SAR TEST REPORT

Test item	:	Cellular/PCS GPRS and Cellular WCDMA/HSDPA/HSUPA Wireless Router with WLAN
Model No.	:	L-02F
Order No.	:	DEMC1309-02886
Date of receipt	:	2013-09-16
Test duration	:	2013-10-05 ~ 2013-10-08
Date of issue	:	2013-10-29
Use of report	:	FCC Original Grant

Applicant : LG Electronics MobileComm USA, Inc.
1000 Sylvan Avenue, Englewood Cliffs NJ 07632

Test laboratory : Digital EMC Co., Ltd.
683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, 449-080, Korea

Test specification	:	47CFR §2.1093
Test environment	:	See appended test report
Test result	:	☒ Pass ☐ Fail

Tested by:	Witnessed by:	Reviewed by:
Engineer NoKyun, Im	Engineer N/A	Technical Director Harvey Sung

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Test Report Version

Test Report No.	Date	Description
DRTFCC1310-1032	Oct. 29, 2013	Final version for approval

1. DESCRIPTION OF DEVICE

Environmental evaluation measurements of specific absorption rate (SAR) distributions in emulated human head and body tissues exposed to radio frequency (RF) radiation from wireless portable devices for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC).

General Information:

Equipment type	Cellular/PCS GPRS and Cellular WCDMA/HSDPA/HSUPA Wireless Router with WLAN		
FCC ID	ZNFL02F		
Equipment model name	L-02F		
Equipment add model name	N/A		
Equipment serial no.	Identical prototype		
Mode(s) of Operation	GPRS 850, GPRS 1900, WCDMA 850, W-LAN(802.11b/g/n HT20, HT40)		
TX Frequency Range	824.2 ~ 848.8 MHz (Cellular Band) / 1850.2 ~ 1909.8 MHz (PCS Band) 826.4 ~ 846.6 MHz (WCDMA FDD V) / 2412 ~ 2462 MHz (802.11b/g/n HT20) 2422 ~ 2452 MHz (802.11n HT40)		
RX Frequency Range	869.2 ~ 893.8 MHz (Cellular Band) / 1930.2 ~ 1989.8 MHz (PCS Band) 871.4 ~ 891.6 MHz (WCDMA FDD V) / 2412 ~ 2462 MHz (802.11b/g/n HT20) 2422 ~ 2452 MHz (802.11n HT40)		
Equipment Class	**Band & Mode**	**Measured Conducted Power [dBm]**	**Reported SAR 1g SAR (W/kg) Hotspot**
PCE	GPRS 850	30.1	1.10
PCE	GPRS 1900	28.3	**1.12**
PCE	WCDMA 850	22.76	0.97
DTS	2.4 GHz W-LAN	12.40	N/A
Simultaneous SAR per KDB 690783 D01v01r03			**1.50**
FCC Equipment Class	Licensed Portable Transmitter (PCB)		
Date(s) of Tests	2013-10-05 ~ 2013-10-08		
Antenna Type	Internal Type Antenna		
Functions	• GPRS(GPRS Class: 10) / EDGE(RX Only) supported • WLAN(2.4GHz 802.11b/g/n(HT20, HT40)) supported • Simultaneous transmission between GPRS, WCDMA & WLAN • Mobile Hotspot supported.		

1.1 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G and Hotspot)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r01 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)

1.2 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GPRS 850	Data	824.2 ~ 848.8 MHz
GPRS 1900	Data	1850.2 ~ 1909.8 MHz
WCDMA 850	Data	826.4 ~ 846.6 MHz
2.4 GHz WLAN	Data	2412 ~ 2462 MHz

1.3 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05r01.

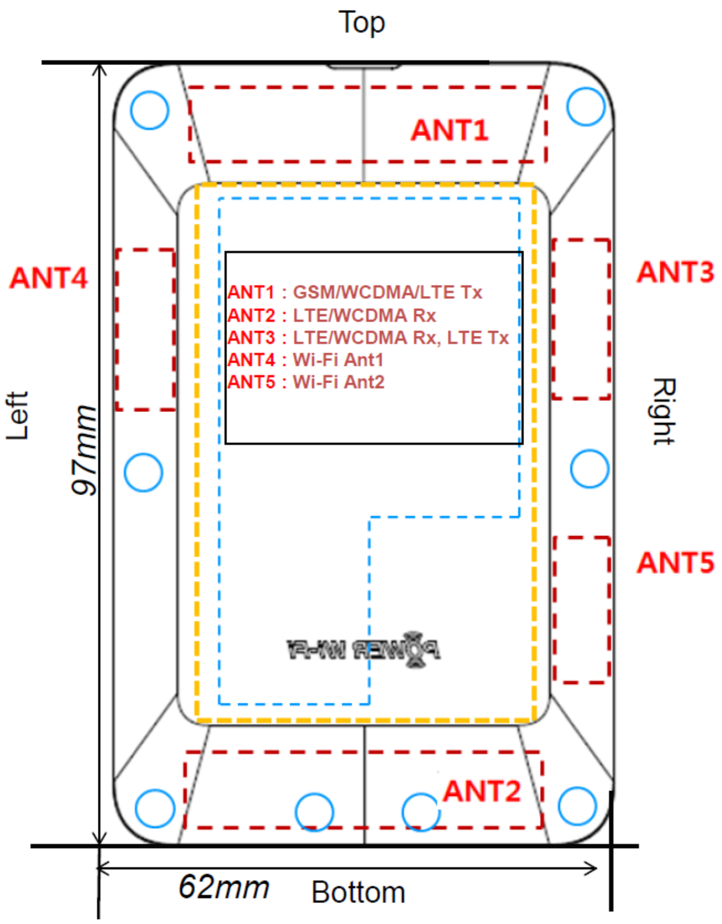
Band & Mode		Burst Average GMSK [dBm]	
		1 TX Slot	2 TX Slot
GPRS 850	Maximum	33.2	30.7
	Nominal	32.7	30.2
GPRS 1900	Maximum	30.2	28.7
	Nominal	29.7	28.2

Band & Mode		Modulated Average [dBm]		
		3GPP RMC	3GPP HSDPA	3GPP HSUPA
WCDMA 850	Maximum	23.2	23.2	23.2
	Nominal	22.7	22.7	22.7

Band & Mode		Modulated Average [dBm]
IEEE 802.11b (2.4 GHz)	Maximum	12.5
	Nominal	12.0
IEEE 802.11g (2.4 GHz)	Maximum	11.5
	Nominal	11.0
IEEE 802.11n (2.4 GHz)	Maximum	10.7
	Nominal	10.2

1.4 DUT Antenna Locations & SAR Test Configurations

DUT Antenna Locations (Front Side View):



Note: Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC Filing.

SAR Test Configurations:

Mode	Mobile Hotspot Sides for SAR Testing					
	Top	Bottom	Front	Rear	Right	Left
GPRS 850	O	X	O	O	O	O
GPRS 1900	O	X	O	O	O	O
WCDMA 850	O	X	O	O	O	O
2.4G W-LAN(802.11b/g/n) - WI-FI ANT 1	O	X	O	O	X	O
2.4G W-LAN(802.11b/g/n) - WI-FI ANT 2	X	O	O	O	O	X

Table 1.1 Mobile Hotspot Sides for SAR Testing

Note: Front and Rear sides of the device, as well as any edge within 2.5 cm of a transmitting antenna, were evaluated for SAR. Particular DUT edges were not required to be evaluated for Wireless Router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v01r01 guidance, page 2. The antenna document shows the distances between the transmit antennas and the edges of the device.

1.5 SAR Test Exclusions Applied

(A) WIFI

Since Wireless Router operations are allowed by the chipset firmware using only 2.4 GHz WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06v01r01.

