FCC SAR Test Report

APPLICANT	**:**	**LG Electronics Inc.**
EQUIPMENT	**:**	**WCDMA & LTE Wireless Router with WLAN.**
BRAND NAME	**:**	**LG**
MODEL NAME	**:**	**CR820**
MARKETING NAME	**:**	**CR820**
FCC ID	**:**	**ZNFCR820**
STANDARD	**:**	**FCC 47 CFR Part 2 (2.1093)**
		ANSI/IEEE C95.1-1992
		IEEE 1528-2003
		FCC OET Bulletin 65 Supplement C (Edition 01-01)

The product was completely tested on Mar. 25, 2013. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by: Eric Huang / Vice Manager

Approved by: Jones Tsai / Manager

SPORTON INTERNATIONAL INC.

No. 52, Hwa Ya 1ˢᵗ Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.

SPORTON INTERNATIONAL INC.
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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA330402	Rev. 01	Initial issue of report	Apr. 03, 2013

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1. *Statement of Compliance*

The maximum results of Specific Absorption Rate (SAR) found during testing for **LG Electronics Inc. WCDMA & LTE Wireless Router with WLAN.**, **LG**, **CR820** are as follows.

<Highest Reported standalone SAR Summary>

Exposure Position	Frequency Band	Reported 1g-SAR (W/kg)	Equipment Class	Highest Reported 1g-SAR (W/kg)
Hotspot (1cm Gap)	WCDMA Band V	**1.07**	PCB	**1.28**
	WCDMA Band II	**0.89**		
	LTE Band 7	**1.28**		
	WLAN 2.4GHz Band	**0.20**	DTS	**0.20**

<Highest Simultaneous transmission SAR>

Frequency Band	Equipment Class	Exposure Position	Highest Reported Simultaneous Transmission 1g-SAR (W/kg)
LTE Band 7	PCB	**Back (1cm Gap)**	1.46
WLAN 2.4GHz Band	DTS		

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003 and FCC OET Bulletin 65 Supplement C (Edition 01-01).

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2. *Administration Data*

2.1 *Testing Laboratory*

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978

2.2 *Applicant*

Company Name	LG Electronics Inc.
Address	60-39, Kasan-dong, Kumchon-gu, Seoul 135-801, Korea

2.3 *Manufacturer*

Company Name	LG Electronics Inc.
Address	60-39, Kasan-dong, Kumchon-gu, Seoul 135-801, Korea

2.4 *Application Details*

Date of Start during the Test	Mar. 06, 2013
Date of End during the Test	Mar. 25, 2013

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3. *General Information*

3.1 *Description of Equipment Under Test (EUT)*

Product Feature & Specification	
EUT	WCDMA & LTE Wireless Router with WLAN.
Brand Name	LG
Model Name	CR820
Marketing Name	CR820
FCC ID	ZNFCR820
IMEI Code	004402342488107: For 3G SAR testing 004402343213066: For LTE SAR testing 004402342488099: For WLAN SAR testing.
TX Frequency	WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz LTE Band 7: 2504 MHz ~ 2537 MHz and 2553.5MHz ~ 2570MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz
Antenna Type	WWAN: PIFA Antenna WLAN: PIFA Antenna
HW Version	Rev.1.0
SW Version	V08a
Uplink Modulations	WCDMA (Rel 99): QPSK HSDPA (Rel 6): QPSK HSUPA (Rel 6): QPSK LTE: QPSK, 16QAM 802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11g/n: OFDM (BPSK / QPSK / 16QAM / 64QAM)
Remark: 1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description. 2. This device, WLAN 2.4GHz supports hotspot operation.	

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3.2 Maximum RF output power among production units

Mode	WCDMA Band V	WCDMA Band II
	Average power(dBm)	
RMC 12.2Kbps	22.7	22.7
HSDPA Subtest-1	22.7	22.7
HSUPA Subtest-5	22.7	22.7

LTE Band 7				
Modulation	BW (MHz)	RB size	Target MPR (dB)	Average power (dBm)
QPSK	20	≤ 18	0	22.7
QPSK	20	> 18	1	21.7
16QAM	20	≤ 18	1	21.7
16QAM	20	> 18	2	20.7
QPSK	10	≤ 12	0	22.7
QPSK	10	> 12	1	21.7
16QAM	10	≤ 12	1	21.7
16QAM	10	> 12	2	20.7
QPSK	5	≤ 8	0	22.7
QPSK	5	> 8	1	21.7
16QAM	5	≤ 8	1	21.7
16QAM	5	> 8	2	20.7

Remark:

1. By design, maximum LTE RF power of smaller supported bandwidth does not exceed the RF power of largest supported bandwidth; the information is included in "tune-up procedure" exhibit

IEEE 802.11 Average power(dBm)			
Mode/Band	b	g	n
WLAN 2.4GHz	15.5	12	11

The table below summarized necessary items addressed in KDB 941225 D05 v02.

FCC ID	ZNFCR820
EUT	WCDMA & LTE Wireless Router with WLAN.
Operating Frequency Range of each LTE transmission band	LTE Band 7: 2504 MHz ~ 2537 MHz and 2553.5MHz ~ 2570MHz
Channel Bandwidth	5MHz, 10MHz, 20MHz

Transmission (H, M, L) channel numbers and frequencies in each LTE band						
	LTE Band 7					
	Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	20815	2506.5	20840	2509	20890	2514
M	21095	2534.5	21070	2532	21020	2527
H	24125	2567.5	21400	2565		

E category, uplink modulations used	Category 3, QPSK, and 16QAM
LTE transmitter and antenna implementation (standalone or sharing hardware components / antennas)	A primary antenna is used for LTE and other wireless interfaces (WCDMA) for transmitting and receiving. LTE and other wireless interfaces (WCDMA) share the same antenna, and cannot transmit simultaneously A 2nd antenna is used for LTE for receiving only.
LTE Voice / Data requirements	Data only

LTE MPR permanently built-in by design	Yes, per 3GPP TS 36.101 v11.0.0

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3

Modulation	Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2

LTE A-MPR	In the base simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing.
Base station simulator used for Testing	Anritsu MT8820C

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3.3 *Applied Standard*

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- ·   FCC 47 CFR Part 2 (2.1093)
- ·   ANSI/IEEE C95.1-1992
- ·   IEEE 1528-2003
- ·   FCC OET Bulletin 65 Supplement C (Edition 01-01)
- ·   FCC KDB 447498 D01 v05
- ·   FCC KDB 248227 D01 v01r02
- ·   FCC KDB 941225 D01 v02
- ·   FCC KDB 941225 D05 v02
- ·   FCC KDB 941225 D06 v01

3.4 *Device Category and SAR Limits*

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

3.5 *Test Conditions*

3.6.1 Ambient Condition

Ambient Temperature	20 to 24 ℃
Humidity	< 60 %

3.6.2 Test Configuration

For WWAN SAR testing, the device was controlled by using a base station emulator. Communication between the device and the emulator was established by air link. The distance between the EUT and the antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of EUT.

During WLAN SAR testing EUT is configured with the WLAN continuous TX tool, and the transmission duty factor was monitored on the spectrum analyzer with zero-span setting
Duty factor observed as below:
    802.11b, 1Mbps: 100%
For WLAN SAR testing, WLAN engineering testing software installed on the EUT can provide continuous transmitting RF signal.

