SAR TEST REPORT

Test item	:	Multi Band GSM/WCDMA/LTE Phone with Bluetooth, WLAN and NFC
Model No.	:	LG-D855V, LGD855V, D855V, LG-D855v, LGD855v, D855v
Order No.	:	DTNC1411-04837
Date of receipt	:	2014-11-05
Test duration	:	2014-11-06 ~ 2014-11-18
Date of issue	:	2014-11-20
Use of report	:	FCC Original Grant

Applicant : LG Electronics MobileComm U.S.A., Inc.
1000 Sylvan Avenue, Englewood Cliffs NJ 07632

Test laboratory : DT&C Co., Ltd.
42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 449-935

Test rule part	:	CFR §2.1093
Test environment	:	See appended test report
Test result	:	☒ Pass ☐ Fail

Tested by:	Witnessed by:	Reviewed by:
Engineer ChangWon, Lee	Engineer N/A	Technical Director Harvey Sung

Table of Contents

1. DESCRIPTION OF DEVICE 5

1.1 Guidance Applied 6
1.2 Device Overview 6
1.3 Nominal and Maximum Output Power Specifications 7
1.4 DUT Antenna Locations 8
1.5 Near Field Communications (NFC) Antenna 9
1.6 SAR Test Exclusions Applied 9
1.7 Power Reduction for SAR 10
1.8 Device Serial Numbers 10
1.9 LTE Information 11

2. INTROCUCTION 12

3. DESCRIPTION OF TEST EQUIPMENT 13

3.1 SAR MEASUREMENT SETUP 13
3.2 EX3DV4 Probe Specification 14
3.3 Probe Calibration Process 15
3.3.1 E-Probe Calibration 15
3.4 Data Extrapolation 16
3.5 SAM Twin PHANTOM 17
3.6 Device Holder for Transmitters 17
3.7 Brain & Muscle Simulation Mixture Characterization 18
3.8 SAR TEST EQUIPMENT 19

4. TEST SYSTEM SPECIFICATIONS 20

5. SAR MEASUREMENT PROCEDURE 21

5.1 Measurement Procedure 21

6. DEFINITION OF REFERENCE POINTS 22

6.1 Ear Reference Point 22
6.2 Handset Reference Points 22

7. TEST CONFIGURATION POSITIONS FOR HANDSETS 23

7.1 Device Holder 23
7.2 Positioning for Cheek/Touch 23
7.3 Positioning for Ear / 15 ° Tilt 23
7.4 Body-Worn Accessory Configurations 24
7.5 Extremity Exposure Configurations 24
7.6 Wireless Router Configurations 25

8. RF EXPOSURE LIMITS 26

9. FCC MEASUREMENT PROCEDURES 27

9.1 Measured and Reported SAR 27
9.2 Procedures Used to Establish RF Signal for SAR 27
9.3 SAR Measurement Conditions for WCDMA (UMTS) 27
9.3.1 Output Power Verification 27
9.3.2 Head SAR Measurements for Handsets 27
9.3.3 Body SAR Measurements 28
9.3.4 SAR Measurements for Handsets with Rel 5 HSDPA 28
9.3.5 SAR Measurements for Handsets with Rel 6 HSUPA 28
9.3.6 SAR Measurements Conditions for DC-HSDPA 29
9.4 SAR Measurement Conditions for LTE 29
9.4.1 Spectrum Plots for RB Configurations 29
9.4.2 MPR 29

9.4.3 A-MPR 29
9.4.4 Required RB Size and RB Offsets for SAR Testing 29
9.5 SAR Testing with 802.11 Transmitters 30
9.5.1 General Device Setup 30
9.5.2 Frequency Channel Configurations 30
10. RF CONDUCTED POWERS 31
10.1 GSM Conducted Powers 31
10.2 WCDMA Conducted Powers 32
10.3 LTE Conducted Powers 33
10.4 WLAN Conducted Powers 41
10.5 Bluetooth Conducted Powers 45
11. SYSTEM VERIFICATION 46
11.1 Tissue Verification 46
11.2 Test System Verification 48
12. SAR TEST RESULTS 49
12.1 Head SAR Results 49
12.2 Standalone Body-Worn SAR Worn SAR Results 52
12.3 Standalone Wireless router SAR Results 53
12.4 SAR Test Notes 56
13. FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS 58
13.1 Introduction 58
13.2 Simultaneous Transmission Procedures 58
13.3 Simultaneous Transmission Capabilities 58
13.4 Head SAR Simultaneous Transmission Analysis 60
13.5 Body-Worn Simultaneous Transmission Analysis 62
13.6 Hotspot SAR Simultaneous Transmission Analysis 63
13.7 Simultaneous Transmission Conclusion 64
14. SAR MEASUREMENT VARIABILITY 64
14.1 Measurement Variability 64
14.2 Measurement Uncertainty 64
15. IEEE P1528 –MEASUREMENT UNCERTAINTIES 65
16.CONCLUSION 79
17. REFERENCES 80
Attachment 1. – Probe Calibration Data 82
Attachment 2. – Dipole Calibration Data 94
Attachment 3. – SAR SYSTEM VALIDATION 137