Per FCC KDB 447498 D01v05r01, the SAR exclusion threshold for distances < 50 mm is defined by the following equation:

$$\frac{Max\ Power\ of\ Channel\ (mW)}{Test\ Separation\ Dist\ (mm)} * \sqrt{Frequency(GHz)} \leq 3.0$$

Based on the maximum conducted power of **2.4 GHz WIFI** (rounded to the nearest mW) and the antenna to user separation distance, **2.4 GHz WIFI SAR was not required**; [(18/10)* √2.462] = **2.8** < 3.0.

Per KDB Publication 447498 D01v05r01, the maximum power of the channel was rounded to the nearest mW before calculation.

1.6 Device Serial Numbers

Band & Mode	Hotspot Serial Number
GPRS 850	#1
GPRS 1900	#1
WCDMA 850	#1
2.4 GHz WLAN	#1

2. INTROCUCTION

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.

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. 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*.1-2005 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring 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 National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. 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.

SAR Definition

Specific Absorption Rate (SAR) 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. 2.1)

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

Fig. 2.1 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 relations 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.

3. DESCRIPTION OF TEST EQUIPMENT

3.1 SAR MEASUREMENT SETUP

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 high precision robotics system (Staubli), robot controller, desktop 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. 3.1).

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 Intel Core i5-2500 3.31GHz desktop computer with Windows NT system and 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, 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.

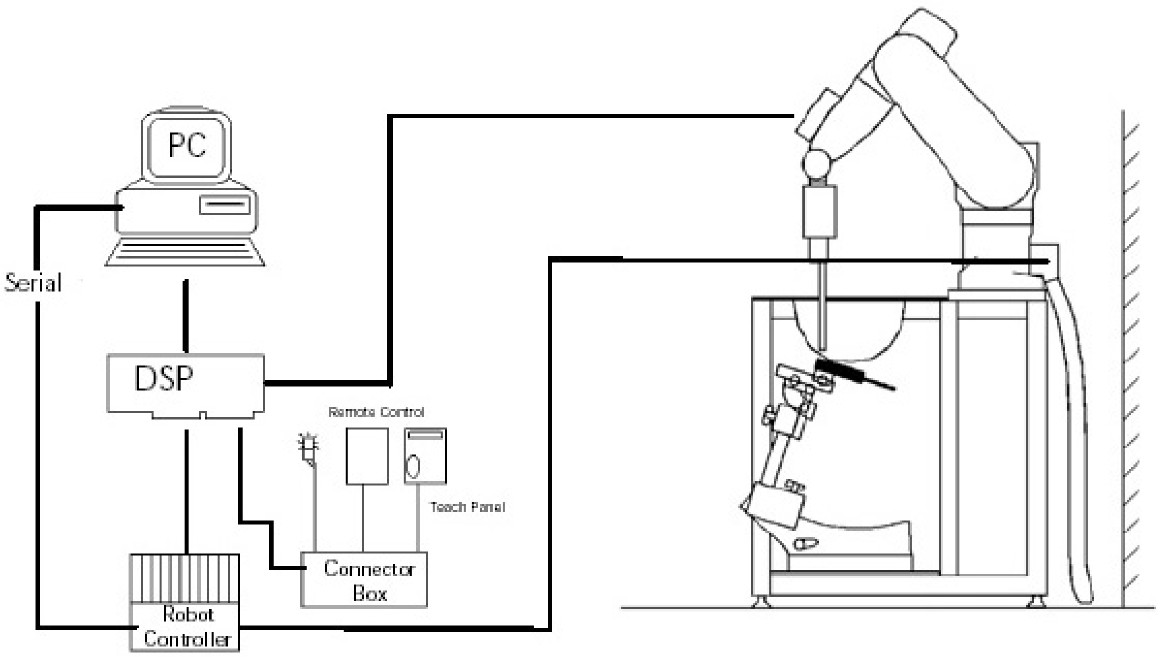


Figure 3.1 SAR Measurement System Setup

The DAE3 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.

3.2 ES3DV3 Probe Specification

Calibration In air from 10 MHz to 4 GHz
In brain and muscle simulating tissue at Frequencies of
450 MHz, 750 MHz, 835 MHz, 900 MHz, 1750 MHz, 1900 MHz, 2300 MHz, 2450 MHz

Frequency 10 MHz to 4 GHz

Linearity ± 0.2 dB (30 MHz to 4 GHz)

Dynamic 5 μW/g to > 100 mW/g

Range Linearity : ± 0.2dB

Dimensions Overall length : 337 mm

Tip length 10 mm

Body diameter 10 mm

Tip diameter 4 mm

Distance from probe tip to sensor center 2.0 mm

Application General dosimetry up to 4 GHz
Dosimetry in strong gradient fields
Compliance tests of mobile phones

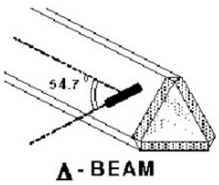


Figure 3.2 Triangular Probe Configurations

Figure 3.3 Probe Thick-Film Technique

DAE System

The SAR measurements were conducted with the dosimetric probe ES3DV3, designed in the classical triangular configuration(see Fig. 3.2) 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 multitier 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 fitting. The approach is stopped at reaching the maximum.

3.3 Probe Calibration Process

3.3.1 E-Probe Calibration

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) 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.

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 the remits or 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 ΔT / Δt , 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;

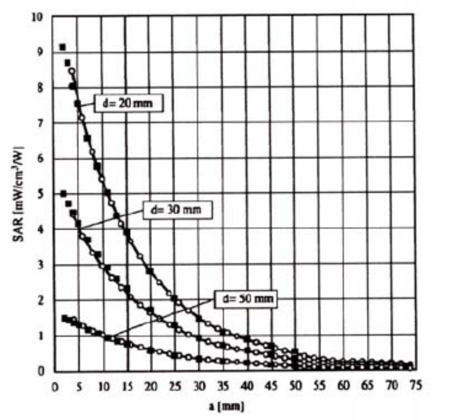


Figure 3.4 E-Field and Temperature Measurements at 900MHz

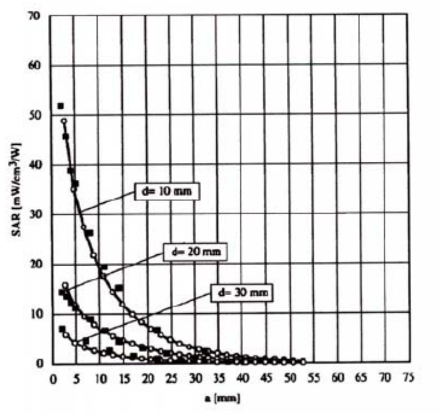


Figure 3.5 E-Field and Temperature Measurements at 1800MHz

3.4 Data Extrapolation

The DASY4 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
σ = conductivity in [mho/m] or [Siemens/m]
ρ = 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

3.5 SAM Twin 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. 3.6)

Figure 3.6 SAM Twin Phantom

SAM Twin Phantom Specification:

Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot. Twin SAM V5.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0, but has reinforced top structure.
Shell Thickness	2 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet

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 alongthemid-sagittal plane into right and left halves (see Fig. 3.7). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimized reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15cm to minimize reflections from the upper surface.

Figure 3.7 Sam Twin Phantom shell

3.6 Device Holder for Transmitters

In combination with the Twin SAM Phantom V4.0/V4.0c or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).

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.

Figure 3.8 Mounting Device

3.7 Brain & Muscle Simulation Mixture Characterization

The brain and muscle mixtures consist of a viscous gel using hydrox-ethylcellulose (HEC) gelling agent and saline solution (see Table 3.1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Harts grove.

