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SAR COMPLIANCE EVALUATION REPORT
INDUSTRY CANADA TECHNICAL REPORT (RSS-102)

Applicant Name:
Novatel Wireless Inc.
9645 Scranton Road, Suite 205
San Diego, CA 92121-3030
United States

Date of Testing:
07/29/11 - 08/09/11
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0Y1106221046.PKR

FCC ID: **PKRNVWMC679**
IC CERTIFICATION NO.: **3229A-MC679**

APPLICANT: **NOVATEL WIRELESS INC.**

EUT Type: USB Dongle
Application Type: Certification
FCC Rule Part(s): CFR §2.1093; FCC/OET Bulletin 65 Supplement C [June 2001]
IC Specification(s): RSS-102 Issue 4; Health Canada Safety Code 6, IEC 62209-1, IEC 62209-2, IEEE 1528
Radio Equipment Type: Cellular Communications Apparatus
Model(s): MC679
IC Model(s): MC679
Test Device Serial No.: Pre-Production [S/N: 485]

Band & Mode	Tx Frequency	Conducted Power [dBm]	SAR 1 gm Body (W/kg)
GPRS/EDGE 850	824.20 - 848.80 MHz	32.58	1.00
GPRS/EDGE 1900	1850.20 - 1909.80 MHz	30.04	0.57
WCDMA/HSPA 850	826.40 - 846.60 MHz	23.03	0.78
WCDMA/HSPA 1900	1852.4 - 1907.6 MHz	22.32	1.13
LTE Band 17	706.5 - 713.5 MHz	22.78	0.53
LTE AWS	1710 - 1754 MHz	22.90	1.13

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001), IEEE 1528-2003 and in applicable Industry Canada Radio Standards Specifications (RSS); for North American frequency bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me 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. Test results reported herein relate only to the item(s) tested.

PCTEST certifies that no party to this application has been 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. 862.

Randy Ortanez
President

ACCREDITED
TESTING LABORATORY
CERTIFICATE #2041.01

T A B L E   O F   C O N T E N T S

1 LTE INFORMATION PER FCC KDB 941225 D05

Per KDB 941224 D05	Info
FCC ID	**PKRNVWMC679**
Form Factor	USB Dongle
Frequency Range of each LTE transmission band	BAND17(704-716 MHz), BAND4(1710-1755 MHz)
Channel Bandwidths	Band17: 5 and 10 MHz BW; Band4: 1.4, 3, 5, 10, and 20 MHz BW
Channel numbers and frequencies	See tables below
UE Category	Category 3
Modulations Supported in UL	QPSK, 16QAM
LTE Transmitter and Antenna Implementation	One Transmitter Path for GSM/WCDMA/LTE
Description of LTE Tx and Ant. Implementation	1Tx/Rx, 1Rx
LTE Voice available ?	Data only

Uplink:

LTE Band Class	B/W (MHz)	Channel # / Frequency (MHz)					
		Low		Mid		High	
		Channel	Freq.	Channel	Freq.	Channel	Freq
17	5	23755	706.5	23790	710.0	23825	713.5
17	10	23780	709.0	23790	710.0	23800	711.0
4	1.4	19957	1710.7	20175	1732.5	20393	1754.3
4	3	19965	1711.5	20175	1732.5	20385	1753.5
4	5	19975	1712.5	20175	1732.5	20375	1752.5
4	10	20000	1715.0	20175	1732.5	20350	1750.0
4	15	20025	1717.5	20175	1732.5	20325	1747.5
4	20	20050	1720.0	20175	1732.5	20300	1745.0

Downlink:

LTE Band Class	B/W (MHz)	Channel # / Frequency (MHz)					
		Low		Mid		High	
		Channel	Freq.	Channel	Freq.	Channel	Freq
17	5	5755	736.5	5790	740.0	5825	743.5
17	10	5780	739.0	5790	740.0	5800	741.0
4	1.4	1957	2110.7	2175	2132.5	2393	2154.3
4	3	1965	2111.5	2175	2132.5	2385	2153.5
4	5	1975	2112.5	2175	2132.5	2375	2152.5
4	10	2000	2115.0	2175	2132.5	2350	2150.0
4	15	2025	2117.5	2175	2132.5	2325	2147.5
4	20	2050	2120.0	2175	2132.5	2300	2145.0

2 INTRODUCTION

The FCC and Industry Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. [1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [24]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

2.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1-1).

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

Figure 1-1
SAR Mathematical Equation

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

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

where:

σ = conductivity of the tissue-simulating material (S/m)
ρ = mass density of the tissue-simulating material (kg/m^3)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

3 TEST SITE LOCATION

3.1 INTRODUCTION

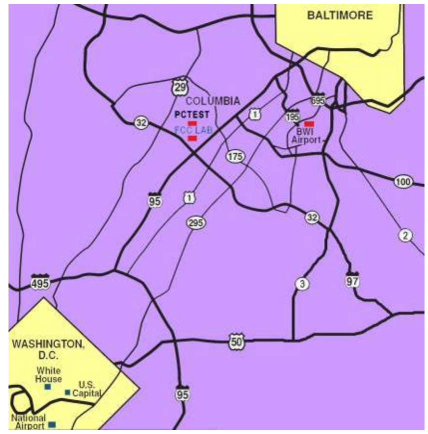


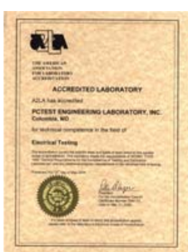
Figure 3-1
Map of the Greater Baltimore and Metropolitan Washington, D.C. area

The map at the right shows the location of the PCTEST LABORATORY in Columbia, Maryland. It is in proximity to the FCC Laboratory, the Baltimore-Washington International (BWI) airport, the city of Baltimore and Washington, DC.

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility in New Concept Business Park, Guilford Industrial Park, Columbia, Maryland. The site address is 6660-B Dobbin Road, Columbia, MD 21045. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39° 11'15" N latitude and 76° 49' 38" W longitude. The facility is 1.5 miles north of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. There are no FM or TV transmitters within 15 miles of the site. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 on January 27, 2006 and Industry Canada. PCTEST facility is an IC registered (2451-A) test laboratory with the site description filed to Industry Canada in accordance with Radio Standards Specifications (RSS).

3.2 Test Facility / Accreditations:

Measurements were performed at an independent accredited PCTEST Engineering Lab located in Columbia, MD 21045, U.S.A.



- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing-Aid Compatibility (HAC), Battery Safety, CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST facility is an FCC registered (PCTEST Reg. No. 90864) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (IC-2451).
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and all Industry Canada Standards (RSS).

- PCTEST facility is an IC registered (IC-2451) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS and CDMA, and EvDO mobile phones.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO Data, CDMA 1xRTT Data

4 SAR MEASUREMENT SETUP

4.1 Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of a high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the SAM phantom containing the head or body 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 Figure 4-1).

4.2 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 SAR Measurement Software DASY4, 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, A/D 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 from the DAE and transfers data to the PC card.

4.3 System Electronics

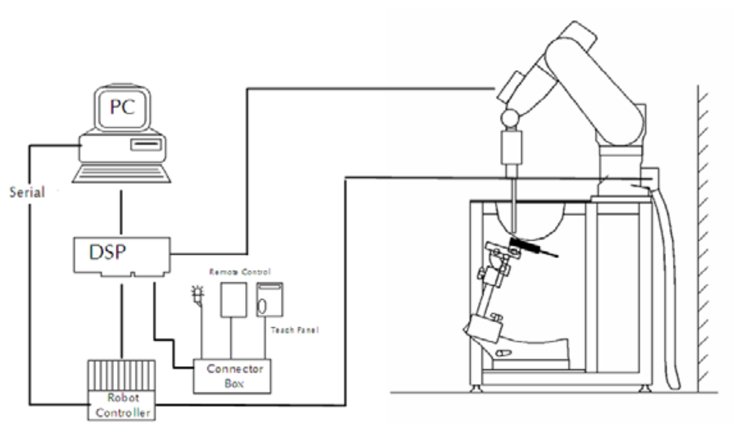


Figure 4-1
SAR Measurement System Setup

The DAE consists of a highly sensitive electrometer-grade auto-zeroing preamplifier, 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.

4.4 Automated Test System Specifications

Test Software:	SPEAG DASY4 version 4.7 Measurement Software
Robot:	Stäubli Unimation Corp. Robot RX60L
Repeatability:	0.02 mm
No. of Axes:	6

Data Acquisition Electronic System (DAE)

Data Converter

Features:	Signal Amplifier, multiplexer, A/D converter & control logic
Software:	SEMCAD software
Connecting Lines:	Optical Downlink for data and status info Optical upload for commands and clock

PC Interface Card

Function:	Link to DAE 16-bit A/D converter for surface detection system Two Serial & Ethernet link to robotics Direct emergency stop output for robot

Phantom

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

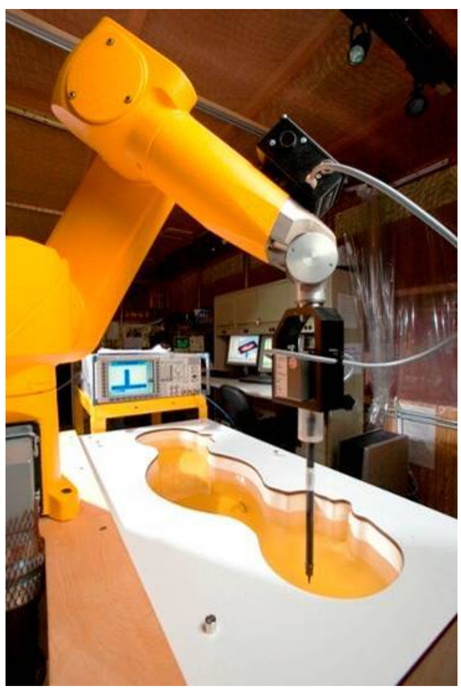


Figure 4-2
SAR Measurement System

5 DASY E-FIELD PROBE SYSTEM

5.1 Probe Measurement System

Figure 5-1
SAR System

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration (see Figure 5-3) and optimized for dosimetric evaluation [9]. 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. 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 DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order curve fitting (see Figure 6-1). The approach is stopped at reaching the maximum.

5.2 Probe Specifications

Model(s):	ES3DV2, ES3DV3, EX3DV4
Frequency Range:	10 MHz – 6.0 GHz (EX3DV4) 10 MHz – 4 GHz (ES3DV3)
Calibration:	In head and body simulating tissue at Frequencies from 300 up to 6000MHz
Linearity:	± 0.2 dB (30 MHz to 6 GHz) for EX3DV4 ± 0.2 dB (30 MHz to 4 GHz) for ES3DV3
Dynamic Range:	10 mW/kg – 100 W/kg
Probe Length:	330 mm
Probe Tip Length:	20 mm
Body Diameter:	12 mm
Tip Diameter:	2.5 mm (3.9mm for ES3DV3)
Tip-Center:	1 mm (2.0 mm for ES3DV3)
Application:	SAR Dosimetry Testing Compliance tests of mobile phones Dosimetry in strong gradient fields

Figure 5-2
Near-Field Probe

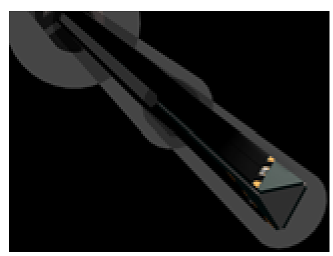


Figure 5-3
Triangular Probe Configuration

6 PROBE CALIBRATION PROCESS

6.1 Dosimetric Assessment Procedure

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm^2) using an RF Signal generator, TEM cell, and RF Power Meter.