Test Report Version

Test Report No.	Date	Description
DRTFCC1411-1480	Nov. 20, 2014	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:

EUT type	Multi Band GSM/WCDMA/LTE Phone with Bluetooth, WLAN and NFC
FCC ID	ZNFD855V
Equipment model name	LG-D855V
Equipment add model name	LGD855V, D855V, LG-D855v, LGD855v, D855v ● 6 models are same mechanical, electrical and functional. ● The only difference is the model name, which are changed for marketing purpose.
Equipment serial no.	Identical prototype
Mode(s) of Operation	GSM 850, PCS 1900, WCDMA 850, WCDMA 1900, LTE Band 5, 2.4 G W-LAN (802.11b/g/n HT20), 5 G W-LAN (802.11a/n HT20/n HT40/ ac VHT20/ ac VHT40/ ac VHT80)
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) 1852.4 ~ 1907.6 MHz (WCDMA FDD II)/ 824.0 ~849.0 MHz (LTE Band 5) / 2412 ~ 2462 MHz (802.11b/g/n HT20) 5180 ~ 5240 MHz (802.11a/n HT20/ac VHT20) / 5190 ~ 5230 MHz (802.11n HT40/ac VHT40) 5260 ~ 5320 MHz (802.11a/n HT20/ac VHT20) / 5270 ~ 5310 MHz (802.11n HT40/ac VHT40) 5500 ~ 5700 MHz (802.11a/n HT20/ac VHT20) / 5510 ~ 5670 MHz (802.11n HT40/ac VHT40) 5745 ~ 5825 MHz (802 11a/n HT20/ac VHT20) / 5755 ~ 5795 MHz (802.11n HT40/ac VHT40) 5210, 5290, 5530, 5775 MHz(802.11ac VHT80)
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) 1932.4 ~ 1987.6 MHz (WCDMA FDD II)/ 869.0 ~894.0 MHz (LTE Band 5) / 2412 ~ 2462 MHz (802.11b) 5180 ~ 5240 MHz (802.11a/n HT20/ac VHT20) / 5190 ~ 5230 MHz (802.11n HT40/ac VHT40) 5260 ~ 5320 MHz (802.11a/n HT20/ac VHT20) / 5270 ~ 5310 MHz (802.11n HT40/ac VHT40) 5500 ~ 5700 MHz (802.11a/n HT20/ac VHT20) / 5510 ~ 5670 MHz (802.11n HT40/ac VHT40) 5745 ~ 5825 MHz (802 11a/n HT20/ac VHT20) / 5755 ~ 5795 MHz (802.11n HT40/ac VHT40) 5210, 5290, 5530, 5775 MHz(802.11ac VHT80)

Equipment Class	Band	Measured Conducted Power [dBm]	Reported SAR 1g SAR (W/kg)		
			Head	Body-worn	Hotspot
PCE	GSM 850	33.20	0.206	0.276	-
PCE	GPRS 850	31.70	0.216	0.290	0.290
PCE	PCS 1900	30.30	0.184	0.641	-
PCE	GPRS 1900	26.60	0.236	0.747	0.747
PCE	WCDMA 850	24.00	0.157	0.311	0.311
PCE	WCDMA 1900	23.80	0.275	1.162	1.162
PCE	LTE Band 5	24.08	0.161	0.357	0.357
DTS	2.4 GHz W-LAN	16.96	0.289	0.195	0.195
NII	5.2 GHz W-LAN	10.43	0.202	0.198	-
NII	5.3 GHz W-LAN	10.51	0.246	0.182	-
NII	5.6 GHz W-LAN	10.22	0.293	0.208	-
NII	5.8 GHz W-LAN	10.23	0.224	0.191	-
DSS/DTS	Bluetooth	6.18	N/A		
Simultaneous SAR per KDB 690783 D01v01r03			0.475	1.370	1.357

