**RF Exposure Lab**

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# CERTIFICATE OF COMPLIANCE
# SAR EVALUATION

| | | | |
|---|---|---|---|
| Novatel Wireless | | Dates of Test: | October 3-5, 2012 |
| 9645 Scranton Road, Suite 205 | | Test Report Number: | SAR.20121001 |
| San Diego, CA 92121 | | | Revision A |

| | |
|---|---|
| FCC ID: | PKRNVWMIFI5510 |
| Model(s): | MiFi5510L |
| Test Sample: | Engineering Unit Same as Production |
| FID Number: | UB3010812700012 |
| Equipment Type: | Wireless Hotspot Modem |
| Classification: | Portable Transmitter Next to Body |
| TX Frequency Range: | 824 – 848 MHz; 1850 – 1909 MHz; 777 – 787 MHz, 1710 – 1755 MHz, 2412 – 2462 MHz |
| Frequency Tolerance: | ± 2.5 ppm |
| Maximum RF Output: | 850 MHz (CDMA) – 24.49 dBm, 1900 MHz (CDMA) – 24.49 dBm, 782 MHz (LTE) – 24.49 dBm, 1735 MHz (LTE) – 24.49 dBm; 2450 MHz – 17.49 dBm Conducted |
| Signal Modulation: | CDMA, QPSK, 16QAM, DSSS, OFDM |
| Antenna Type: | WWAN – Pulse, P/N W3671 (Main), PIFA Antenna; Pulse, P/N W3672 (Diversity), PIFA Antenna<br>WLAN – Pulse, P/N W3300, PIFA Antenna |
| Application Type: | Certification |
| FCC Rule Parts: | Part 2, 15C, 22, 24, 27 |
| KDB Test Methodology: | KDB 447498, KDB 248227, KDB 941225 D01, D05 & D06 |
| Industry Canada: | RSS-102, Safety Code 6 |
| Max. Stand Alone SAR Value: | 1.437 W/kg |
| Max. Simultaneous SAR Value: | 1.496 W/kg |
| Separation Distance: | 10 mm |

This wireless mobile and/or portable device has been shown to be compliant for localized specific absorption rate (SAR) for uncontrolled environment/general exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in IEEE 1528-2003, and OET Bulletin 65 Supp. C (See test report).

I attest to the accuracy of the data. All measurements were performed by myself or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RF Exposure Lab, LLC certifies that no party to this application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).

Jay M. Moulton
Vice President

ACCREDITED
Certificate # 2387.01

# Table of Contents

# 1. Introduction

This measurement report shows compliance of the Novatel Wireless Model MiFi5510L FCC ID: PKRNVWMIFI5510 with FCC Part 2, 1093, ET Docket 93-62 Rules for mobile and portable devices. The FCC have adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on August 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC regulated portable devices. [1], [6]

The test results recorded herein are based on a single type test of Novatel Wireless Model MiFi5510L and therefore apply only to the tested sample.

The test procedures, as described in ANSI C95.1 – 1999 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [2], ANSI C95.3 – 2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields [3], FCC OET Bulletin 65 Supp. C – 2001 [4], IEEE Std.1528 – 2003 Recommended Practice [5], and Industry Canada Safety Code 6 Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3kHz to 300 GHz were employed.

The following table indicates all the wireless technologies operating in the MiFi5510L wireless modem. The table also shows the tolerance for the power level for each mode.

| Band | Technology | Class | 3GPP Nominal Power dBm | Setpoint Nominal Power dBm | Tolerance dBm | Lower Tolerance dBm | Upper Tolerance dBm |
|---|---|---|---|---|---|---|---|
| Band 4 – 1750 MHz | LTE | 3 | 23 | 23 | +1.5/-1.0 | 22.0 | 24.5 |
| Band 13 – 782 MHz | LTE | 3 | 23 | 23 | +1.5/-1.0 | 22.0 | 24.5 |
| Band Class 0 – 835 MHz | CDMA | 3 | 23.75 | 23.7 | +0.75/-0.75 | 23.0 | 24.5 |
| Band Class 0 – 1900 MHz | CDMA | 2 | 23.75 | 23.7 | +0.75/-0.75 | 23.0 | 24.5 |
| WLAN – 2.4 GHz | 802.11b | N/A | N/A | 13.5 | ±4.0 | 9.5 | 17.5 |
| WLAN – 2.4 GHz | 802.11g/n(Ch. 1 and 11) | N/A | N/A | 7 | ±4.0 | 3 | 11 |
| WLAN – 2.4 GHz | 802.11 g/n(Ch. 2-10 | N/A | N/A | 11 | ±4.0 | 7 | 15 |

## SAR Definition [5]

Specific Absorption Rate is defined as 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 ($\rho$).

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

SAR is expressed in units of watts per kilogram (W/kg). *SAR* can be related to the electric field at a point by

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

where:

$\sigma$ = conductivity of the tissue (S/m)

$\rho$ = mass density of the tissue (kg/m$^3$)

$E$ = rms electric field strength (V/m)

# 2. SAR Measurement Setup

## Robotic System

These measurements are performed using the DASY52 automated dosimetric assessment system. The DASY52 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Intel Core2 computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 2.1).

## System Hardware

A cell controller system contains the power supply, robot controller teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the HP Intel Core2 computer with Windows XP system and SAR Measurement Software DASY52, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

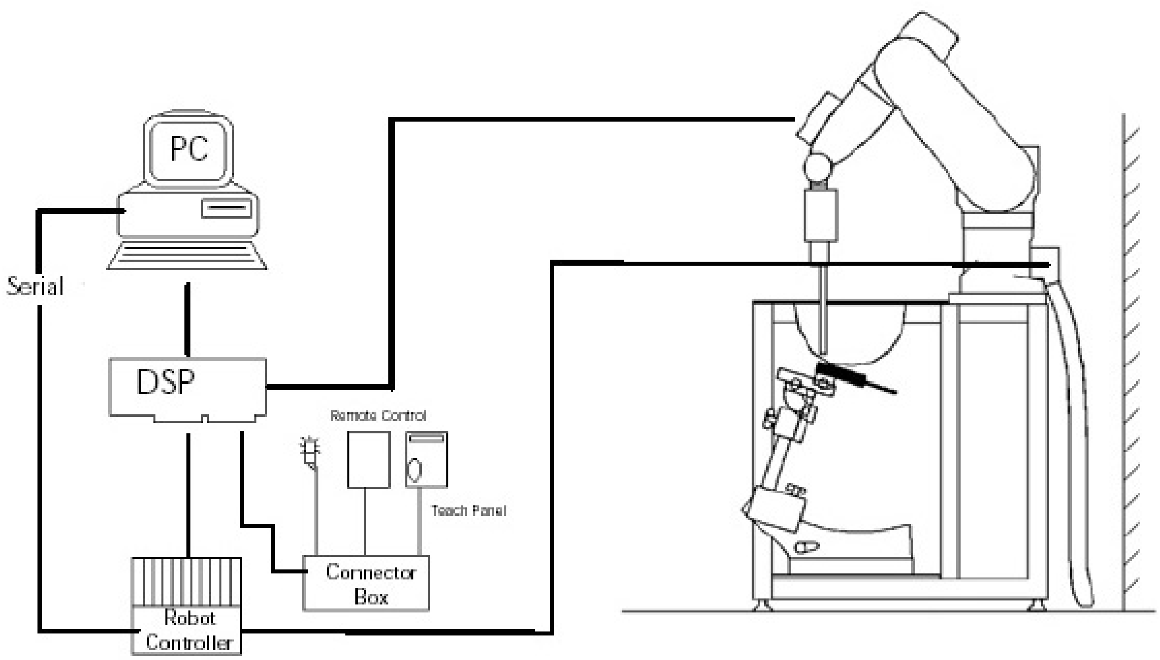



**Figure 2.1 SAR Measurement System Setup**

## System Electronics

The DAE4 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 PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in.

## Probe Measurement System

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration (see Fig. 2.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi fiber line ending at the front of the probe tip. (see Fig. 2.3) It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY52 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

**DAE System**

## Probe Specifications

**Calibration:** In air from 10 MHz to 6.0 GHz
In brain and muscle simulating tissue at Frequencies of 450 MHz, 835 MHz, 1750 MHz, 1900 MHz, 2450 MHz, 2600 MHz, 3500 MHz, 5200 MHz, 5300 MHz, 5600 MHz, 5800 MHz

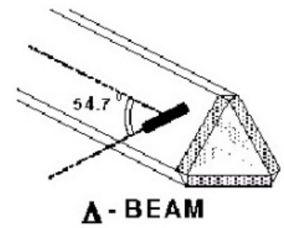



**Figure 2.2 Triangular Probe Configurations**

**Frequency**: 10 MHz to 6 GHz

**Linearity:** ±0.2dB (30 MHz to 6 GHz)

**Dynamic:** 10 mW/kg to 100 W/kg

**Range:** Linearity: ±0.2dB

**Dimensions:** Overall length: 330 mm

**Tip length:** 20 mm

**Body diameter:** 12 mm

**Tip diameter:** 2.5 mm

**Distance from probe tip to sensor center:** 1 mm

**Application:** SAR Dosimetry Testing
Compliance tests of wireless device

**Figure 2.3 Probe Thick-Film Technique**

# Probe Calibration Process

## Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure described in with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in and found to be better than +/-0.25dB. The sensitivity parameters (Norm X, Norm Y, Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe is tested.

## Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a waveguide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/cm$^2$.

## Temperature Assessment *

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium, correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor based temperature probe is used in conjunction with the E-field probe

$$\text{SAR} = C\frac{\Delta T}{\Delta t}$$

where:

$\Delta t$ = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

$\Delta T$ = temperature increase due to RF exposure.

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

where:

$\sigma$ = simulated tissue conductivity,

$\rho$ = Tissue density (1.25 g/cm$^3$ for brain tissue)

SAR is proportional to $\Delta T / \Delta t$, the initial rate of tissue heating, before thermal diffusion takes place.
Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

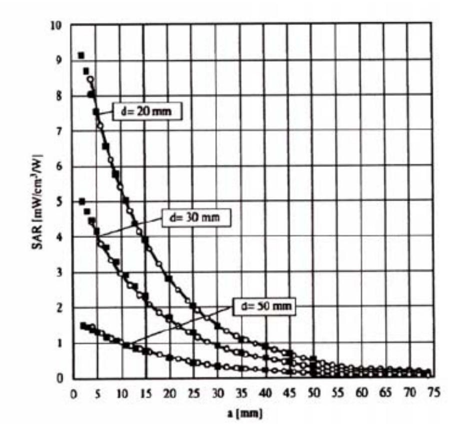



**Figure 2.4 E-Field and Temperature Measurements at 900MHz**

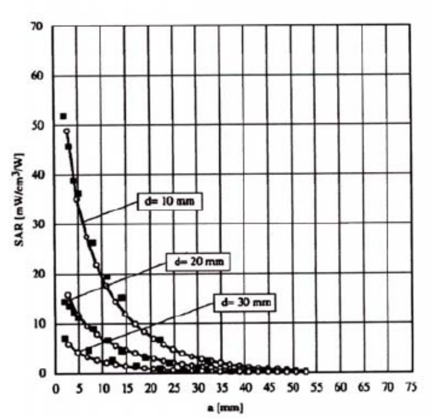



**Figure 2.5 E-Field and Temperature Measurements at 1800MHz**

## Data Extrapolation

The DASY52 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given like below;

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with
$V_i$ = compensated signal of channel i (i=x,y,z)
$U_i$ = input signal of channel i (i=x,y,z)
cf = crest factor of exciting field (DASY parameter)
$dcp_i$ = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with
$V_i$ = compensated signal of channel i (i = x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i = x,y,z) $\mu V/(V/m)^2$ for E-field probes
ConvF = sensitivity of enhancement in solution
$E_i$ = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermetian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with
SAR = local specific absorption rate in W/g
$E_{tot}$ = total field strength in V/m
$\sigma$ = conductivity in [mho/m] or [Siemens/m]
$\rho$ = equivalent tissue density in $g/cm^3$