6.2 Free Space Assessment

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

6.3 Temperature Assessment

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated head tissue. The E-field in the medium correlates with the temperature rise in the 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:
Δt = exposure time (30 seconds),
C = heat capacity of tissue (brain or muscle),
ΔT = temperature increase due to RF exposure.

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

where:
σ = simulated tissue conductivity,
ρ = 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. The electric field in the simulated tissue can be used to estimate SAR by equating the thermally derived SAR to that with the E- field component.

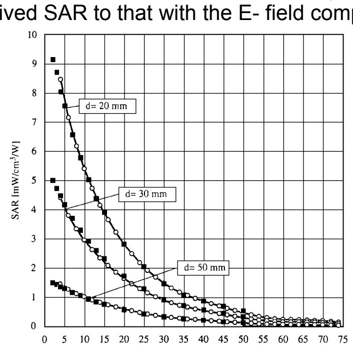


Figure 6-1 E-Field and Temperature measurements at 900MHz [9]

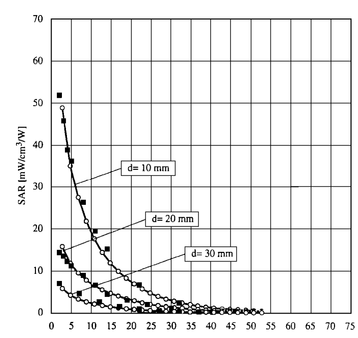


Figure 6-2 E-Field and temperature measurements at 1.9GHz [9]

7 PHANTOM AND EQUIVALENT TISSUES

7.1 SAM Phantoms

Figure 6-1
SAM Phantoms

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to represent the 90th percentile of the population [12][13]. The phantom enables the dosimetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. 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. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

7.2 Tissue Simulating Mixture Characterization

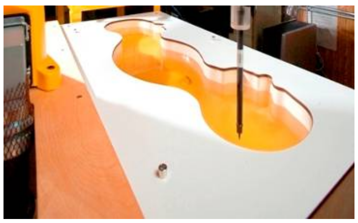


Figure 6-2
SAM Phantom with Simulating Tissue

The mixture is characterized to obtain proper dielectric constant (permittivity) and conductivity of the tissue of interest. The tissue dielectric parameters recommended in IEEE 1528 and IEC 62209 have been used as targets for the compositions, and are to match within 5%, per the FCC recommendations.

Table 7-1
Composition of the Tissue Equivalent Matter

Frequency (MHz)	835	1750	1900
Tissue	Body	Body	Body
Ingredients (% by weight)			
Bactericide	0.1		
DGBE		31	29.44
HEC	1		
NaCl	0.94	0.2	0.39
Sucrose	44.9		
Water	53.06	68.8	70.17

See next page for 750 MHz tissue info.

Table 7-2
Composition of the 750MHz Body Tissue Equivalent Matter

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

H_2O	Water, 35 – 58%
Sucrose	Sugar, white, refined, 40 – 60%
NaCl	Sodium Chloride, 0 – 6%
Hydroxyethyl-cellulose	Medium Viscosity (CAS# 9004-62-0), <0.3%
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyyl-3(2H)-isothiazolone, 0.1 – 0.7% Relevant for safety; Refer to the respective Safety Data Sheet*.

Note: 750MHz Body liquid recipe is proprietary SPEAG. The composition is approximate to the actual liquids utilized. Thus the manufacturer production sheet is provided below.

Figure 6-1
750MHz Body Tissue Equivalent Matter

f [MHz]	HP-e'	HP-e"	sigma
300	61.02	35.43	0.59
350	60.21	32.13	0.63
400	59.50	29.71	0.66
450	58.79	28.00	0.70
500	58.16	26.60	0.74
550	57.57	25.54	0.78
600	56.99	24.68	0.82
650	56.43	23.97	0.87
700	55.88	23.46	0.91
750	55.35	22.91	0.96
800	55.02	22.56	1.00
850	54.50	22.31	1.06
900	54.02	22.08	1.11
950	53.55	21.89	1.16
1000	53.05	21.70	1.21

P/N:	SL AAM 075
Charge:	090224-1
Mea Date:	05-Mrz-09
Temp [°C]	22

TARGET PARAMETERS

f [MHz]	eps	sigma
700	55.7	0.96
750	55.5	0.96
800	55.3	0.97

8 DOSIMETRIC ASSESSMENT & PHANTOM SPECS

8.1 Measurement Procedure

The evaluation was performed using the following procedure:

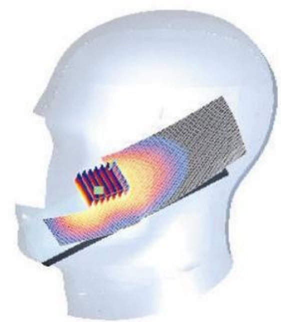


Figure 8-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15mm x 15mm.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during testing the 1 gram cube. This fixed point was measured and used as a reference value.
3. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation. Around this point, a volume of 30mm x 30mm x 30mm (fine resolution volume scan, zoom scan) was assessed by measuring 7 x 7 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual for more details):
   a. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete. If the value deviated by more than 5%, the evaluation was repeated.

8.2 Specific Anthropomorphic Mannequin (SAM) Specifications

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Figure 8-2). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimize reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15 cm.

Figure 8-2
SAM Twin Phantom Shell

9 FCC AND HEALTH CANADA SAFETY CODE 6 RF EXPOSURE LIMITS

9.1 Uncontrolled Environment

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

9.2 Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. 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 9-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT *General Population* (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT *Occupational* (W/kg) or (mW/g)
SPATIAL PEAK SAR Brain	1.6	8.0
SPATIAL AVERAGE SAR Whole Body	0.08	0.4
SPATIAL PEAK SAR Hands, Feet, Ankles, Wrists	4.0	20

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.

10 SAR TEST CONFIGURATIONS

10.1 SAR test procedure for USB Dongles

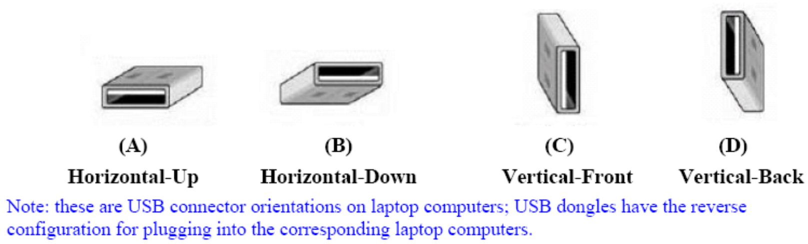


Figure 10-1
USB Dongle Test Configurations

This device was tested according to KDB Publication 447498. USB orientations (see Figure 10-1) with a device to phantom separation distance of 5 mm or less, according to KDB Publication 447498 requirements. Current generation laptop computers should be used to ensure proper measurement distances. The same test separation distance should be used for all frequency bands and modes in each USB orientation. The typical Horizontal-Up USB connection (A), found in the majority of laptop computers, must be tested using an appropriate laptop computer. A laptop with either Vertical-Front (C) or Vertical-Back (D) USB connection should be used to test one of the vertical USB orientations. If laptop computers are not available for testing the Horizontal-Down (B) or the remaining Vertical USB orientation, a short and high quality USB cable (12 inches or less) may be used for testing these other orientations. It should be ensured that the USB cable does not affect device radiating characteristics and output power of the dongle.

KDB Publication 941225 D05 was used to determine the bandwidth, resource block, and offset test configurations recommended for the LTE portion of the tests.

Per KDB Inquiry discussions, the Horizontal-Up dongle position was excluded from SAR testing due to the limitation of the antenna's range of operation with respect to the hinge angle of 110° ~ 130°. The Horizontal-Down recommended test setup is provided below.

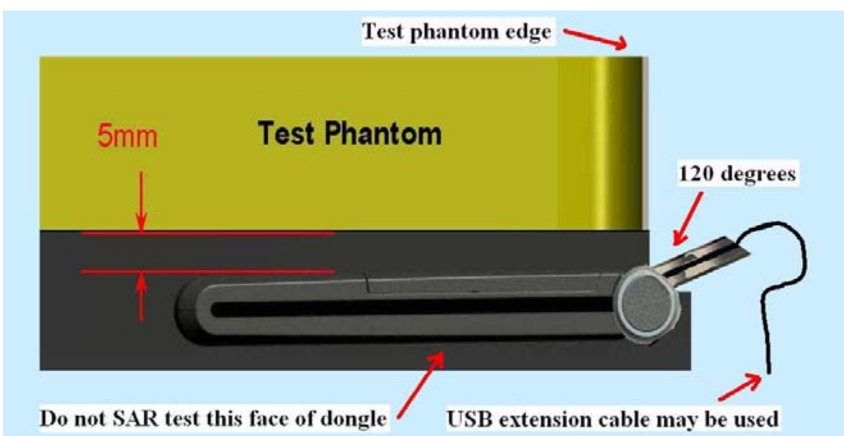


Figure 10-2
Horizontal-Down Test Position

10.2 SAR Device Functionality

The MC679 utilizes a mechanism that alters the transmit functionality of the device based on the angle of the USB connector. When the device is inserted into a horizontal USB port (reference KDB publication 447498, Horizontal Up position ‘A’) the modem hinge has been engineered to automatically orient the modem angle to 120°. At this angle the modem will function normally. If the modem is moved slightly either up or down (110° to 130°) there is no effect on the performance of the device. Should the MC679 move at an angle less than 110° or greater than 130°, the transmit power will turn off. There is a delay mechanism that allows the modem to continue transmitting for 5 seconds in the case of accidental movement. Once the device has been returned to the 120° position, normal operation will be restored.

The measured SAR orientations have been considered based on the possible USB positions stated in the KDB publication 447498.

In the enclosed example a live call has been established with a network operator with the MC679 modem in a Start angle of 120°. The modem is then slowly moved to the End angle, as indicated in the table. The operation of the detection system is verified by monitoring the operation using a QXDM tool. The QXDM plots are referenced in the following table. Also, the same procedure was used while output power measurements were taken with a call box in WCDMA mode-PCS band and these values are tabled below.