FCC Equipment Class	Licensed Portable Transmitter Held to Ear (PCE)
Date(s) of Tests	2014-11-06 ~ 2014-11-18
Antenna Type	Internal Type Antenna
Functions	● GSM/GPRS(GPRS Class: 12) / EDGE (EDGE Class: 12) supported * DTM not supported ● BT(2.4GHz) / W-LAN(2.4GHz 802.11b/g/n(HT20)) supported W-LAN(5GHz 802.11a/n(HT20)/n(HT40)/ac(VHT20)/ac(VHT40)/ac(VHT80)) supported * No simultaneous transmission between BT & WLAN ● Simultaneous transmission between GSM, WCDMA voice & WLAN / GPRS, WCDMA & WLAN / LTE & WLAN ● VoIP supported. ● WiFi 2.4GHz Mobile Hotspot supported.

1.1 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01 3G SAR Measurement Procedures v03
- FCC KDB Publication 941225 D05 SAR for LTE Devices v02r03
- FCC KDB Publication 941225 D06 Hot Spot SAR v02
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 648474 D03v01r02 Wireless Charging Battery Cover.
- FCC KDB Publication 648474 D04 Handset SAR v01r02
- FCC KDB Publication 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- FCC KDB Publication 865664 D02 RF Exposure Reporting v01r01
- October 2013 TCB Workshop Notes (GPRS testing criteria)

1.2 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 850	Voice/Data	824.2 ~ 848.8 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.2 ~ 1909.8 MHz
WCDMA 850	Voice/Data	826.4 ~ 846.6 MHz
WCDMA 1900	Voice/Data	1852.4 ~ 1907.6 MHz
LTE Band 5	Data	824.0 ~ 849.0 MHz
2.4 GHz WLAN	Data	2412 ~ 2462 MHz
5.2 GHz WLAN	Data	5180 ~ 5240 MHz
5.3 GHz WLAN	Data	5260 ~ 5320 MHz
5.6 GHz WLAN	Data	5500 ~ 5700 MHz
5.8 GHz WLAN	Data	5745 ~ 5825 MHz
Bluetooth	Data	2402 ~ 2480 MHz
NFC	Data	13.56 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 D01v05r02.

Band & Mode		Voice [dBm]	Burst Average GMSK [dBm]				Burst Average 8-PSK [dBm]			
		1 TX Slot	1 TX Slot	2 TX Slot	3 TX Slot	4 TX Slot	1 TX Slot	2 TX Slot	3 TX Slot	4 TX Slot
GSM/GPRS/EDGE 850	Maximum	33.7	33.7	31.7	29.6	27.7	27.7	27.7	26.7	25.7
	Nominal	33.2	33.2	31.2	29.1	27.2	27.2	27.2	26.2	25.2
GSM/GPRS/EDGE 1900	Maximum	30.7	30.7	28.7	27.7	26.7	26.7	26.7	25.7	24.7
	Nominal	30.2	30.2	28.2	27.2	26.2	26.2	26.2	25.2	24.2

Band & Mode		Modulated Average [dBm]				
		3GPP WCDMA	3GPP HSDPA			
		Rel. 99	Rel. 5			
			Subtest 1	Subtest 2	Subtest 3	Subtest 4
WCDMA 850	Maximum	24.7	24.7	24.7	24.2	24.2
	Nominal	24.2	24.2	24.2	23.7	23.7
WCDMA 1900	Maximum	24.2	24.2	24.2	23.7	23.7
	Nominal	23.7	23.7	23.7	23.2	23.2

Note : This device supports HSUPA but the manufacturer only declares on the tune-up procedure that the HSUPA transmitter's power will not exceed the R99 maximum transmit power in devices based on Qualcomm's HSPA chipset solution.