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4. Specific Absorption Rate (SAR)

4.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

4.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

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

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

SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = C\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific heat capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

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

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

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5. *SAR Measurement System*
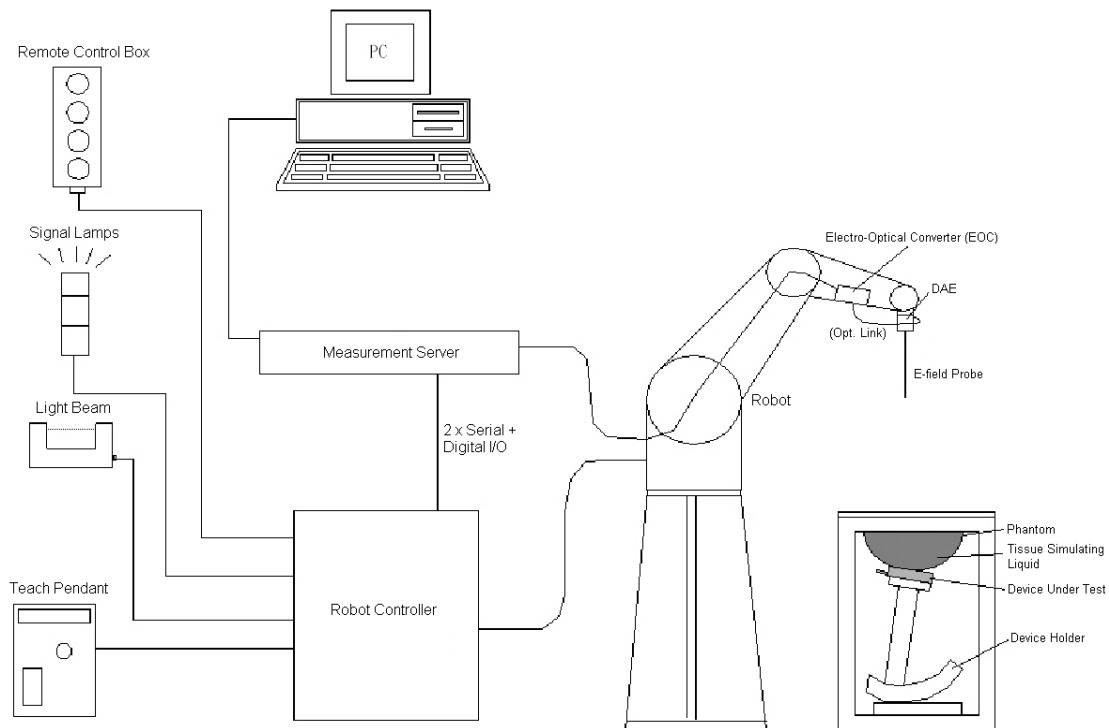
Fig 5.1 SPEAG DASY System Configurations

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

➢ A standard high precision 6-axis robot with controller, a teach pendant and software
➢ A data acquisition electronic (DAE) attached to the robot arm extension
➢ A dosimetric probe equipped with an optical surface detector system
➢ The electro-optical converter (EOC) performs the conversion between optical and electrical signals
➢ A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
➢ A probe alignment unit which improves the accuracy of the probe positioning
➢ A computer operating Windows XP
➢ DASY software
➢ Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
➢ The SAM twin phantom
➢ A device holder
➢ Tissue simulating liquid
➢ Dipole for evaluating the proper functioning of the system

Component details are described in in the following sub-sections.

5.1 *E-Field Probe*

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

5.1.1 *E-Field Probe Specification*

<ET3DV6 Probe >

Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 3 GHz; Linearity: ± 0.2 dB	
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)	
Dynamic Range	5 µW/g to 100 mW/g; Linearity: ± 0.2 dB	
Dimensions	Overall length: 330 mm (Tip: 16 mm) Tip diameter: 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm	**Fig 5.2 Photo of ET3DV6**

<ES3DV3 Probe >

Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 3 GHz; Linearity: ± 0.2 dB	
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)	
Dynamic Range	10 µW/g to 100 mW/g; Linearity: ± 0.2 dB	
Dimensions	Overall length: 337 mm (Tip: 10 mm) Tip diameter: 4 mm (Body: 10 mm) Distance from probe tip to dipole centers: 3 mm	**Fig 5.3 Photo of ES3DV3**

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<EX3DV4 Probe>

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 6 GHz; Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 µW/g to 100 mW/g; Linearity: ± 0.2 dB (noise: typically < 1 µW/g)	
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	**Fig 5.4 Photo of EX3DV4**
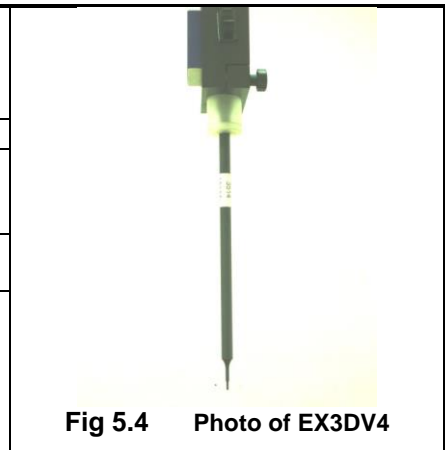
5.1.2 E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than ± 10%. The spherical isotropy shall be evaluated and within ± 0.25dB. The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to appendix C of this report.

5.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) 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 measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.5   Photo of DAE

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5.3 _Robot_

The SPEAG DASY system uses the high precision robots (DASY4: RX90BL; DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

➢ High precision (repeatability ±0.035 mm)
➢ High reliability (industrial design)
➢ Jerk-free straight movements
➢ Low ELF interference (the closed metallic construction shields against motor control fields)

Fig 5.6　　Photo of DASY4

Fig 5.7　　Photo of DASY5

5.4 _Measurement Server_

The measurement server is based on a PC/104 CPU board with CPU (DASY4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chipdisk (DASY4: 32 MB; DASY5: 128 MB), RAM (DASY4: 64 MB, DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

Fig 5.8　　Photo of Server for DASY4

Fig 5.9　　Photo of Server for DASY5

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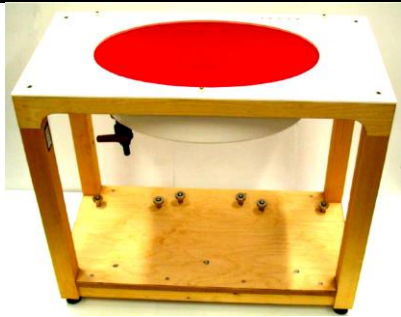
5.5 *Phantom*

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm	
Filling Volume	Approx. 25 liters	 **Fig 5.10 Photo of SAM Phantom**
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet	
Measurement Areas	Left Hand, Right Hand, Flat Phantom	

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI4 Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)	
Filling Volume	Approx. 30 liters	 **Fig 5.11 Photo of ELI4 Phantom**
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm	

The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

5.6 *Device Holder*

<Device Holder for SAM Twin Phantom>

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of ± 0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

Fig 5.12   Device Holder

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.
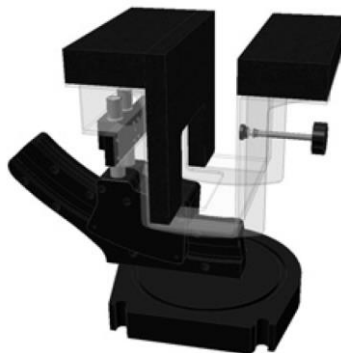
Fig 5.13   Laptop Extension Kit

5.7 _Data Storage and Evaluation_

5.7.1 Data Storage

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [A/m], [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a non-lose media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

5.7.2 Data Evaluation

The DASY post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software：

Probe parameters：	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcp_i
Device parameters：	- Frequency	f
	- Crest factor	cf
Media parameters：	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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 as：

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

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：

$$\text{E-field Probes：} E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\text{H-field Probes：} H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

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 enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
E_i = electric field strength of channel i in V/m
H_i = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian 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 mW/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