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770}$$

with
$P_{pwe}$ = equivalent power density of a plane wave in $W/cm^2$
$E_{tot}$ = total electric field strength in V/m

## SAM PHANTOM

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 2.6)

## Phantom Specification

**Phantom:** SAM Twin Phantom (V4.0)
**Shell Material:** Vivac Composite
**Thickness:** 2.0 ± 0.2 mm

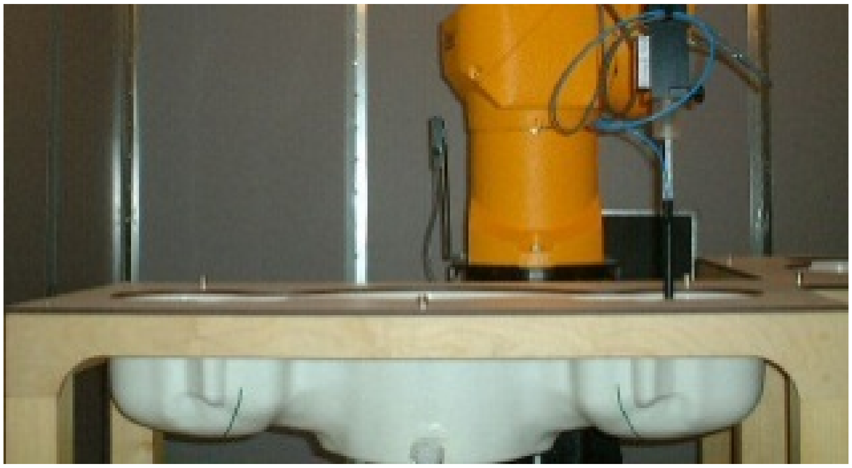


**Figure 2.6 SAM Twin Phantom**

## Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0 the Mounting Device (see Fig. 2.7), enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately, and repeat ably be positioned according to the FCC, CENELEC, IEC and IEEE specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

**Figure 2.7 Mounting Device**

Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

# 3. Probe and Dipole Calibration

**See Appendix D and E.**

# 4. Simulating Tissue Specifications

## Head & Body Simulating Mixture Characterization

The head and body mixtures consist of the material based on the table listed below. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. Body tissue parameters that have not been specified in P1528 are derived from the issue dielectric parameters computed from the 4-Cole-Cole equations.

**Table 4.1 Typical Composition of Ingredients for Tissue**

| Ingredients | | Simulating Tissue | | | | |
|---|---|---|---|---|---|---|
| | | 835 MHz Body | 1900 MHz Body | 2450 MHz Body | 750 MHz Body | 1750 MHz Body |
| Mixing Percentage | | | | | | |
| Water | | 52.50 | 69.91 | 73.20 | Proprietary | Proprietary |
| Sugar | | 45.00 | 0.00 | 0.00 | | |
| Salt | | 1.40 | 0.13 | 0.10 | | |
| HEC | | 1.00 | 0.00 | 0.00 | | |
| Bactericide | | 0.10 | 0.00 | 0.00 | | |
| DGBE | | 0.00 | 29.96 | 26.70 | | |
| Dielectric Constant | Target | 55.20 | 53.30 | 52.70 | 55.5 | 53.4 |
| Conductivity (S/m) | Target | 0.97 | 1.52 | 1.95 | 0.96 | 1.49 |

# 5. ANSI/IEEE C95.1 – 1992 RF Exposure Limits [2]

## 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.

## 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. This 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.

**Table 5.1 Human Exposure Limits**

| | UNCONTROLLED ENVIRONMENT<br>General Population<br>(W/kg) or (mW/g) | CONTROLLED ENVIROMENT<br>Professional Population<br>(W/kg) or (mW/g) |
|---|---|---|
| SPATIAL PEAK SAR[1]<br>Head | 1.60 | 8.00 |
| SPATIAL AVERAGE SAR[2]<br>Whole Body | 0.08 | 0.40 |
| SPATIAL PEAK SAR[3]<br>Hands, Feet, Ankles, Wrists | 4.00 | 20.00 |

[1] The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
[2] The Spatial Average value of the SAR averaged over the whole body.
[3] The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

# 6. Measurement Uncertainty

## Exposure Assessment Measurement Uncertainty

| Source of Uncertainty | Tolerance Value | Probability Distribution | Divisor | $c_i^1$ (1-g) | $c_i^1$ (10-g) | Standard Uncertainty (1-g) % | Standard Uncertainty (10-g) % | $v_i$ |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Measurement System | | | | | | | | |
| | | | | | | | | |
| Probe Calibration | 3.5 | normal | 1 | 1 | 1 | 3.5 | 3.5 | ∞ |
| Axial Isotropy | 3.7 | rectangular | √3 | 0.7 | 0.7 | 1.5 | 1.5 | ∞ |
| Hemispherical Isotropy | 10.9 | rectangular | √3 | 0.7 | 0.7 | 4.4 | 4.4 | ∞ |
| Boundary Effect | 1.0 | rectangular | √3 | 1 | 1 | 0.6 | 0.6 | ∞ |
| Linearity | 4.7 | rectangular | √3 | 1 | 1 | 2.7 | 2.7 | ∞ |
| Detection Limit | 1.0 | rectangular | √3 | 1 | 1 | 0.6 | 0.6 | ∞ |
| Readout Electronics | 1.0 | normal | 1 | 1 | 1 | 1.0 | 1.0 | ∞ |
| Response Time | 0.8 | rectangular | √3 | 1 | 1 | 0.5 | 0.5 | ∞ |
| Integration Time | 1.7 | rectangular | √3 | 1 | 1 | 1.0 | 1.0 | ∞ |
| RF Ambient Condition | 3.0 | rectangular | √3 | 1 | 1 | 1.7 | 1.7 | ∞ |
| Probe Positioner Mech. Restriction | 0.4 | rectangular | √3 | 1 | 1 | 0.2 | 0.2 | ∞ |
| Probe Positioning with respect to Phantom Shell | 2.9 | rectangular | √3 | 1 | 1 | 1.7 | 1.7 | ∞ |
| Extrapolation and Integration | 3.7 | rectangular | √3 | 1 | 1 | 2.1 | 2.1 | ∞ |
| Test Sample Positioning | 4.0 | normal | 1 | 1 | 1 | 4.0 | 4.0 | 7 |
| Device Holder Uncertainty | 2.0 | normal | 1 | 1 | 1 | 2.0 | 2.0 | 2 |
| Drift of Output Power | 4.8 | rectangular | √3 | 1 | 1 | 2.5 | 2.5 | ∞ |
| | | | | | | | | |
| Phantom and Setup | | | | | | | | |
| Phantom Uncertainty(shape & thickness tolerance) | 3.4 | rectangular | √3 | 1 | 1 | 2.0 | 2.0 | ∞ |
| Liquid Conductivity(target) | 5.0 | rectangular | √3 | 0.7 | 0.5 | 2.0 | 1.4 | ∞ |
| Liquid Conductivity(meas.) | 0.5 | normal | 1 | 0.7 | 0.5 | 0.4 | 0.3 | 5 |
| Liquid Permittivity(target) | 5.0 | rectangular | √3 | 0.6 | 0.5 | 1.7 | 1.4 | ∞ |
| Liquid Permittivity(meas.) | 1.0 | normal | 1 | 0.6 | 0.5 | 0.6 | 0.5 | 5 |
| Combined Uncertainty | | RSS | | | | 9.6 | 9.4 | >500 |
| Combined Uncertainty (coverage factor=2) | | Normal(k=2) | | | | 19.2 | 18.9 | >500 |

# 7. System Validation

## Tissue Verification

**Table 7.1 Measured Tissue Parameters**

| | | 750 MHz Body | | 835 MHz Body | | 1900 MHz Body | |
|---|---|---|---|---|---|---|---|
| Date(s) | | Oct. 5, 2012 | | Oct. 4, 2012 | | Oct. 3, 2012 | |
| Liquid Temperature (˚C) | 20.0 | Target | Measured | Target | Measured | Target | Measured |
| Dielectric Constant: ε | | 55.53 | 54.69 | 55.20 | 55.91 | 53.30 | 52.32 |
| Conductivity: σ | | 0.96 | 0.94 | 0.97 | 0.99 | 1.52 | 1.59 |

| | | 1750 MHz Body | | 2450 MHz Body | |
|---|---|---|---|---|---|
| Date(s) | | Oct. 6, 2012 | | Oct. 4, 2012 | |
| Liquid Temperature (˚C) | 20.0 | Target | Measured | Target | Measured |
| Dielectric Constant: ε | | 53.43 | 52.68 | 52.70 | 51.68 |
| Conductivity: σ | | 1.49 | 1.56 | 1.95 | 1.93 |

See Appendix A for data printout.

## Test System Verification

Prior to assessment, the system is verified to the ±10% of the specifications at the test frequency by using the system kit. Power is normalized to 1 watt. (Graphic Plots Attached)

**Table 7.2 System Dipole Validation Target & Measured**

| | Test Frequency | Targeted $SAR_{1g}$ (W/kg) | Measure $SAR_{1g}$ (W/kg) | Tissue Used for Verification | Deviation (%) | Plot Number |
|---|---|---|---|---|---|---|
| 04-Oct-2012 | 750 MHz | 8.82 | 8.50 | Body | - 3.63 | 1 |
| 04-Oct-2012 | 835 MHz | 9.89 | 9.87 | Body | - 0.20 | 2 |
| 03-Oct-2012 | 1900 MHz | 39.90 | 40.70 | Body | + 2.01 | 3 |
| 05-Oct-2012 | 1750 MHz | 37.60 | 39.80 | Body | + 5.85 | 4 |
| 04-Oct-2012 | 2450 MHz | 50.30 | 51.70 | Body | + 2.78 | 5 |

See Appendix A for data plots.

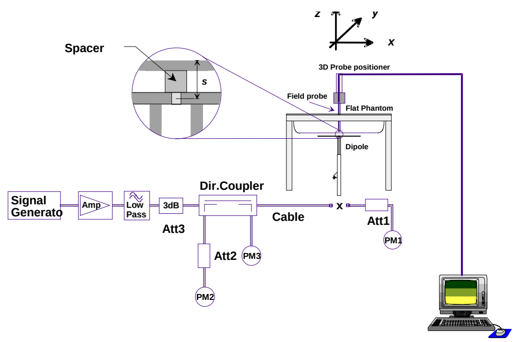



**Figure 8.1 Dipole Validation Test Setup**

Note: KDB 450824 was applied for probe calibration frequencies greater than or equal to 50 MHz of the DUT frequencies.