Start Angle (degrees)	End Angle (degrees)	Measured O/P Power (dBm) @ Start	Measured O/P Power (dBm) @ End	Call State	Comments
120	90	22.6	0	Changed to Idle	See diagram 1
120	100	22.6	0	Changed to Idle	See diagram 2
120	110	22.6	22.6	Conversation	See diagram 3
120	120	22.6	22.6	Conversation	See diagram 4
120	130	22.6	22.6	Conversation	See diagram 5
120	140	22.6	0	Changed to Idle	See diagram 6
120	180	22.6	0	Changed to Idle	See diagram 7

Diagram 1 (End angle 90°)

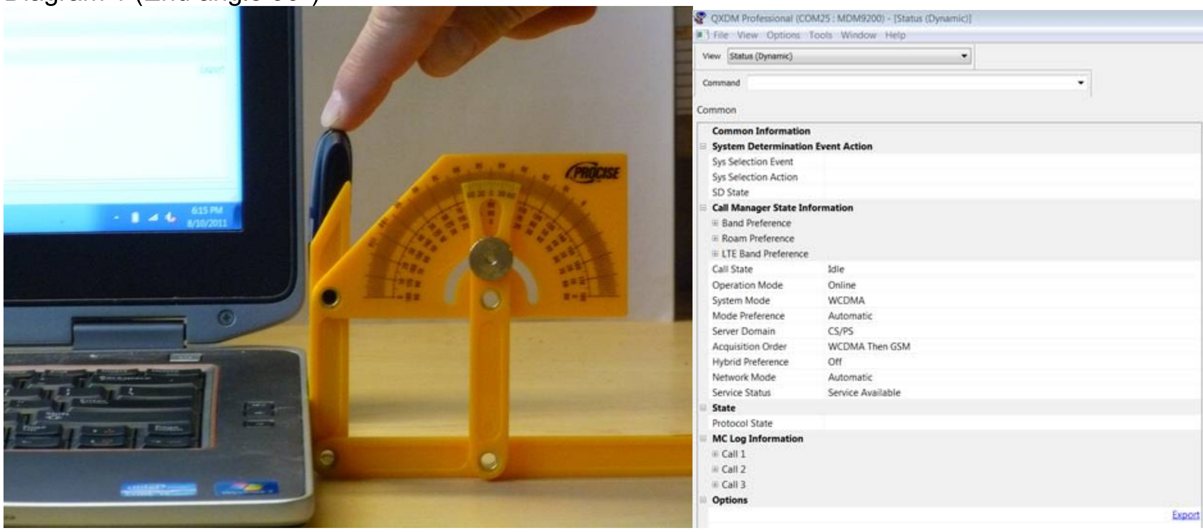


Diagram 2 (End angle 100°)

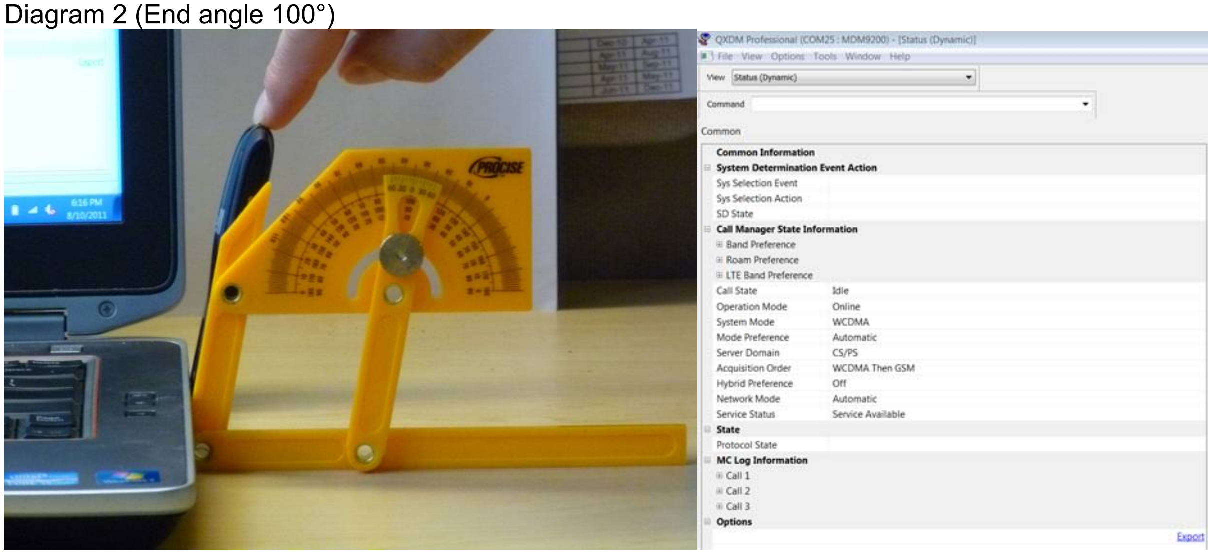


Diagram 3 (End angle 110°)

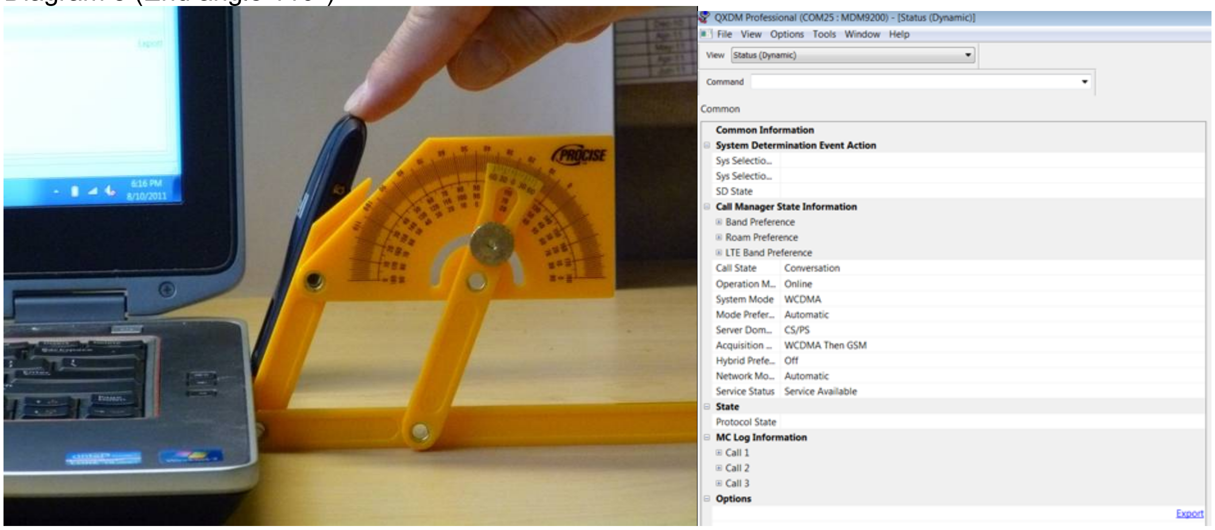


Diagram 4 (End angle 120°)

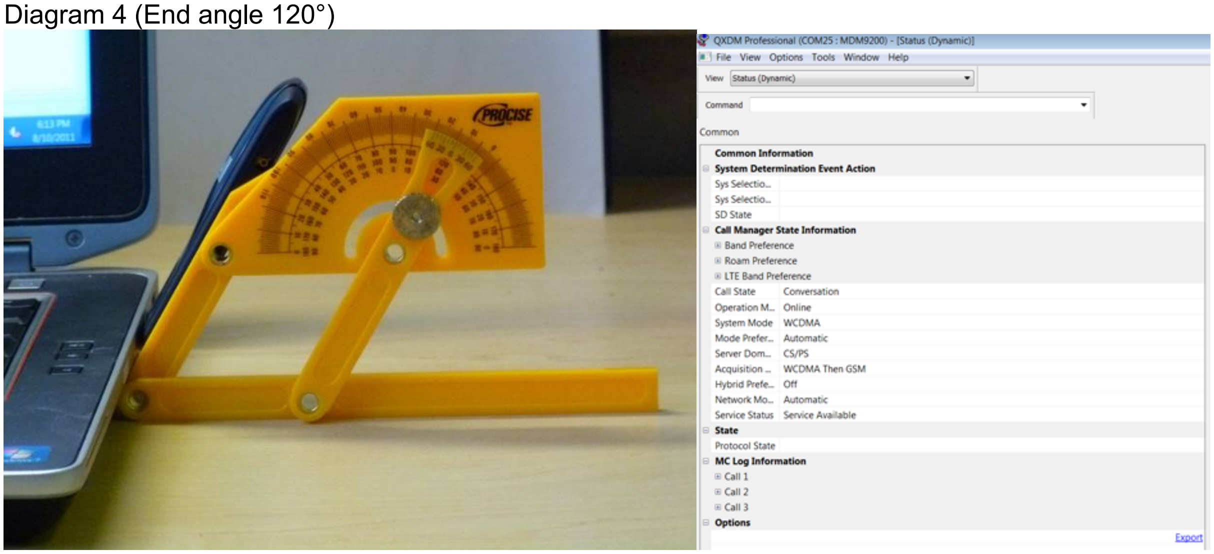


Diagram 5 (End angle 130°)

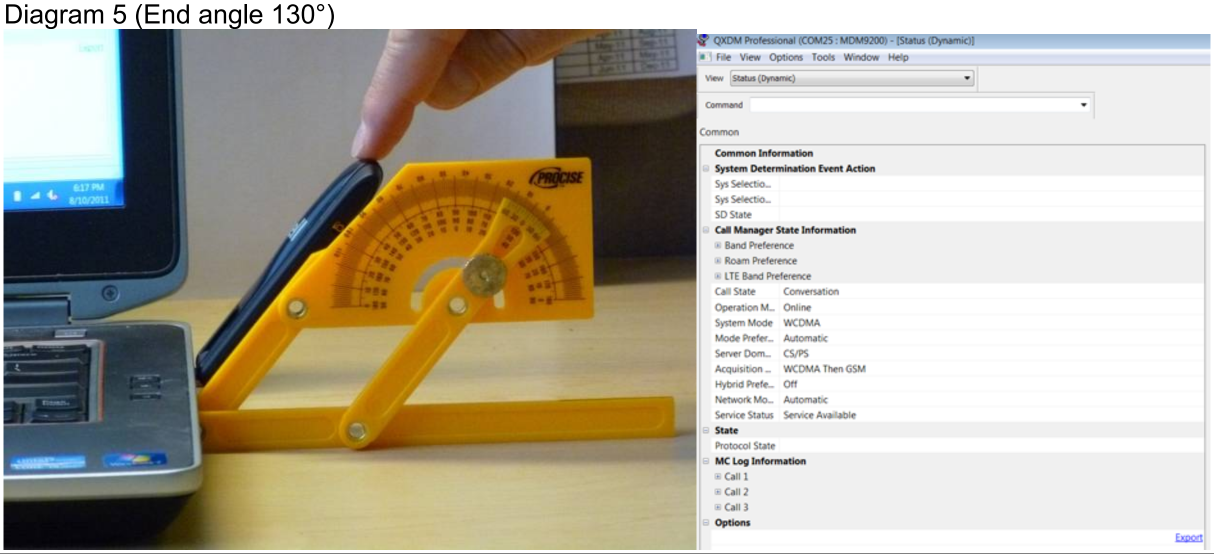


Diagram 6 (End angle 140°)