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

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5.8 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz System Validation Kit	D835V2	499	Mar. 22, 2010	Mar. 21, 2013
SPEAG	1900MHz System Validation Kit	D1900V2	5d041	Mar. 23, 2010	Mar. 22, 2013
SPEAG	2450MHz System Validation Kit	D2450V2	736	Jul. 25, 2011	Jul. 24, 2013
SPEAG	2600MHz System Validation Kit	D2600V2	1008	Sep. 28, 2011	Sep. 27, 2013
SPEAG	Data Acquisition Electronics	DAE4	778	Aug. 27, 2012	Aug. 26, 2013
SPEAG	Data Acquisition Electronics	DAE3	495	Apr. 23, 2012	Apr. 22, 2013
SPEAG	Data Acquisition Electronics	DAE4	1279	Jan. 28, 2013	Jan. 27, 2014
SPEAG	Data Acquisition Electronics	DAE4	1338	Jun. 12, 2012	Jun. 11, 2013
SPEAG	Dosimetric E-Field Probe	ET3DV6	1787	May. 29, 2012	May. 28, 2013
SPEAG	Dosimetric E-Field Probe	EX3DV4	3697	Sep. 28, 2012	Sep. 27, 2013
SPEAG	Dosimetric E-Field Probe	EX3DV4	3792	Jun. 21, 2012	Jun. 20, 2013
SPEAG	Dosimetric E-Field Probe	ES3DV3	3270	Sep. 28, 2012	Sep. 27, 2013
H.M.IRIS	Thermometer	TH-08	TM658	Nov. 13, 2012	Nov. 12, 2013
SPEAG	SAM Phantom	QD 000 P40 CD	TP-1719	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1383	NCR	NCR
SPEAG	ELI4 Phantom	QD 0VA 001 BB	1026	NCR	NCR
SPEAG	ELI4 Phantom	QD 0VA 002 AA	TP-1127	NCR	NCR
Agilent	ENA Network Analyzer	E5071C	MY46316648	Feb. 07, 2013	Feb. 06, 2014
Agilent	ESG Vector Series Signal Generator	E4438C	MY49070755	Oct. 02, 2012	Oct. 01, 2013
Anritsu	Power Meter	ML2495A	1132003	Aug. 14, 2012	Aug. 13, 2013
Anritsu	Radio Communication Analyzer	MT8820C	6201074414	Dec. 11, 2012	Dec. 10, 2014
Agilent	Wireless Communication Test Set	E5515C	MY48360820	Jan. 05, 2012	Jan. 04, 2014
Agilent	Dual Directional Coupler	778D	50422	Note 4	
Woken	Attenuator 1	WK0602-XX	N/A	Note 4	
PE	Attenuator 2	PE7005-10	N/A	Note 4	
PE	Attenuator 3	PE7005- 3	N/A	Note 4	
Agilent	Dielectric Probe Kit	85070D	US01440205	Note 5	
AR	Power Amplifier	5S1G4M2	328767	Note 6	
R&S	Spectrum Analyzer	FSP	101131	Jul. 23, 2012	Jul. 22, 2013

Table 5.1 Test Equipment List

Note:
1. The calibration certificate of DASY can be referred to appendix C of this report.
2. Referring to KDB 865664 D01v01, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The justification data of dipole D835V2, SN: 499, D1900V2, SN: 5d041, D2450V2, SN: 736, D2600V2, SN:1008 can be found in appendix C. The return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration.
4. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
5. The dielectric probe kit was calibrated via the network analyzer, with the specified procedure (calibrated in pure water) and calibration kit (standard) short circuit, before the dielectric measurement. The specific procedure and calibration kit are provided by Agilent.
6. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1W input power according to the ratio of 1W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it
7. Attenuator 1 insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.
8. In this report GSM850/GSM1900 testing data has completed at March/06/2013 that before to the expiration of the Validation Kit calibration

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6. *Tissue Simulating Liquids*

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 6.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 6.2.
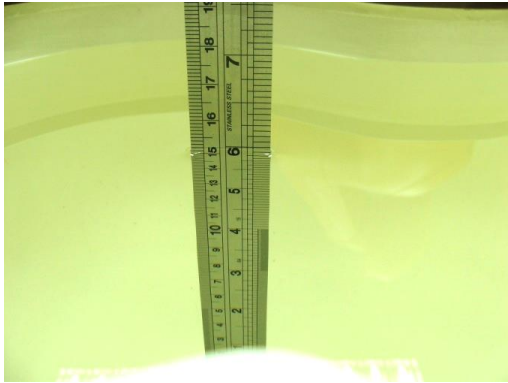
Fig 6.1 Photo of Liquid Height for Head SAR

Fig 6.2 Photo of Liquid Height for Body SAR

The following table gives the recipes for tissue simulating liquid.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (ε_r)
For Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
For Body								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7

Table 6.1 Recipes of Tissue Simulating Liquid

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The dielectric parameters of the liquids were verified prior to the SAR evaluation using an Agilent 85070D Dielectric Probe Kit and an Agilent Network Analyzer.

The following table shows the measuring results for simulating liquid.

Frequency (MHz)	Liquid Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (εr)	Conductivity Target (σ)	Permittivity Target (εr)	Delta (σ) (%)	Delta (εr) (%)	Limit (%)	Date
835	Body	21.5	0.963	54.498	0.97	55.2	-0.72	-1.27	±5	Mar. 06, 2013
1900	Body	21.2	1.526	52.813	1.52	53.3	0.39	-0.91	±5	Mar. 06, 2013
2450	Body	21.4	1.904	51.836	1.95	52.7	-2.36	-1.64	±5	Mar. 08, 2013
2600	Body	21.4	2.165	53.823	2.16	52.5	0.23	2.52	±5	Mar. 19, 2013
2600	Body	21.6	2.201	52.823	2.16	52.5	1.90	0.62	±5	Mar. 25, 2013

Table 6.2 Measuring Results for Simulating Liquid

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7. *SAR System Verification*

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

7.1 *Purpose of System Performance check*

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

7.2 *System Setup*

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:
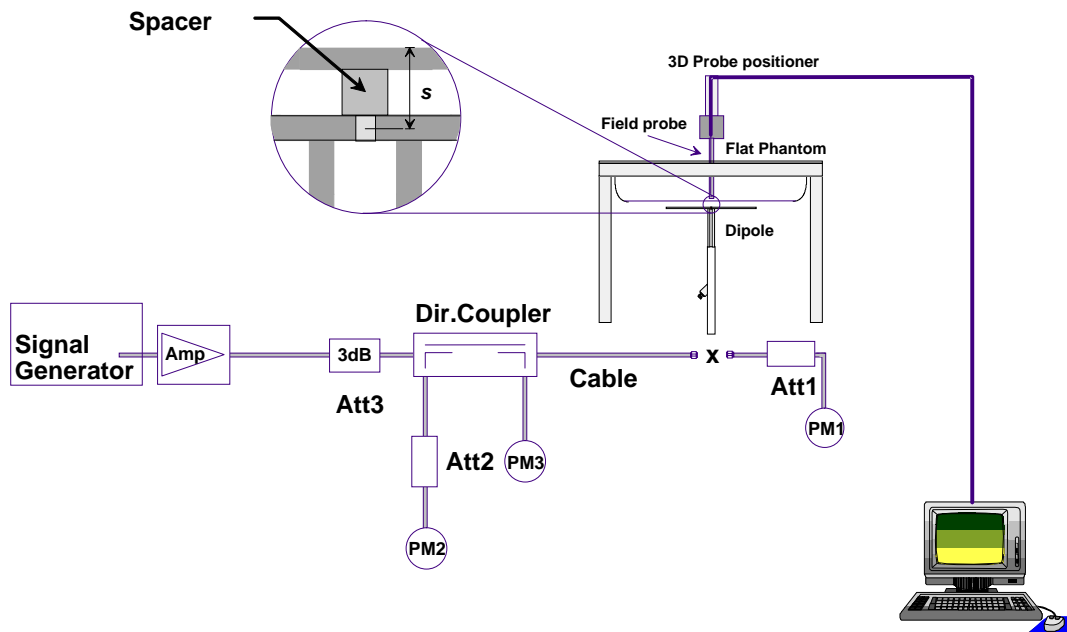
Fig 7.1 System Setup for System Evaluation

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. Calibrated Dipole

Fig 7.2 Photo of Dipole Setup

7.3 SAR System Verification Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Table 7.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Liquid Type	Power fed onto reference dipole (mW)	Targeted SAR (W/kg)	Measured SAR (W/kg)	Normalized SAR (W/kg)	Deviation (%)
Mar. 06, 2013	835	Body	250	9.82	2.45	9.8	-0.20
Mar. 06, 2013	1900	Body	250	40	9.66	38.64	-3.40
Mar. 08, 2013	2450	Body	250	52.3	12.5	50	-4.40
Mar. 19, 2013	2600	Body	250	55.9	13.8	55.2	-1.25
Mar. 25, 2013	2600	Body	250	55.9	14.7	58.8	5.19

Table 7.1 Target and Measurement SAR after Normalized

8. EUT Testing Position

This EUT was tested in six different positions. They are Front/Back/Right Side/Left Side/Top Side/Bottom Side of the EUT with phantom 1 cm gap, as illustrated below. Please refer to Appendix D for the test setup photo

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9. _Measurement Procedures_

The measurement procedures are as follows:

<u><Conducted power measurement></u>
(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b) Read the WWAN RF power level from the base station simulator.
(c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<u><SAR measurement></u>
(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

9.1 _Spatial Peak SAR Evaluation_

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

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9.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

9.3 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. Area scan and zoom scan resolution setting follows KDB 865664 D01v01 quoted below.