# 8. LTE Document Checklist

1) Identify the operating frequency range of each LTE transmission band used by the device

| LTE Operating Band | Uplink (transmit) | Downlink (Receive) | Duplex mode (FDD/TDD) |
|---|---|---|---|
| | Low - high | Low - high | |
| 4 | 1710-1755 | 2110-2155 | FDD |
| 13 | 777-787 | 746-756 | FDD |

2) Identify the channel bandwidths used in each frequency band; 1.4, 3, 5, 10, 15, 20 MHz etc

| LTE Band Class | Bandwidth (MHz) | Frequency or Freq. Band (MHz) |
|---|---|---|
| 4 | 1.4, 3, 5, 10, 15, 20 | 1710-1755 MHz |
| 13 | 5, 10 | 777-787 MHz |

3) Identify the high, middle and low (H, M, L) channel numbers and frequencies in each LTE frequency band

| LTE Band Class | Bandwidth (MHz) | Frequency (MHz)/Channel # | | | | | |
|---|---|---|---|---|---|---|---|
| | | Low | | Mid | | High | |
| 4 | 1.4 | 1710.7 | 19957 | 1732.5 | 20175 | 1754.3 | 20393 |
| 4 | 3 | 1711.5 | 19965 | 1732.5 | 20175 | 1753.5 | 20385 |
| 4 | 5 | 1712.5 | 19975 | 1732.5 | 20175 | 1752.5 | 20375 |
| 4 | 10 | 1715.0 | 20000 | 1732.5 | 20175 | 1750.0 | 20350 |
| 4 | 15 | 1717.5 | 20025 | 1732.5 | 20175 | 1747.5 | 20325 |
| 4 | 20 | 1720.0 | 20050 | 1732.5 | 20175 | 1745.0 | 20300 |
| 13 | 5 | 779.5 | 23205 | - | - | 784.5 | 23255 |
| 13 | 10 | - | - | 782.0 | 23230 | - | - |

4) Specify the UE category and uplink modulations used:
   - UE Category: 3
   - Uplink modulations: QPSK and 16QAM

5) Include descriptions of the LTE transmitter and antenna implementation; and also identify whether it is a standalone transmitter operating independently of other wireless transmitters in the device or sharing hardware components and/or antenna(s) with other transmitters etc

The MiFi5510L has 3 antennas:

- WWAN Main (Transmit and Receive) Antenna
- WLAN Main (Transmit and Receive) Antenna
- Diversity (Receive Only) Antenna with GPS (Receive Only) capabilities

Transmission relationship

- All transmission (TX) is limited to the WWAN and WLAN antennas only
- The device is unable to transmit CDMA and LTE simultaneously.
- The Diversity antenna is receive only antenna which is reserved for the WWAN operation.
- Rx is simultaneous on Main and Diversity
- Simultaneous Tx with the WWAN and WLAN is allowed.

| Antenna port | CDMA | | LTE | | 802.11 b/g/n | | GPS |
|---|---|---|---|---|---|---|---|
| | TX | RX | TX | RX | TX | RX | RX |
| #1 WWAN Main | **Yes** | **Yes** | **Yes** | **Yes** | No | No | No |
| #2 WLAN Main | No | No | No | No | **Yes** | **Yes** | No |
| #3 (Diversity/GPS) | No | **Yes** | No | **Yes** | No | No | **Yes** |

6) Identify the LTE voice/data requirements in each operating mode and exposure condition with respect to head and body test configurations, antenna locations, handset flip-cover or slide positions, antenna diversity conditions etc

The MiFi5510L is a data only hotspot device. Data mode was tested in each operating mode and exposure condition in the body configuration. See test setup photos to see all configurations tested.

7) Identify if Maximum Power Reduction (MPR) is optional or mandatory, i.e. built-in by design:

a) Only mandatory MPR may be considered during SAR testing, when the maximum output power is permanently limited by the MPR implemented within the UE; and only for the applicable RB (resource block) configurations specified in LTE standards

MPR is mandatory, built-in by design on all production units. It was enabled during testing.

| Modulation | Channel Bandwidth/transmission Bandwidth Configuration (RB) | | | | | | MPR (dB) |
|---|---|---|---|---|---|---|---|
| | 1.4 MHz | 3.0 MHZ | 5 MHz | 10 MHz | 15 MHz | 20 MHz | |
| QPSK | > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | ≤ 1 |
| 16QAM | ≤ 5 | ≤ 4 | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 18 | ≤ 1 |
| 16QAM | > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | ≤ 2 |

b) A-MPR (additional MPR) must be disabled
c) A-MPR was disabled during testing.

8) Include the maximum average conducted output power measured on the required test channels for each channel bandwidth and UL modulation used in each frequency band:

The maximum average conducted output power measured for the testing is listed on pages 28-32 of this report. The below table shows the factory set point with the allowable tolerance.

| Band | Technology | Class | 3GPP Nominal Power dBm | Setpoint Nominal Power dBm | Tolerance dBm | Lower Tolerance dBm | Upper Tolerance dBm |
|---|---|---|---|---|---|---|---|
| Band 4 – 1750 MHz | LTE | 3 | 23 | 23 | +1.5/-1.0 | 22.0 | 24.5 |
| Band 13 – 782 MHz | LTE | 3 | 23 | 23 | +1.5/-1.0 | 22.0 | 24.5 |

9) Identify all other U.S. wireless operating modes (3G, Wi-Fi, WiMax, Bluetooth etc), device/exposure configurations (head and body, antenna and handset flip-cover or slide positions, antenna diversity conditions etc.) and frequency bands used for these modes

Other wireless modes:

| Band | Technology | Class | 3GPP Nominal Power dBm | Setpoint Nominal Power dBm | Tolerance dBm | Lower Tolerance dBm | Upper Tolerance dBm |
|---|---|---|---|---|---|---|---|
| Band 4 – 1750 MHz | LTE | 3 | 23 | 23 | +1.5/-1.0 | 22.0 | 24.5 |
| Band 13 – 782 MHz | LTE | 3 | 23 | 23 | +1.5/-1.0 | 22.0 | 24.5 |
| Band Class 0 – 835 MHz | CDMA | 3 | 23.75 | 23.7 | +0.75/-0.75 | 23.0 | 24.5 |
| Band Class 0 – 1900 MHz | CDMA | 2 | 23.75 | 23.7 | +0.75/-0.75 | 23.0 | 24.5 |
| WLAN – 2.4 GHz | 802.11b | N/A | N/A | 13.5 | ±4.0 | 9.5 | 17.5 |
| WLAN – 2.4 GHz | 802.11g/n(Ch. 1 and 11) | N/A | N/A | 7 | ±4.0 | 3 | 11 |
| WLAN – 2.4 GHz | 802.11 g/n(Ch. 2-10 | N/A | N/A | 11 | ±4.0 | 7 | 15 |

10) Include the maximum average conducted output power measured for the other wireless modes and frequency bands.

The maximum average conducted output power measured for the testing is listed on pages 23-24 of this report. The table in item 9 shows the factory set point with the allowable tolerance.

11) Identify the simultaneous transmission conditions for the voice and data configurations supported by all wireless modes, device configurations and frequency bands, for the head and body exposure conditions and device operating configurations (handset flip or cover positions, antenna diversity conditions etc.)

The device is unable to transmit CDMA and LTE simultaneously.

The MiFi5510L is able to transmit WWAN and WLAN simultaneously.

| TX Modes | CDMA | LTE | 802.11 b/g/n |
|---|---|---|---|
| 1 | **ON** | OFF | **ON** |
| 2 | OFF | **ON** | **ON** |

12) When power reduction is applied to certain wireless modes to satisfy SAR compliance for simultaneous transmission conditions, other equipment certification or operating requirements, include the maximum average conducted output power measured in each power reduction mode applicable to the simultaneous voice/data transmission configurations for such wireless configurations and frequency bands; and also include details of the power reduction implementation and measurement setup

Power reduction is not required to satisfy SAR compliance.

13) Include descriptions of the test equipment, test software, built-in test firmware etc. required to support testing the device when power reduction is applied to one or more transmitters/antennas for simultaneous voice/data transmission

Power reduction is not required to satisfy SAR compliance.

14) When appropriate, include a SAR test plan proposal with respect to the above

Power reduction is not required to satisfy SAR compliance.

15) If applicable, include preliminary SAR test data and/or supporting information in laboratory testing inquiries to address specific issues and concerns or for requesting further test reduction considerations appropriate for the device; for example, simultaneous transmission configurations.

Not applicable.

# 9. SAR Test Data Summary

## See Measurement Result Data Pages

See Appendix B for SAR Test Data Plots.
See Appendix C for SAR Test Setup Photos.

## Procedures Used To Establish Test Signal

The device was either placed into simulated transmit mode using the manufacturer's test codes or the actual transmission is activated through a base station simulator or similar equipment. See data pages for actual procedure used in measurement.

## Device Test Condition

In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power unless otherwise noted. If a conducted power deviation of more than 5% occurred, the test was repeated. The power drift of each test is measured at the start of the test and again at the end of the test. The drift percentage is calculated by the formula ((end/start)-1)*100 and rounded to three decimal places. The drift percentage is calculated into the resultant SAR value on the data sheet for each test.

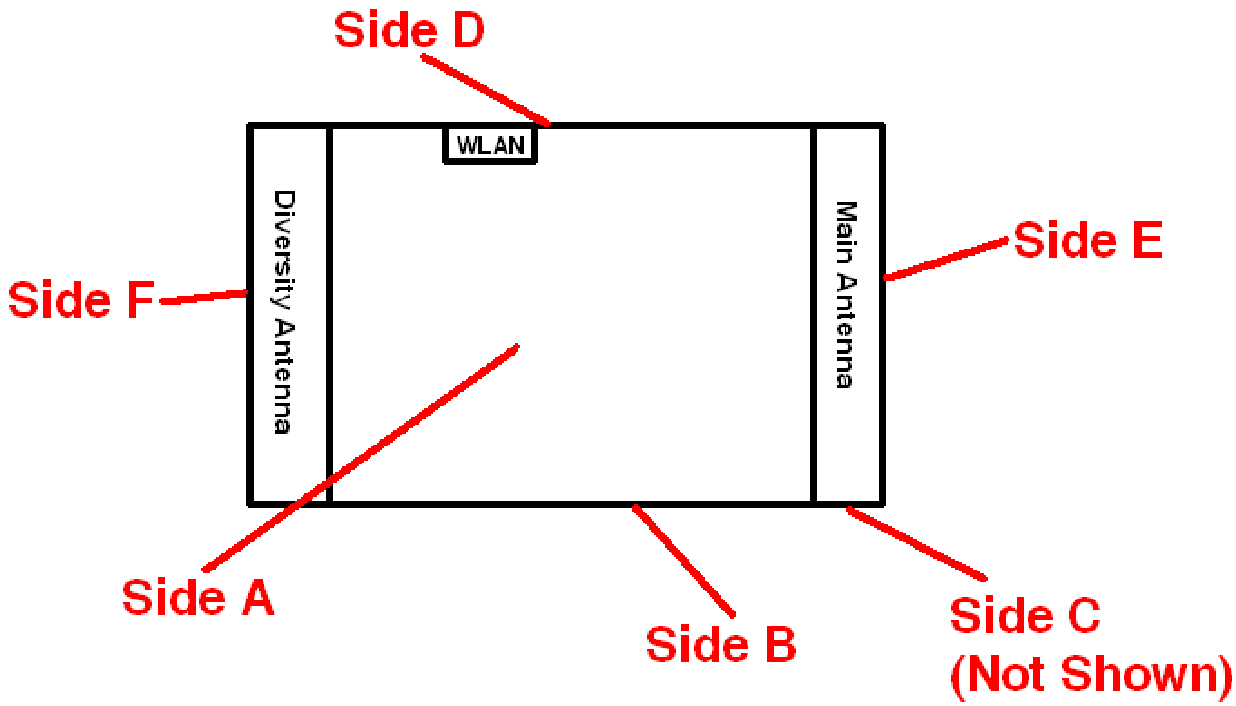
The testing was conducted on all edges closest to each antenna. Side A, Side B, Side C, Side D and Side E testing was conducted for the WWAN antenna. The Side F was not tested as the WWAN antenna was more than 2.5 cm from this side. The Side A, Side B, and Side C were tested for the WLAN antenna. Side D, Side E and Side F were not tested as the WLAN antenna was more than 2.5 cm from these sides. All further test reductions are shown on pages 26 for CDMA bands, page 25 for WLAN and pages 33-36 for LTE bands. All testing was conducted per KDB 941225 D06. See the photo in Appendix C for a pictorial of the setups, labeling of the sides tested and antenna locations. The distance between the WWAN and WLAN antenna is 44.14 cm.

The 1xRTT testing was conducted in RC3 with the device configured using TDSO/SO32 with FCH transmitting at full rate. The power control was set to "All Bits Up." 1xRTT did not require SAR testing due to the measured power being less than ¼ dB higher than Rev. 0.

The Rev. 0 testing was conducted with the Reverse Data Channel rate of 153.6 kbps. The Forward Traffic Channel data rate is set to the 2-slot version of 307.2 kbps with the ACK Channel transmitting in all slots. The power control was set to "All Bits Up." Other rates were not tested due to the conducted power measured was less than ¼ dB higher than 153.6 kbps.