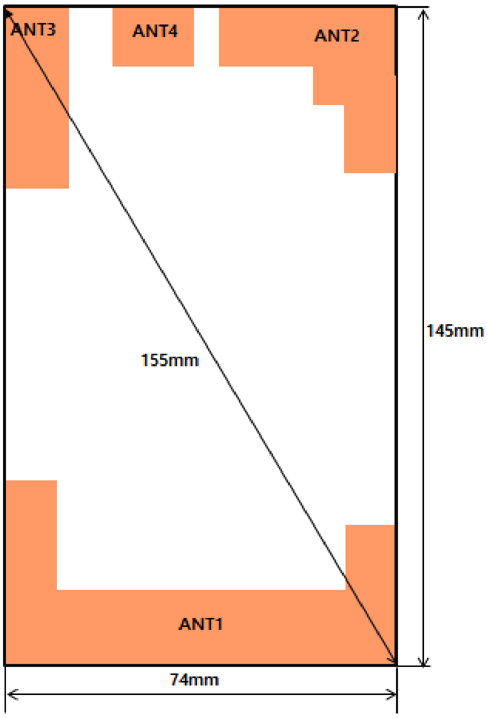
Band & Mode		Modulated Average [dBm]
LTE Band 5 (Cell)	Maximum	24.7
	Nominal	24.2

Band & Mode		Modulated Average [dBm]
IEEE 802.11b (2.4 GHz)	Maximum	17.0
	Nominal	16.0
IEEE 802.11g (2.4 GHz)	Maximum	10.5
	Nominal	9.5
IEEE 802.11n (2.4 GHz)	Maximum	10.0
	Nominal	9.0
IEEE 802.11a (5 GHz)	Maximum	11.0
	Nominal	10.0
IEEE 802.11n HT20 (5 GHz)	Maximum	9.5
	Nominal	8.5
IEEE 802.11n HT40 (5 GHz)	Maximum	9.5
	Nominal	8.5
IEEE 802.11ac VHT20 (5 GHz)	Maximum	9.5
	Nominal	8.5
IEEE 802.11ac VHT40 (5 GHz)	Maximum	8.0
	Nominal	7.0
IEEE 802.11ac VHT80 (5 GHz)	Maximum	9.5
	Nominal	8.5

Band & Mode		Modulated Average [dBm]
Bluetooth 1 Mbps	Maximum	6.5
	Nominal	5.5
Bluetooth 2 Mbps	Maximum	4.0
	Nominal	3.0
Bluetooth 3 Mbps	Maximum	4.0
	Nominal	3.0
Bluetooth LE	Maximum	2.5
	Nominal	1.5

1.4 DUT Antenna Locations

LG-D855V Antenna Distance



ANT1	GSM Quad WCDMA B1/2/5/8 LTE B1/3/5/8/20
ANT1	LTE B28/7/40
ANT2	LTE B1/3/5/8/20/28/40 2nd RX WCDMA B1/5/8 2nd RX
ANT3	GPS LTE B7 2nd RX
ANT4	BT/Wi-Fi

Rear View

Note 1: Exact antenna dimensions and separation distances are shown in the "Antenna Location_ZNFD855V" in the FCC Filing.
Note 2: Since the diagonal dimension of this device is < 160 mm , it is not considered a "phablet".

Mode	Mobile Hotspot Sides for SAR Testing					
	Top	Bottom	Front	Rear	Right	Left
GPRS 850	X	O	O	O	O	O
GPRS 1900	X	O	O	O	O	O
WCDMA 850	X	O	O	O	O	O
WCDMA 1900	X	O	O	O	O	O
LTE Band 5	X	O	O	O	O	O
2.4G W-LAN(802.11b)	O	X	O	O	O	O
5G W-LAN(802.11a)	X	X	X	O	X	X