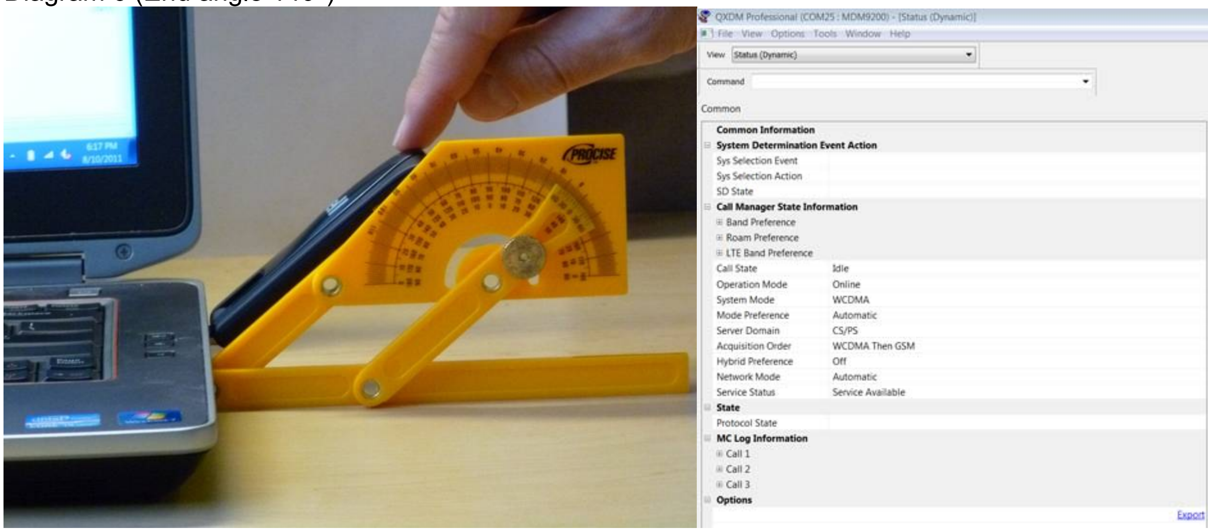
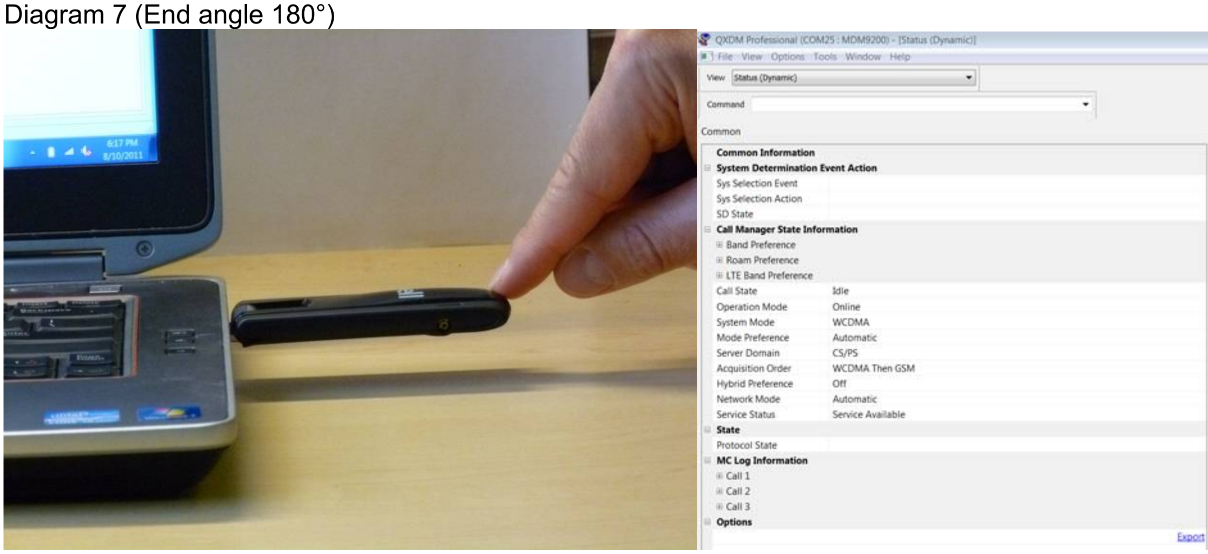


Diagram 7 (End angle 180°)



11 POWER MEASUREMENT PROCEDURES

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

11.1 Procedures Used to Establish RF Signal for SAR

The following procedures are according to KDB 941225 D01, "SAR test for 3G Devices v02".

The device was placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. Devices under test were evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device was tested throughout the SAR test at maximum output power, the SAR measurement system measures a "point SAR" at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. Any power drifts of greater than 5% were repeated.

11.2 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05 publication. Please see notes following SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 was used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing.

11.2.1 MPR

MPR is permanently implemented for this device. With the MPR permanently implemented, this device will never operate at higher power levels. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.

11.2.2 A-MPR

A-MPR (Additional MPR) has been disabled for all SAR tests

11.2.3 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05:

1. Per KDB Publication 941225 D05 Page 4, footnote 2, Since the maximum output power variations across H, M and L channels is ≤1/2 dB and SAR is ≤0.8 W/kg, low and high channels were not required.
2. Per KDB Publication 941225 D05 Page 4, 3) A), QPSK with 50% RB is required.
3. Per KDB Publication 941225 D05 Page 4, 3) B), QPSK with 1 RB for both channel edges are required.
4. Per KDB Publication 941225 D05 Page 4, 4) A), 16QAM with 50% RB is required.
5. Per KDB Publication 941225 D05 Page 4, 4) B), 16QAM with 1RB for both channel edges are required.
6. Per KDB Publication 941225 D05 Page 4, A) I), 100% RB Allocation is not required to be tested since SAR is not > 1.45 W/kg.

11.2.4 Power Reduction for LTE

There is no power reduction scheme implemented for LTE operations for this model.

11.3 SAR Measurement Conditions for UMTS (WCDMA) per FCC KDB Publication 941225

11.3.1 Output Power Verification

Maximum output power is measured on the High, Middle and Low channels for each applicable transmission band according to the general descriptions in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all “1s”.

Maximum output power is verified on the High, Middle and Low channels according to the general descriptions in section 5.2 of 3GPP TS 34.121 (release 5), using the appropriate RMC with TPC (transmit power control) set to all “1s”. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HS-DPCCH) is tabulated in the test report. All configurations that are not supported by the DUT or cannot be measured due to technical or equipment limitations is identified.

11.3.2 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all “1s”.

11.3.3 Procedures Used to Establish RF Signal for SAR HSDPA Data Devices

The following procedures are applicable to HSDPA data devices operating under 3GPP Release 5. Body exposure conditions are typically applicable to these devices, including handsets and data modems operating in various electronic devices. HSDPA operates in conjunction with WCDMA and requires an active DPCCH. The default test configuration is to measure SAR in WCDMA without HSDPA, with an established radio link between the DUT and a communication test set with 12.2 kbps RMC mode configured in Test Loop Mode 1; and tested with HSDPA with FRC and a 12.2 kbps RMC using the highest SAR configuration in WCDMA. SAR is selectively confirmed for other physical channel configurations according to output power, exposure conditions and device operating capabilities. Maximum output power is verified according to 3GPP TS 23.121 (Release 5) and SAR must be measured according to these maximum output conditions.

11.3.4 SAR Measurement Conditions for HSUPA Data Devices

SAR for body exposure configurations are measured according to the ‘Body SAR Measurements’ procedures in the ‘WCDMA Handsets’ section of the KDB 941225 D01 FCC 3G document. In addition, Body SAR is also measured for HSPA when the maximum average output of each RF channel with HSPA active is at least ¼ dB higher of that measured without HSPA in 12.2 kbps RMC mode or the maximum SAR for 12.2 kbps RMC is above 75% of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 with power control algorithm 2, according to the highest body SAR configuration in 12.2 kbps RMC without HSPA.

Due to inner loop power control requirements in HSPA, a commercial communication test set should be used for the output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and EDCH configurations for HSPA should be configured according to the β values indicated below as well as other applicable procedures described in the ‘WCDMA Handset’ and ‘Release 5 HSDPA Data Devices’ sections of the FCC 3G document.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} [1]	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM[2] (dB)	MPR (dB)	AG[4] Index	E-TFCI
1	11/15[3]	15/15[3]	64	11/15[3]	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}: 47/15 β_{ed2}: 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15[4]	15/15[4]	64	15/15[4]	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.
Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.
Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to β_c = 10/15 and β_d = 15/15.
Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to β_c = 14/15 and β_d = 15/15.
Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.
Note 6: β_{ed} can not be set directly; it is set by Absolute Grant Value.

11.4 RF Conducted Powers

11.4.1 GPRS/EDGE Conducted Powers

		Maximum Burst-Averaged Output Power							
		GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
Cellular	128	**32.58**	**28.23**	**26.51**	**25.50**	25.75	23.73	22.10	21.00
	190	**32.38**	**28.38**	**26.39**	**25.51**	25.51	23.69	22.05	20.97
	251	**32.21**	**28.39**	**26.23**	**25.10**	25.56	23.64	22.03	20.91
PCS	512	29.27	25.79	23.74	22.24	24.69	23.09	21.25	19.03
	661	29.45	25.65	23.69	22.26	24.72	23.12	21.30	19.94
	810	**30.04**	26.23	24.36	22.20	25.15	23.14	21.64	20.33

		Calculated Maximum Frame-Averaged Output Power							
		GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
Cellular	128	**23.55**	**22.21**	**22.25**	**22.49**	16.72	17.71	17.84	17.99
	190	**23.35**	**22.36**	**22.13**	**22.50**	16.48	17.67	17.79	17.96
	251	**23.18**	**22.37**	**21.97**	**22.09**	16.53	17.62	17.77	17.90
PCS	512	20.24	19.77	19.48	19.23	15.66	17.07	16.99	16.02
	661	20.42	19.63	19.43	19.25	15.69	17.10	17.04	16.93
	810	**21.01**	20.21	20.10	19.19	16.12	17.12	17.38	17.32

Notes:

1. Both burst-averaged and calculated frame-averaged powers are included. The frame-averaged power was calculated from the measured burst averaged power by converting the slot powers into linear units and calculating the energy over 8 time slots. The bolded GPRS/EDGE mode was selected according to the highest frame-averaged output power table according to KDB Publication 941225 D03.
2. GPRS/EDGE (GMSK) conducted powers were measured with CS1 and EDGE (8-PSK) conducted powers were measured with MCS7.

GSM Class: C (data only)
GPRS Multislot class: 12 (max 4 Tx Uplink slots)
EDGE Multislot class: 12 (max 4Tx Uplink slots)
DTM Multislot Class: N/A

11.4.2 HSPA Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			βc	βd	MPR
			4132	4183	4233	9262	9400	9538			
99	WCDMA	12.2 kbps RMC	23.00	23.03	**23.05**	22.30	**22.32**	22.17	-	-	-
6	HSDPA	Subtest 1	22.94	22.90	22.91	**22.36**	22.31	22.19	2	15	0
6		Subtest 2	**23.06**	22.98	23.00	22.29	22.35	22.16	11	15	0
6		Subtest 3	22.53	22.52	22.60	21.84	21.86	21.75	15	8	0.5
6		Subtest 4	22.59	22.45	22.56	21.81	21.89	21.70	15	4	0.5
6	HSUPA	Subtest 1	22.39	22.12	**22.45**	22.14	22.32	22.10	10	15	0
6		Subtest 2	21.38	21.21	21.62	20.86	20.58	20.19	6	15	2
6		Subtest 3	22.11	21.91	22.24	21.20	21.42	21.27	15	9	1
6		Subtest 4	21.69	21.26	21.66	21.04	21.25	20.66	2	15	2
6		Subtest 5	22.40	22.29	22.39	**22.43**	22.36	22.12	14	15	0

WCDMA mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01. HSPA SAR tests were not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.