The Rev. A Subtype 2 testing was conducted with the Reverse Data Channel payload size of 4096 bits and Termination Target of 16 slots. The Forward Traffic Channel data rate is set to the 2-slot version of 307.2 kbps with the ACK Channel transmitting in all slots. The power control was set to "All Bits Up." Rev. A did not require SAR testing due to the measured power being less than ¼ dB higher than Rev. 0.

**Figure 9.1**
**SAR Location Diagram of Modem Testing**




## Antenna Distances

| | |
|---|---|
| WWAN main to WLAN (mm): | 44.14 mm |
| WWAN main to Diversity (mm): | 73.10 mm |
| WLAN to Diversity (mm): | 27.25 mm |

# 10. FCC 3G Measurement Procedures

Power measurements were performed using a base station simulator under average power.

## 10.1 Procedures Used to Establish RF Signal for SAR

The device was placed into a simulated call using a base station simulator in a screen room. Such test signals offer a consistent means for testing SAR and recommended for evaluating SAR. The SAR measurement software calculates a reference point at the start and end of the test to check for power drifts. If conducted power deviations of more than 5% occurred, the tests were repeated.

## 10.2 SAR Measurement Conditions for CDMA2000, 1xEV-DO

### 10.2.1 Output Power Verification 1xRTT

Use CDMA2000 Rev 6 protocol in the call box.

1) Test for RC 3 Reverse FCH, RC3 Reverse SCH0 and demodulation of RC 3, 4 and 5.
   a. Set up a call using Supplemental Channel Test Mode 3 (RC 3, SO 32) with 9600 bps Fundamental Channel and 9600 bps SCH0 data rate.
   b. As per C.S0011 or TIA/EIA-98-F Table 4.4.5.2-2, set the test parameters.
   c. Send alternating ‘0’ and ‘1’ power control bit to the device
   d. Determine the active channel configuration. If the desired channel configuration is not the active channel configuration, increase Îor by 1 dB and repeat the verification. Repeat this step until the desired channel configuration becomes active.
   e. Measure the output power at the device antenna connector.
   f. Decrease Îor by 0.5 dB.
   g. Determine the active channel configuration. If the active channel configuration is the desired channel configuration, measure the output power at the device antenna connector.
   h. Repeat step f and g until the output power no longer increases or the desired channel configuration is no longer active. Record the highest output power achieved with the desired channel configuration active.
   i. Repeat step a through h ten times and average the result.

### 10.2.2 Output Power Verification 1xEvDo

1) Use 1xEV-DO Rel 0 protocol in the call box 8960.
   a. FTAP
      - Select Test Application Protocol to FTAP
      - Set FTAP Rate to 307.2 kbps (2 Slot, QPSK)
      - Generator Info -> Termination Parameters -> Max Forward Packet Duration -> 16 Slots
      - Set Îor to -60 dBm/1.23 MHz
      - Send continuously ‘0’ power control bits
      - Measure the power at device antenna connector
   b. RTAP
      - Select Test Application Protocol to RTAP
      - Set RTAP Rate to 9.6 kbps
      - Generator Info -> Termination Parameters -> Max Forward Packet Duration -> 16 Slots

- Set Îor to -60 dBm/1.23 MHz
- Send continuously '0' power control bits
- Measure the power at device antenna connector
- Repeat above steps for RTAP Rate = 19.2 kbps, 38.4 kbps, 76.8 kbps and 153.6 kbps respectively

2) Use 1xEV-DO Rev A protocol in the call box 8960
   a. FETAP
      - Select Test Application Protocol to FETAP
      - Set FETAP Rate to 307.2 kbps (2 Slot, QPSK)
      - Generator Info -> Termination Parameters -> Max Forward Packet Duration -> 16 Slots
      - Set Îor to -60 dBm/1.23 MHz
      - Send continuously '0' power control bits
      - Measure the power at device antenna connector
   b. RETAP
      - Select Test Application Protocol to RETAP
      - F-Traffic Format -> 4 (1024, 2, 128) Canonical (307.2k, QPSK) • Set R-Data Pkt Size to 128
      - Protocol Subtype Config -> Release A Physical Layer Subtype -> Subtype 2 ->PL Subtype 2 Access Channel MAC Subtype -> Default (Subtype 0)
      - Generator Info -> Termination Parameters -> Max Forward Packet Duration -> 16 Slots ->ACK R-Data After -> Subpacket 0 (All ACK)
      - Set Îor to -60 dBm/1.23 MHz
      - Send continuously '0' power control bits
      - Measure the power at device antenna connector
      - Repeat above steps for R-Data Pkt Size = 256, 512, 768, 1024, 1536, 2048, 3072, 4096, 6144, 8192, 12288 respectively.

**CDMA Power Measurements**
**Power Control was set in "All Bits Up" for all measurements.**

| | | IS-2000 | 1Xev-Do Rev. 0 | 1Xev-Do Rev. A Subtype 0/1 |
|---|---|---|---|---|
| | Channel | TDSO SO32 RC3 | RTAP [dBm] | RTAP [dBm] |
| Cellular | 1013 | 24.47 | 24.46 | 24.46 |
| | 384 | 24.49 | 24.46 | 24.44 |
| | 777 | 24.48 | 24.46 | 24.42 |
| | | | | |
| PCS | 25 | 24.44 | 24.42 | 24.46 |
| | 600 | 24.44 | 24.33 | 24.45 |
| | 1175 | 24.49 | 24.35 | 24.48 |

| Band | Mode | Channel | Data Rate | Frequency (MHz) | Conducted Power (dBm) Main |
|---|---|---|---|---|---|
| 2450 MHz | 802.11b | 1 | 1 | 2412 | 17.22 |
| | | | 2 | | 17.14 |
| | | | 5.5 | | 17.24 |
| | | | 11 | | 17.49 |
| | | 6 | 1 | 2437 | 17.36 |
| | | | 2 | | 17.32 |
| | | | 5.5 | | 17.48 |
| | | | 11 | | 17.35 |
| | | 11 | 1 | 2462 | 17.29 |
| | | | 2 | | 17.23 |
| | | | 5.5 | | 17.40 |
| | | | 11 | | 17.26 |
| | 802.11g | 1 | 6 | 2412 | 10.64 |
| | | | 9 | | 10.62 |
| | | | 12 | | 10.59 |
| | | | 18 | | 10.59 |
| | | | 24 | | 10.99 |
| | | | 36 | | 10.89 |
| | | | 48 | | 10.83 |
| | | | 54 | | 10.76 |
| | | 6 | 6 | 2437 | 14.70 |
| | | | 9 | | 14.67 |
| | | | 12 | | 14.79 |
| | | | 18 | | 14.81 |
| | | | 24 | | 14.95 |
| | | | 36 | | 14.69 |
| | | | 48 | | 14.68 |
| | | | 54 | | 14.64 |
| | | 11 | 6 | 2462 | 10.99 |
| | | | 9 | | 10.98 |
| | | | 12 | | 10.96 |
| | | | 18 | | 10.94 |
| | | | 24 | | 10.57 |
| | | | 36 | | 10.45 |
| | | | 48 | | 10.93 |
| | | | 54 | | 10.87 |
| | 802.11n | 1 | 6.5/7.2 | 2412 | 10.77 |
| | | | 13/14.4 | | 10.67 |
| | | | 19.5/21.7 | | 10.70 |
| | | | 26/28.9 | | 10.75 |
| | | | 39/43.3 | | 10.60 |
| | | | 52/57.8 | | 10.51 |
| | | | 58.5/65 | | 10.98 |
| | | | 65/72.2 | | 10.94 |
| | | 6 | 6.5/7.2 | 2437 | 14.91 |
| | | | 13/14.4 | | 14.76 |
| | | | 19.5/21.7 | | 14.82 |
| | | | 26/28.9 | | 14.69 |
| | | | 39/43.3 | | 14.64 |
| | | | 52/57.8 | | 14.82 |
| | | | 58.5/65 | | 14.84 |
| | | | 65/72.2 | | 14.79 |
| | | 11 | 6.5/7.2 | 2462 | 10.64 |
| | | | 13/14.4 | | 10.55 |
| | | | 19.5/21.7 | | 10.60 |
| | | | 26/28.9 | | 10.80 |
| | | | 39/43.3 | | 10.59 |
| | | | 52/57.8 | | 10.58 |
| | | | 58.5/65 | | 10.58 |
| | | | 65/72.2 | | 10.57 |

## Conducted Average Power Measurements

## Figure 10.2.1 Test Reduction Table – WiFi

| Mode | Side | Required Channel | Tested/Reduced |
|---|---|---|---|
| 802.11b | Side A | 1 – 2412 MHz | Reduced[1] |
| | | 6 – 2437 MHz | Tested |
| | | 11 – 2462 MHz | Reduced[1] |
| | Side C | 1 – 2412 MHz | Reduced[1] |
| | | 6 – 2437 MHz | Tested |
| | | 11 – 2462 MHz | Reduced[1] |
| | Side D | 1 – 2412 MHz | Reduced[1] |
| | | 6 – 2437 MHz | Tested |
| | | 11 – 2462 MHz | Reduced[1] |
| 802.11g | Side A | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side C | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side D | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| 802.11n | Side A | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side C | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side D | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |

Reduced[1] – When the mid channel is 3 dB below the limit, the remaining channels are not required per KDB 447498 section 1) e) i) page 2.

Reduced[2] – When the conducted power in this mode is less than 0.25 dB higher than the b mode, testing is not required per KDB248227 page 5.

## Figure 10.2.2 Test Reduction Table – 3G

| Band/ Frequency (MHz) | Technology | Side | Required Channel | Tested/ Reduced |
|---|---|---|---|---|
| Band 5 824-849 MHz | CDMA | A | 1013 | Tested |
| | | | 384 | Tested |
| | | | 777 | Tested |
| | | B | 1013 | Reduced[1] |
| | | | 384 | Tested |
| | | | 777 | Reduced[1] |
| | | C | 1013 | Tested |
| | | | 384 | Tested |
| | | | 777 | Tested |
| | | D | 1013 | Reduced[1] |
| | | | 384 | Tested |
| | | | 777 | Reduced[1] |
| | | E | 1013 | Reduced[1] |
| | | | 384 | Tested |
| | | | 777 | Reduced[1] |
| Band 2 1850-1910 MHz | CDMA | A | 25 | Tested |
| | | | 600 | Tested |
| | | | 1175 | Tested |
| | | B | 25 | Reduced[1] |
| | | | 600 | Reduced[1] |
| | | | 1175 | Tested |
| | | C | 25 | Tested |
| | | | 600 | Tested |
| | | | 1175 | Tested |
| | | D | 25 | Reduced[1] |
| | | | 600 | Reduced[1] |
| | | | 1175 | Tested |
| | | E | 25 | Tested |
| | | | 600 | Tested |
| | | | 1175 | Tested |

Reduced[1] – When the highest conducted power channel is 3 dB below the limit, the remaining channels are not required per KDB 447498 section 1) e) i) page 2.

## 10.3 SAR Measurement Conditions for LTE Bands

### 10.3.1 LTE Functionality

The follow table identifies all the channel bandwidths in each frequency band supported by this device.

| LTE Band Class | Bandwidth (MHz) | Frequency or Freq. Band (MHz) |
|---|---|---|
| 4 | 1.4, 3, 5, 10, 15, 20 | 1710-1755 MHz |
| 13 | 5, 10 | 777-787 MHz |

### 10.3.2 Test Conditions

All SAR measurements for LTE were performed using the Anritsu MT8820C. A closed loop power control setting allowed the UE to transmit at the maximum output power during the SAR measurements. The Figure 10.3.2 table indicates all the test reduction utilized for this report.

MPR was enabled for this device. A-MPR was disabled for all SAR test measurements.

