18 | 23.50 |
| | | | Front | -0.18 | 0.2040 | **0.1744** | 24.18 | 23.50 |
| 5/18/2016 | CDMA PCS Band, High Channel (1175) | Pouch | Back | -0.02 | 1.2500 | **1.2587** | 23.47 | 23.50 |
| | | | Front | | | **0.0000** | 23.47 | 23.50 |
| 1g SAR Limit (Head & Body) = 1.6W/kg | | | | | | | | |

*Table 12: CDMA PCS SAR Results*

| | Body Mode SAR Results Using 1900MHz MSL. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date** | **TX Mode** | | **Position** | **Power Drift (dB)** | **Measured SAR 1g (W/kg)** | **Reported SAR 1g (W/kg)** | **Measured Conducted Output Power (dBm)** | **Maximum Conducted Output Power (dBm)** |
| 6/28/2016 | CDMA PCS Band, High Channel (1175) (Repeatability Measurement) | Pouch | Back | 0.23 | 1.1100 | **1.1177** | 23.47 | 23.50 |
| | | | Front | | | | | |
| 1g SAR Limit (Head & Body) = 1.6W/kg | | | | | | | | |

*Table 13: CDMA PCS SAR Results (Repeatability Measurement)*

| | Body Mode SAR Results Using 2450MHz MSL. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date** | **TX Mode** | **Spacing** | **Position** | **Power Drift (dB)** | **Measured SAR 1g (W/kg)** | **Reported SAR 1g (W/kg)** | **Measured Conducted Output Power (dBm)** | **Maximum Conducted Output Power (dBm)** |
| 5/26/2016 | 802.11b (Low) | Pouch | Back | -0.23 | 0.0760 | **0.0570** | 22.25 | 21.00 |
| | | | Front | | | | | |
| 5/26/2016 | 802.11b (Mid) | Pouch | Back | -0.23 | 0.0570 | **0.0338** | 23.27 | 21.00 |
| | | | Front | -0.21 | 0.0560 | **0.0332** | 23.27 | 21.00 |
| 5/26/2016 | 802.11b High) | Pouch | Back | -0.24 | 0.0930 | **0.0571** | 23.12 | 21.00 |
| | | | Front | | | | | |
| 5/26/2016 | 802.11g (Low) | Pouch | Back | -0.18 | 0.0570 | **0.0343** | 22.21 | 20.00 |
| | | | Front | | | | | |
| 5/26/2016 | 802.11g (Mid) | Pouch | Back | -0.26 | 0.0960 | **0.0535** | 22.54 | 20.00 |
| | | | Front | -0.21 | 0.0250 | **0.0139** | 22.54 | 20.00 |
| 5/26/2016 | 802.11g (High) | Pouch | Back | -0.15 | 0.1040 | **0.0568** | 22.63 | 20.00 |
| | | | Front | | | | | |
| 5/26/2016 | 802.11n (Low) | Pouch | Back | | | | | |
| | | | Front | | | | | |
| 5/26/2016 | 802.11n (Mid) | Pouch | Back | | | | | |
| | | | Front | | | | | |
| 5/26/2016 | 802.11n (High) | Pouch | Back | | | | | |
| | | | Front | | | | | |
| **1g SAR Limit (Head & Body) = 1.6W/kg** | | | | | | | | |

*Table 14: WiFi SAR Results*

| | Body Mode SAR Results Using 2450MHz MSL. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date** | **TX Mode** | | **Position** | **Power Drift (dB)** | **Measured SAR 1g (W/kg)** | **Reported SAR 1g (W/kg)** | **Measured Conducted Output Power (dBm)** | **Maximum Conducted Output Power (dBm)** |
| | Bluetooth Low Channel | Pouch | Back | | | | | |
| | | | Front | | | | | |
| 7/1/2016 | Bluetooth Mid Channel | Pouch | Back | 0.10 | 0.0198 | **0.0220** | 7.28 | 7.73 |
| | | | Front | -0.19 | 0.0196 | **0.0217** | 7.28 | 7.73 |
| | Bluetooth High Channel | Pouch | Back | | | | | |
| | | | Front | | | | | |
| **1g SAR Limit (Head & Body) = 1.6W/kg** | | | | | | | | |