For any secondary peaks found in the area scan which are within 2 dB of the maximum peak and are not within this zoom scan, the zoom scan should be repeated

			≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			$30° \pm 1°$	$20° \pm 1°$
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}			≤ 2 GHz: ≤ 15 mm $2 - 3$ GHz: ≤ 12 mm	$3 - 4$ GHz: ≤ 12 mm $4 - 6$ GHz: ≤ 10 mm
			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm $2 - 3$ GHz: ≤ 5 mm*	$3 - 4$ GHz: ≤ 5 mm* $4 - 6$ GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface		uniform grid: $\Delta z_{Zoom}(n)$	≤ 5 mm	$3 - 4$ GHz: ≤ 4 mm $4 - 5$ GHz: ≤ 3 mm $5 - 6$ GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	$3 - 4$ GHz: ≤ 3 mm $4 - 5$ GHz: ≤ 2.5 mm $5 - 6$ GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	$3 - 4$ GHz: ≥ 28 mm $4 - 5$ GHz: ≥ 25 mm $5 - 6$ GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the _reported_ SAR from the area scan based _1-g SAR estimation_ procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

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9.4 _Volume Scan Procedures_

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

9.5 _SAR Averaged Methods_

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

9.6 _Power Drift Monitoring_

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

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10. *Conducted RF Output Power (Unit: dBm)*

<u>**<WCDMA Conducted Power>**</u>

The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification.

A summary of these settings are illustrated below:

HSDPA Setup Configuration:

    a.   The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.

    b.   The RF path losses were compensated into the measurements.

    c.   A call was established between EUT and Base Station with following setting:

        i.   Set Gain Factors (β_c and β_d) and parameters were set according to each

        ii.   Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121

        iii.   Set RMC 12.2Kbps + HSDPA mode.

        iv.   Set Cell Power = -86 dBm

        v.   Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)

        vi.   Select HSDPA Uplink Parameters

        vii.   Set Delta ACK, Delta NACK and Delta CQI = 8

        viii.   Set Ack-Nack Repetition Factor to 3

        ix.   Set CQI Feedback Cycle (k) to 4 ms

        x.   Set CQI Repetition Factor to 2

        xi.   Power Ctrl Mode = All Up bits

    d.   The transmitted maximum output power was recorded.

Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH

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: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_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, Δ_{ACK} and Δ_{NACK} = 30/15 with β_{hs} = 30/15 * β_c , and Δ_{CQI} = 24/15 with β_{hs} = 24/15 * β_c .

Note 3:   CM = 1 for β_c/β_d =12/15, β_{hs}/β_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.

Note 4:   For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 11/15 and β_d = 15/15.

Setup Configuration

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HSUPA Setup Configuration:

a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
b. The RF path losses were compensated into the measurements.
c. A call was established between EUT and Base Station with following setting * :
   i. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
   ii. Set the Gain Factors (β_c and β_d) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.3, quoted from the TS 34.121
   iii. Set Cell Power = -86 dBm
   iv. Set Channel Type = 12.2k + HSPA
   v. Set UE Target Power
   vi. Power Ctrl Mode= Alternating bits
   vii. Set and observe the E-TFCI
   viii. Confirm that E-TFCI is equal to the target E-TFCI of 75 for sub-test 1, and other subtest's E-TFCI
d. The transmitted maximum output power was recorded.

Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note1)	β_{ec}	β_{ed} (Note 5) (Note 6)	β_{ed} (SF)	β_{ed} (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 6)	E-TFCI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/225	1309/225	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_{ed}1: 47/15 β_{ed}2: 47/15	4 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 (Note 4)	15/15 (Note 4)	64	15/15 (Note 4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with $\beta_{hs} = 30/15 * \beta_c$.

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 signalled 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 signalled gain factors for the reference TFC (TF1, TF1) to β_c = 14/15 and β_d = 15/15.

Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 6: β_{ed} can not be set directly, it is set by Absolute Grant Value.

Setup Configuration

<u>**<WCDMA Conducted Power>**</u>

Note:

1.   It is expected by the manufacturer that MPR for some HSDPA/HSUPA, subtests may differ from the specification of 3GPP, according to the chipset implementation in this model. The implementation and expected deviation are detailed in tune-up procedure exhibit.

Band		WCDMA V			WCDMA II		
TX Channel		**4132**	**4182**	**4233**	**9262**	**9400**	**9538**
Rx Channel		**4357**	**4407**	**4458**	**9662**	**9800**	**9938**
Frequency (MHz)		**826.4**	**836.4**	**846.6**	**1852.4**	**1880**	**1907.6**
3GPP Rel 99	**RMC 12.2Kbps**	22.54	22.66	22.57	22.67	22.59	22.53
3GPP Rel 6	**HSDPA Subtest-1**	22.16	22.32	22.24	22.19	22.08	21.98
3GPP Rel 6	**HSDPA Subtest-2**	22.14	22.28	22.21	22.14	22.03	21.96
3GPP Rel 6	**HSDPA Subtest-3**	21.78	21.88	21.84	21.70	21.60	21.55
3GPP Rel 6	**HSDPA Subtest-4**	21.76	21.86	21.81	21.68	21.58	21.53
3GPP Rel 6	**HSUPA Subtest-1**	22.25	22.40	22.29	22.18	22.12	22.07
3GPP Rel 6	**HSUPA Subtest-2**	20.71	20.96	20.81	20.93	20.88	20.81
3GPP Rel 6	**HSUPA Subtest-3**	21.22	21.39	21.27	21.23	21.15	21.07
3GPP Rel 6	**HSUPA Subtest-4**	21.02	21.18	21.08	21.15	21.06	21.07
3GPP Rel 6	**HSUPA Subtest-5**	22.29	22.52	22.39	22.40	22.29	22.24
3GPP MPR specification		**WCDMA V**			**WCDMA II**		
0	**HSDPA Subtest-1**	0.00	0.00	0.00	0.00	0.00	0.00
0	**HSDPA Subtest-2**	0.02	0.04	0.03	0.05	0.05	0.02
≦0.5	**HSDPA Subtest-3**	0.38	0.44	0.40	0.49	0.48	0.43
≦0.5	**HSDPA Subtest-4**	0.40	0.46	0.43	0.51	0.50	0.45
≦0	**HSUPA Subtest-1**	0.04	0.12	0.10	0.22	0.17	0.17
≦2	**HSUPA Subtest-2**	1.58	1.56	1.58	1.47	1.41	1.43
≦1	**HSUPA Subtest-3**	1.07	1.13	1.12	1.17	1.14	1.17
≦2	**HSUPA Subtest-4**	1.27	1.34	1.31	1.25	1.23	1.17
≦0	**HSUPA Subtest-5**	0.00	0.00	0.00	0.00	0.00	0.00

<LTE Conducted Power>

Note:

1. Anritsu MT8820C base station simulator was used to setup the connection with EUT; the frequency band, channel bandwidth, RB allocation configuration, modulation type are set in the base station simulator to configure EUT transmitting at maximum power and at different configurations which are requested to be reported to FCC, for conducted power measurement and SAR testing.