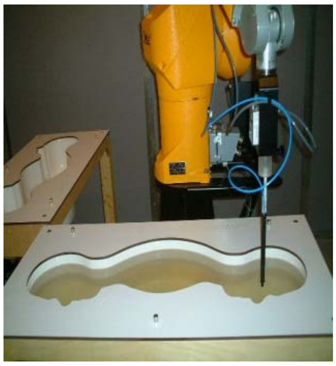


Figure 3.9 Simulated Tissue

Table 3.1 Composition of the Tissue Equivalent Matter

Ingredients (% by weight)	Frequency (MHz)							
	835		1900		2450		5200 ~ 5800	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body
Water	40.19	50.75	55.24	70.23	71.88	73.40	65.52	80.00
Salt (NaCl)	1.480	0.940	0.310	0.290	0.160	0.060	-	-
Sugar	57.90	48.21	-	-	-	-	-	-
HEC	0.250	-	-	-	-	-	-	-
Bactericide	0.180	0.100	-	-	-	-	-	-
Triton X-100	-	-	-	-	19.97	-	17.24	-
DGBE	-	-	44.45	29.48	7.990	26.54	-	-
Diethylene glycol hexyl ether	-	-	-	-	-	-	17.24	-
Polysorbate (Tween) 80	-	-	-	-	-	-	-	20.00
Target for Dielectric Constant	41.5	55.2	40.0	53.3	39.2	52.7	-	-
Target for Conductivity (S/m)	0.90	0.97	1.40	1.52	1.80	1.95	-	-

Salt:	99 % Pure Sodium Chloride	Sugar:	98 % Pure Sucrose
Water:	De-ionized, 16M resistivity	HEC:	Hydroxyethyl Cellulose
DGBE:	99 % Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy) ethanol]		
Triton X-100(ultra pure):	Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl] ether		

3.8 SAR TEST EQUIPMENT

Table 3.2 Test Equipment Calibration

	Type	Manufacturer	Model	Cal.Date	Next.Cal.Date	S/N
☒	SEMITEC Engineering	SEMITEC	N/A	N/A	N/A	Shield Room
☒	Robot	SCHMID	RX90BL	N/A	N/A	F02/5Q85A1/A/01
☒	Robot Controller	SCHMID	CS7MB	N/A	N/A	F02/5Q85A1/C/01
☒	Joystick	SCHMID	N/A	N/A	N/A	D221340031
☒	Intel Core i5-2500 3,31 GHz Windows XP Professional	N/A	N/A	N/A	N/A	N/A
☒	Probe Alignment Unit LB	N/A	N/A	N/A	N/A	SE UKS 030 AA
☒	Mounting Device	SCHMID	SD000H01HA	N/A	N/A	N/A
☒	Twin SAM Phantom	SCHMID	TP1223	N/A	N/A	N/A
☒	Twin SAM Phantom	SCHMID	TP1224	N/A	N/A	N/A
☐	Twin SAM Phantom	SCHMID	QD000P40CD	N/A	N/A	1679
☒	Head/Body Equivalent Matter(835MHz)	N/A	N/A	2013-01-01	2014-01-01	N/A
☒	Head/Body Equivalent Matter(1900MHz)	N/A	N/A	2013-01-01	2014-01-01	N/A
☐	Head/Body Equivalent Matter(2450MHz)	N/A	N/A	2013-01-01	2014-01-01	N/A
☐	Head/Body Equivalent Matter(5000MHz)	N/A	N/A	2013-01-01	2014-01-01	N/A
☒	Data Acquisition Electronics	SCHMID	DAE3V1	2013-01-23	2014-01-23	519
☒	Dosimetric E-Field Probe	SCHMID	ES3DV3	2013-09-10	2014-09-10	3327
☐	Dummy Probe	N/A	N/A	N/A	N/A	N/A
☒	835MHz SAR Dipole	SCHMID	D835V2	2013-09-05	2015-09-05	4d159
☒	1900MHz SAR Dipole	SCHMID	D1900V2	2013-09-05	2015-09-05	5d176
☐	2450MHz SAR Dipole	SCHMID	D2450V2	2013-09-10	2015-09-10	920
☐	5000MHz SAR Dipole	SCHMID	D5GHzV2	2013-03-15	2015-03-15	1103
☒	Network Analyzer	Agilent	E5071C	2012-11-02 2013-10-21	2013-11-02 2014-10-21	MY46106970
☒	Signal Generator	Rohde Schwarz	SMR20	2013-02-28	2014-02-28	101251
☒	Amplifier	EMPOWER	BBS3Q7ELU	2013-09-12	2014-09-12	1020
☐	High Power RF Amplifier	EMPOWER	BBS3Q8CCJ	2012-11-02 2013-10-22	2013-11-02 2014-10-22	1005
☒	Power Meter	HP	EPM-442A	2013-02-28	2014-02-28	GB37170267
☒	Power Meter	Anritsu	ML2495A	2013-03-06	2014-03-06	1306007
☒	Wide Bandwidth Power Sensor	Anritsu	MA2490A	2013-03-06	2014-03-06	1249001
☒	Power Sensor	HP	8481A	2013-02-28	2014-02-28	3318A96566
☒	Power Sensor	HP	8481A	2013-02-14	2014-02-14	3318A96030
☒	Dual Directional Coupler	Agilent	778D-012	2013-01-08	2014-01-08	50228
☒	Directional Coupler	HP	773D	2013-06-27	2014-06-27	2389A00640
☒	Low Pass Filter 1,5GHz	Micro LAB	LA-15N	2013-01-08	2014-01-08	N/A
☒	Low Pass Filter 3,0GHz	Micro LAB	LA-30N	2013-09-12	2014-09-12	N/A
☐	Low Pass Filter 6,0GHz	Micro LAB	LA-60N	2013-03-12	2014-03-12	03942
☒	Attenuators(3 dB)	Agilent	8491B	2013-06-27	2014-06-27	MY39260700
☒	Attenuators(10 dB)	WEINSCHEL	23-10-34	2013-01-08	2014-01-08	BP4387
☐	Step Attenuator	HP	8494A	2013-09-12	2014-09-12	3308A33341
☒	Dielectric Probe kit	SCHMID	DAK-3.5	2012-12-11	2013-12-11	1092
☒	8960 Series 10 Wireless Comms. Test Set	Agilent	E5515C	2013-02-28	2014-02-28	GB43461134

NOTE: The E-field probe was calibrated by SPEAG, by temperature measurement procedure. Dipole Verification measurement is performed by Digital EMC before each test. The brain and muscle simulating material are calibrated by Digital EMC using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

4. TEST SYSTEM SPECIFICATIONS

Automated TEST SYSTEM SPECIFICATIONS:

Positioner

Robot	Stäubli Unimation Corp. Robot Model: RX90BL
Repeatability	0.02 mm
No. of axis	6

Data Acquisition Electronic (DAE) System

Cell Controller

Processor	Intel Core i5-2500
Clock Speed	3.31 GHz
Operating System	Windows XP Professional
Data Card	DASY4 PC-Board

Data Converter

Features	Signal, multiplexer, A/D converter. & control logic
Software	DASY4
Connecting Lines	Optical downlink for data and status info Optical uplink for commands and clock

PC Interface Card

Function	24 bit (64 MHz) DSP for real time processing Link to DAE 3 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot

E-Field Probes

Model	ES3DV3 S/N: 3327
Construction	Triangular core fiber optic detection system
Frequency	10 MHz to 4 GHz
Linearity	± 0.2 dB (30 MHz to 4 GHz)