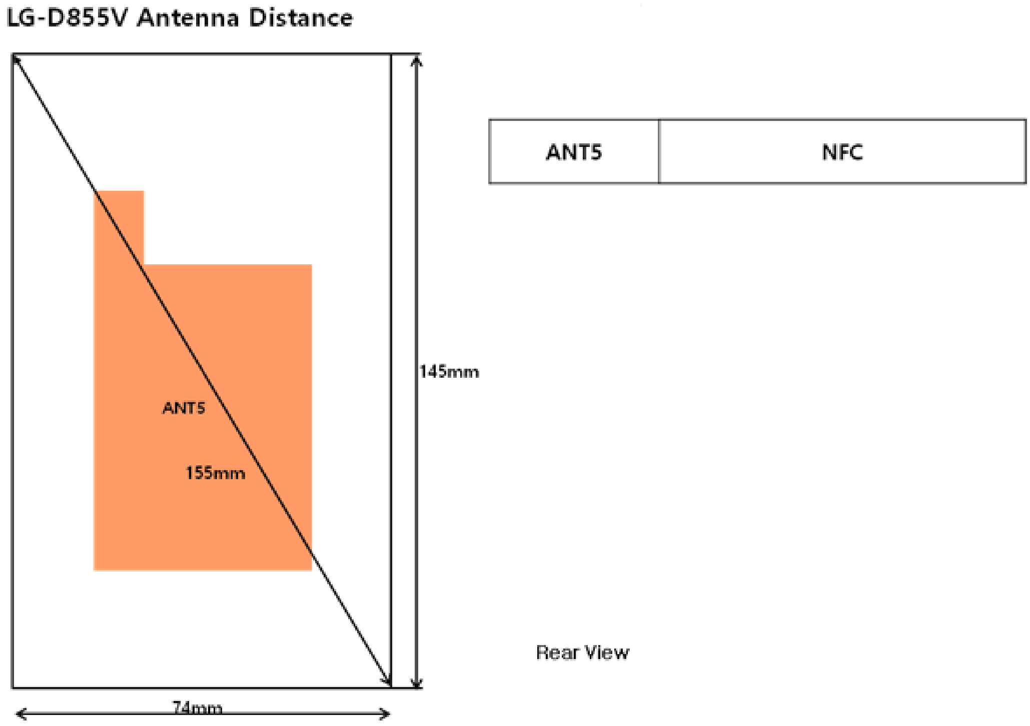
Table 1.1 Mobile Hotspot Sides for SAR Testing

Note:

1. 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 D06v02 guidance, page 2. The antenna document shows the distances between the transmit antennas and the edges of the device.

1.5 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the back cover. The SAR tests were performed with the back cover with NFC antenna already incorporated.



1.6 SAR Test Exclusions Applied

(A) WIFI & BT

Since Wireless Router operations of this device are only allowed using 2.4 GHz WIFI, 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 D06v02.

Per FCC KDB 447498 D01v05r02, 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 **Bluetooth** (rounded to the nearest mW) and the antenna to user separation distance, **Bluetooth SAR was not required**; [(4/10)* √2.480] = **0.7** < 3.0.

Based on the maximum conducted power of **Bluetooth LE** (rounded to the nearest mW) and the antenna to user separation distance, **Bluetooth LE SAR was not required**; [(2/10)* √2.480] = **0.3** < 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 required**; [(50/10)* √2.462] = **7.9** > 3.0.

Based on the maximum conducted power of **5 GHz WIFI** (rounded to the nearest mW) and the antenna to user separation distance, **5 GHz WIFI SAR was required**; [(13/10)* √5.825] = **3.038** > 3.0.

Per KDB Publication 447498 D01v05r02, the maximum power of the channel was rounded to the nearest mW before calculation.

(B) Licensed Transmitter(s)

GSM/GPRS DTM is not supported for US bands. Therefore, the GSM Voice modes in this report do not transmit simultaneously with GPRS/EDGE Data.

1.7 Power Reduction for SAR

There is no power reduction used for any band/mode implemented in this device for SAR purposes.

1.8 Device Serial Numbers

Band & Mode	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
GSM/GPRS 850	FCC #1	FCC #1	FCC #1
GSM/GPRS 1900	FCC #1	FCC #1	FCC #1
WCDMA 850	FCC #1	FCC #1	FCC #1
WCDMA 1900	FCC #1	FCC #1	FCC #1
LTE Band 5	FCC #1	FCC #1	FCC #1
2.4 GHz WLAN	FCC #1	FCC #1	FCC #1
5 GHz WLAN	FCC #1	FCC #1	FCC #1