MPR for some HSUPA subtests may be more than expected (i.e. up to 2.5 dB more power reduction possible than 3GPP expected MPR, but also as low as 0 dB power reduction) according to the chipset implementation in this model. Detailed information is included in the operational description explaining how the MPR is applied for this model.

Note: This device is only capable of HSUPA in the uplink (QPSK in the uplink), but is capable of HSPA+ in the downlink. Information about the uplink and downlink capabilities are explained in further detail in the technical descriptions for this model.

11.4.3 LTE Conducted Powers

Table 1 - LTE Band 17 Conducted Power – Mid Channel

Frequency [MHz]	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	TBS Index	Mod	Maximum Average Power [dBm]	MPR Targets
710	23790	5	1	0	0	QPSK	**22.97**	0
710	23790	5	1	24	0	QPSK	22.89	**0**
710	23790	5	12	6	0	QPSK	21.89	1
710	23790	5	25	0	0	QPSK	22.01	1
710	23790	5	1	0	11	16-QAM	22.13	1
710	23790	5	1	24	11	16-QAM	22.01	1
710	23790	5	12	6	11	16-QAM	20.93	2
710	23790	5	25	0	11	16-QAM	20.98	2
710	23790	10	1	0	0	QPSK	22.78	0
710	23790	10	1	49	0	QPSK	22.59	0
710	23790	10	25	12	0	QPSK	22.06	1
710	23790	10	50	0	0	QPSK	21.92	1
710	23790	10	1	0	11	16-QAM	22.20	1
710	23790	10	1	49	11	16-QAM	22.12	1
710	23790	10	25	12	15	16-QAM	21.52	2
710	23790	10	50	0	15	16-QAM	21.05	2

Notes:

1. Differences from expected MPR levels are a result of measurement uncertainty. Per the manufacturer, the measured powers are acceptable for use within the intended network infrastructure. Powers measured below the expected levels on the devices were extrapolated to ensure compliance for SAR.
2. Per KDB Publication 447498 D01, Page 7, 6) C only 1 channel is required for Band 13 LTE

Table 2 – LTE AWS Conducted Power – Low Channel

Frequency [MHz]	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Maximum Average Power [dBm]	MPR Targets
1710.7	19957	1.4	1	0	QPSK	22.90	0
1710.7	19957	1.4	1	5	QPSK	22.87	0
1710.7	19957	1.4	3	2	QPSK	22.98	0
1710.7	19957	1.4	6	0	QPSK	21.94	1
1710.7	19957	1.4	1	0	16-QAM	22.24	1
1710.7	19957	1.4	1	5	16-QAM	22.39	1
1710.7	19957	1.4	3	2	16-QAM	22.18	1
1710.7	19957	1.4	6	0	16-QAM	21.41	2
1711.5	19965	3	1	0	QPSK	22.86	0
1711.5	19965	3	1	14	QPSK	23.06	0
1711.5	19965	3	8	4	QPSK	21.85	1
1711.5	19965	3	15	0	QPSK	21.69	1
1711.5	19965	3	1	0	16-QAM	21.88	1
1711.5	19965	3	1	14	16-QAM	21.87	1
1711.5	19965	3	8	4	16-QAM	20.89	2
1711.5	19965	3	15	0	16-QAM	20.96	2
1712.5	19975	5	1	0	QPSK	23.04	0
1712.5	19975	5	1	24	QPSK	23.02	0
1712.5	19975	5	12	6	QPSK	21.34	1
1712.5	19975	5	25	0	QPSK	21.78	1
1712.5	19975	5	1	0	16-QAM	22.01	1
1712.5	19975	5	1	24	16-QAM	22.13	1
1712.5	19975	5	12	6	16-QAM	20.97	2
1712.5	19975	5	25	0	16-QAM	21.06	2
1715	20000	10	1	0	QPSK	22.83	0
1715	20000	10	1	49	QPSK	22.74	0
1715	20000	10	25	12	QPSK	22.02	1
1715	20000	10	50	0	QPSK	21.84	1
1715	20000	10	1	0	16-QAM	22.30	1
1715	20000	10	1	49	16-QAM	22.20	1
1715	20000	10	25	12	16-QAM	20.86	2
1715	20000	10	50	0	16-QAM	20.93	2
1717.5	20025	15	1	0	QPSK	**23.22**	**0**
1717.5	20025	15	1	74	QPSK	22.96	0
1717.5	20025	15	36	18	QPSK	21.96	1
1717.5	20025	15	75	0	QPSK	21.98	1
1717.5	20025	15	1	0	16-QAM	22.26	1
1717.5	20025	15	1	74	16-QAM	22.01	1
1717.5	20025	15	36	18	16-QAM	21.16	2
1717.5	20025	15	75	0	16-QAM	20.98	2
1720	20050	20	1	0	QPSK	22.80	0
1720	20050	20	1	99	QPSK	22.90	0
1720	20050	20	50	25	QPSK	21.94	1
1720	20050	20	100	0	QPSK	21.85	1
1720	20050	20	1	0	16-QAM	22.12	1
1720	20050	20	1	99	16-QAM	22.21	1
1720	20050	20	50	25	16-QAM	20.97	2
1720	20050	20	100	0	16-QAM	20.91	2

Note: Differences from expected MPR levels are a result of measurement uncertainty. Per the manufacturer, the measured powers are acceptable for use within the intended network infrastructure. Powers measured below the expected levels on the devices were extrapolated to ensure compliance for SAR.

Table 3 – LTE AWS Conducted Power – Mid Channel

Frequency [MHz]	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	TBS	Mod	Maximum Average Power [dBm]	MPR Targets
1732.5	20175	1.4	1	0	0	QPSK	22.94	0
1732.5	20175	1.4	1	5	0	QPSK	22.84	0
1732.5	20175	1.4	3	2	0	QPSK	22.91	0
1732.5	20175	1.4	6	0	0	QPSK	21.94	1
1732.5	20175	1.4	1	0	11	16-QAM	22.15	1
1732.5	20175	1.4	1	5	11	16-QAM	22.27	1
1732.5	20175	1.4	3	2	11	16-QAM	22.03	1
1732.5	20175	1.4	6	0	11	16-QAM	21.37	2
1732.5	20175	3	1	0	0	QPSK	22.82	0
1732.5	20175	3	1	14	0	QPSK	22.78	0
1732.5	20175	3	8	4	0	QPSK	22.14	1
1732.5	20175	3	15	0	0	QPSK	21.93	1
1732.5	20175	3	1	0	11	16-QAM	22.30	1
1732.5	20175	3	1	14	11	16-QAM	22.23	1
1732.5	20175	3	8	4	11	16-QAM	21.11	2
1732.5	20175	3	15	0	11	16-QAM	21.08	2
1732.5	20175	5	1	0	0	QPSK	22.28	0
1732.5	20175	5	1	24	0	QPSK	22.18	0
1732.5	20175	5	12	6	0	QPSK	21.31	1
1732.5	20175	5	25	0	0	QPSK	21.35	1
1732.5	20175	5	1	0	11	16-QAM	21.38	1
1732.5	20175	5	1	24	11	16-QAM	21.20	1
1732.5	20175	5	12	6	11	16-QAM	20.27	2
1732.5	20175	5	25	0	11	16-QAM	20.31	2
1732.5	20175	10	1	0	0	QPSK	22.58	0
1732.5	20175	10	1	49	0	QPSK	22.75	0
1732.5	20175	10	25	12	0	QPSK	21.95	1
1732.5	20175	10	50	0	0	QPSK	21.93	1
1732.5	20175	10	1	0	11	16-QAM	22.24	1
1732.5	20175	10	1	49	11	16-QAM	22.14	1
1732.5	20175	10	25	12	15	16-QAM	20.87	2
1732.5	20175	10	50	0	15	16-QAM	20.97	2
1732.5	20175	15	1	0	0	QPSK	22.96	**0**
1732.5	20175	15	1	74	0	QPSK	22.93	0
1732.5	20175	15	36	18	0	QPSK	22.06	1
1732.5	20175	15	75	0	0	QPSK	22.00	1
1732.5	20175	15	1	0	11	16-QAM	22.06	1
1732.5	20175	15	1	74	11	16-QAM	22.03	1
1732.5	20175	15	36	18	11	16-QAM	21.12	2
1732.5	20175	15	75	0	11	16-QAM	21.02	2
1732.5	20175	20	1	0	0	QPSK	22.89	0
1732.5	20175	20	1	99	0	QPSK	22.79	0
1732.5	20175	20	50	25	0	QPSK	22.07	1
1732.5	20175	20	100	0	0	QPSK	22.11	1
1732.5	20175	20	1	0	11	16-QAM	22.09	1
1732.5	20175	20	1	99	11	16-QAM	21.99	1
1732.5	20175	20	50	25	11	16-QAM	21.16	2
1732.5	20175	20	100	0	11	16-QAM	21.10	2

Note: Differences from expected MPR levels are a result of measurement uncertainty. Per the manufacturer, the measured powers are acceptable for use within the intended network infrastructure. Powers measured below the expected levels on the devices were extrapolated to ensure compliance for SAR.

Table 4 – LTE AWS Conducted Power – High Channel

Frequency [MHz]	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	TBS	Mod	Maximum Average Power [dBm]	MPR Targets
1754.3	20393	1.4	1	0	0	QPSK	22.81	0
1754.3	20393	1.4	1	5	0	QPSK	22.80	0
1754.3	20393	1.4	3	2	0	QPSK	22.86	0
1754.3	20393	1.4	6	0	0	QPSK	21.81	1
1754.3	20393	1.4	1	0	11	16-QAM	22.22	1
1754.3	20393	1.4	1	5	11	16-QAM	22.19	1
1754.3	20393	1.4	3	2	11	16-QAM	22.02	1
1754.3	20393	1.4	6	0	11	16-QAM	21.25	2
1753.5	20385	3	1	0	0	QPSK	22.81	0
1753.5	20385	3	1	14	0	QPSK	22.86	0
1753.5	20385	3	8	4	0	QPSK	21.81	1
1753.5	20385	3	15	0	0	QPSK	21.82	1
1753.5	20385	3	1	0	11	16-QAM	21.97	1
1753.5	20385	3	1	14	11	16-QAM	21.76	1
1753.5	20385	3	8	4	11	16-QAM	20.92	2
1753.5	20385	3	15	0	11	16-QAM	20.91	2
1752.5	20375	5	1	0	0	QPSK	22.81	0
1752.5	20375	5	1	24	0	QPSK	22.84	0
1752.5	20375	5	12	6	0	QPSK	21.98	1
1752.5	20375	5	25	0	0	QPSK	21.86	1
1752.5	20375	5	1	0	11	16-QAM	21.91	1
1752.5	20375	5	1	24	11	16-QAM	21.98	1
1752.5	20375	5	12	6	11	16-QAM	20.97	2
1752.5	20375	5	25	0	11	16-QAM	21.02	2
1750	20350	10	1	0	0	QPSK	22.70	0
1750	20350	10	1	49	0	QPSK	22.61	0
1750	20350	10	25	12	0	QPSK	21.85	1
1750	20350	10	50	0	0	QPSK	21.90	1
1750	20350	10	1	0	11	16-QAM	22.19	1
1750	20350	10	1	49	11	16-QAM	22.21	1
1750	20350	10	25	12	15	16-QAM	21.30	2
1750	20350	10	50	0	15	16-QAM	20.93	2
1747.5	20325	15	1	0	0	QPSK	23.02	**0**
1747.5	20325	15	1	74	0	QPSK	22.90	0
1747.5	20325	15	36	18	0	QPSK	22.19	1
1747.5	20325	15	75	0	0	QPSK	22.04	1
1747.5	20325	15	1	0	11	16-QAM	22.15	1
1747.5	20325	15	1	74	11	16-QAM	22.06	1
1747.5	20325	15	36	18	11	16-QAM	21.06	2
1747.5	20325	15	75	0	11	16-QAM	20.88	2
1745	20300	20	1	0	0	QPSK	22.73	0
1745	20300	20	1	99	0	QPSK	22.77	0
1745	20300	20	50	25	0	QPSK	22.16	1
1745	20300	20	100	0	0	QPSK	21.89	1
1745	20300	20	1	0	11	16-QAM	21.95	1
1745	20300	20	1	99	11	16-QAM	22.06	1
1745	20300	20	50	25	11	16-QAM	21.11	2
1745	20300	20	100	0	11	16-QAM	20.85	2

Note: Differences from expected MPR levels are a result of measurement uncertainty. Per the manufacturer, the measured powers are acceptable for use within the intended network infrastructure. Powers measured below the expected levels on the devices were extrapolated to ensure compliance for SAR.