Phantom

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

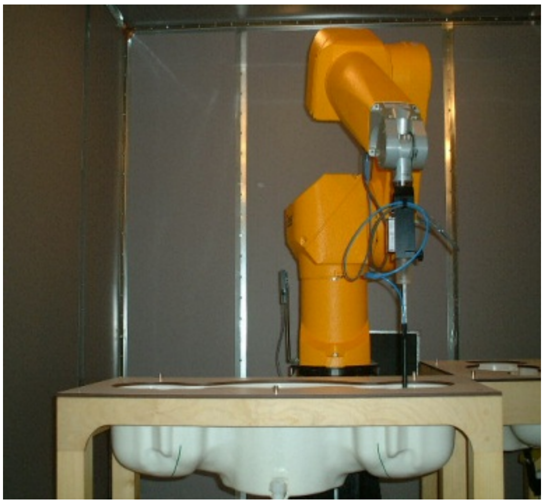


Figure 2.2 DASY4 Test System

5. SAR MEASUREMENT PROCEDURE

5.1 Measurement Procedure

The evaluation was performed using the following procedure:

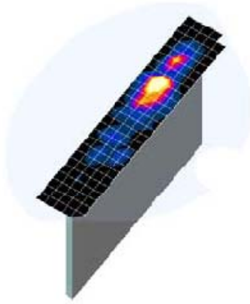


Figure 5.1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body 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 device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664D01v01r01 (See Table 5.1).

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 the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.

3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r01 (See Table 5.1). On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online 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 2.7mmaway 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 to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

Frequency	Maximum Area Scan Resolution (mm) (Δx_{area}, Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom}, Δy_{zoom})	Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan Volume (mm) (x,y,z)
			Uniform Grid	Graded Grid		
			$\Delta z_{zoom}(n)$	$\Delta z_{zoom}(1)$*	$\Delta z_{zoom}(n>1)$*	
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤ 4	≤ 1.5*Δz_{zoom}(n-1)	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*Δz_{zoom}(n-1)	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*Δz_{zoom}(n-1)	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*Δz_{zoom}(n-1)	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*Δz_{zoom}(n-1)	≥ 22

Table 5.1 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r01

6. TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

6.2 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06v01r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

This device operates using simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes.

Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v05r01 publication procedures.

7. RF EXPOSURE LIMITS

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 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 7.1.SAR Human Exposure Specified in ANSI/IEEE C95.1-2005

	HUMAN EXPOSURE LIMITS	
	General Public Exposure (W/kg) or (mW/g)	Occupational Exposure (W/kg) or (mW/g)
SPATIAL PEAK SAR * (Brain)	1.60	8.00
SPATIAL AVERAGE SAR ** (Whole Body)	0.08	0.40
SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist)	4.00	20.0

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.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

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).

8. FCC MEASUREMENT PROCEDURES

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

8.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v05r01, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported SAR. The highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r02.

8.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01v02r02 "SAR Measurement Procedures for 3G Devices" v02, October 2007.

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. If the power drift deviated by more than 5%, the SAR test and drift measurements were repeated.

8.3 SAR Measurement Conditions for WCDMA(UMTS)

8.3.1 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" or applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HS-DPCCH etc) are tabulated in this test report. All configurations that are not supported by the DUT or cannot be measured due to technical or equipment limitations are identified.

8.3.2 Body SAR Measurements

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

8.3.3 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 UMTS and requires an active DPCCH. The default test configuration is to measure SAR in UMTS 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 UMTS. 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.

Sub-Test	β_c	β_d	β_d *(SF)*	β_c/β_d	β_{HS} *(Note1, Note 2)*	CM (dB) *(Note 3)*	MPR (dB) *(Note 3)*
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 *(Note 4)*	15/15 *(Note 4)*	64	12/15 *(Note 4)*	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: Λ_{ACK}, Λ_{NACK} and $\Lambda_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.
Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Λ_{ACK} and $\Lambda_{NACK} = 8$ ($A_{hs} = 30/15$) with $\beta_{hs} = 30/15 * \beta_c$, and $\Delta_{CQI} = 7$ ($A_{hs} = 24/15$) with $\beta_{hs} = 24/15 * \beta_c$.
Note 3: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Figure 9.1 Table C.10.1.4 of TS 234.121-1

8.3.4 SAR Measurements for Handsets with Rel 6 HSUPA

SAR for body exposure configurations are measured according to the 'Body SAR Measurements' procedures in the 'WCDMA Handsets' section of the KDB 941225 D01v02r02 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. When VOIP is applicable for head exposure, SAR is not required when the maximum output of each RF channel with HSPA is less than ¼ dB higher than that measured using 12.2 kbps RMC; otherwise, the same HSPA configuration used for body measurements should be used to test for head exposure.

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 $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. 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 $\beta_c = 10/15$ and $\beta_d = 15/15$.
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 $\beta_c = 14/15$ and $\beta_d = 15/15$.
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.

8.4 SAR Testing with 802.11 Transmitters

Normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g/n /ac transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v01r02 for more details.

8.4.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

8.4.2 Frequency Channel Configurations

For 2.4 GHz, the highest average RF output power channel between the low, mid and high channel at the lowest data rate was selected for SAR evaluation in 802.11b mode. 802.11g/n modes and higher data rates for 802.11b were additionally evaluated for SAR if the output power of the respective mode was 0.25 dB or higher than the powers of the SAR configurations tested in the 802.11b mode.

If the maximum extrapolated peak SAR of the zoom scan for the highest output channel was less than 1.6 W/kg and if the 1g averaged SAR was less than 0.8 W/kg, SAR testing was not required for the other test channels in the band.

9. RF CONDUCTED POWERS

9.1 GSM Conducted Powers

Band	Channel	Maximum Burst-Averaged Output Power (dBm)	
		GPRS/EDGE (GMSK) Data	
		GPRS 1 TX Slot	GPRS 2 TX Slot
GSM 850	128	32.4	30.1
	190	32.4	30.2
	251	32.4	30.1
PCS 1900	512	29.5	28.1
	661	29.6	28.3
	810	29.6	28.3
Band	**Channel**	**Calculated Maximum Frame-Averaged Output Power (dBm)**	
		GPRS/EDGE (GMSK) Data	
		GPRS 1 TX Slot	**GPRS 2 TX Slot**
GSM 850	128	23.37	**24.08**
	190	23.37	**24.18**
	251	23.37	**24.08**
PCS 1900	512	20.47	**22.08**
	661	20.57	**22.28**
	810	20.57	**22.28**

Table 9.1 The power was measured by E5515C

Note:

1. Both burst-averaged and calculated frame-averaged powers are included. 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 timeslots.
2. The bolded GPRS modes were selected according to the highest frame-averaged output power table according to KDB 941225 D03v01.
3. GPRS/EDGE (GMSK) output powers were measured with coding scheme setting of 1 (CS1) on the base station simulator. CS1 was configured to measure GPRS output power measurements and SAR to ensure GMSK modulation in the signal. Our Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.
4. This device does not support EDGE. (EDGE RX only)

GSM Class: B
GPRS Multislot class: 10 (max 2 TX Uplink slots)
DTM Multislot Class: N/A

Figure 9.1 Power Measurement Setup

9.2 WCDMA Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band (dBm)			3GPP MPR (dB)
			4132	4183	4233	
99	WCDMA	12.2 kbps RMC	22.76	22.81	22.74	-
5	HSDPA	Subtest 1	22.71	22.79	22.70	0
5		Subtest 2	22.69	22.75	22.69	0
5		Subtest 3	22.23	22.24	22.22	0.5
5		Subtest 4	22.21	22.23	22.20	0.5
6	HSUPA	Subtest 1	22.69	22.71	22.65	0
6		Subtest 2	20.71	20.76	20.68	2
6		Subtest 3	21.73	21.79	21.69	1
6		Subtest 4	20.70	20.72	20.69	2
6		Subtest 5	22.65	22.69	22.64	0

Table 9.2 The power was measured by E5515C

WCDMA SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v02r02. 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.