1.9 LTE Information

LTE Information			
FCC ID	**ZNFD855V**		
Form Factor	Portable Handset		
Frequency Range of each LTE transmission Band	LTE Band 5 (824.0 ~ 849.0 MHz)		
	LTE Band 5: 10 MHz, 5 MHz, 3 MHz, 1.4 MHz		
Channel Number and Frequencies (MHz)	Low	Mid	High
LTE Band 5: 10 MHz	829(20450)	836.5(20525)	844(20600)
LTE Band 5: 5 MHz	826.5(20425)	836.5(20525)	846.5(20625)
LTE Band 5: 3 MHz	825.5(20415)	836.5(20525)	847.5(20635)
LTE Band 5: 1.4 MHz	824.7(20407)	836.5(20525)	848.3(20643)
UE Category / Modulations Supported	UE Category 4 / QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	Yes		
A-MPR (Additional MPR) disabled for SAR Testing?	N/A (This device does not support A-MPR)		

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)

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

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 DASY5 automated dosimetric assessment system. The DASY5 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 i7-3770 3.40 GHz desktop computer with Windows NT system and SAR Measurement Software DASY5, 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.

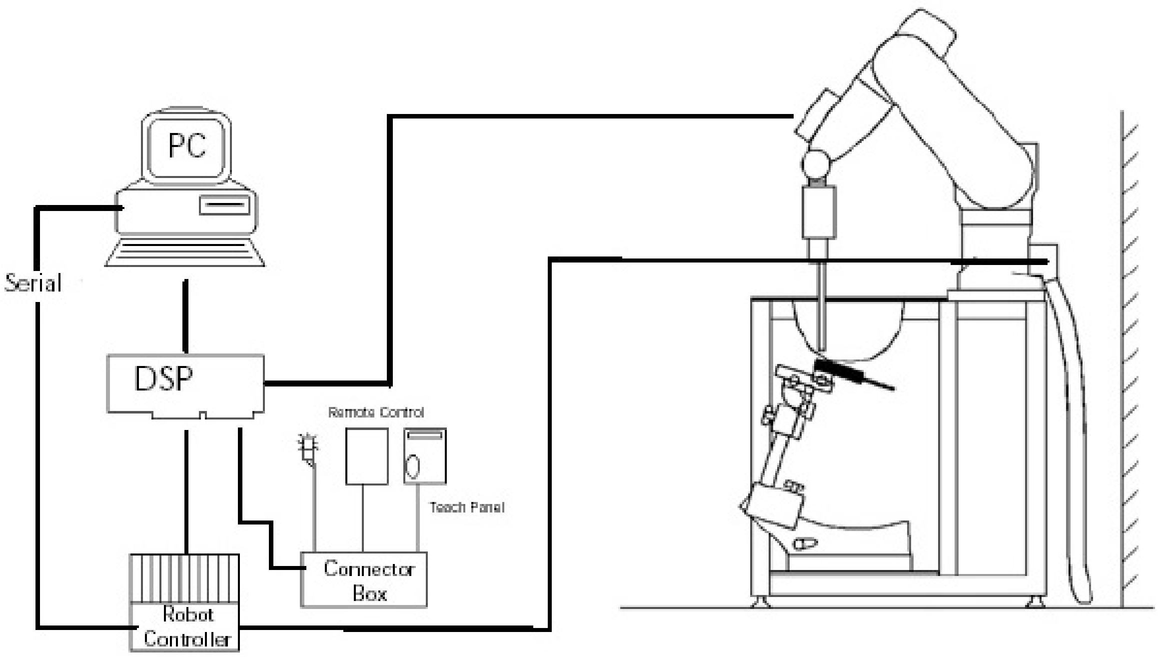


Figure 3.1 SAR Measurement System Setup

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail.

3.2 EX3DV4 Probe Specification

Calibration In air from 10 MHz to 6 GHz
In brain and muscle simulating tissue at Frequencies of
450 MHz, 600 MHz, 750 MHz, 835 MHz, 900 MHz, 1750 MHz, 1900 MHz, 2300 MHz,
2450 MHz, 2600 MHz, 3500 MHz, 5200 MHz, 5300 MHz, 5500 MHz, 5600 MHz, 5800 MHz

Frequency 10 MHz to 6 GHz

Linearity ± 0.2 dB (30 MHz to 6 GHz)