**Table 10.3.1 LTE Power Measurements**

| Band | Modulation | Bandwidth | RB Size | RB Offset | Channel | Frequency | Power |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 4 | QPSK | 1.4 MHz | 6 | 0 | 19957 | 1710.7 | 23.45 |
| | | | | | 20175 | 1732.5 | 23.52 |
| | | | | | 20393 | 1754.3 | 23.58 |
| | | | 3 | 1 | 19957 | 1710.7 | 24.49 |
| | | | | | 20175 | 1732.5 | 24.44 |
| | | | | | 20393 | 1754.3 | 24.45 |
| | | | 1 | 0 | 19957 | 1710.7 | 24.44 |
| | | | | | 20175 | 1732.5 | 24.48 |
| | | | | | 20393 | 1754.3 | 24.36 |
| | | | 1 | 5 | 19957 | 1710.7 | 24.47 |
| | | | | | 20175 | 1732.5 | 24.46 |
| | | | | | 20393 | 1754.3 | 24.33 |
| | | 3 MHz | 15 | 0 | 19965 | 1711.5 | 23.45 |
| | | | | | 20175 | 1732.5 | 23.48 |
| | | | | | 20385 | 1753.5 | 23.54 |
| | | | 8 | 3 | 19965 | 1711.5 | 23.52 |
| | | | | | 20175 | 1732.5 | 23.50 |
| | | | | | 20385 | 1753.5 | 23.53 |
| | | | 1 | 0 | 19965 | 1711.5 | 24.48 |
| | | | | | 20175 | 1732.5 | 24.47 |
| | | | | | 20385 | 1753.5 | 24.45 |
| | | | 1 | 14 | 19965 | 1711.5 | 24.37 |
| | | | | | 20175 | 1732.5 | 24.36 |
| | | | | | 20385 | 1753.5 | 24.39 |
| | | 5 MHz | 25 | 0 | 19975 | 1712.5 | 23.47 |
| | | | | | 20175 | 1732.5 | 23.31 |
| | | | | | 20375 | 1752.5 | 23.54 |
| | | | 12 | 6 | 19975 | 1712.5 | 23.55 |
| | | | | | 20175 | 1732.5 | 23.41 |
| | | | | | 20375 | 1752.5 | 23.70 |
| | | | 1 | 0 | 19975 | 1712.5 | 24.48 |
| | | | | | 20175 | 1732.5 | 24.37 |
| | | | | | 20375 | 1752.5 | 24.48 |
| | | | 1 | 24 | 19975 | 1712.5 | 24.41 |
| | | | | | 20175 | 1732.5 | 24.44 |
| | | | | | 20375 | 1752.5 | 24.40 |

| Band | Modulation | Bandwidth | RB Size | RB Offset | Channel | Frequency | Power |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 4 | QPSK | 10 MHz | 50 | 0 | 20000 | 1715 | 23.45 |
| | | | | | 20175 | 1732.5 | 23.46 |
| | | | | | 20350 | 1750 | 23.37 |
| | | | 25 | 12 | 20000 | 1715 | 23.56 |
| | | | | | 20175 | 1732.5 | 23.34 |
| | | | | | 20350 | 1750 | 23.43 |
| | | | 1 | 0 | 20000 | 1715 | 24.45 |
| | | | | | 20175 | 1732.5 | 24.45 |
| | | | | | 20350 | 1750 | 24.37 |
| | | | 1 | 49 | 20000 | 1715 | 24.46 |
| | | | | | 20175 | 1732.5 | 24.48 |
| | | | | | 20350 | 1750 | 24.38 |
| | | 15 MHz | 75 | 0 | 20025 | 1717.5 | 23.35 |
| | | | | | 20175 | 1732.5 | 23.36 |
| | | | | | 20325 | 1747.5 | 23.28 |
| | | | 36 | 19 | 20025 | 1717.5 | 23.37 |
| | | | | | 20175 | 1732.5 | 23.41 |
| | | | | | 20325 | 1747.5 | 23.27 |
| | | | 1 | 0 | 20025 | 1717.5 | 24.45 |
| | | | | | 20175 | 1732.5 | 24.45 |
| | | | | | 20325 | 1747.5 | 24.40 |
| | | | 1 | 74 | 20025 | 1717.5 | 24.47 |
| | | | | | 20175 | 1732.5 | 24.41 |
| | | | | | 20325 | 1747.5 | 24.47 |
| | | 20 MHz | 100 | 0 | 20050 | 1720 | 23.49 |
| | | | | | 20175 | 1732.5 | 23.38 |
| | | | | | 20300 | 1745 | 23.36 |
| | | | 50 | 25 | 20050 | 1720 | 23.44 |
| | | | | | 20175 | 1732.5 | 23.42 |
| | | | | | 20300 | 1745 | 23.28 |
| | | | 1 | 0 | 20050 | 1720 | 24.48 |
| | | | | | 20175 | 1732.5 | 24.48 |
| | | | | | 20300 | 1745 | 24.45 |
| | | | 1 | 99 | 20050 | 1720 | 24.48 |
| | | | | | 20175 | 1732.5 | 24.38 |
| | | | | | 20300 | 1745 | 24.39 |

| Band | Modulation | Bandwidth | RB Size | RB Offset | Channel | Frequency | Power |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 4 | 16QAM | 1.4 MHz | 6 | 0 | 19957 | 1710.7 | 22.49 |
| | | | | | 20175 | 1732.5 | 22.44 |
| | | | | | 20393 | 1754.3 | 22.31 |
| | | | 3 | 1 | 19957 | 1710.7 | 23.53 |
| | | | | | 20175 | 1732.5 | 23.49 |
| | | | | | 20393 | 1754.3 | 23.53 |
| | | | 1 | 0 | 19957 | 1710.7 | 23.34 |
| | | | | | 20175 | 1732.5 | 23.38 |
| | | | | | 20393 | 1754.3 | 23.36 |
| | | | 1 | 5 | 19957 | 1710.7 | 23.51 |
| | | | | | 20175 | 1732.5 | 23.29 |
| | | | | | 20393 | 1754.3 | 23.38 |
| | | 3 MHz | 15 | 0 | 19965 | 1711.5 | 22.35 |
| | | | | | 20175 | 1732.5 | 22.43 |
| | | | | | 20385 | 1753.5 | 22.26 |
| | | | 8 | 3 | 19965 | 1711.5 | 22.39 |
| | | | | | 20175 | 1732.5 | 22.39 |
| | | | | | 20385 | 1753.5 | 22.22 |
| | | | 1 | 0 | 19965 | 1711.5 | 23.41 |
| | | | | | 20175 | 1732.5 | 23.41 |
| | | | | | 20385 | 1753.5 | 23.34 |
| | | | 1 | 14 | 19965 | 1711.5 | 23.32 |
| | | | | | 20175 | 1732.5 | 23.21 |
| | | | | | 20385 | 1753.5 | 23.31 |
| | | 5 MHz | 25 | 0 | 19975 | 1712.5 | 22.22 |
| | | | | | 20175 | 1732.5 | 22.35 |
| | | | | | 20375 | 1752.5 | 22.23 |
| | | | 12 | 6 | 19975 | 1712.5 | 22.45 |
| | | | | | 20175 | 1732.5 | 22.43 |
| | | | | | 20375 | 1752.5 | 22.41 |
| | | | 1 | 0 | 19975 | 1712.5 | 23.39 |
| | | | | | 20175 | 1732.5 | 23.05 |
| | | | | | 20375 | 1752.5 | 23.46 |
| | | | 1 | 24 | 19975 | 1712.5 | 23.29 |
| | | | | | 20175 | 1732.5 | 23.43 |
| | | | | | 20375 | 1752.5 | 23.45 |

| Band | Modulation | Bandwidth | RB Size | RB Offset | Channel | Frequency | Power |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 4 | 16QAM | 10 MHz | 50 | 0 | 20000 | 1715 | 22.32 |
| | | | | | 20175 | 1732.5 | 22.27 |
| | | | | | 20350 | 1750 | 22.21 |
| | | | 25 | 12 | 20000 | 1715 | 22.57 |
| | | | | | 20175 | 1732.5 | 22.33 |
| | | | | | 20350 | 1750 | 22.31 |
| | | | 1 | 0 | 20000 | 1715 | 23.50 |
| | | | | | 20175 | 1732.5 | 23.65 |
| | | | | | 20350 | 1750 | 23.36 |
| | | | 1 | 49 | 20000 | 1715 | 23.42 |
| | | | | | 20175 | 1732.5 | 23.44 |
| | | | | | 20350 | 1750 | 23.28 |
| | | 15 MHz | 75 | 0 | 20025 | 1717.5 | 22.28 |
| | | | | | 20175 | 1732.5 | 22.32 |
| | | | | | 20325 | 1747.5 | 22.15 |
| | | | 36 | 19 | 20025 | 1717.5 | 22.42 |
| | | | | | 20175 | 1732.5 | 22.32 |
| | | | | | 20325 | 1747.5 | 22.19 |
| | | | 1 | 0 | 20025 | 1717.5 | 23.49 |
| | | | | | 20175 | 1732.5 | 23.61 |
| | | | | | 20325 | 1747.5 | 23.30 |
| | | | 1 | 74 | 20025 | 1717.5 | 23.41 |
| | | | | | 20175 | 1732.5 | 23.39 |
| | | | | | 20325 | 1747.5 | 23.32 |
| | | 20 MHz | 100 | 0 | 20050 | 1720 | 22.35 |
| | | | | | 20175 | 1732.5 | 22.24 |
| | | | | | 20300 | 1745 | 22.21 |
| | | | 50 | 25 | 20050 | 1720 | 22.40 |
| | | | | | 20175 | 1732.5 | 22.30 |
| | | | | | 20300 | 1745 | 22.15 |
| | | | 1 | 0 | 20050 | 1720 | 23.49 |
| | | | | | 20175 | 1732.5 | 23.52 |
| | | | | | 20300 | 1745 | 23.49 |
| | | | 1 | 99 | 20050 | 1720 | 23.26 |
| | | | | | 20175 | 1732.5 | 23.21 |
| | | | | | 20300 | 1745 | 23.41 |

| Band | Modulation | Bandwidth | RB Size | RB Offset | Channel | Frequency | Power |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 13 | QPSK | 5 MHz | 25 | 0 | 23205 | 779.5 | 23.35 |
| | | | | | 23255 | 784.5 | 23.35 |
| | | | 12 | 6 | 23205 | 779.5 | 23.46 |
| | | | | | 23255 | 784.5 | 23.47 |
| | | | 1 | 0 | 23205 | 779.5 | 24.45 |
| | | | | | 23255 | 784.5 | 24.40 |
| | | | 1 | 24 | 23205 | 779.5 | 24.49 |
| | | | | | 23255 | 784.5 | 24.44 |
| | | 10 MHz | 50 | 0 | 23230 | 782.0 | 23.26 |
| | | | 25 | 13 | 23230 | 782.0 | 23.51 |
| | | | 1 | 0 | 23230 | 782.0 | 24.48 |
| | | | 1 | 49 | 23230 | 782.0 | 24.48 |
| | 16QAM | 5 MHz | 25 | 0 | 23205 | 779.5 | 22.33 |
| | | | | | 23255 | 784.5 | 22.32 |
| | | | 12 | 6 | 23205 | 779.5 | 22.58 |
| | | | | | 23255 | 784.5 | 22.66 |
| | | | 1 | 0 | 23205 | 779.5 | 23.48 |
| | | | | | 23255 | 784.5 | 23.55 |
| | | | 1 | 24 | 23205 | 779.5 | 23.64 |
| | | | | | 23255 | 784.5 | 23.57 |
| | | 10 MHz | 50 | 0 | 23230 | 782.0 | 22.20 |
| | | | 25 | 13 | 23230 | 782.0 | 22.48 |
| | | | 1 | 0 | 23230 | 782.0 | 23.38 |
| | | | 1 | 49 | 23230 | 782.0 | 23.30 |