This device does not support DC-HSDPA.

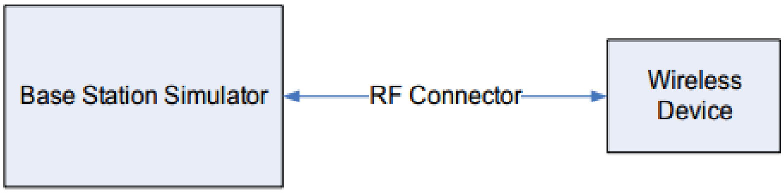


Figure 9.2 Power Measurement Setup

9.3 WLAN Conducted Powers

9.3.1 WLAN Ant. 1 Conducted Powers

Band	Freq. (MHz)	Channel	802.11b (2.4 GHz) Conducted Power (dBm)			
			Data Rate (Mbps)			
			1	2	5.5	11
802.11b	2412	1	11.28	11.12	10.93	10.71
	2437	6	11.98	11.93	11.90	11.84
	2462	11	12.40	12.28	12.17	12.13

Table 9.3 IEEE 802.11b Average RF Power - Ant. 1

Band	Freq. (MHz)	Channel	802.11g (2.4 GHz) Conducted Power (dBm)							
			Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
802.11g	2412	1	10.95	10.94	10.94	10.95	10.40	10.47	10.59	10.47
	2437	6	11.33	11.12	10.95	11.04	11.04	11.17	10.84	10.71
	2462	11	10.82	10.72	10.67	10.66	10.47	10.59	10.49	10.36

Table 9.4 IEEE 802.11g Average RF Power - Ant. 1

Band	Freq. (MHz)	Channel	802.11n (2.4 GHz) Conducted Power (dBm)							
			Data Rate (Mbps)							
			6.5	13	19.5	26	39	52	58.5	65
802.11n (HT-20)	2412	1	9.57	9.39	9.50	9.43	9.49	9.54	9.49	9.30
	2437	6	10.34	10.15	10.27	10.22	10.11	10.21	10.05	9.97
	2462	11	9.67	9.45	9.41	9.21	9.46	9.65	9.62	9.41

Table 9.5 IEEE 802.11n Average RF Power - Ant. 1

Band	Freq. (MHz)	Channel	802.11n (2.4 GHz) Conducted Power (dBm)							
			Data Rate (Mbps)							
			13.5	27	40.5	54	81	108	121.5	135
802.11n (HT-40)	2422	3	7.57	7.39	7.47	7.41	7.45	7.58	7.11	7.14
	2437	6	9.96	9.71	9.60	9.54	9.76	9.82	9.87	9.73
	2452	9	6.51	6.50	6.56	6.09	6.49	6.41	6.53	6.56

Table 9.6 IEEE 802.11n Average RF Power - Ant. 1

9.3.2 WLAN Ant. 2 Conducted Powers

Band	Freq. (MHz)	Channel	802.11b (2.4 GHz) Conducted Power (dBm)			
			Data Rate (Mbps)			
			1	2	5.5	11
802.11b	2412	1	11.57	11.38	11.17	11.03
	2437	6	11.97	11.72	11.28	11.19
	2462	11	12.12	12.12	11.85	11.62

Table 9.7 IEEE 802.11b Average RF Power - Ant. 2

Band	Freq. (MHz)	Channel	802.11g (2.4 GHz) Conducted Power (dBm) Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
802.11g	2412	1	10.73	10.72	10.69	10.52	10.65	10.31	10.64	10.33
	2437	6	11.16	11.12	11.07	11.15	11.00	10.96	10.99	10.63
	2462	11	10.38	10.36	10.30	10.15	10.18	9.95	10.08	9.77

Table 9.8 IEEE 802.11g Average RF Power - Ant. 2

Band	Freq. (MHz)	Channel	802.11n (2.4 GHz) Conducted Power (dBm) Data Rate (Mbps)							
			6.5	13	19.5	26	39	52	58.5	65
802.11n (HT-20)	2412	1	8.77	8.51	8.62	8.61	8.62	8.65	8.74	8.42
	2437	6	9.88	9.66	9.73	9.73	9.79	9.85	9.83	9.63
	2462	11	9.08	8.94	9.05	8.82	8.95	8.92	8.67	8.64

Table 9.9 IEEE 802.11n Average RF Power - Ant. 2

Band	Freq. (MHz)	Channel	802.11n (2.4 GHz) Conducted Power (dBm) Data Rate (Mbps)							
			13.5	27	40.5	54	81	108	121.5	135
802.11n (HT-40)	2422	3	7.93	7.97	7.68	7.60	7.78	7.81	7.84	7.83
	2437	6	9.38	9.14	9.09	8.90	9.07	9.35	9.38	9.36
	2452	9	6.90	6.78	6.85	6.86	6.85	6.91	6.78	6.46

Table 9.10 IEEE 802.11n Average RF Power - Ant. 2

9.3.3 WLAN 2 Tx Conducted Powers

Band	Ant.	Freq. (MHz)	Ch.	802.11n (2.4 GHz) Conducted Power (dBm) Data Rate (MCS)							
				8	9	10	11	12	13	14	15
802.11n (HT-20)	1	2412	1	6.90	6.74	6.97	6.97	7.08	6.55	6.54	6.59
		2437	6	7.45	7.59	7.42	7.42	7.50	7.01	6.93	6.94
		2462	11	7.23	7.24	6.74	6.88	6.54	6.71	6.83	6.95
	2	2412	1	7.40	7.20	7.33	7.22	6.96	7.06	7.11	7.15
		2437	6	7.65	7.44	7.65	7.53	7.48	7.57	7.57	7.59
		2462	11	6.99	6.91	7.06	7.22	7.22	7.12	7.13	6.86
	1 + 2	2412	1	10.17	9.99	10.16	10.11	10.03	9.82	9.84	9.89
		2437	6	10.56	10.53	10.55	10.49	10.50	10.31	10.27	10.29
		2462	11	10.12	10.09	9.91	10.06	9.90	9.93	9.99	9.92

Table 9.10 IEEE 802.11n Average RF Power - 2 Tx

Band	Ant.	Freq. (MHz)	Ch.	802.11n (2.4 GHz) Conducted Power (dBm)							
				Data Rate (MCS)							
				8	9	10	11	12	13	14	15
802.11n (HT-40)	1	2422	3	4.47	4.34	4.45	4.49	4.42	4.42	4.56	4.48
		2437	6	6.95	7.09	6.87	6.88	7.12	6.96	6.92	6.76
		2452	9	3.97	3.87	3.69	3.74	3.48	3.64	3.74	3.53
	2	2422	3	5.42	5.43	5.08	4.93	4.84	4.92	4.85	4.57
		2437	6	7.30	7.03	7.36	7.07	7.04	7.09	7.14	7.09
		2452	9	3.84	3.79	3.65	3.71	3.54	3.45	3.55	3.53
	1 + 2	2422	3	7.98	7.93	7.79	7.73	7.65	7.69	7.72	7.54
		2437	6	10.14	10.07	10.13	9.99	10.09	10.04	10.04	9.94
		2452	9	6.92	6.84	6.68	6.74	6.52	6.56	6.66	6.54