*Table 15: Bluetooth SAR Results*

## Standalone SAR Measurements (Hand Held Mode):

| | Extremity SAR Results Using 900MHz MSL. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | TX Mode | | Position | Power Drift (dB) | Measured SAR 10g (W/kg) | Reported SAR 10g (W/kg) | Measured Conducted Output Power (dBm) | Maximum Conducted Output Power (dBm) |
| 5/17/2016 | CDMA Cell Band, Low Channel (1013) | Pouch | Back | 0.06 | 0.5220 | **0.6204** | 23.75 | 24.50 |
| | | | Front | | | | | |
| | | | Left | | | | | |
| | | | Right | | | | | |
| 5/17/2016 | CDMA Cell Band, Mid Channel (384) | Pouch | Back | 0.13 | 0.7560 | **0.8138** | 24.18 | 24.50 |
| | | | Front | -0.03 | 0.4890 | **0.5264** | 24.18 | 24.50 |
| | | | Left | 0.14 | 0.1120 | **0.1206** | 24.18 | 24.50 |
| | | | Right | 0.25 | 0.5020 | **0.5404** | 24.18 | 24.50 |
| 5/17/2016 | CDMA Cell Band, High Channel (777) | Pouch | Back | 0.34 | 0.4600 | **0.5831** | 23.47 | 24.50 |
| | | | Front | | | | | |
| | | | Left | | | | | |
| | | | Right | | | | | |
| 10g SAR Limit (Extremities) = 4.0 | | | | | | | | |

*Table 16: CDMA Cell SAR Results*

| | Extremity SAR Results Using 1900MHz MSL. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | TX Mode | | Position | Power Drift (dB) | Measured SAR 10g (W/kg) | Reported SAR 10g (W/kg) | Measured Conducted Output Power (dBm) | Maximum Conducted Output Power (dBm) |
| 5/18/2016 | CDMA PCS Band, Low Channel | Direct Contact with Phantom | Back | 0.07 | 2.5500 | **2.7198** | 23.22 | 23.50 |
| | | | Front | | | | | |
| | | | Left | 0.02 | 3.1600 | **3.3704** | 23.22 | 23.50 |
| | | | Right | | | | | |
| 5/18/2016 | CDMA PCS Band, Mid Channel | Direct Contact with Phantom | Back | -0.16 | 1.7000 | **1.8300** | 23.18 | 23.50 |
| | | | Front | 0.21 | 0.2930 | **0.3154** | 23.18 | 23.50 |
| | | | Left | -0.29 | 3.0000 | **3.2294** | 23.18 | 23.50 |
| | | | Right | -0.04 | 0.0110 | **0.0118** | 23.18 | 23.50 |
| 6/6/2016 | CDMA PCS Band, High Channel | Direct Contact with Phantom | Back | 0.09 | 2.7500 | **2.8466** | 23.35 | 23.50 |
| | | | Front | | | | | |
| | | | Left | 0.10 | 3.7700 | **3.9025** | 23.35 | 23.50 |
| | | | Right | | | | | |
| 10g SAR Limit (Extremities) = 4.0 | | | | | | | | |

*Table 17: CDMA PCS SAR Results*

| | Extremity SAR Results Using 1900MHz MSL. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | TX Mode | Spacing | Position | Power Drift (dB) | Measured SAR 10g (W/kg) | Reported SAR 10g (W/kg) | Measured Conducted Output Power (dBm) | Maximum Conducted Output Power (dBm) |
| 6/28/2016, 7/6/2016 | CDMA PCS Band, High Channel (Repeatability Measurements) | Direct Contact with Phantom | Left | -0.20 | 3.4000 | **3.5195** | 23.35 | 23.50 |
| | | | Left | -0.15 | 3.4200 | **3.5402** | 23.35 | 23.50 |
| | | | | | | | | |
| | | | | | | | | |
| 10g SAR Limit (Extremities) = 4.0 | | | | | | | | |