# Table 10.3.2 Test Reduction Table – LTE

| Band/ Frequency (MHz) | Side | Required Test Channel | Bandwidth | Modulation | RB Allocation | RB Offset | Tested/ Reduced |
|---|---|---|---|---|---|---|---|
| Band 4 1710-1755 MHz | A | 20050 | 20 MHz | QPSK | 50 | 25 | Tested |
| | | 20175 | | | | | Tested |
| | | 20300 | | | | | Tested |
| | | 20050 | | | 100 | 0 | Reduced[1] |
| | | 20175 | | | | | Reduced[1] |
| | | 20300 | | | | | Reduced[1] |
| | | 20050 | | | 1 | 0 | Tested |
| | | 20175 | | | | | Reduced[2] |
| | | 20300 | | | | | Reduced[2] |
| | | 20050 | | | | 99 | Tested |
| | | 20175 | | | | | Reduced[2] |
| | | 20300 | | | | | Reduced[2] |
| | | 20050 | | 16QAM | 50 | 25 | Tested |
| | | 20175 | | | | | Reduced[3] |
| | | 20300 | | | | | Reduced[3] |
| | | 20050 | | | 100 | 0 | Reduced[1] |
| | | 20175 | | | | | Reduced[1] |
| | | 20300 | | | | | Reduced[1] |
| | | 20050 | | | 1 | 0 | Tested |
| | | 20175 | | | | | Reduced[4] |
| | | 20300 | | | | | Reduced[4] |
| | | 20050 | | | | 99 | Tested |
| | | 20175 | | | | | Reduced[4] |
| | | 20300 | | | | | Reduced[4] |
| | | All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz) | | | | | Reduced[5] |
| | B | 20050 | 20 MHz | QPSK | 50 | 25 | Tested |
| | | 20175 | | | | | Reduced[6] |
| | | 20300 | | | | | Reduced[6] |
| | | 20050 | | | 100 | 0 | Reduced[1] |
| | | 20175 | | | | | Reduced[1] |
| | | 20300 | | | | | Reduced[1] |
| | | 20050 | | | 1 | 0 | Tested |
| | | 20175 | | | | | Reduced[2] |
| | | 20300 | | | | | Reduced[2] |
| | | 20050 | | | | 99 | Tested |
| | | 20175 | | | | | Reduced[2] |
| | | 20300 | | | | | Reduced[2] |
| | | 20050 | | 16QAM | 50 | 25 | Tested |
| | | 20175 | | | | | Reduced[3] |
| | | 20300 | | | | | Reduced[3] |
| | | 20050 | | | 100 | 0 | Reduced[1] |
| | | 20175 | | | | | Reduced[1] |
| | | 20300 | | | | | Reduced[1] |
| | | 20050 | | | 1 | 0 | Tested |
| | | 20175 | | | | | Reduced[4] |
| | | 20300 | | | | | Reduced[4] |
| | | 20050 | | | | 99 | Tested |
| | | 20175 | | | | | Reduced[4] |
| | | 20300 | | | | | Reduced[4] |
| | | All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz) | | | | | Reduced[5] |

Reduced[1] – If the SAR value in the 50% RB testing is less than 1.45 W/kg, the 100% RB testing is reduced per KDB941225 D05 3) A) I) page 4.

Reduced[2] - If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 3) B) I) page 4.

Reduced[3] - If the SAR value in the 50% RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 4) A) I) page 4.

Reduced[4]- If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 4) B) I) page 5.

Reduced[5]- If the conducted power is within ±0.5 dB, all testing where the SAR value is less than 1.45 W/kg is reduced per KDB941225 D05 5) B) I) page 5.

Reduced[6]- If the SAR value measured on the middle channel is less than 0.8 W/kg and the conducted power is within ±0.5 dB, the remaining channels are reduced per KDB941225 D05 page 4 footnote 2.

| Band/ Frequency (MHz) | Side | Required Test Channel | Bandwidth | Modulation | RB Allocation | RB Offset | Tested/ Reduced |
|---|---|---|---|---|---|---|---|
| Band 4 1710-1755 MHz | C | 20050 | 20 MHz | QPSK | 50 | 25 | Tested |
| | | 20175 | | | | | Tested |
| | | 20300 | | | | | Tested |
| | | 20050 | | | 100 | 0 | Reduced[1] |
| | | 20175 | | | | | Reduced[1] |
| | | 20300 | | | | | Reduced[1] |
| | | 20050 | | | 1 | 0 | Tested |
| | | 20175 | | | | | Reduced[2] |
| | | 20300 | | | | | Reduced[2] |
| | | 20050 | | | | 99 | Tested |
| | | 20175 | | | | | Reduced[2] |
| | | 20300 | | | | | Reduced[2] |
| | | 20050 | | 16QAM | 50 | 25 | Tested |
| | | 20175 | | | | | Reduced[3] |
| | | 20300 | | | | | Reduced[3] |
| | | 20050 | | | 100 | 0 | Reduced[1] |
| | | 20175 | | | | | Reduced[1] |
| | | 20300 | | | | | Reduced[1] |
| | | 20050 | | | 1 | 0 | Tested |
| | | 20175 | | | | | Reduced[4] |
| | | 20300 | | | | | Reduced[4] |
| | | 20050 | | | | 99 | Tested |
| | | 20175 | | | | | Reduced[4] |
| | | 20300 | | | | | Reduced[4] |
| | | All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz) | | | | | Reduced[5] |
| | D | 20050 | 20 MHz | QPSK | 50 | 25 | Tested |
| | | 20175 | | | | | Reduced[6] |
| | | 20300 | | | | | Reduced[6] |
| | | 20050 | | | 100 | 0 | Reduced[1] |
| | | 20175 | | | | | Reduced[1] |
| | | 20300 | | | | | Reduced[1] |
| | | 20050 | | | 1 | 0 | Tested |
| | | 20175 | | | | | Reduced[2] |
| | | 20300 | | | | | Reduced[2] |
| | | 20050 | | | | 99 | Tested |
| | | 20175 | | | | | Reduced[2] |
| | | 20300 | | | | | Reduced[2] |
| | | 20050 | | 16QAM | 50 | 25 | Tested |
| | | 20175 | | | | | Reduced[3] |
| | | 20300 | | | | | Reduced[3] |
| | | 20050 | | | 100 | 0 | Reduced[1] |
| | | 20175 | | | | | Reduced[1] |
| | | 20300 | | | | | Reduced[1] |
| | | 20050 | | | 1 | 0 | Tested |
| | | 20175 | | | | | Reduced[4] |
| | | 20300 | | | | | Reduced[4] |
| | | 20050 | | | | 99 | Tested |
| | | 20175 | | | | | Reduced[4] |
| | | 20300 | | | | | Reduced[4] |
| | | All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz) | | | | | Reduced[5] |

Reduced[1] – If the SAR value in the 50% RB testing is less than 1.45 W/kg, the 100% RB testing is reduced per KDB941225 D05 3) A) I) page 4.

Reduced[2] - If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 3) B) I) page 4.

Reduced[3] - If the SAR value in the 50% RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 4) A) I) page 4.

Reduced[4]- If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 4) B) I) page 5.

Reduced[5]- If the conducted power is within ±0.5 dB, all testing where the SAR value is less than 1.45 W/kg is reduced per KDB941225 D05 5) B) I) page 5.

Reduced[6]- If the SAR value measured on the middle channel is less than 0.8 W/kg and the conducted power is within ±0.5 dB, the remaining channels are reduced per KDB941225 D05 page 4 footnote 2.

| Band/ Frequency (MHz) | Side | Required Test Channel | Bandwidth | Modulation | RB Allocation | RB Offset | Tested/ Reduced |
|---|---|---|---|---|---|---|---|
| Band 4 1710-1755 MHz | E | 20050 | 20 MHz | QPSK | 50 | 25 | Tested |
| | | 20175 | | | | | Reduced[6] |
| | | 20300 | | | | | Reduced[6] |
| | | 20050 | | | 100 | 0 | Reduced[1] |
| | | 20175 | | | | | Reduced[1] |
| | | 20300 | | | | | Reduced[1] |
| | | 20050 | | | 1 | 0 | Tested |
| | | 20175 | | | | | Reduced[2] |
| | | 20300 | | | | | Reduced[2] |
| | | 20050 | | | | 99 | Tested |
| | | 20175 | | | | | Reduced[2] |
| | | 20300 | | | | | Reduced[2] |
| | | 20050 | | 16QAM | 50 | 25 | Tested |
| | | 20175 | | | | | Reduced[3] |
| | | 20300 | | | | | Reduced[3] |
| | | 20050 | | | 100 | 0 | Reduced[1] |
| | | 20175 | | | | | Reduced[1] |
| | | 20300 | | | | | Reduced[1] |
| | | 20050 | | | 1 | 0 | Tested |
| | | 20175 | | | | | Reduced[4] |
| | | 20300 | | | | | Reduced[4] |
| | | 20050 | | | | 99 | Tested |
| | | 20175 | | | | | Reduced[4] |
| | | 20300 | | | | | Reduced[4] |
| | | All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz) | | | | | Reduced[5] |

Reduced[1] – If the SAR value in the 50% RB testing is less than 1.45 W/kg, the 100% RB testing is reduced per KDB941225 D05 3) A) I) page 4.

Reduced[2] - If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 3) B) I) page 4.

Reduced[3] - If the SAR value in the 50% RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 4) A) I) page 4.

Reduced[4]- If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 4) B) I) page 5.

Reduced[5]- If the conducted power is within ±0.5 dB, all testing where the SAR value is less than 1.45 W/kg is reduced per KDB941225 D05 5) B) I) page 5.

Reduced[6]- If the SAR value measured on the highest conducted power channel is less than 0.8 W/kg and the conducted power is within ±0.5 dB, the remaining channels are reduced per KDB941225 D05 page 4 footnote 2.

| Band/ Frequency (MHz) | Side | Required Test Channel | Bandwidth | Modulation | RB Allocation | RB Offset | Tested/ Reduced |
|---|---|---|---|---|---|---|---|
| Band 13 777-787 MHz | A | 23230 | 10 MHz | QPSK | 25 | 13 | Tested |
| | | 23230 | | | 50 | 0 | Reduced[1] |
| | | 23230 | | | 1 | 0 | Tested |
| | | 23230 | | | 1 | 49 | Tested |
| | | 23230 | | 16QAM | 25 | 13 | Tested |
| | | 23230 | | | 50 | 0 | Reduced[1] |
| | | 23230 | | | 1 | 0 | Tested |
| | | 23230 | | | 1 | 49 | Tested |
| | | All lower bandwidths (5 MHz) | | | | | Reduced[2] |
| | B | 23230 | 10 MHz | QPSK | 25 | 13 | Tested |
| | | 23230 | | | 50 | 0 | Reduced[1] |
| | | 23230 | | | 1 | 0 | Tested |
| | | 23230 | | | 1 | 49 | Tested |
| | | 23230 | | 16QAM | 25 | 13 | Tested |
| | | 23230 | | | 50 | 0 | Reduced[1] |
| | | 23230 | | | 1 | 0 | Tested |
| | | 23230 | | | 1 | 49 | Tested |
| | | All lower bandwidths (5 MHz) | | | | | Reduced[2] |
| | C | 23230 | 10 MHz | QPSK | 25 | 13 | Tested |
| | | 23230 | | | 50 | 0 | Reduced[1] |
| | | 23230 | | | 1 | 0 | Tested |
| | | 23230 | | | 1 | 49 | Tested |
| | | 23230 | | 16QAM | 25 | 13 | Tested |
| | | 23230 | | | 50 | 0 | Reduced[1] |
| | | 23230 | | | 1 | 0 | Tested |
| | | 23230 | | | 1 | 49 | Tested |
| | | All lower bandwidths (5 MHz) | | | | | Reduced[2] |
| | D | 23230 | 10 MHz | QPSK | 25 | 13 | Tested |
| | | 23230 | | | 50 | 0 | Reduced[1] |
| | | 23230 | | | 1 | 0 | Tested |
| | | 23230 | | | 1 | 49 | Tested |
| | | 23230 | | 16QAM | 25 | 13 | Tested |
| | | 23230 | | | 50 | 0 | Reduced[1] |
| | | 23230 | | | 1 | 0 | Tested |
| | | 23230 | | | 1 | 49 | Tested |
| | | All lower bandwidths (5 MHz) | | | | | Reduced[2] |
| | E | 23230 | 10 MHz | QPSK | 25 | 13 | Tested |
| | | 23230 | | | 50 | 0 | Reduced[1] |
| | | 23230 | | | 1 | 0 | Tested |
| | | 23230 | | | 1 | 49 | Tested |
| | | 23230 | | 16QAM | 25 | 13 | Tested |
| | | 23230 | | | 50 | 0 | Reduced[1] |
| | | 23230 | | | 1 | 0 | Tested |
| | | 23230 | | | 1 | 49 | Tested |
| | | All lower bandwidths (5 MHz) | | | | | Reduced[2] |

Reduced[1] – If the SAR value in the 50% RB testing is less than 1.45 W/kg, the 100% RB testing is reduced per KDB941225 D05 3) A) I) page 4.