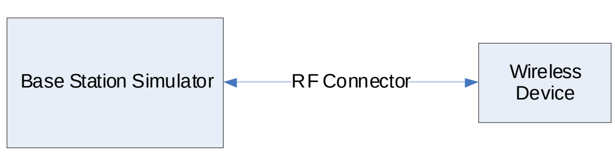


Figure 11-1
Power Measurement Setup

12 SYSTEM VERIFICATION

12.1 Tissue Verification

Table 12-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
08/05/2011	750B	680	0.919	56.88	0.956	56.069	-3.87%	1.45%
		695	0.931	56.73	0.957	55.985	-2.72%	1.33%
		710	0.947	56.60	0.958	55.901	-1.15%	1.25%
		725	0.958	56.56	0.960	55.817	-0.21%	1.33%
		740	0.981	56.42	0.961	55.733	2.08%	1.23%
		755	0.991	56.11	0.963	55.649	2.91%	0.83%
08/02/2011	835B	820	0.980	53.91	0.969	55.284	1.14%	-2.49%
		835	0.980	54.19	0.970	55.200	1.03%	-1.83%
		850	1.001	53.90	0.988	55.154	1.32%	-2.27%
08/08/2011	835B	820	0.945	54.35	0.969	55.284	-2.48%	-1.69%
		835	0.949	54.62	0.970	55.200	-2.16%	-1.05%
		850	0.974	54.65	0.988	55.154	-1.42%	-0.91%
08/09/2011	835B	820	0.959	55.00	0.969	55.284	-1.03%	-0.51%
		835	0.970	54.93	0.970	55.200	0.00%	-0.49%
		850	0.991	54.74	0.988	55.154	0.30%	-0.75%
07/29/2011	1750B	1710	1.486	52.90	1.460	53.540	1.78%	-1.20%
		1750	1.539	52.75	1.490	53.430	3.29%	-1.27%
		1790	1.571	52.64	1.510	53.330	4.04%	-1.29%
08/04/2011	1900B	1850	1.455	51.55	1.520	53.300	-4.28%	-3.28%
		1880	1.476	51.41	1.520	53.300	-2.89%	-3.55%
		1910	1.475	51.10	1.520	53.300	-2.96%	-4.13%

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

The above measured tissue parameters were used in the DASY software to perform interpolation via the DASY software to determine actual dielectric parameters at the test frequencies (per IEEE 1528 6.6.1.2). The SAR test plots may slightly differ from the table above since the DASY software rounds to three significant digits.

12.2 Measurement Procedure for Tissue verification

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the sample which was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
3) The complex admittance with respect to the probe aperture was measured
4) The complex relative permittivity , for example from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{[\ln(b/a)]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp\left[-j\omega r(\mu_0\varepsilon_r^{'}\varepsilon_0)^{1/2}\right]}{r} d\phi' d\rho' d\rho$$

where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

12.3 Test System Verification

Prior to assessment, the system is verified to ±10% of the manufacturer SAR measurement on the reference dipole at the time of calibration.

Table 12-2
System Verification Results

System Verification TARGET & MEASURED										
Date:	**Amb. Temp (°C)**	**Liquid Temp (°C)**	**Input Power (W)**	**Tissue Frequency (MHz)**	**Dipole SN**	**Tissue Type**	**Measured SAR_{1g} (W/kg)**	**1 W Target SAR_{1g} (W/kg)**	**1 W Normalized SAR_{1g} (W/kg)**	**Deviation (%)**
08/05/2011	23.5	22.1	0.250	750	1003	Body	2.22	8.850	8.880	0.34%
08/02/2011	22.8	21.7	0.250	835	4d047	Body	2.4	9.850	9.600	-2.54%
08/08/2011	24.3	22.7	0.100	835	4d047	Body	1.01	9.850	10.100	2.54%
08/09/2011	23.9	22.2	0.100	835	4d047	Body	0.939	9.850	9.390	-4.67%
07/29/2011	24.3	22.6	0.040	1750	1051	Body	1.55	37.000	38.750	4.73%
08/04/2011	24.7	23.1	0.100	1900	502	Body	4.04	41.100	40.400	-1.70%

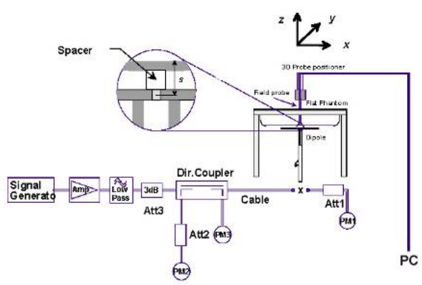


Figure 12-1
System Verification Setup Diagram

Figure 12-2
System Verification Setup Photo

13 SAR DATA SUMMARY

Table 13-1
GPRS/EDGE 850 Body SAR Results

MEASUREMENT RESULTS											
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Spacing	Test Config	Serial Number	# of GPRS Slots	Side	SAR (1g)
MHz	Ch.										(W/kg)
824.20	128	GSM 850	GPRS	32.58	0.00	0.5 cm	USB Cable	485	1	horizontal down	0.998
836.60	190	GSM 850	GPRS	32.38	-0.05	0.5 cm	USB Cable	485	1	horizontal down	0.944
848.80	251	GSM 850	GPRS	32.21	-0.10	0.5 cm	USB Cable	485	1	horizontal down	0.802
824.20	128	GSM 850	GPRS	28.23	0.01	0.5 cm	USB Cable	485	2	horizontal down	0.844
836.60	190	GSM 850	GPRS	28.38	0.06	0.5 cm	USB Cable	485	2	horizontal down	0.901
848.80	251	GSM 850	GPRS	28.39	-0.09	0.5 cm	USB Cable	485	2	horizontal down	0.753
836.60	190	GSM 850	GPRS	26.39	0.06	0.5 cm	USB Cable	485	3	horizontal down	0.695
836.60	190	GSM 850	GPRS	25.51	-0.05	0.5 cm	USB Cable	485	4	horizontal down	0.776
836.60	190	GSM 850	GPRS	32.58	0.03	0.5 cm	Laptop	485	1	vertical back	0.422
824.20	128	GSM 850	GPRS	32.38	0.02	0.5 cm	USB Cable	485	1	vertical front	0.948
836.60	190	GSM 850	GPRS	32.58	-0.07	0.5 cm	USB Cable	485	1	vertical front	0.842
848.80	251	GSM 850	GPRS	32.21	0.01	0.5 cm	USB Cable	485	1	vertical front	0.691
836.60	190	GSM 850	GPRS	32.38	0.08	0.5 cm	Laptop	485	1	tip	0.124
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram					

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001], IEEE 1528-2003 and RSS-102.
2. All modes of operation were investigated, and worst-case results are reported.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Liquid tissue depth was at least 15.0 cm.
5. Justification for reduced test configurations: Per FCC/OET Bulletin 65 Supplement C (June 2001) and Public Notice DA-02-1438, if the SAR measured at the middle channel for each test configuration is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).
6. IBM ThinkPad notebooks were used as hosts for testing the modem configurations
7. A spacing of 0.5 cm was used for all sides of the modem per KDB Inquiry discussions and KDB Publication 447498 for USB dongles.
8. The Horizontal-Up position was exempt from testing per switching off mechanism per KDB Inquiry discussions.
9. Justification for reduced test configurations per KDB Publication 941225 D03: The source-based time-averaged output power was evaluated for all multi-slot operations. In addition to the worst-case reported, all source-based time-averaged powers within 10% of the worst-case were additionally included in the evaluation for hotspot body SAR.

Table 13-2
GPRS/EDGE 1900 Body SAR Results

MEASUREMENT RESULTS											
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Spacing	Test Config	Serial Number	# of GPRS Slots	Side	SAR (1g)
MHz	Ch.										(W/kg)
1909.80	810	GSM 1900	GPRS	30.04	-0.09	0.5 cm	USB Cable	485	1	horizontal down	0.568
1909.80	810	GSM 1900	GPRS	30.04	0.01	0.5 cm	Laptop	485	1	vertical back	0.391
1909.80	810	GSM 1900	GPRS	30.04	-0.06	0.5 cm	USB Cable	485	1	vertical front	0.574
1909.80	810	GSM 1900	GPRS	30.04	-0.01	0.5 cm	Laptop	485	1	tip	0.253
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram					

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001], IEEE 1528-2003 and RSS-102.
2. All modes of operation were investigated, and worst-case results are reported.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Liquid tissue depth was at least 15.0 cm.
5. Per April 2010 TCB Workshop Presentation: Since the output power level across all 3 channels varied by ≥ 0.5 dB the channel with the highest output level was measured, and its SAR was compared to 0.8 W/kg to determine if the other two channels are to be tested.
6. IBM ThinkPad notebooks were used as hosts for testing the modem configurations
7. A spacing of 0.5 cm was used for all sides of the modem per KDB Inquiry discussions and KDB Publication 447498 for USB dongles.
8. The Horizontal-Up position was exempt from testing per switching off mechanism per KDB Inquiry discussions.
9. Justification for reduced test configurations per KDB Publication 941225 D03: The source-based time-averaged output power was evaluated for all multi-slot operations. In addition to the worst-case reported, all source-based time-averaged powers within 10% of the worst-case were additionally included in the evaluation for hotspot body SAR.

Table 13-3
WCDMA 850 Body SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Spacing	Test Config	Serial Number	Side	SAR (1g)
MHz	Ch.									(W/kg)
836.60	4183	WCDMA 850	RMC	23.03	-0.01	0.5 cm	USB Cable	485	horizontal down	0.781
836.60	4183	WCDMA 850	RMC	23.03	0.03	0.5 cm	Laptop	485	vertical back	0.358
836.60	4183	WCDMA 850	RMC	23.03	-0.08	0.5 cm	USB Cable	485	vertical front	0.751
836.60	4183	WCDMA 850	RMC	23.03	0.10	0.5 cm	Laptop	485	tip	0.117
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram				

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001], IEEE 1528-2003 and RSS-102.
2. All modes of operation were investigated, and worst-case results are reported.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Liquid tissue depth was at least 15.0 cm.
5. Justification for reduced test configurations: Per FCC/OET Bulletin 65 Supplement C (June 2001) and Public Notice DA-02-1438, if the SAR measured at the middle channel for each test configuration is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).
6. IBM ThinkPad notebooks were used as hosts for testing the modem configurations
7. A spacing of 0.5 cm was used for all sides of the modem per KDB Inquiry discussions and KDB Publication 447498 for USB dongles.
8. The Horizontal-Up position was exempt from testing per switching off mechanism per KDB Inquiry discussions.
9. WCDMA mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.