2. Per KDB 941225 D05v02, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.

3. Per KDB 941225 D05v02, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each *required test channel*.

4. Per KDB 941225 D05v02, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure

5. 16QAM output power for each RB allocation configuration is not > ½ dB higher than the same configuration in QPSK

6. Smaller bandwidth output power for each RB allocation configuration is not > ½ dB higher than the same configuration in the largest supported bandwidth

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<LTE Band 7 Conducted Power >

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Target MPR	MPR Low Ch. / Freq.	MPR Middle Ch. / Freq.	MPR High Ch. / Freq.
	Channel			20890	21020			20890	21020	
	Frequency (MHz)			2514	2527			2514	2527	
20	QPSK	1	0	22.01	22.02		0	0.33	0.46	
20	QPSK	1	49	22.34	22.37			0.00	0.11	
20	QPSK	1	99	22.20	22.48			0.14	0.00	
20	QPSK	50	0	21.31	21.37		1	1.03	1.11	
20	QPSK	50	24	21.35	21.30			0.99	1.18	
20	QPSK	50	49	21.23	21.44			1.11	1.04	
20	QPSK	100	0	21.34	21.42			1.00	1.06	
20	16QAM	1	0	21.06	21.27		1	1.28	1.21	
20	16QAM	1	49	21.48	21.62			0.86	0.86	
20	16QAM	1	99	21.65	21.67			0.69	0.81	
20	16QAM	50	0	20.34	20.63		2	2.00	1.85	
20	16QAM	50	24	20.45	20.42			1.89	2.06	
20	16QAM	50	49	20.49	20.67			1.85	1.81	
20	16QAM	100	0	20.47	20.55			1.87	1.93	
	Channel			20840	21070	21400		20840	21070	21400
	Frequency (MHz)			2509	2532	2565		2509	2532	2565
10	QPSK	1	0	21.92	22.18	22.20	0	0.20	0.13	0.07
10	QPSK	1	24	22.12	22.31	22.27		0.00	0.00	0.00
10	QPSK	1	49	22.11	22.21	22.02		0.01	0.10	0.25
10	QPSK	25	0	21.17	21.40	21.50	1	0.95	0.91	0.77
10	QPSK	25	12	21.35	21.42	21.46		0.77	0.89	0.81
10	QPSK	25	24	21.32	21.43	21.33		0.80	0.88	0.94
10	QPSK	50	0	21.34	21.41	21.32		0.78	0.90	0.95
10	16QAM	1	0	21.63	21.35	21.46	1	0.49	0.96	0.81
10	16QAM	1	24	21.69	21.70	21.60		0.43	0.61	0.67
10	16QAM	1	49	21.50	21.21	21.21		0.62	1.10	1.06
10	16QAM	25	0	20.42	20.66	20.63	2	1.70	1.65	1.64
10	16QAM	25	12	20.59	20.64	20.60		1.53	1.67	1.67
10	16QAM	25	24	20.66	20.67	20.68		1.46	1.64	1.59
10	16QAM	50	0	20.36	20.30	20.39		1.76	2.01	1.88
	Channel			20815	21095	21425		20815	21095	21425
	Frequency (MHz)			2506.5	2534.5	2567.5		2506.5	2534.5	2567.5
5	QPSK	1	0	22.11	22.26	22.23	0	0.17	0.15	0.03
5	QPSK	1	12	22.02	22.41	22.26		0.26	0.00	0.00
5	QPSK	1	24	22.28	22.31	22.09		0.00	0.10	0.17
5	QPSK	12	0	21.15	21.38	21.32	1	1.13	1.03	0.94
5	QPSK	12	6	21.13	21.40	21.23		1.15	1.01	1.03
5	QPSK	12	11	21.10	21.39	21.24		1.18	1.02	1.02
5	QPSK	25	0	21.20	21.34	21.28		1.08	1.07	0.98
5	16QAM	1	0	21.25	21.01	21.25	1	1.03	1.40	1.01
5	16QAM	1	12	21.68	21.36	21.50		0.60	1.05	0.76
5	16QAM	1	24	21.61	21.29	21.61		0.67	1.12	0.65
5	16QAM	12	0	20.02	20.25	20.23	2	2.26	2.16	2.03
5	16QAM	12	6	20.08	20.16	20.16		2.20	2.25	2.10
5	16QAM	12	11	20.04	20.43	20.21		2.24	1.98	2.05
5	16QAM	25	0	20.41	20.70	20.66		1.87	1.71	1.60

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\<WLAN 2.4GHz Conducted Power\>

WLAN 2.4GHz 802.11b Average Power (dBm)						
Power vs. Channel			Power vs. Data Rate			
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)		
		1M		2M	5.5M	11M
CH 1	2412	15.41	CH 6	15.45	15.45	15.43
CH 6	2437	**15.46**				
CH 11	2462	15.35				

WLAN 2.4GHz 802.11g Average Power (dBm)									
Power vs. Channel			Power vs. Data Rate						
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)					
		6M		9M	12M	18M	24M	36M	48M	54M
CH 1	2412	11.96	CH 6	11.88	11.78	11.87	11.91	11.79	11.92	11.96
CH 6	2437	**11.98**							
CH 11	2462	11.33							

WLAN 2.4GHz 802.11n (BW 20MHz) Average Power (dBm)									
Power vs. Channel			Power vs. Data Rate						
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index					
		MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH 1	2412	10.93	CH 6	10.94	10.95	10.89	10.95	10.83	10.80	10.82
CH 6	2437	**10.97**							
CH 11	2462	10.71							

Note:
1. Per KDB 248227 D01 v01r02, choose the highest output power channel to test SAR and determine further SAR exclusion
2. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at the lowest data rate
3. Per KDB 248227 D01 v01r02, 11g and 11n-HT20 output power is less than 1/4dB higher than 11b mode, thus the SAR can be excluded.

11. *Exposure Positions Consideration*
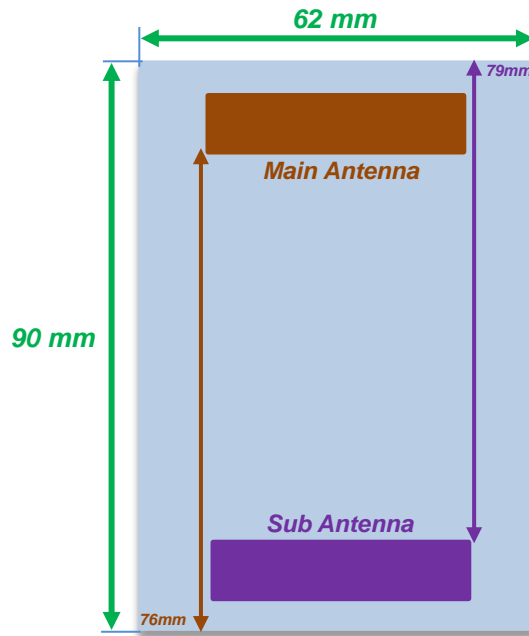
Antennas	Wireless Interface
Main Antenna (Tx / Rx)	WCDMA Band V WCDMA Band II LTE Band 7
Sub Antenna (Tx / Rx)	WLAN 2.4GHz LTE Band 7(Rx)

Distance of the Antenna to the EUT surface/edge						
Antennas	**Back**	**Front**	**Top Side**	**Bottom Side**	**Right Side**	**Left Side**
Main	≤ 25mm	≤ 25mm	≤ 25mm	76mm	≤ 25mm	≤ 25mm
Sub	≤ 25mm	≤ 25mm	79mm	≤ 25mm	≤ 25mm	≤ 25mm

Positions for SAR tests; Hotspot mode Test distance: 10 mm						
Antennas	**Back**	**Front**	**Top Side**	**Bottom Side**	**Right Side**	**Left Side**
Main	Yes	Yes	Yes	NO	Yes	Yes
Sub	Yes	Yes	NO	Yes	Yes	Yes

1.　Referring to KDB 941225 D06 v01, when the overall device length and width are ≥ 9cm*5cm, the test distance is 10 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge

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12. SAR Test Results

Note:

1. Per KDB 447498 D01v05, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.

    Scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.