Reduced[2]- If the conducted power is within ±0.5 dB, all testing where the SAR value is less than 1.45 W/kg is reduced per KDB941225 D05 5) B) I) page 5.

## SAR Data Summary – 835 MHz Body - CDMA

# MEASUREMENT RESULTS

| Gap | Plot | Frequency | | Modulation | Position | End Power | Reverse Channel | Forward Channel | SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | Ch. | | | (dBm) | | | |
| 10 mm | - | 824.7 | 1013 | CDMA | Side A | 24.46 | 153.6 kbps | 2 Slot 307.2 kbps | 1.170 |
| | - | 836.52 | 384 | CDMA | | 24.46 | 153.6 kbps | 2 Slot 307.2 kbps | 1.270 |
| | - | 848.31 | 777 | CDMA | | 24.46 | 153.6 kbps | 2 Slot 307.2 kbps | 1.080 |
| | - | 836.52 | 384 | CDMA | Side B | 24.46 | 153.6 kbps | 2 Slot 307.2 kbps | 0.664 |
| | - | 824.7 | 1013 | CDMA | Side C | 24.46 | 153.6 kbps | 2 Slot 307.2 kbps | 1.170 |
| | 1 | 836.52 | 384 | CDMA | | 24.46 | 153.6 kbps | 2 Slot 307.2 kbps | 1.300* |
| | - | 848.31 | 777 | CDMA | | 24.46 | 153.6 kbps | 2 Slot 307.2 kbps | 1.180 |
| | - | 836.52 | 384 | CDMA | Side D | 24.46 | 153.6 kbps | 2 Slot 307.2 kbps | 0.683 |
| | - | 836.52 | 384 | CDMA | Side E | 24.46 | 153.6 kbps | 2 Slot 307.2 kbps | 0.091 |

**Body**
**1.6 W/kg (mW/g)**
averaged over 1 gram

1. SAR Measurement
   Phantom Configuration ☐ Left Head ☒ Eli4 ☐ Right Head
   SAR Configuration ☐ Head ☒ Body
2. Test Signal Call Mode ☐ Test Code ☒ Base Station Simulator
3. Test Configuration ☐ With Belt Clip ☐ Without Belt Clip ☒ N/A
4. Tissue Depth is at least 15.0 cm

*The highest SAR value calculated to the upper limit of the tolerance yields a SAR value of 1.312.

## SAR Data Summary – 1900 MHz Body - CDMA

MEASUREMENT RESULTS

| Gap | Plot | Frequency | | Modulation | Position | End Power | Reverse Channel | Forward Channel | SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | Ch. | | | (dBm) | | | |
| 10 mm | - | 25 | 1851.25 | CDMA | Side A | 24.42 | 153.6 kbps | 2 Slot 307.2 kbps | 0.709 |
| | - | 600 | 1880.00 | CDMA | | 24.33 | 153.6 kbps | 2 Slot 307.2 kbps | 0.714 |
| | - | 1175 | 1908.75 | CDMA | | 24.35 | 153.6 kbps | 2 Slot 307.2 kbps | 0.810 |
| | - | 1175 | 1908.75 | CDMA | Side B | 24.35 | 153.6 kbps | 2 Slot 307.2 kbps | 0.469 |
| | - | 25 | 1851.25 | CDMA | Side C | 24.42 | 153.6 kbps | 2 Slot 307.2 kbps | 1.330 |
| | - | 600 | 1880.00 | CDMA | | 24.33 | 153.6 kbps | 2 Slot 307.2 kbps | 1.190 |
| | - | 1175 | 1908.75 | CDMA | | 24.35 | 153.6 kbps | 2 Slot 307.2 kbps | 1.390 |
| | - | 1175 | 1908.75 | CDMA | Side D | 24.35 | 153.6 kbps | 2 Slot 307.2 kbps | 0.144 |
| | - | 25 | 1851.25 | CDMA | Side E | 24.42 | 153.6 kbps | 2 Slot 307.2 kbps | 1.350 |
| | - | 600 | 1880.00 | CDMA | | 24.33 | 153.6 kbps | 2 Slot 307.2 kbps | 1.130 |
| | 2 | 1175 | 1908.75 | CDMA | | 24.35 | 153.6 kbps | 2 Slot 307.2 kbps | 1.400* |

**Body**
**1.6 W/kg (mW/g)**
averaged over 1 gram

1. SAR Measurement
   Phantom Configuration ☐Left Head ☒Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
2. Test Signal Call Mode ☐Test Code ☒Base Station Simulator
3. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
4. Tissue Depth is at least 15.0 cm

*The highest SAR value calculated to the upper limit of the tolerance yields a SAR value of 1.449.

## SAR Data Summary – 1735 MHz Body – LTE Band 4

**MEASUREMENT RESULTS**

| Gap | Plot | Position | Frequency MHz | Frequency Ch. | BW/ Modulation | RB Size | RB Offset | MPR Target | End Power (dBm) | SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 mm | - | Side A | 1720.0 | 20050 | 20 MHz/QPSK | 50 | 24 | 1 | 23.44 | 0.822 |
| | - | | 1732.5 | 20175 | 20 MHz/QPSK | 50 | 24 | 1 | 23.42 | 0.755 |
| | - | | 1745.0 | 20300 | 20 MHz/QPSK | 50 | 24 | 1 | 23.28 | 0.745 |
| | - | | 1720.0 | 20050 | 20 MHz/QPSK | 1 | 0 | 0 | 24.48 | 1.020 |
| | - | | | | 20 MHz/QPSK | 1 | 99 | 0 | 24.48 | 0.858 |
| | - | | 1720.0 | 20050 | 20 MHz/16QAM | 50 | 24 | 2 | 22.40 | 0.664 |
| | - | | | | 20 MHz/16QAM | 1 | 0 | 1 | 23.49 | 0.847 |
| | - | | | | 20 MHz/16QAM | 1 | 99 | 1 | 23.26 | 0.697 |
| | - | Side B | 1720.0 | 20050 | 20 MHz/QPSK | 50 | 24 | 1 | 23.44 | 0.236 |
| | - | | 1720.0 | 20050 | 20 MHz/QPSK | 1 | 0 | 0 | 24.48 | 0.267 |
| | - | | | | 20 MHz/QPSK | 1 | 99 | 0 | 24.48 | 0.221 |
| | - | | 1720.0 | 20050 | 20 MHz/16QAM | 50 | 24 | 2 | 22.40 | 0.178 |
| | - | | | | 20 MHz/16QAM | 1 | 0 | 1 | 23.49 | 0.215 |
| | - | | | | 20 MHz/16QAM | 1 | 99 | 1 | 23.26 | 0.180 |
| | - | Side C | 1720.0 | 20050 | 20 MHz/QPSK | 50 | 24 | 1 | 23.44 | 1.250 |
| | - | | 1732.5 | 20175 | 20 MHz/QPSK | 50 | 24 | 1 | 23.42 | 1.050 |
| | - | | 1745.0 | 20300 | 20 MHz/QPSK | 50 | 24 | 1 | 23.28 | 1.070 |
| | 3 | | 1720.0 | 20050 | 20 MHz/QPSK | 1 | 0 | 0 | 24.48 | 1.430* |
| | - | | | | 20 MHz/QPSK | 1 | 99 | 0 | 24.48 | 1.200 |
| | - | | 1720.0 | 20050 | 20 MHz/16QAM | 50 | 24 | 2 | 22.40 | 0.987 |
| | - | | | | 20 MHz/16QAM | 1 | 0 | 1 | 23.49 | 1.170 |
| | - | | | | 20 MHz/16QAM | 1 | 99 | 1 | 23.26 | 0.996 |
| | - | Side D | 1720.0 | 20050 | 20 MHz/QPSK | 50 | 24 | 1 | 23.44 | 0.214 |
| | - | | 1720.0 | 20050 | 20 MHz/QPSK | 1 | 0 | 0 | 24.48 | 0.258 |
| | - | | | | 20 MHz/QPSK | 1 | 99 | 0 | 24.48 | 0.295 |
| | - | | 1720.0 | 20050 | 20 MHz/16QAM | 50 | 24 | 2 | 22.40 | 0.170 |
| | - | | | | 20 MHz/16QAM | 1 | 0 | 1 | 23.49 | 0.207 |
| | - | | | | 20 MHz/16QAM | 1 | 99 | 1 | 23.26 | 0.175 |
| | - | Side E | 1720.0 | 20050 | 20 MHz/QPSK | 50 | 24 | 1 | 23.44 | 0.757 |
| | - | | 1720.0 | 20050 | 20 MHz/QPSK | 1 | 0 | 0 | 24.48 | 0.949 |
| | - | | | | 20 MHz/QPSK | 1 | 99 | 0 | 24.48 | 0.776 |
| | - | | 1720.0 | 20050 | 20 MHz/16QAM | 50 | 24 | 2 | 22.40 | 0.612 |
| | - | | | | 20 MHz/16QAM | 1 | 0 | 1 | 23.49 | 0.734 |
| | - | | | | 20 MHz/16QAM | 1 | 99 | 1 | 23.26 | 0.631 |

**Body**
**1.6 W/kg (mW/g)**
averaged over 1 gram

1. SAR Measurement
   Phantom Configuration ☐Left Head ☒Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
2. Test Signal Call Mode ☐Test Code ☒Base Station Simulator
3. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
4. Tissue Depth is at least 15.0 cm

*The highest SAR value calculated to the upper limit of the tolerance yields a SAR value of 1.437.