Table 9.11 IEEE 802.11n Average RF Power - 2 Tx

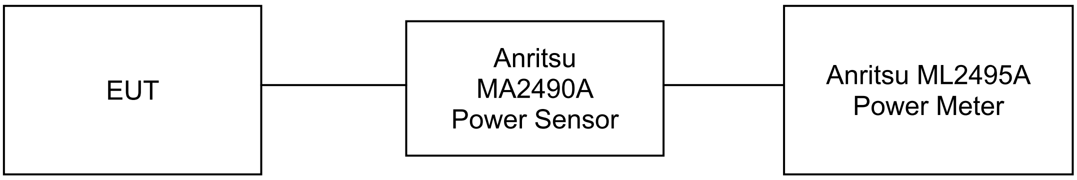


Figure 9.3 Power Measurement Setup for Bandwidths < 50 MHz

10. SYSTEM VERIFICATION

10.1 Tissue Verification

MEASURED TISSUE PARAMETERS										
Date(s)	Tissue Type	Ambient Temp.[°C]	Liquid Temp.[°C]	Measured Frequency [MHz]	Target Dielectric Constant, εr	Target Conductivity, σ (S/m)	Measured Dielectric Constant, εr	Measured Conductivity, σ (S/m)	Er Deviation [%]	σ Deviation [%]
Oct. 05. 2013	835 Body	22.0	22.7	824.2	55.240	0.969	54.1	0.977	-2.06	0.83
				835.0	55.200	0.970	54.0	0.988	-2.17	1.86
				836.6	55.195	0.972	54.0	0.989	-2.17	1.75
				848.8	55.158	0.987	53.9	1.000	-2.28	1.32
Oct. 07. 2013	835 Body	22.1	22.6	826.4	55.230	0.969	54.0	0.983	-2.23	1.44
				835.0	55.200	0.970	53.9	0.991	-2.36	2.16
				836.6	55.195	0.972	53.9	0.993	-2.35	2.16
				846.6	55.160	0.984	53.8	1.000	-2.47	1.63
Oct. 08. 2013	1900 Body	22.3	22.8	1850.2	53.300	1.520	54.8	1.470	2.81	-3.29
				1880.0	53.300	1.520	54.8	1.500	2.81	-1.32
				1900.0	53.300	1.520	54.7	1.520	2.63	0.00
				1909.8	53.300	1.520	54.7	1.530	2.63	0.66

Tissue Verification Note:

Note: The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per IEEE 1528 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

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 $j = \sqrt{-1}$.

10.2 Test System Verification

Prior to assessment, the system is verified to the± 10 % of the specifications at 835 MHz and 1900 MHz by using the SAR Dipole kit(s). (Graphic Plots Attached)

SYSTEM DIPOLE VERIFICATION TARGET & MEASURED												
SAR System #	Freq. [MHz]	SAR Dipole kits	Date(s)	Liquid	Ambient Temp.[°C]	Liquid Temp.[°C]	Probe S/N	Input Power (mW)	1 W Target SAR_{1g} (W/kg)	Measured SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	Deviation [%]
H	835	D835V2, SN:4d159	Oct. 05. 2013	Body	22.0	22.7	3327	250	9.28	2.19	8.76	-5.60
H	835	D835V2, SN:4d159	Oct. 07. 2013	Body	22.1	22.6	3327	250	9.28	2.36	9.44	1.72
H	1900	D1900V2, SN:5d176	Oct. 08. 2013	Body	22.3	22.8	3327	250	40.7	10.6	42.40	4.18

Note1 : System Verification was measured with input 250 mW and normalized to 1W.

Note2 : To confirm the proper SAR liquid depth, the z-axis plots from the system verifications were included since the system verifications were performed using the same liquid, probe and DAE as the SAR tests in the same time period.

Note3: Full system validation status and results can be found in Attachment 3.

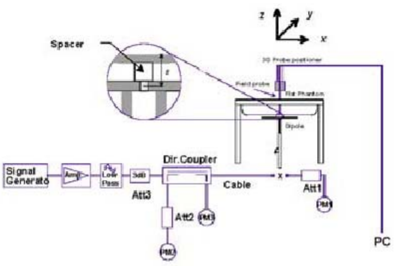


Figure 10.1 Dipole Verification Test Setup

11. SAR TEST RESULTS

11.1 Standalone Wireless router SAR Results

Table 11.1 GPRS Hotspot SAR

MEASUREMENT RESULTS													
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	# of Time Slots	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)
MHz	Ch												
836.6	190	GSM 850	GPRS	30.7	30.2	-0.080	10 mm [Top]	#1	2	1:4.15	0.155	1.122	0.174
824.2	128	GSM 850	GPRS	30.7	30.1	-0.007	10 mm [Front]	#1	2	1:4.15	0.704	1.148	0.808
836.6	190	GSM 850	GPRS	30.7	30.2	-0.007	10 mm [Front]	#1	2	1:4.15	0.827	1.122	0.928
848.8	251	GSM 850	GPRS	30.7	30.1	0.026	10 mm [Front]	#1	2	1:4.15	0.674	1.148	0.774
824.2	128	GSM 850	GPRS	33.2	32.4	-0.046	10 mm [Rear]	#1	1	1:8.3	0.866	1.202	1.041
836.6	190	GSM 850	GPRS	33.2	32.4	0.144	10 mm [Rear]	#1	1	1:8.3	0.745	1.202	0.896
848.8	251	GSM 850	GPRS	33.2	32.4	-0.072	10 mm [Rear]	#1	1	1:8.3	0.663	1.202	0.797
824.2	128	GSM 850	GPRS	30.7	30.1	-0.001	10 mm [Rear]	#1	2	1:4.15	0.954	1.148	**1.095**
836.6	190	GSM 850	GPRS	30.7	30.2	-0.072	10 mm [Rear]	#1	2	1:4.15	0.858	1.122	0.963
848.8	251	GSM 850	GPRS	30.7	30.1	0.106	10 mm [Rear]	#1	2	1:4.15	0.728	1.148	0.836
836.6	190	GSM 850	GPRS	30.7	30.2	0.014	10 mm [Right]	#1	2	1:4.15	0.468	1.122	0.525
836.6	190	GSM 850	GPRS	30.7	30.2	-0.011	10 mm [Left]	#1	2	1:4.15	0.520	1.122	0.583
824.2	128	GSM 850	GPRS	30.7	30.1	0.017	10 mm [Rear]	#1	2	1:4.15	0.945	1.148	1.085
1850.2	512	PCS1900	GPRS	28.7	28.1	-0.068	10 mm [Top]	#1	2	1:4.15	0.733	1.148	0.842
1880.0	661	PCS1900	GPRS	28.7	28.3	-0.041	10 mm [Top]	#1	2	1:4.15	0.805	1.096	0.883
1909.8	810	PCS1900	GPRS	28.7	28.3	-0.033	10 mm [Top]	#1	2	1:4.15	0.967	1.096	1.060
1880.0	661	PCS1900	GPRS	30.2	29.6	-0.092	10 mm [Front]	#1	1	1:8.3	0.630	1.148	0.723
1850.2	512	PCS1900	GPRS	28.7	28.1	0.050	10 mm [Front]	#1	2	1:4.15	0.820	1.148	0.941
1880.0	661	PCS1900	GPRS	28.7	28.3	-0.020	10 mm [Front]	#1	2	1:4.15	0.877	1.096	0.962
1909.8	810	PCS1900	GPRS	28.7	28.3	-0.120	10 mm [Front]	#1	2	1:4.15	1.020	1.096	**1.118**
1850.2	512	PCS1900	GPRS	28.7	28.1	-0.037	10 mm [Rear]	#1	2	1:4.15	0.706	1.148	0.811
1880.0	661	PCS1900	GPRS	28.7	28.3	0.134	10 mm [Rear]	#1	2	1:4.15	0.788	1.096	0.864
1909.8	810	PCS1900	GPRS	28.7	28.3	-0.007	10 mm [Rear]	#1	2	1:4.15	0.812	1.096	0.890
1880.0	661	PCS1900	GPRS	28.7	28.3	-0.022	10 mm [Right]	#1	2	1:4.15	0.263	1.096	0.288
1880.0	661	PCS1900	GPRS	28.7	28.3	0.010	10 mm [Left]	#1	2	1:4.15	0.487	1.096	0.534
1909.8	810	PCS1900	GPRS	28.7	28.3	-0.037	10 mm [Front]	#1	2	1:4.15	0.991	1.096	1.087
ANSI / IEEE C95.1-2005– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Body** **1.6 W/kg (mW/g)** averaged over 1 gram					

Note: Blue entries indicate variability measurements.