    Reported SAR(W/kg)= Measured SAR(W/kg)* Scaling Factor

2. Per KDB 447498 D01v05, for each exposure position, if the highest output channel reported SAR ≤0.8W/kg, other channels SAR testing are not necessary

12.1 Test Record of Hotspot SAR Test

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	Measured SAR$_{1g}$ (W/kg)	Reported SAR$_{1g}$ (W/kg)
10	WCDMA V	RMC 12.2Kbps	Front	1cm	4182	836.4	22.66	22.7	1.009	0.01	0.885	0.893
11	WCDMA V	RMC 12.2Kbps	Front	1cm	4132	826.4	22.54	22.7	1.038	-0.07	0.82	0.851
12	WCDMA V	RMC 12.2Kbps	Front	1cm	4233	846.6	22.57	22.7	1.030	0.03	0.827	0.852
13	WCDMA V	RMC 12.2Kbps	Back	1cm	4182	836.4	22.66	22.7	1.009	0.02	1	1.009
14	WCDMA V	RMC 12.2Kbps	Back	1cm	4132	826.4	22.54	22.7	1.038	0.02	1.03	**1.069**
15	WCDMA V	RMC 12.2Kbps	Back	1cm	4233	846.6	22.57	22.7	1.030	0.01	0.971	1.001
16	WCDMA V	RMC 12.2Kbps	Left Side	1cm	4182	836.4	22.66	22.7	1.009	-0.03	0.342	0.345
17	WCDMA V	RMC 12.2Kbps	Right Side	1cm	4182	836.4	22.66	22.7	1.009	-0.01	0.279	0.282
18	WCDMA V	RMC 12.2Kbps	Top Side	1cm	4182	836.4	22.66	22.7	1.009	-0.01	0.157	0.158
1	WCDMA II	RMC 12.2Kbps	Front	1cm	9262	1852.4	22.67	22.7	1.007	-0.04	0.615	0.619
2	WCDMA II	RMC 12.2Kbps	Back	1cm	9262	1852.4	22.67	22.7	1.007	-0.01	0.813	0.819
3	WCDMA II	RMC 12.2Kbps	Back	1cm	9400	1880	22.59	22.7	1.026	-0.14	0.865	**0.887**
4	WCDMA II	RMC 12.2Kbps	Back	1cm	9538	1907.6	22.53	22.7	1.040	-0.14	0.838	0.871
5	WCDMA II	RMC 12.2Kbps	Left Side	1cm	9262	1852.4	22.67	22.7	1.007	0.05	0.144	0.145
6	WCDMA II	RMC 12.2Kbps	Right Side	1cm	9262	1852.4	22.67	22.7	1.007	-0.08	0.259	0.261
7	WCDMA II	RMC 12.2Kbps	Top Side	1cm	9262	1852.4	22.67	22.7	1.007	0	0.417	0.420

Note:

1. Body SAR, per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA/HSUPA output power is < 0.25dB higher than RMC, or Reported SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA SAR evaluation can be excluded.

<LTE SAR>

Plot No.	Band	Mode	BW [MHz]	RB Size	RB Offset	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR₁g (W/kg)	Scaled SAR₁g (W/kg)
21	LTE Band 7	QPSK	20M	1	99	Front	1cm	21020	2527	22.48	22.7	1.052	-0.04	0.895	0.942
22	LTE Band 7	QPSK	20M	1	99	Front	1cm	20890	2514	22.2	22.7	1.122	-0.07	0.692	0.776
30	LTE Band 7	QPSK	20M	50	49	Front	1cm	21020	2527	21.44	21.7	1.062	-0.13	0.603	0.640
32	LTE Band 7	QPSK	20M	100	0	Front	1cm	21020	2527	21.42	21.7	1.067	-0.02	0.584	0.623
23	LTE Band 7	QPSK	20M	1	99	Back	1cm	21020	2527	22.48	22.7	1.052	-0.1	1.2	1.262
24	LTE Band 7	QPSK	20M	1	99	Back	1cm	20890	2514	22.2	22.7	1.122	-0.03	1.08	1.212
33	LTE Band 7	QPSK	20M	50	49	Back	1cm	21020	2527	21.44	21.7	1.062	0.04	1.14	1.210
34	LTE Band 7	QPSK	20M	50	49	Back	1cm	20890	2514	21.23	21.7	1.114	-0.09	1.12	1.248
35	LTE Band 7	QPSK	20M	100	0	Back	1cm	21020	2527	21.42	21.7	1.067	-0.07	1.12	1.195
36	LTE Band 7	QPSK	20M	1	99	Left Side	1cm	21020	2527	22.48	22.7	1.052	-0.07	0.1	0.105
37	LTE Band 7	QPSK	20M	50	49	Left Side	1cm	21020	2527	21.44	21.7	1.062	-0.15	0.076	0.081
38	LTE Band 7	QPSK	20M	1	99	Right Side	1cm	21020	2527	22.48	22.7	1.052	0.07	0.208	0.219
39	LTE Band 7	QPSK	20M	50	49	Right Side	1cm	21020	2527	21.44	21.7	1.062	-0.1	0.149	0.158
27	LTE Band 7	QPSK	20M	1	99	Top Side	1cm	21020	2527	22.48	22.7	1.052	0.18	1.22	**1.283**
28	LTE Band 7	QPSK	20M	1	99	Top Side	1cm	20890	2514	22.2	22.7	1.122	-0.07	1.12	1.257
40	LTE Band 7	QPSK	20M	50	49	Top Side	1cm	21020	2527	21.44	21.7	1.062	-0.05	1.09	1.157
41	LTE Band 7	QPSK	20M	50	49	Top Side	1cm	20890	2514	21.23	21.7	1.114	0.02	0.92	1.025
42	LTE Band 7	QPSK	20M	100	0	Top Side	1cm	21020	2527	21.42	21.7	1.067	0.01	1	1.067

Note:
1. Per KDB 941225 D05v02, when reported SAR of 1RB and 50%RB allocation for QPSK ≤0.8W/kg, and 100%RB with QPSK output power is less than 1RB and 50%RB, 100%RB allocation for QPSK is not required.
2. Per KDB 941225 D05v02, when reported SAR of 1RB and 50%RB allocation for QPSK >0.8W/kg for any exposure position, SAR testing of 100%RB allocation for QPSK is performed at the highest power channel.
3. 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the *reported* SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02, 16QAM SAR testing is not required.
4. Smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the *reported* SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02, smaller bandwidth SAR testing is not required.