Dynamic 10 μW/g to > 100 mW/g

Range Linearity : ± 0.2 dB

Dimensions Overall length : 337 mm

Tip length 20 mm

Body diameter 12 mm

Tip diameter 2.5 mm

Distance from probe tip to sensor center 1.0 mm

Application SAR Dosimetry Testing
Compliance tests of mobile phones

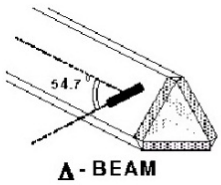
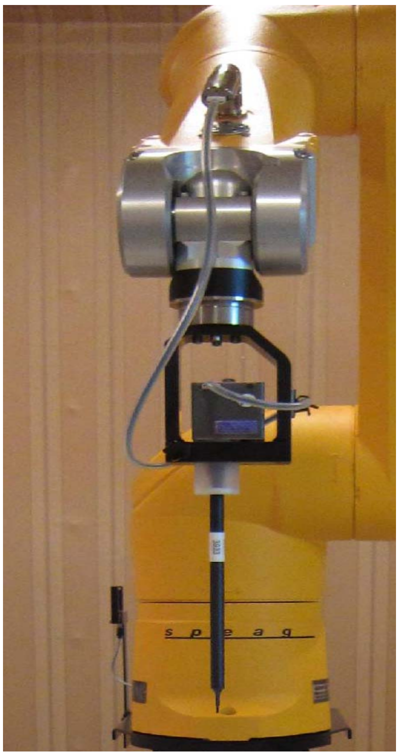


Figure 3.2 Triangular Probe Configurations

Figure 3.3 Probe Thick-Film Technique



DAE System

The SAR measurements were conducted with the dosimetric probe EX3DV4, 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 DASY5 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.

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

where:

Δt = exposure time (30 seconds),

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

ΔT = temperature increase due to RF exposure.

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

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;

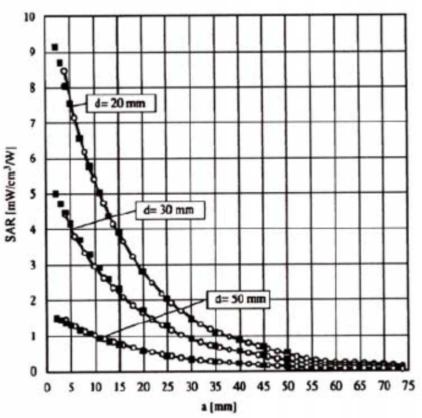


Figure 3.4 E-Field and Temperature Measurements at 900MHz

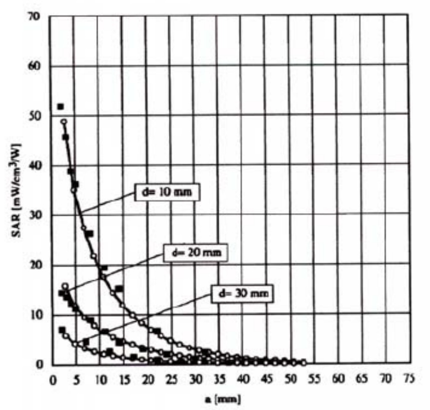


Figure 3.5 E-Field and Temperature Measurements at 1800MHz

3.4 Data Extrapolation

The DASY5 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 V5.0 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, V5.0 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.