Table 13-4
WCDMA 1900 Body SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Spacing	Test Config	Serial Number	Side	SAR (1g)
MHz	Ch.									(W/kg)
1852.40	9262	WCDMA 1900	RMC	22.30	-0.04	0.5 cm	USB Cable	485	horizontal down	1.050
1880.00	9400	WCDMA 1900	RMC	22.32	0.07	0.5 cm	USB Cable	485	horizontal down	1.130
1907.60	9538	WCDMA 1900	RMC	22.17	-0.01	0.5 cm	USB Cable	485	horizontal down	0.971
1880.00	9400	WCDMA 1900	RMC	22.32	0.07	0.5 cm	Laptop	485	vertical back	0.719
1852.40	9262	WCDMA 1900	RMC	22.30	0.04	0.5 cm	USB Cable	485	vertical front	1.000
1880.00	9400	WCDMA 1900	RMC	22.32	0.05	0.5 cm	USB Cable	485	vertical front	1.110
1907.60	9538	WCDMA 1900	RMC	22.17	-0.04	0.5 cm	USB Cable	485	vertical front	0.963
1880.00	9400	WCDMA 1900	RMC	22.32	0.03	0.5 cm	Laptop	485	tip	0.541
ANSI / IEEE C95.1 1992 - SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population**						**Body** **1.6 W/kg (mW/g)** averaged over 1 gram				

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001], IEEE 1528-2003 and RSS-102.
2. All modes of operation were investigated, and worst-case results are reported.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Liquid tissue depth was at least 15.0 cm.
5. Justification for reduced test configurations: Per FCC/OET Bulletin 65 Supplement C (June 2001) and Public Notice DA-02-1438, if the SAR measured at the middle channel for each test configuration is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).
6. IBM ThinkPad notebooks were used as hosts for testing the modem configurations
7. A spacing of 0.5 cm was used for all sides of the modem per KDB Inquiry discussions and KDB Publication 447498 for USB dongles.
8. The Horizontal-Up position was exempt from testing per switching off mechanism per KDB Inquiry discussions.
9. WCDMA mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.

Table 13-5
LTE Band 17 Body SAR Results

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Spacing	Bandwidth (MHz)	Test Config	Serial Number	Number of Resource Blocks	RB Offset	MPR Target	Side	SAR (1g)
MHz	Ch.													(W/kg)
710	23790	LTE Band 17	QPSK	22.06	0.06	0.5 cm	10	USB Cable	485	25	12	1	horizontal down	0.429
710	23790	LTE Band 17	QPSK	22.78	-0.04	0.5 cm	10	USB Cable	485	1	0	0	horizontal down	0.529
710	23790	LTE Band 17	QPSK	22.59	-0.09	0.5 cm	10	USB Cable	485	1	49	0	horizontal down	0.495
710	23790	LTE Band 17	16QAM	21.52	-0.05	0.5 cm	10	USB Cable	485	25	12	2	horizontal down	0.384
710	23790	LTE Band 17	16QAM	22.20	0.02	0.5 cm	10	USB Cable	485	1	0	1	horizontal down	0.432
710	23790	LTE Band 17	16QAM	22.12	0.05	0.5 cm	10	USB Cable	485	1	49	1	horizontal down	0.372
710	23790	LTE Band 17	QPSK	22.06	-0.09	0.5 cm	10	Laptop	485	25	12	1	vertical back	0.213
710	23790	LTE Band 17	QPSK	22.78	-0.06	0.5 cm	10	Laptop	485	1	0	0	vertical back	0.256
710	23790	LTE Band 17	QPSK	22.59	-0.09	0.5 cm	10	Laptop	485	1	49	0	vertical back	0.236
710	23790	LTE Band 17	16QAM	21.52	-0.05	0.5 cm	10	Laptop	485	25	12	2	vertical back	0.118
710	23790	LTE Band 17	16QAM	22.20	0.01	0.5 cm	10	Laptop	485	1	0	1	vertical back	0.217
710	23790	LTE Band 17	16QAM	22.12	-0.06	0.5 cm	10	Laptop	485	1	49	1	vertical back	0.185
710	23790	LTE Band 17	QPSK	22.06	-0.01	0.5 cm	10	USB Cable	485	25	12	1	vertical front	0.252
710	23790	LTE Band 17	QPSK	22.78	-0.10	0.5 cm	10	USB Cable	485	1	0	0	vertical front	0.243
710	23790	LTE Band 17	QPSK	22.59	0.00	0.5 cm	10	USB Cable	485	1	49	0	vertical front	0.235
710	23790	LTE Band 17	16QAM	21.52	0.00	0.5 cm	10	USB Cable	485	25	12	2	vertical front	0.226
710	23790	LTE Band 17	16QAM	22.20	-0.01	0.5 cm	10	USB Cable	485	1	0	1	vertical front	0.182
710	23790	LTE Band 17	16QAM	22.12	0.05	0.5 cm	10	USB Cable	485	1	49	1	vertical front	0.178
710	23790	LTE Band 17	QPSK	22.06	0.08	0.5 cm	10	Laptop	485	25	12	1	tip	0.040
710	23790	LTE Band 17	QPSK	22.78	-0.02	0.5 cm	10	Laptop	485	1	0	0	tip	0.036
710	23790	LTE Band 17	QPSK	22.59	-0.08	0.5 cm	10	Laptop	485	1	49	0	tip	0.041
710	23790	LTE Band 17	16QAM	21.52	-0.09	0.5 cm	10	Laptop	485	25	12	2	tip	0.037
710	23790	LTE Band 17	16QAM	22.20	-0.05	0.5 cm	10	Laptop	485	1	0	1	tip	0.027
710	23790	LTE Band 17	16QAM	22.12	-0.04	0.5 cm	10	Laptop	485	1	49	1	tip	0.031
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram								

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001], IEEE 1528-2003 and RSS-102.
2. All modes of operation were investigated, and worst-case results are reported.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Liquid tissue depth was at least 15.0 cm.
5. IBM ThinkPad notebooks were used as hosts for testing the modem configurations
6. A spacing of 0.5 cm was used for all sides of the modem per KDB Inquiry discussions and KDB Publication 447498 for USB dongles.
7. The Horizontal-Up position was exempt from testing per switching off mechanism per KDB Inquiry discussions.
8. Considerations: LTE test configurations are determined according to SAR Test Considerations for LTE handsets and Data Modems KDB 941225 D05 Publication:
    a. Per KDB Publication 941225 D05 Page 4, 3) A), QPSK with 50% RB is required for the highest bandwidth (10 MHz).
    b. Per KDB Publication 941225 D05 Page 4, 3) B), QPSK with 1 RB for both channel edges are required for the highest bandwidth (10 MHz).

b. Per KDB Publication 941225 D05 Page 4, 3) B), QPSK with 1 RB for both channel edges are required for the highest bandwidth (10 MHz).
c. Per KDB Publication 941225 D05 Page 4, 4) A), 16QAM with 50% RB is required for the highest bandwidth (10 MHz).
d. Per KDB Publication 941225 D05 Page 4, 4) B), 16QAM with 1RB for both channel edges are required for the highest bandwidth (10 MHz).
e. Per KDB Publication 941225 D05 Page 4, A) I), 100% RB Allocation is not required to be tested since SAR is not > 1.45 W/kg for the highest bandwidth (10 MHz).
f. Per KDB Publication 941225 D05 Page 5, 5) B), 5 MHz bandwidth is not required to be tested for SAR since output powers are within ½ dB higher or lower of the 10 MHz BW, and also SAR is not > 1.45 W/kg
g. Per KDB Publication 941225 D05, Low and high channel were not required for LTE Band 17 since the SAR was <0.8 W/kg and the power variation across all three channels was ≤ 0.5 dB for all configurations.

9. There is a permanently applied MPR implemented by the manufacturer. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1. The differences noted are not cases of implemented MPR but rather associated with measurement uncertainty and allowable tolerances per 3GPP standard and the manufacturer.

Table 13-6
LTE AWS Body SAR Results

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Spacing	Bandwidth (MHz)	Test Config	Serial Number	Number of Resource Blocks	RB Offset	MPR Target	Side	SAR (1g)
MHz	Ch.													(W/kg)
1720	20050	LTE AWS	QPSK	22.80	0.00	0.5 cm	20	USB Cable	485	1	0	0	horizontal down	0.840
1720	20050	LTE AWS	QPSK	22.90	0.09	0.5 cm	20	USB Cable	485	1	99	0	horizontal down	0.786
1720	20050	LTE AWS	16QAM	22.12	0.08	0.5 cm	20	USB Cable	485	1	0	1	horizontal down	0.714
1720	20050	LTE AWS	16QAM	22.21	0.07	0.5 cm	20	USB Cable	485	1	99	1	horizontal down	0.475
1732.50	20175	LTE AWS	QPSK	22.07	0.06	0.5 cm	20	USB Cable	485	50	25	1	horizontal down	0.721
1732.50	20175	LTE AWS	QPSK	22.89	0.10	0.5 cm	20	USB Cable	485	1	0	0	horizontal down	0.935
1732.50	20175	LTE AWS	QPSK	22.79	0.09	0.5 cm	20	USB Cable	485	1	99	0	horizontal down	1.130
1732.50	20175	LTE AWS	16QAM	21.16	0.06	0.5 cm	20	USB Cable	485	50	25	2	horizontal down	0.664
1732.50	20175	LTE AWS	16QAM	22.09	-0.09	0.5 cm	20	USB Cable	485	1	0	1	horizontal down	0.831
1732.50	20175	LTE AWS	16QAM	21.99	-0.08	0.5 cm	20	USB Cable	485	1	99	1	horizontal down	0.962
1745	20300	LTE AWS	QPSK	22.73	0.07	0.5 cm	20	USB Cable	485	1	0	0	horizontal down	0.671
1745	20300	LTE AWS	QPSK	22.77	-0.08	0.5 cm	20	USB Cable	485	1	99	0	horizontal down	0.578
1745	20300	LTE AWS	16QAM	21.95	0.09	0.5 cm	20	USB Cable	485	1	0	1	horizontal down	0.594
1745	20300	LTE AWS	16QAM	22.06	0.06	0.5 cm	20	USB Cable	485	1	99	1	horizontal down	0.483
1732.50	20175	LTE AWS	QPSK	22.07	0.08	0.5 cm	20	Laptop	485	50	25	1	vertical back	0.304
1732.50	20175	LTE AWS	QPSK	22.89	0.07	0.5 cm	20	Laptop	485	1	0	0	vertical back	0.357
1732.50	20175	LTE AWS	QPSK	22.79	0.07	0.5 cm	20	Laptop	485	1	99	0	vertical back	0.441
1732.50	20175	LTE AWS	16QAM	21.16	0.07	0.5 cm	20	Laptop	485	50	25	2	vertical back	0.257
1732.50	20175	LTE AWS	16QAM	22.09	0.07	0.5 cm	20	Laptop	485	1	0	1	vertical back	0.305
1732.50	20175	LTE AWS	16QAM	21.99	-0.09	0.5 cm	20	Laptop	485	1	99	1	vertical back	0.371
1732.50	20175	LTE AWS	QPSK	22.07	0.10	0.5 cm	20	USB Cable	485	50	25	1	vertical front	0.562
1732.50	20175	LTE AWS	QPSK	22.89	0.10	0.5 cm	20	USB Cable	485	1	0	0	vertical front	0.668
1732.50	20175	LTE AWS	QPSK	22.79	0.02	0.5 cm	20	USB Cable	485	1	99	0	vertical front	0.723
1732.50	20175	LTE AWS	16QAM	21.16	0.07	0.5 cm	20	USB Cable	485	50	25	2	vertical front	0.484
1732.50	20175	LTE AWS	16QAM	22.09	0.07	0.5 cm	20	USB Cable	485	1	0	1	vertical front	0.622
1732.50	20175	LTE AWS	16QAM	21.99	0.07	0.5 cm	20	USB Cable	485	1	99	1	vertical front	0.659
1732.50	20175	LTE AWS	QPSK	22.07	0.07	0.5 cm	20	Laptop	485	50	25	1	tip	0.398
1732.50	20175	LTE AWS	QPSK	22.89	0.06	0.5 cm	20	Laptop	485	1	0	0	tip	0.480
1732.50	20175	LTE AWS	QPSK	22.79	0.09	0.5 cm	20	Laptop	485	1	99	0	tip	0.528
1732.50	20175	LTE AWS	16QAM	21.16	0.06	0.5 cm	20	Laptop	485	50	25	2	tip	0.326
1732.50	20175	LTE AWS	16QAM	22.09	0.07	0.5 cm	20	Laptop	485	1	0	1	tip	0.423
1732.50	20175	LTE AWS	16QAM	21.99	0.00	0.5 cm	20	Laptop	485	1	99	1	tip	0.442
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram								