Table 11.2 WCDMA Hotspot SAR

MEASUREMENT RESULTS													
FREQUENCY		**Mode/ Band**	**Service**	**Maximum Allowed Power [dBm]**	**Conducted Power [dBm]**	**Drift Power [dB]**	**Spacing [Side]**	**Device Serial Number**	**# of Time Slots**	**Duty Cycle**	**1g SAR (W/kg)**	**Scaling Factor**	**1g Scaled SAR (W/kg)**
MHz	**Ch**												
836.6	4183	WCDMA 850	RMC	23.2	22.81	0.089	10 mm [Top]	#1	N/A	1:1	0.149	1.094	0.163
836.6	4183	WCDMA 850	RMC	23.2	22.81	-0.006	10 mm [Front]	#1	N/A	1:1	0.643	1.094	0.703
826.4	4132	WCDMA 850	RMC	23.2	22.76	0.005	10 mm [Rear]	#1	N/A	1:1	0.874	1.107	**0.967**
836.6	4183	WCDMA 850	RMC	23.2	22.81	-0.026	10 mm [Rear]	#1	N/A	1:1	0.841	1.094	0.920
846.6	4233	WCDMA 850	RMC	23.2	22.74	0.004	10 mm [Rear]	#1	N/A	1:1	0.737	1.112	0.819
836.6	4183	WCDMA 850	RMC	23.2	22.81	0.076	10 mm [Right]	#1	N/A	1:1	0.422	1.094	0.462
836.6	4183	WCDMA 850	RMC	23.2	22.81	0.014	10 mm [Left]	#1	N/A	1:1	0.459	1.094	0.502
826.4	4132	WCDMA 850	RMC	23.2	22.76	-0.042	10 mm [Rear]	#1	N/A	1:1	0.870	1.107	0.963
ANSI / IEEE C95.1-2005– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Body** **1.6 W/kg (mW/g)** averaged over 1 gram					

Note: Blue entries indicate variability measurements.

11.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in KDB Publication 941225 D06v01r01 and FCC KDB Publication447498 D01v05r01.
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05r01.
6. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v01r01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.2 for more details).
7. Per FCC KDB 865664 D01v01r01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 14 for variability analysis.

GSM Notes:

1. Per FCC KDB Publication 447498 D01v05r01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

WCDMA Notes:

1. WCDMA mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v02r02. 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.
2. Per FCC KDB Publication 447498 D01v05r01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

12. FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05r01 are applicable to handsets with built-in unlicensed transmitters such as 802.11a/b/g/n/ac and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

12.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05r01 IV.C.1.iii, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05r01 4.3.2 2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

$$\text{Estimated SAR} = \frac{\sqrt{f(GHz)}}{7.5} * \frac{(\text{Max Power of channel, mW})}{\text{Min. Separation Distance, mm}}$$

Table 12.1 Estimated SAR

Mode	Frequency	Maximum Allowed Power		Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mW]	[mm]	[W/kg]
2.4 G W-LAN	2462	12.5	18	10	0.377

Note : Per KDB Publication 447498 D01v05r01, the maximum power of the channel was rounded to the nearest mW before calculation.

12.3 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v05r01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 13.1 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

<u>**Path 1**</u>	<u>**Path 2**</u>
GPRS, WCDMA	WIFI

Figure 12.1 Simultaneous Transmission Paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v05r01 3) procedures.

Table 12.2 Simultaneous Transmission Scenarios

Ref.	Simultaneous Transmit Configurations	Body Hot Spot FCC KDB 941225 D06	Note
1	GPRS 850 + 2.4 GHz WIFI	Yes	
2	GPRS 1900 + 2.4 GHz WIFI	Yes	
3	WCDMA 850 + 2.4 GHz WIFI	Yes	

Notes:
1. 2.4 GHz WIFI is supported Hotspot.
2. WCDMA, GPRS is supported Hotspot.
3. GSM and WCDMA cannot transmit simultaneously since they share the same chip.

12.4 Hotspot SAR Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D06v01r01, the device edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR ("-").

Table 12.3 Simultaneous Transmission Scenario (Hotspot at 10 mm)

Simult TX	Configuration	GPRS 850 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	GPRS 1900 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Body SAR	Top	0.174	0.377	0.551	Body SAR	Top	1.060	0.377	1.437
	Bottom	-	0.377	0.377		Bottom	-	0.377	0.377
	Front	0.928	0.377	1.305		Front	1.118	0.377	1.495
	Rear	1.095	0.377	1.472		Rear	0.890	0.377	1.267
	Right	0.525	0.377	0.902		Right	0.288	0.377	0.665
	Left	0.583	0.377	0.960		Left	0.534	0.377	0.911

Table 12.4 Simultaneous Transmission Scenario (Hotspot at 10 mm)

Simult TX	Configuration	WCDMA 850 GPRS SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Body SAR	Top	0.163	0.377	0.54
	Bottom	-	0.377	0.377
	Front	0.703	0.377	1.080
	Rear	0.967	0.377	1.344
	Right	0.462	0.377	0.839
	Left	0.502	0.377	0.879

12.5 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05r01.

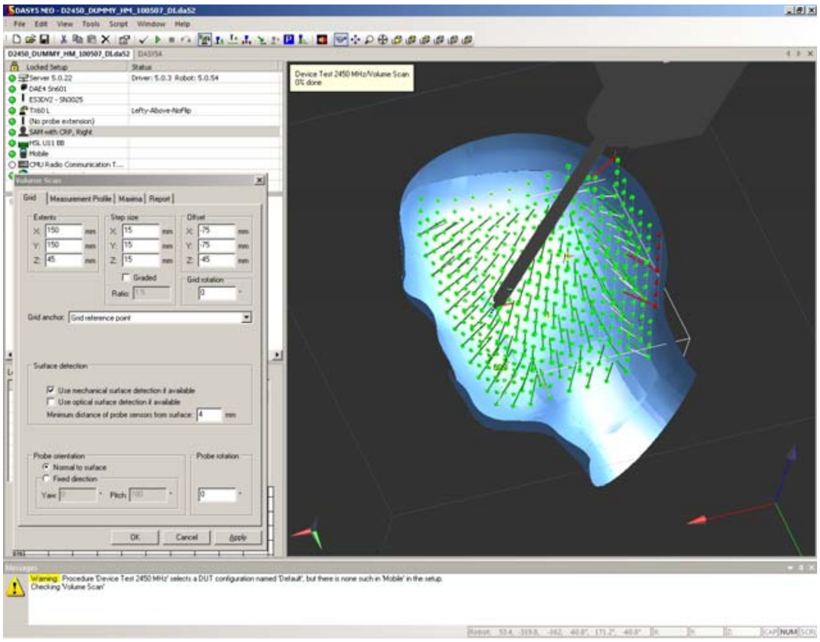
Description of Volume Scan:

In order to determine the EM field distribution in a three-dimensional spatial extension, volume scans are required.
In free space, these assessments can help to gain more information on the performance of the DUT(e.g., to determine the degree of symmetry of the filed radiated from a horn antenna).