*Table 18: CDMA PCS SAR Results (Repeatability Measurements)*

| | Extremity SAR Results Using 2450MHz MSL. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date** | **TX Mode** | **Spacing** | **Position** | **Power Drift (dB)** | **Measured SAR 10g (W/kg)** | **Reported SAR 10g (W/kg)** | **Measured Conducted Output Power (dBm)** | **Maximum Conducted Output Power (dBm)** |
| 5/26/2016 | 802.11b (Mid) | Direct Contact with Phantom | Back | -0.29 | 0.0920 | **0.0545** | 23.27 | 21.00 |
| | | | Right | 0.01 | 0.1870 | **0.1109** | 23.27 | 21.00 |
| | | | Left | 0.10 | 0.0083 | **0.0049** | 23.27 | 21.00 |
| | | | Front | -0.24 | 0.0830 | **0.0492** | 23.27 | 21.00 |
| 5/26/2016 | 802.11g (Mid) | Direct Contact with Phantom | Back | -0.27 | 0.0780 | **0.0435** | 22.54 | 20.00 |
| | | | Right | -0.04 | 0.1880 | **0.1048** | 22.54 | 20.00 |
| | | | Left | -0.10 | 0.0059 | **0.0033** | 22.54 | 20.00 |
| | | | Front | -0.14 | 0.0980 | **0.0546** | 22.54 | 20.00 |
| 5/26/2016 | 802.11n (Mid) | Direct Contact with Phantom | Back | | | | | |
| | | | Right | | | | | |
| | | | Left | | | | | |
| | | | Front | | | | | |
| **10g SAR Limit (Extremities) = 4.0** | | | | | | | | |

*Table 19: WiFi SAR Results*

**Conducted Output Power Measurements:**

| Mode | Frequency (MHz) | Channel Number | Type | Conducted Power (dBm) Data Rate (Mbps) 1 | 2 | 5.5 | 11 |
|---|---|---|---|---|---|---|---|
| 802.11b | 2412 | 1 | Peak | 22.25 | 22.23 | 22.22 | 22.21 |
| | 2437 | 6 | Peak | 23.27 | 23.18 | 22.92 | 22.92 |
| | 2462 | 11 | Peak | 23.12 | 23.09 | 23.06 | 22.94 |

*Table 20: Conducted Power Measurements (802.11b)*

| Mode | Frequency (MHz) | Channel Number | Type | Conducted Power (dBm) Data Rate (Mbps) 6 | 9 | 12 | 18 | 24 | 36 | 48 | 54 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.11g | 2412 | 1 | Peak | 22.21 | 22.18 | 20.42 | 19.85 | 19.91 | 19.92 | 18.42 | 18.42 |
| | 2437 | 6 | Peak | 22.54 | 22.32 | 20.36 | 19.92 | 19.76 | 19.72 | 18.89 | 18.54 |
| | 2462 | 11 | Peak | 22.63 | 22.55 | 21.89 | 20.97 | 20.01 | 19.78 | 18.99 | 18.61 |

*Table 21: Conducted Power Measurements (802.11g)*

| Mode | Frequency (MHz) | Channel Number | Type | Conducted Power (dBm) MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.11n | 2412 | 1 | Peak | 22.19 | 20.21 | 19.91 | 19.89 | 19.75 | 18.11 | 18.13 | 15.45 |
| | 2437 | 6 | Peak | 22.54 | 21.86 | 20.73 | 19.91 | 19.64 | 18.43 | 17.65 | 16.06 |
| | 2462 | 11 | Peak | 22.62 | 22.06 | 21.56 | 20.87 | 20.01 | 18.98 | 18.02 | 16.21 |

*Table 22: Conducted Power Measurements (802.11n)*

| Band | Channel | Frequency (MHz) | Power Readings in dBm RC1/SO55 | RC3/SO55 | RC3/SO32 (+F-SCH) | RC3/SO32 (+SCH) |
|---|---|---|---|---|---|---|
| Cellular | 1013 | 824.7 | 23.79 | 23.75 | 23.71 | 23.72 |
| | 384 | 836.52 | 24.18 | 24.12 | 23.16 | 23.14 |
| | 777 | 848.31 | 23.49 | 23.87 | 23.53 | 23.47 |
| PCS | 25 | 1851.25 | 23.22 | 23.21 | 22.99 | 22.99 |
| | 600 | 1880 | 23.18 | 23.09 | 22.98 | 23.02 |
| | 1175 | 1908.75 | 23.35 | 23.32 | 23.07 | 22.98 |

*Table 23: Conducted Power Measurements (CDMA)*

| Mode | Channel | Frequency (MHz) | Output Power (Average, dBm) | Output Power (Peak, dBm) |
|---|---|---|---|---|
| GFSK | 0 | 2402 | 6.76 | 7.28 |
| | 39 | 2440 | 7.28 | 7.78 |
| | 78 | 2480 | 7.27 | 7.73 |
| EDR2 | 0 | 2402 | 4.46 | 5.38 |
| | 39 | 2440 | 4.5 | 5.46 |
| | 78 | 2480 | 4.51 | 5.43 |
| EDR3 | 0 | 2402 | 4.37 | 7.01 |
| | 39 | 2440 | 4.53 | 7.43 |
| | 78 | 2480 | 4.52 | 7.43 |
| BLE | 0 | 2402 | 6.75 | 7.26 |
| | 39 | 2440 | 7.26 | 7.73 |
| | 78 | 2480 | 7.25 | 7.71 |

*Note that the Bluetooth radio is exempt from SAR testing due to the low output power

*Table 24: Conducted Power Measurements (Bluetooth)*

**Simultaneous Transmission Calculations:**

The device does not support simultaneous transmission with any of the radios that are onboard.