<WLAN SAR DTS>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR₁g (W/kg)	Scaled SAR₁g (W/kg)
50	WLAN2.4GHz	802.11b 1Mbps	Front	1cm	6	2437	15.46	15.50	1.008	-0.11	0.161	0.162
51	WLAN2.4GHz	802.11b 1Mbps	Back	1cm	6	2437	15.46	15.50	1.008	0.02	0.196	**0.198**
52	WLAN2.4GHz	802.11b 1Mbps	Left Side	1cm	6	2437	15.46	15.50	1.008	-0.03	0.074	0.075
53	WLAN2.4GHz	802.11b 1Mbps	Right Side	1cm	6	2437	15.46	15.50	1.008	0.01	0.021	0.021
54	WLAN2.4GHz	802.11b 1Mbps	Bottom Side	1cm	6	2437	15.46	15.50	1.008	0.04	0.072	0.073

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12.2 Repeated SAR Measurement

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured SAR 1g (W/kg)	Ratio	Scaled SAR 1g (W/kg)
14	WCDMA V	-	-	-	-	RMC 12.2Kbps	Back	1cm	4132	826.4	22.54	22.7	1.038	0.02	1.03	1	1.069
20	WCDMA V	-	-	-	-	RMC 12.2Kbps	Back	1cm	4132	826.4	22.54	22.7	1.038	0.01	1	1.03	1.038
3	WCDMA II	-	-	-	-	RMC 12.2Kbps	Back	1cm	9400	1880	22.59	22.7	1.026	-0.14	0.865	1	0.887
9	WCDMA II	-	-	-	-	RMC 12.2Kbps	Back	1cm	9400	1880	22.59	22.7	1.026	0.08	0.843	1.03	0.865
29	LTE Band 7	20M	QPSK	1	99	-	Top Side	1cm	21020	2527	22.48	22.7	1.052	-0.02	1.33	1	1.399
27	LTE Band 7	20M	QPSK	1	99	-	Top Side	1cm	21020	2527	22.48	22.7	1.052	-0.09	1.32	1.01	1.389

Note:

1. Per KDB 865664 D01v01, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg

2. Per KDB 865664 D01v01, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.

3. The ratio is the difference in percentage between original and repeated *measured SAR*.

4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

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12.3 *Highest SAR Plot*

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab   Date: 2013/3/6

#14_WCDMA V_RMC 12.2Kbps_Back_1cm_Ch4132

DUT: 330402

Communication System: WCDMA; Frequency: 826.4 MHz;Duty Cycle: 1:1
Medium: MSL_850_130306 Medium parameters used: f = 826.4 MHz; σ = 0.955 mho/m; ε_r = 54.588; ρ = 1000 kg/m^3
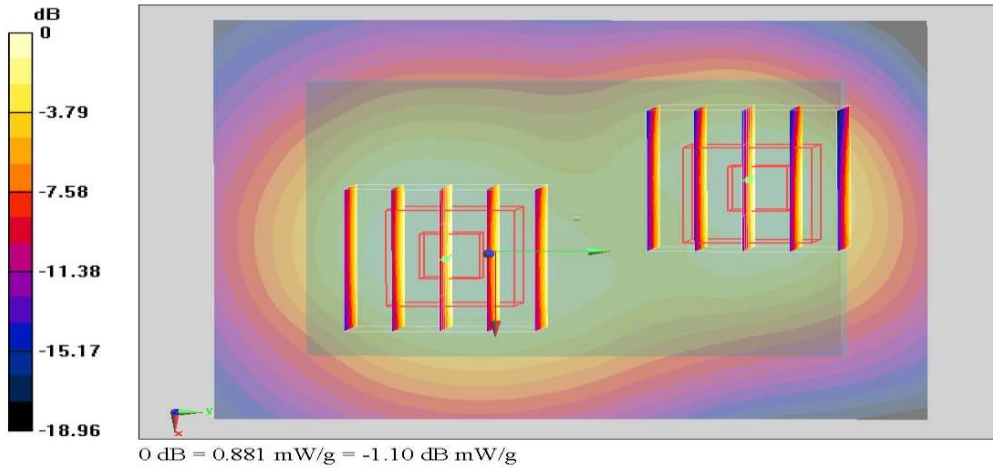Ambient Temperature：22.5 ℃；Liquid Temperature：21.5 ℃

DASY5 Configuration:
- Probe: ET3DV6 - SN1787; ConvF(6.08, 6.08, 6.08); Calibrated: 2012/5/29;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2012/4/23
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (3); SEMCAD X Version 14.6.5 (6469)

Configuration/Ch4132/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.10 mW/g

Configuration/Ch4132/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 29.914 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 1.435 mW/g
SAR(1 g) = 1.03 mW/g; SAR(10 g) = 0.697 mW/g
Maximum value of SAR (measured) = 1.11 mW/g
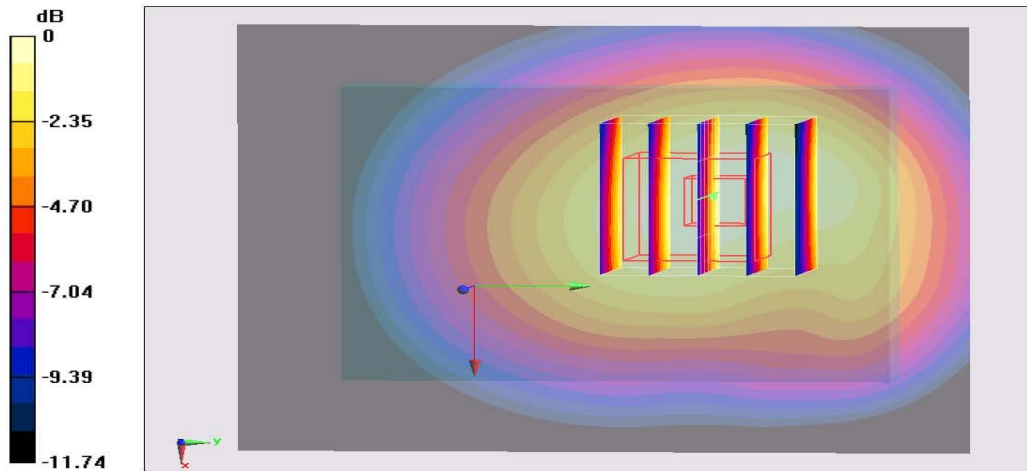
0 dB = 1.11 mW/g = 0.91 dB mW/g

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab   Date: 2013/3/6

#03_WCDMA II_RMC 12.2Kbps_Back_1cm_Ch9400

DUT: 330402

Communication System: WCDMA; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: MSL1900_130306 Medium parameters used: f = 1880 MHz; σ = 1.509 mho/m; ε_r = 52.919; ρ = 1000 kg/m^3
Ambient Temperature：22.2 ℃; Liquid Temperature：21.2 ℃

DASY5 Configuration:
- Probe: ET3DV6 - SN1787; ConvF(4.58, 4.58, 4.58); Calibrated: 2012/5/29;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2012/4/23
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (3); SEMCAD X Version 14.6.5 (6469)

Configuration/Ch9400/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.973 mW/g

Configuration/Ch9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.700 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 1.254 mW/g
SAR(1 g) = 0.865 mW/g; SAR(10 g) = 0.548 mW/g
Maximum value of SAR (measured) = 0.942 mW/g

Configuration/Ch9400/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.700 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 1.301 mW/g
SAR(1 g) = 0.807 mW/g; SAR(10 g) = 0.463 mW/g
Maximum value of SAR (measured) = 0.881 mW/g

0 dB = 0.881 mW/g = -1.10 dB mW/g

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab   Date: 2013/3/25

#27_LTE Band 7_20M_QPSK_1RB_99Offset_Top Side_1cm_Ch21020
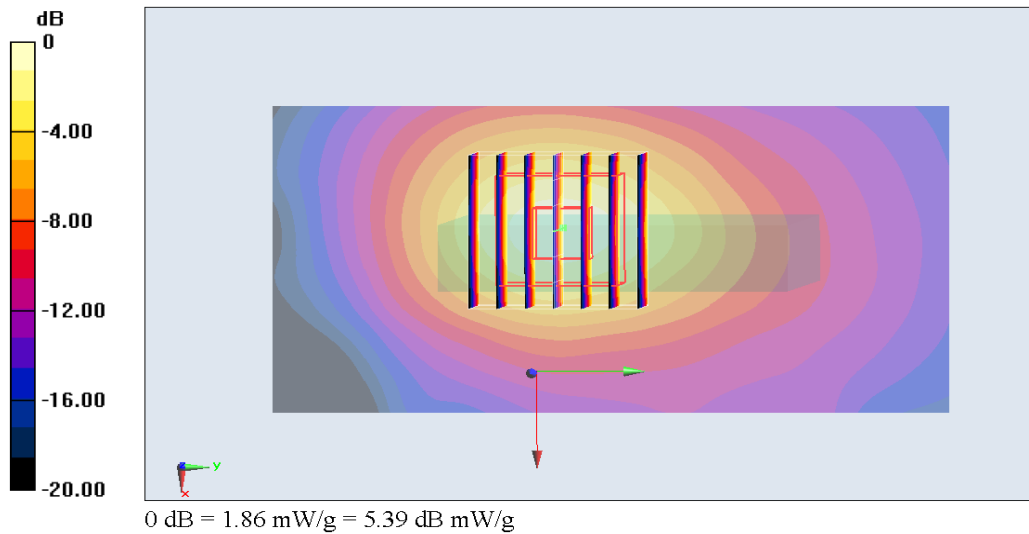
DUT: 330402