For dosimetric application, it is necessary to assess the peak spatial SAR value averaged over a volume. For this purpose, fine resolution volume scans need to be performed at the peak SAR location(s) determined during the Area Scan. In DASY4 software these scans are called Zoom Scan jobs. The default Zoom Scan measures 7 x 7 x 7 points with a step size of 5 mm. Faster evaluations can be achieved with a reduced number of measurement points. For example, a Zoom Scan with a grid step size in x- and y-directions of 7.5 mm (5 x 5 x 7cube configuration) reduces the measurement time to almost half with only 1-2% difference in SAR reading compared to the fine-resolution 7 x 7 x 7 scan.

For SAR evaluations with larger spatial extensions (e.g., within a complete phantom head section)a Volume Scan job should be used.

The Volume Scan job is compatible with DASY4 SAR, PRO and NEO system levels. Volume Scans are used to assess peak SAR and averaged SAR measurement in largely extended 3-dimensionalvolumes within any phantom. This measurement does not need any previous area scan. The grid can be anchored to a user specific point or to the current probe location With an Administrator access mode, the grid can be optionally graded in Z-direction, whereby the smallest grid step and the grading ratio can be defined. Chosen grading ratio is automatically adjusted so that the desired extent in Z-direction is fully covered.



Under the Report page, the quantity to be evaluated for an instant report may be selected. This quantity can be: field magnitude, SAR, interpolated SAR or averaged SAR.

SAR Assessment:

Alternative1

- Evaluation Method
  - Maximum summed SAR Value
- Description
  - Easiest and most conservative method to determine the upper limit of multi-band SAR
  - Example
    - F1's SAR Value is 0.9
    - F2's SAR Value is 1.3
    - Multi-band SAR Value is 0.9 + 1.3 = 2.2

Alternative2

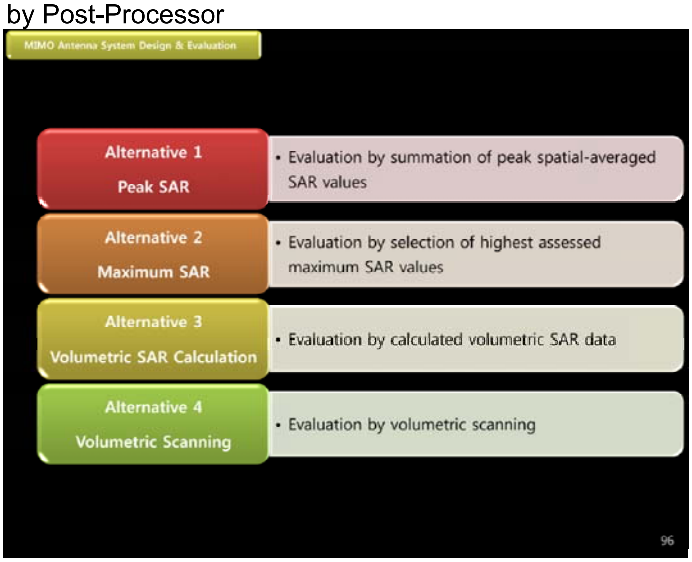
- Evaluation Method
  - Selection of highest assessed maximum SAR Value
- Description
  - Accurate estimate of the multi-band SAR
  - Example
    - F1's SAR Value is 0.9
    - F2's SAR Value is 1.3
    - Multi-band SAR Value is 1.3

Alternative3

- Evaluation Method
  - Combining existing Area and Zoom Scan results by Post-Processor
- Description
  - Rapid way of obtaining the multi-band SAR. It is always applicable.
  - Example
    - F1's SAR Value is 0.9
    - F2's SAR Value is 1.3
    - Combining results by Post-Processor

Alternative4

- Evaluation Method
  - Combining existing Area and Zoom Scan results by Post-Processor
- Description
  - The most accurate way of assessing the multi-band SAR and always applicable.
  - Example
    - F1's SAR Value is 0.9
    - F2's SAR Value is 1.3
    - Combining results by Post-Processor



13. SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r01, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1. When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2. A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3. A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4. Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

Table 13.1 Body SAR Measurement Variability Results

Frequency		Mode	Service	# of Time Slots	Spacing [Side]	Measured SAR (1g)	1st Repeated SAR(1g)	Ratio	2nd Repeated SAR(1g)	Ratio	3rd Repeated SAR(1g)	Ratio
MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
824.2	128	GSM 850	GPRS	2	10 mm [Rear]	0.954	0.945	1.01	N/A	N/A	N/A	N/A
1909.8	810	PCS1900	GPRS	2	10 mm [Front]	1.020	0.991	1.03	N/A	N/A	N/A	N/A
826.4	4132	WCDMA 850	RMC	N/A	10 mm [Rear]	0.874	0.870	1.00	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1-2005– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure							**Body 1.6 W/kg (mW/g)** averaged over 1 gram					

13.2 Measurement Uncertainty

The measured SAR was < 1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664D01v01r01, the standard measurement uncertainty analysis per IEEE 1528-2003 was not required.

14. IEEE P1528 –MEASUREMENT UNCERTAINTIES

835 MHz Body

Error Description	Uncertaint value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	± 6.0 %	∞
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.714 %	∞
Hemispherical isotropy	± 9.6	Rectangular	√3	1	± 5.543 %	∞
Boundary Effects	± 0.8	Rectangular	√3	1	± 0.462 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.714 %	∞
Detection limits	± 0.25	Rectangular	√3	1	± 0.144 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.462 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.501 %	∞
RF Ambient Conditions	± 3.0	Rectangular	√3	1	± 1.732 %	∞
Probe Positioner	± 0.4	Rectangular	√3	1	± 0.231 %	∞
Probe Positioning	± 2.9	Rectangular	√3	1	± 1.674 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.577 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.887 %	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	√3	1	± 2.309 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 4.3	Normal	1	0.64	± 4.3 %	∞
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.887 %	∞
Liquid permittivity (Meas.)	± 4.5	Normal	1	0.6	± 4.5 %	∞
Combined Standard Uncertainty					**± 12.2 %**	330
Expanded Uncertainty (k=2)					**± 24.4 %**	

The above measurement uncertainties are according to IEEE P1528 (2003)

1900 MHz Body

Error Description	Uncertaint value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	± 6.0 %	∞
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.714 %	∞
Hemispherical isotropy	± 9.6	Rectangular	√3	1	± 5.543 %	∞
Boundary Effects	± 0.8	Rectangular	√3	1	± 0.462 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.714 %	∞
Detection limits	± 0.25	Rectangular	√3	1	± 0.144 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.462 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.501 %	∞
RF Ambient Conditions	± 3.0	Rectangular	√3	1	± 1.732 %	∞
Probe Positioner	± 0.4	Rectangular	√3	1	± 0.231 %	∞
Probe Positioning	± 2.9	Rectangular	√3	1	± 1.674 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.577 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.887 %	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	√3	1	± 2.309 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 4.1	Normal	1	0.64	± 4.1 %	∞
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.887 %	∞
Liquid permittivity (Meas.)	± 4.6	Normal	1	0.6	± 4.6 %	∞
Combined Standard Uncertainty					**± 12.1 %**	330
Expanded Uncertainty (k=2)					**± 24.2 %**	

The above measurement uncertainties are according to IEEE P1528 (2003)

15.CONCLUSION

Measurement 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 the worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect toall 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 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 impossible biological effect 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.

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