# SAR Data Summary – 782 MHz Body – LTE Band 13

| MEASUREMENT RESULTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gap | Plot | Position | Frequency | | BW/ Modulation | RB Size | RB Offset | MPR Target | End Power | SAR (W/kg) |
| | | | MHz | Ch. | | | | | (dBm) | |
| 10 mm | - | Side A | 782.0 | 23230 | 10 MHz/QPSK | 25 | 13 | 1 | 23.51 | 0.545 |
| | - | | | | 10 MHz/QPSK | 1 | 0 | 0 | 24.48 | 0.782 |
| | - | | | | 10 MHz/QPSK | 1 | 49 | 0 | 24.48 | 0.536 |
| | - | | | | 10 MHz/16QAM | 25 | 13 | 2 | 22.48 | 0.421 |
| | - | | | | 10 MHz/16QAM | 1 | 0 | 1 | 23.38 | 0.623 |
| | - | | | | 10 MHz/16QAM | 1 | 49 | 1 | 23.30 | 0.445 |
| | - | Side B | 782.0 | 23230 | 10 MHz/QPSK | 25 | 13 | 1 | 23.51 | 0.553 |
| | 4 | | | | 10 MHz/QPSK | 1 | 0 | 0 | 24.48 | 0.849* |
| | - | | | | 10 MHz/QPSK | 1 | 49 | 0 | 24.48 | 0.527 |
| | - | | | | 10 MHz/16QAM | 25 | 13 | 2 | 22.48 | 0.421 |
| | - | | | | 10 MHz/16QAM | 1 | 0 | 1 | 23.38 | 0.684 |
| | - | | | | 10 MHz/16QAM | 1 | 49 | 1 | 23.30 | 0.423 |
| | - | Side C | 782.0 | 23230 | 10 MHz/QPSK | 25 | 13 | 1 | 23.51 | 0.372 |
| | - | | | | 10 MHz/QPSK | 1 | 0 | 0 | 24.48 | 0.541 |
| | - | | | | 10 MHz/QPSK | 1 | 49 | 0 | 24.48 | 0.396 |
| | - | | | | 10 MHz/16QAM | 25 | 13 | 2 | 22.48 | 0.298 |
| | - | | | | 10 MHz/16QAM | 1 | 0 | 1 | 23.38 | 0.443 |
| | - | | | | 10 MHz/16QAM | 1 | 49 | 1 | 23.30 | 0.324 |
| | - | Side D | 782.0 | 23230 | 10 MHz/QPSK | 25 | 13 | 1 | 23.51 | 0.362 |
| | - | | | | 10 MHz/QPSK | 1 | 0 | 0 | 24.48 | 0.495 |
| | - | | | | 10 MHz/QPSK | 1 | 49 | 0 | 24.48 | 0.368 |
| | - | | | | 10 MHz/16QAM | 25 | 13 | 2 | 22.48 | 0.279 |
| | - | | | | 10 MHz/16QAM | 1 | 0 | 1 | 23.38 | 0.411 |
| | - | | | | 10 MHz/16QAM | 1 | 49 | 1 | 23.30 | 0.304 |
| | - | Side E | 782.0 | 23230 | 10 MHz/QPSK | 25 | 13 | 1 | 23.51 | 0.051 |
| | - | | | | 10 MHz/QPSK | 1 | 0 | 0 | 24.48 | 0.069 |
| | - | | | | 10 MHz/QPSK | 1 | 49 | 0 | 24.48 | 0.050 |
| | - | | | | 10 MHz/16QAM | 25 | 13 | 2 | 22.48 | 0.038 |
| | - | | | | 10 MHz/16QAM | 1 | 0 | 1 | 23.38 | 0.055 |
| | - | | | | 10 MHz/16QAM | 1 | 49 | 1 | 23.30 | 0.040 |
| | | | | | | Body<br>**1.6 W/kg (mW/g)**<br>averaged over 1 gram | | | | |

1. SAR Measurement
   Phantom Configuration ☐Left Head ☒Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
2. Test Signal Call Mode ☐Test Code ☒Base Station Simulator
3. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
4. Tissue Depth is at least 15.0 cm

*The highest SAR value calculated to the upper limit of the tolerance yields a SAR value of 0.853.

## SAR Data Summary – 2450 MHz Body 802.11b

| MEASUREMENT RESULTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Gap** | **Plot** | **Position** | **Frequency** | | **Modulation** | **Antenna** | **End Power** | **SAR (W/kg)** |
| | | | **MHz** | **Ch.** | | | **(dBm)** | |
| 10 mm | - | Side A | 2437 | 6 | DSSS | Main | 17.36 | 0.194 |
| | - | Side C | 2437 | 6 | DSSS | | 17.36 | 0.059 |
| | 5 | Side D | 2437 | 6 | DSSS | | 17.36 | 0.212* |
| | - | Side E | 2437 | 6 | DSSS | | 17.36 | 0.033 |
| | | | | | **Body**<br>**1.6 W/kg (mW/g)**<br>averaged over 1 gram | | | |

1. SAR Measurement
   Phantom Configuration ☐Left Head ☒Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
2. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
3. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
4. Tissue Depth is at least 15.0 cm

*The highest SAR value calculated to the upper limit of the tolerance yields a SAR value of 0.219.

## SAR Data Summary – Simultaneous Transmit

| MEASUREMENT RESULTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Plot | Position | Frequency (WLAN) | | Frequency (WWAN) | | WWAN Technology | SAR (W/kg) WLAN | SAR (W/kg) WWAN | Total SAR (W/kg) |
| | | MHz | Ch. | MHz | Ch. | | | | |
| - | Side A | 2437 | 6 | 836.52 | 384 | CDMA | 0.194 | 1.270 | 1.464* |
| - | Side B | 2437 | 6 | 782.0 | 23230 | LTE | 0.400[1] | 0.849 | 1.249* |
| - | Side C | 2437 | 6 | 1720.0 | 20050 | LTE | 0.059 | 1.430 | 1.489* |
| - | Side D | 2437 | 6 | 836.52 | 384 | CDMA | 0.212 | 0.683 | 0.895* |
| - | Side E | 2437 | 6 | 1908.75 | 1175 | CDMA | 0.033 | 1.400 | 1.433* |
| | | | | | | Body 1.6 W/kg (mW/g) averaged over 1 gram | | | |

1. SAR Measurement
   Phantom Configuration ☐Left Head ☒Uniphantom ☐Right Head
   SAR Configuration ☐Head ☒Body
2. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
3. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
4. Tissue Depth is at least 15.0 cm

Note: The WWAN and WLAN antennas can transmit simultaneously. Therefore, the SAR is calculated by summing the individual SAR values on each side. The highest SAR value of all bands was used to determine each sides compliance.

* Calculating the SAR value at the high end of the power level tolerance. See calculation on page 43.

[1] SAR testing was not required in this position due to the distance of the antenna from this side. The SAR value was calculated based on the Draft version of the new KDB 447498 dated September 12, 2012 4.3.2 #2 on page 12.

### Calculated SAR value for positions not requiring testing.

Information used for calculations:

| | |
|---|---|
| WiFi maximum power level: | 56 mW |
| $f_{GHz}$ | 2.45 GHz |
| Side B Antenna Distance: | 66 mm (56 mm from side + 10 mm gap) |
| Side B WiFi Antenna: | Due to the distance being greater than 50 mm, the SAR is applied at 0.4 W/kg |

**Calculated simultaneous SAR value at the upper limit of the tolerance.**

For side A: Conducted power tested was 24.46 dB for the WWAN and the upper limit of the tolerance is 24.50 dB. Extrapolating the SAR value to the upper limit for WWAN results in a 0.93% increase in SAR. Conducted power tested was 17.36 dB for the WLAN and the upper limit of the tolerance is 17.50 dB. Extrapolating the SAR value to the upper limit for WLAN results in a 3.28% increase in SAR.

For side B: Conducted power tested was 24.48 dB for the WWAN and the upper limit of the tolerance is 24.50 dB. Extrapolating the SAR value to the upper limit for WWAN results in a 0.46% increase in SAR. Conducted power tested was 17.36 dB for the WLAN and the upper limit of the tolerance is 17.50 dB. Extrapolating the SAR value to the upper limit for WLAN results in a 3.28% increase in SAR.

For side C: Conducted power tested was 24.48 dB for the WWAN and the upper limit of the tolerance is 24.50 dB. Extrapolating the SAR value to the upper limit for WWAN results in a 0.46% increase in SAR. Conducted power tested was 17.48 dB for the WLAN and the upper limit of the tolerance is 17.50 dB. Extrapolating the SAR value to the upper limit for WLAN results in a 0.46% increase in SAR.

For side D: Conducted power tested was 24.46 dB for the WWAN and the upper limit of the tolerance is 24.50 dB. Extrapolating the SAR value to the upper limit for WWAN results in a 0.93% increase in SAR. Conducted power tested was 17.36 dB for the WLAN and the upper limit of the tolerance is 17.50 dB. Extrapolating the SAR value to the upper limit for WLAN results in a 3.28% increase in SAR.

For side E: Conducted power tested was 24.35 dB for the WWAN and the upper limit of the tolerance is 24.50 dB. Extrapolating the SAR value to the upper limit for WWAN results in a 3.51% increase in SAR. Conducted power tested was 17.36 dB for the WLAN and the upper limit of the tolerance is 17.50 dB. Extrapolating the SAR value to the upper limit for WLAN results in a 3.28% increase in SAR.

| Position | Measured SAR for WLAN | Calculated SAR for WLAN | Measured SAR for WWAN | Calculated SAR for WWAN | Extrapolated Simultaneous SAR |
|---|---|---|---|---|---|
| Side A | 0.194 | 0.200 | 1.270 | 1.282 | 1.482 |
| Side B | 0.400 | 0.400 | 0.849 | 0.853 | 1.253 |
| Side C | 0.059 | 0.059 | 1.430 | 1.437 | 1.496 |
| Side D | 0.212 | 0.219 | 0.683 | 0.689 | 0.908 |
| Side E | 0.033 | 0.034 | 1.400 | 1.449 | 1.483 |

# 11. Test Equipment List

**Table 11.1 Equipment Specifications**

| Type | Calibration Due Date | Calibration Done Date | Serial Number |
|---|---|---|---|
| Staubli Robot TX60L | N/A | N/A | F07/55M6A1/A/01 |
| Measurement Controller CS8c | N/A | N/A | 1012 |
| ELI4 Flat Phantom | N/A | N/A | 1065 |
| Device Holder | N/A | N/A | N/A |
| Data Acquisition Electronics 4 | 08/15/2013 | 08/15/2012 | 759 |
| SAR Software V52.8.2.969 | N/A | N/A | N/A |
| SPEAG E-Field Probe EX3DV4 | 08/20/2013 | 08/20/2012 | 3693 |
| Speag Validation Dipole D750V2 | 11/02/2012 | 11/02/2010 | 1016 |
| Speag Validation Dipole D835V2 | 11/09/2012 | 11/09/2010 | 4d089 |
| Speag Validation Dipole D1750V2 | 11/12/2012 | 11/12/2010 | 1018 |
| Speag Validation Dipole D1900V2 | 11/12/2012 | 11/12/2010 | 5d116 |
| Speag Validation Dipole D2450V2 | 11/11/2012 | 11/11/2010 | 829 |
| Agilent N1911A Power Meter | 03/29/2013 | 03/29/2012 | GB45100254 |
| Agilent N1922A Power Sensor | 03/29/2013 | 03/29/2012 | MY45240464 |
| Advantest R3261A Spectrum Analyzer | 03/29/2013 | 03/29/2012 | 31720068 |
| Agilent (HP) 8350B Signal Generator | 03/29/2013 | 03/29/2012 | 2749A10226 |
| Agilent (HP) 83525A RF Plug-In | 03/29/2013 | 03/29/2012 | 2647A01172 |
| Agilent (HP) 8753C Vector Network Analyzer | 03/29/2013 | 03/29/2012 | 3135A01724 |
| Agilent (HP) 85047A S-Parameter Test Set | 04/03/2013 | 04/03/2012 | 2904A00595 |
| Agilent (HP) 8960 Base Station Sim. | 04/05/2014 | 04/05/2012 | MY48360364 |
| Anritsu MT8820C | 08/03/2014 | 08/03/2012 | 6201176199 |
| Aprel Dielectric Probe Assembly | N/A | N/A | 0011 |
| Body Equivalent Matter (750 MHz) | N/A | N/A | N/A |
| Body Equivalent Matter (835 MHz) | N/A | N/A | N/A |
| Body Equivalent Matter (1750 MHz) | N/A | N/A | N/A |
| Body Equivalent Matter (1900 MHz) | N/A | N/A | N/A |
| Body Equivalent Matter (2450 MHz) | N/A | N/A | N/A |

# 12. Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body is a very complex phenomena that depends on the mass, shape, and size of the body; the orientation of the body with respect to the field vectors; and, the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

# 13. References

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radio Frequency Radiation, August 1996

[2] ANSI/IEEE C95.1 – 1992, American National Standard Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300kHz to 100GHz, New York: IEEE, 1992.

[3] ANSI/IEEE C95.3 – 1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave, New York: IEEE, 1992.

[4] Federal Communications Commission, OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, June 2001.

[5] IEEE Standard 1528 – 2003, IEEE Recommended Practice for Determining the Peak-Spatial Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, October 2003.

[6] Industry Canada, RSS – 102e, Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), March 2010.

[7] Health Canada, Safety Code 6, Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3kHz to 300 GHz, 2009.