Communication System: LTE; Frequency: 2527 MHz;Duty Cycle: 1:1
Medium: MSL_2600_130325 Medium parameters used: f = 2527 MHz; σ = 2.112 mho/m; ε_r = 52.931; ρ
= 1000 kg/m^3
Ambient Temperature：22.6 ℃；Liquid Temperature：21.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3697; ConvF(6.4, 6.4, 6.4); Calibrated: 2012/9/28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: SAM RIGHT; Type: SAM; Serial: 1719
-Measurement SW: DASY52, Version 52.8 (4); SEMCAD X Version 14.6.8 (7028)

Configuration/Ch21020/Area Scan (51x101x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 1.67 mW/g

Configuration/Ch21020/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm,
dz=5mm
Reference Value = 29.302 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 2.502 mW/g
SAR(1 g) = 1.22 mW/g; SAR(10 g) = 0.617 mW/g
Maximum value of SAR (measured) = 1.86 mW/g

0 dB = 1.86 mW/g = 5.39 dB mW/g

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab   Date: 2013/3/8

#51_WLAN2.4G_802.11b_Back_1cm_Ch6

DUT: 330402

Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_130308 Medium parameters used: f = 2437 MHz; σ = 1.887 mho/m; ε_r = 51.868; ρ = 1000 kg/m^3
Ambient Temperature：22.4 ℃; Liquid Temperature：21.4 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3270; ConvF(4.17, 4.17, 4.17); Calibrated: 2012/9/28;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2012/8/27
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6477)

Configuration/Ch6/Area Scan (81x101x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.245 mW/g

Configuration/Ch6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.392 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.386 mW/g
SAR(1 g) = 0.196 mW/g; SAR(10 g) = 0.103 mW/g
Maximum value of SAR (measured) = 0.243 mW/g

0 dB = 0.243 mW/g = -12.29 dB mW/g
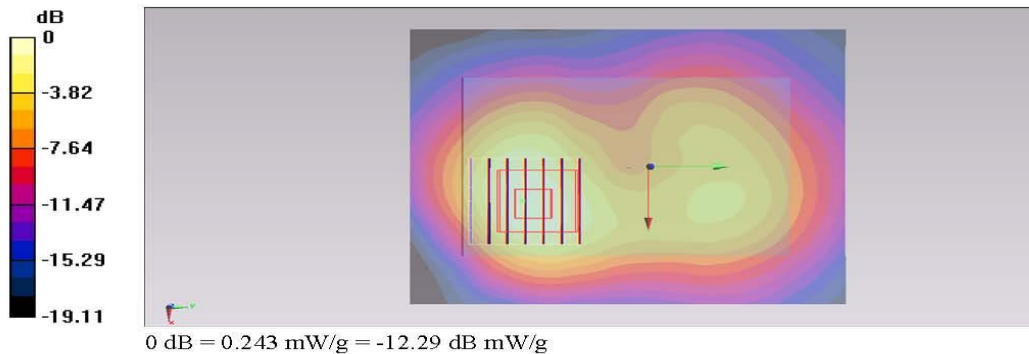
12.4 *Simultaneous Multi-band Transmission Analysis*

No.	Applicable Simultaneous Transmission Combination
1.	**WCDMA(data) + WLAN 2.4GHz (Hotspot)**
2.	**LTE (data) + WLAN 2.4GHz (r Hotspot)**

Note:
1. WCDMA and LTE share the same antenna, and cannot transmit simultaneously
2. The Scaled SAR summation is calculated based on the same configuration and test position.
3. This device WLAN2.4GHz supports Hotspot operation.
4. Per KDB 447498 D01v05, simultaneous transmission SAR is compliant if,
(i)   Scalar SAR summation < 1.6W/kg.
(ii) $SPLSR = (SAR1 + SAR2)1.5 /$ (min. separation distance, mm), and the peak separation distance is determined from the square root of $[(x1-x2)2 + (y1-y2)2 + (z1-z2)2]$, where $(x1, y1, z1)$ and $(x2, y2, z2)$ are the coordinates of the extrapolated peak SAR locations in the zoom scan
        If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary
(iii) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg

<Co-location of Hotspot SAR>

Position	WWAN			WLAN-DTS		WWAN + WLAN
	WWAN Band	Plot No	Reported SAR (W/kg)	Plot No	Reported SAR (W/kg)	
Front	WCDMA V	10	0.893	50	0.162	**1.06**
	WCDMA II	1	0.619	50	0.162	**0.78**
	LTE Band 7	21	0.942	50	0.162	**1.10**
Back	WCDMA V	14	1.069	51	0.198	**1.27**
	WCDMA II	3	0.887	51	0.198	**1.09**
	LTE Band 7	23	1.262	51	0.198	**1.46**
Left Side	WCDMA V	16	0.345	52	0.075	**0.42**
	WCDMA II	5	0.145	52	0.075	**0.22**
	LTE Band 7	36	0.105	52	0.075	**0.18**
Right Side	WCDMA V	17	0.282	53	0.021	**0.30**
	WCDMA II	6	0.261	53	0.021	**0.28**
	LTE Band 7	38	0.219	53	0.021	**0.24**
Top Side	WCDMA V	18	0.158			**0.16**
	WCDMA II	7	0.42			**0.42**
	LTE Band 7	27	1.283			**1.28**
Bottom Side	WCDMA V			54	0.073	**0.07**
	WCDMA II			54	0.073	**0.07**
	LTE Band 7			54	0.073	**0.07**

Test Engineer： <u>Aaron Chen</u> and <u>Ted Sun</u>

13. *Uncertainty Assessment*

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 12.1

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor[a]	$1/k$ [b]	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Table 13.1 Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)
Measurement System							
Probe Calibration	6.0	Normal	1	1	1	± 6.0 %	± 6.0 %
Axial Isotropy	4.7	Rectangular	√3	0.7	0.7	± 1.9 %	± 1.9 %
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	0.7	± 3.9 %	± 3.9 %
Boundary Effects	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Linearity	4.7	Rectangular	√3	1	1	± 2.7 %	± 2.7 %
System Detection Limits	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %
Response Time	0.8	Rectangular	√3	1	1	± 0.5 %	± 0.5 %
Integration Time	2.6	Rectangular	√3	1	1	± 1.5 %	± 1.5 %
RF Ambient Noise	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
RF Ambient Reflections	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
Probe Positioner	0.4	Rectangular	√3	1	1	± 0.2 %	± 0.2 %
Probe Positioning	2.9	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
Max. SAR Eval.	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Test Sample Related							
Device Positioning	2.9	Normal	1	1	1	± 2.9 %	± 2.9 %
Device Holder	3.6	Normal	1	1	1	± 3.6 %	± 3.6 %
Power Drift	5.0	Rectangular	√3	1	1	± 2.9 %	± 2.9 %
Phantom and Setup							
Phantom Uncertainty	4.0	Rectangular	√3	1	1	± 2.3 %	± 2.3 %
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %
Liquid Conductivity (Meas.)	2.5	Normal	1	0.64	0.43	± 1.6 %	± 1.1 %
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	0.49	± 1.7 %	± 1.4 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.6	0.49	± 1.5 %	± 1.2 %
Combined Standard Uncertainty						± 11.0 %	± 10.8 %
Coverage Factor for 95 %						K=2	
Expanded Uncertainty						**± 22.0 %**	**± 21.5 %**

Table 13.2 Uncertainty Budget for frequency range 300 MHz to 3 GHz according to IEEE 1528-2003

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