**SAR Test Exclusions:**

The Bluetooth radio was excluded from standalone SAR due to the low output power.

The Near Field Communication radio was excluded from standalone SAR since it operates under 15.225 and has a low output power.

## 9.0 REFERENCES

[1] ANSI, *ANSI/IEEE C95.1-1991: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz*, The Institute of electrical and Electronics Engineers, Inc., New York, NY 10017, 1992

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[4] Niels Kuster, Ralph Kastle, and Thomas Schmid, “Dosimetic evaluation of mobile communications equipment with know precision”, IEICE Transactions on Communications, vol. E80-B, no. 5, pp.645-652, May 1997.

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[7] Federal Communications Commission, KDG 248227 - “SAR Measurement Procedures for 802.11 a/b/g Transmitters”

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[10] Federal Communications Commission, KDB 616217 – “SAR Evaluation Considerations for Laptop Computers with Antennas Built-in on Display Screens”.

[11] Federal Communications Commission, KDB 450824 – “SAR Probe Calibration and System Verification Considerations for Measurements at 150MHz – 3GHz”.

[12] Federal Communications Commission, KDB 865664 – “SAR Measurement Requirements for 3-6GHz”.

[13] Federal Communications Commission, KDB 941225 – “SAR Measurement Procedures for 3G Devices”.

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## APPENDIX – SYSTEM VALIDATION SUMMARY

Per FCC KDB 865664, a tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters have been included in the summary table below. The validation was performed with reference dipoles using the required tissue equivalent media for system validation according to KDB 865664. Each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point. All measurements were performed using probes calibrated for CW signals. Modulations in the table above represent test configurations for which the SAR system has been validated. The SAR system was also validated with modulated signals per KDB 865664.

| | | | | Probe Calibration Point | | Dielectric Properties | | CW Validation | | | Modulation Validation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Date | Probe (SN#) | Probe (Model #) | Frequency (MHz) | Fluid Type | σ | $\epsilon_r$ | Sensitivity | Probe Linearity | Probe Isotropy | Mod. Type | Duty Factor | PAR |
| 835 | 12/20/2015 | 3516 | EX3DV3 | 835 | Body | 54.2 | 0.98 | Pass | Pass | Pass | GMSK | Pass | N/A |
| 900 | 12/20/2015 | 3516 | EX3DV3 | 900 | Body | 54 | 1.02 | Pass | Pass | Pass | GMSK | Pass | N/A |
| 1750 | 12/20/2015 | 3516 | EX3DV3 | 1800 | Body | 52.9 | 1.41 | Pass | Pass | Pass | GMSK | Pass | N/A |
| 1900 | 12/20/2015 | 3516 | EX3DV3 | 1900 | Body | 52.7 | 1.48 | Pass | Pass | Pass | GMSK | Pass | N/A |

| | | | | Probe Calibration Point | | Dielectric Properties | | CW Validation | | | Modulation Validation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Date | Probe (SN#) | Probe (Model #) | Frequency (MHz) | Fluid Type | σ | $\epsilon_r$ | Sensitivity | Probe Linearity | Probe Isotropy | Mod. Type | Duty Factor | PAR |
| 2450 | 12/22/2015 | 3516 | EX3DV3 | 2450 | Body | 50.65 | 2.02 | Pass | Pass | Pass | OFDM | N/A | Pass |
| 5200 | 12/21/2015 | 3516 | EX3DV3 | 5200 | Body | 48.71 | 5.54 | Pass | Pass | Pass | OFDM | N/A | Pass |
| 5500 | 12/21/2015 | 3516 | EX3DV3 | 5500 | Body | 47.68 | 6.29 | Pass | Pass | Pass | OFDM | N/A | Pass |
| 5800 | 12/21/2015 | 3516 | EX3DV3 | 5800 | Body | 48.71 | 5.54 | Pass | Pass | Pass | OFDM | N/A | Pass |

*Table 25: SAR System Validation Summary*