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001], IEEE 1528-2003 and RSS-102.
2. All modes of operation were investigated, and worst-case results are reported.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Liquid tissue depth was at least 15.0 cm.
5. IBM ThinkPad notebooks were used as hosts for testing the modem configurations
6. A spacing of 0.5 cm was used for all sides of the modem per KDB Inquiry discussions and KDB Publication 447498 for USB dongles.

7. The Horizontal-Up position was exempt from testing per switching off mechanism per KDB Inquiry discussions.
8. AWS LTE SAR was measured with a probe calibrated at 1750 MHz and is valid for measuring SAR within 50 MHz. The 1750MHz specific liquid was verified with specific probe calibration factors as required per FCC KDB Publication 450824.
9. Considerations: LTE test configurations are determined according to SAR Test Considerations for LTE handsets and Data Modems KDB 941225 D05 Publication:
   a. Per KDB Publication 941225 D05 Page 4, 3) A), QPSK with 50% RB is required for the highest bandwidth (20 MHz).
   b. Per KDB Publication 941225 D05 Page 4, 3) B), QPSK with 1 RB for both channel edges are required for the highest bandwidth (20 MHz).
   c. Per KDB Publication 941225 D05 Page 4, 4) A), 16QAM with 50% RB is required for the highest bandwidth (20 MHz).
   d. Per KDB Publication 941225 D05 Page 4, 4) B), 16QAM with 1RB for both channel edges are required for the highest bandwidth (20 MHz).
   e. Per KDB Publication 941225 D05 Page 4, A) I), 100% RB Allocation is not required to be tested since SAR is not > 1.45 W/kg for the highest bandwidth (20 MHz).
   f. Per KDB Publication 941225 D05 Page 5, 5) B), 1.4, 3, 5, 10, and 15 MHz bandwidths are not required to be tested for SAR since output powers are within ½ dB higher or lower of the 20 MHz BW, and also SAR is not > 1.45 W/kg
10. For test configurations where the measured SAR was greater than 0.8 W/kg, low and high channels were additionally tested.
11. There is a permanently applied MPR implemented by the manufacturer. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1. The differences noted are not cases of implemented MPR but rather associated with measurement uncertainty and allowable tolerances per 3GPP standard and the manufacturer.

14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	85070B	Dielectric Probe Kit	8/22/2010	Annual	8/22/2011	US33020316
Agilent	8648D	(9kHz-4GHz) Signal Generator	10/13/2010	Annual	10/13/2011	3613A00315
Agilent	8753E	(30kHz-6GHz) Network Analyzer	4/21/2011	Annual	4/21/2012	JP38020182
Agilent	E5515C	Wireless Communications Test Set	10/11/2010	Annual	10/11/2011	GB46110872
Agilent	E5515C	Wireless Communications Test Set	10/8/2010	Annual	10/8/2011	GB46310798
Agilent	E5515C	Wireless Communications Test Set	7/6/2011	Annual	7/6/2012	GB41450275
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/8/2011	Annual	4/8/2012	MY45470194
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/11/2010	Annual	10/11/2011	1833460
Gigatronics	8651A	Universal Power Meter	10/11/2010	Annual	10/11/2011	8650319
Rohde & Schwarz	CMU200	Base Station Simulator	11/11/2010	Annual	11/11/2011	836371/0079
Rohde & Schwarz	CMU200	Base Station Simulator	6/1/2011	Annual	6/1/2012	833855/0010
Rohde & Schwarz	CMU200	Base Station Simulator	4/19/2011	Annual	4/19/2012	107826
Rohde & Schwarz	NRVD	Dual Channel Power Meter	4/8/2011	Biennial	4/8/2013	101695
SPEAG	D1765V2	1765 MHz SAR Dipole	6/16/2011	Annual	6/16/2012	1008
SPEAG	D1900V2	1900 MHz SAR Dipole	2/17/2011	Annual	2/17/2012	502
SPEAG	D1900V2	1900 MHz SAR Dipole	8/18/2009	Biennial	8/18/2011	5d080
SPEAG	D2450V2	2450 MHz SAR Dipole	8/27/2009	Biennial	8/27/2011	719
SPEAG	D2450V2	2450 MHz SAR Dipole	2/8/2011	Annual	2/8/2012	797
SPEAG	D2600V2	2600 MHz SAR Dipole	4/15/2011	Annual	4/15/2012	1004
SPEAG	D5GHzV2	5 GHz SAR Dipole	8/19/2009	Biennial	8/19/2011	1007
SPEAG	D5GHzV2	5 GHz SAR Dipole	2/11/2011	Annual	2/11/2012	1057
SPEAG	D835V2	835 MHz SAR Dipole	2/9/2011	Annual	2/9/2012	4d047
SPEAG	D835V2	835 MHz SAR Dipole	8/24/2009	Biennial	8/24/2011	4d026
SPEAG	DAE3	Dasy Data Acquisition Electronics	11/18/2010	Annual	11/18/2011	455
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/17/2011	Annual	3/17/2012	704
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/20/2011	Annual	4/20/2012	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/21/2011	Annual	2/21/2012	649
SPEAG	ES3DV2	SAR Probe	9/21/2010	Annual	9/21/2011	3022
SPEAG	EX3DV4	SAR Probe	8/19/2010	Annual	8/19/2011	3561
SPEAG	EX3DV4	SAR Probe	2/14/2011	Annual	2/14/2012	3550
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/19/2011	Annual	5/19/2012	859
SPEAG	D750V3	750 MHz Dipole	2/14/2011	Annual	2/14/2012	1003
SPEAG	ES3DV3	SAR Probe	3/24/2011	Annual	3/24/2012	3213
SPEAG	ES3DV3	SAR Probe	4/18/2011	Annual	4/18/2012	3209
Rohde & Schwarz	SMIQ03B	Signal Generator	4/6/2011	Annual	4/6/2012	DE27259
SPEAG	D1640V2	1640 MHz Dipole	8/17/2010	Annual	8/17/2011	321
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	8/30/2010	Annual	8/30/2011	100976
Anritsu	MA2481A	Power Sensor	2/7/2011	Annual	2/7/2012	5318
Anritsu	MA2481A	Power Sensor	2/7/2011	Annual	2/7/2012	5442
Anritsu	ML2438A	Power Meter	2/7/2011	Annual	2/7/2012	1190013
Anritsu	ML2438A	Power Meter	2/7/2011	Annual	2/7/2012	98150041
Agilent	8648D	Signal Generator	4/5/2011	Annual	4/5/2012	3629U00687
Anritsu	ML2438A	Power Meter	2/7/2011	Annual	2/7/2012	1070030
Anritsu	MA2481A	Power Sensor	2/7/2011	Annual	2/7/2012	5821
Anritsu	MA2481A	Power Sensor	2/7/2011	Annual	2/7/2012	8013
Anritsu	MA2481A	Power Sensor	2/7/2011	Annual	2/7/2012	5605
Anritsu	MA2481A	Power Sensor	2/7/2011	Annual	2/7/2012	2400
Agilent	E5515C	Wireless Communications Test Set	7/6/2011	Annual	7/6/2012	GB43304447
Agilent	E5515C	Wireless Communications Tester	4/21/2011	Annual	4/21/2012	US41140256
Amplifier Research	5S1G4	5W, 800MHz-4.2GHz	N/A			21910
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	N/A			N/A
Agilent	E5515C	Wireless Communications Test Set	2/8/2011	Annual	2/8/2012	GB45360985
SPEAG	D3700V2	3700 MHz SAR Dipole	2/16/2011	Annual	2/16/2012	1002
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	3/11/2011	Annual	3/11/2012	103962
Control Company	61220-416	Long-Stem Thermometer	2/15/2011	Biennial	2/15/2013	111331322
Control Company	61220-416	Long-Stem Thermometer	2/15/2011	Biennial	2/15/2013	111331323
Control Company	61220-416	Long-Stem Thermometer	2/15/2011	Biennial	2/15/2013	111331330
Control Company	61220-416	Long-Stem Thermometer	2/15/2011	Biennial	2/15/2013	111331332
Control Company	61220-416	Long-Stem Thermometer	3/16/2011	Biennial	3/16/2013	111391601
SPEAG	ES3DV3	SAR Probe	4/8/2011	Annual	4/8/2012	3258
SPEAG	D1750V2	1750 MHz SAR Dipole	5/24/2011	Annual	5/24/2012	1051
MiniCircuits	SLP-2400+	Low Pass Filter	N/A			R8979500903
Narda	4772-3	Attenuator (3dB)	N/A			9406
Narda	BW-S3W2	Attenuator (3dB)	N/A			120
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	8/5/2011	Annual	8/5/2012	112347

15 MEASUREMENT UNCERTAINTIES

Applicable for 700 – 3000 MHz.

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	**IEEE 1528 Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i 1gm**	**c_i 10 gms**	**1gm u_i (± %)**	**10gms u_i (± %)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.0	N	1	1.0	1.0	6.0	6.0	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E.2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E.2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E.2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E.2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E.6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E.4.1	3.32	R	1.73	1.0	1.0	1.9	1.9	∞
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)			RSS				12.1	11.7	299
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				24.2	23.5	

The above measurement uncertainties are according to IEEE Std. 1528-2003

16 CONCLUSION

16.1 Measurement Conclusion

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

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend 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 various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

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