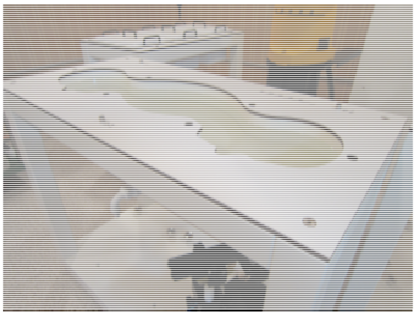


Figure 3.9 Simulated Tissue

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	TX90XL	N/A	N/A	F13/5RR2A1/A/01
☒	Robot Controller	SCHMID	C58C	N/A	N/A	F13/5RR2A1/C/01
☒	Joystick	SCHMID	N/A	N/A	N/A	S-13200990
☒	IntelCorei7-37703.40GHz Windows 7 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	Holder	N/A	N/A	SD000H01KA
☒	Twin SAM Phantom	SCHMID	QD000P40CD	N/A	N/A	1782
☐	2mm Oval Phantom ELI5	SCHMID	QDOVA002AA	N/A	N/A	1166
☒	Data Acquisition Electronics	SCHMID	DAE4V1	2014-05-19	2015-05-19	1392
☒	Dosimetric E-Field Probe	SCHMID	EX3DV4	2014-04-24	2015-04-24	3916
☐	Dummy Probe	N/A	N/A	N/A	N/A	N/A
☒	835MHz SAR Dipole	SCHMID	D835V2	2014-01-22	2016-01-22	464
☐	1800 MHz SAR Dipole	SCHMID	D1800V2	2014-07-18	2016-07-18	2d047
☒	1900MHz SAR Dipole	SCHMID	D1900V2	2014-01-29	2016-01-29	5d029
☒	2450MHz SAR Dipole	SCHMID	D2450V2	2014-01-21	2016-01-21	726
☒	5000 MHz SAR Dipole	SCHMID	D5GHzV2	2014-03-26	2016-03-26	1103
☒	Network Analyzer	Agilent	E5071C	2014-10-21	2015-10-21	MY46106970
☒	Signal Generator	Agilent	ESG-3000A	2014-06-26	2015-06-26	US37230529
☒	Signal Generator	Rohde Schwarz	SMR20	2014-05-12	2015-05-12	101251
☒	Amplifier	EMPOWER	BBS3Q7ELU	2014-09-12	2015-09-12	1020
☒	High Power RF Amplifier	EMPOWER	BBS3Q8CCJ	2014-10-20	2015-10-20	1005
☒	Power Meter	HP	EPM-442A	2014-02-28	2015-02-28	GB37170267
☒	Power Meter	Anritsu	ML2495A	2014-03-12	2015-03-12	1306007
☒	Wide Bandwidth Power Sensor	Anritsu	MA2490A	2014-03-12	2015-03-12	1249001
☒	Power Sensor	HP	8481A	2014-02-28	2015-02-28	3318A96566
☒	Power Sensor	HP	8481A	2014-01-07	2015-01-07	3318A96030
☒	Dual Directional Coupler	Agilent	778D-012	2014-01-07	2015-01-07	50228
☒	Directional Coupler	HP	773D	2014-06-27	2015-06-27	2389A00640
☒	Low Pass Filter 1.5GHz	Micro LAB	LA-15N	2014-01-07	2015-01-07	N/A
☒	Low Pass Filter 3.0GHz	Micro LAB	LA-30N	2014-09-11	2015-09-11	N/A
☒	Low Pass Filter 6.0GHz	Micro LAB	LA-60N	2014-02-27	2015-02-27	03942
☒	Attenuators(3 dB)	Agilent	8491B	2014-06-27	2015-06-27	MY39260700
☒	Attenuators(10 dB)	WEINSCHEL	23-10-34	2014-01-07	2015-01-07	BP4387
☐	Step Attenuator	HP	8494A	2014-09-11	2015-09-11	3308A33341
☒	Dielectric Probe kit	SCHMID	DAK-3.5	2014-01-07	2015-01-07	1092
☒	8960 Series 10 Wireless Comms. Test Set	Agilent	E5515C	2014-02-28	2015-02-28	GB43461134
☒	Wideband Radio Communication Tester	Rohde Schwarz	CMW500	2014-09-18	2015-09-18	101414
☒	Power Splitter	Anritsu	K241B	2014-02-28	2015-02-28	1301183
☒	Bluetooth Tester	TESCOM	TC-3000B	2014-06-26	2015-06-26	3000B640046

NOTE: The E-field probe was calibrated by SPEAG, by temperature measurement procedure. Dipole Verification measurement is performed by DT&C before each test. The brain and muscle simulating material are calibrated by DT&C using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material. Each equipment item was used solely within its respective calibration period.

4. TEST SYSTEM SPECIFICATIONS

Automated TEST SYSTEM SPECIFICATIONS:

Positioner

Robot	Stäubli Unimation Corp. Robot Model: TX60L
Repeatability	0.02 mm
No. of axis	6

Data Acquisition Electronic (DAE) System

Cell Controller

Processor	Intel Core i7-2600
Clock Speed	3.40 GHz
Operating System	Windows 7 Professional
Data Card	DASY5 PC-Board

Data Converter

Features	Signal, multiplexer, A/D converter. & control logic
Software	DASY5
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 4 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot

E-Field Probes

Model	EX3DV4 S/N: 3916
Construction	Triangular core fiber optic detection system
Frequency	10 MHz to 6 GHz
Linearity	± 0.2 dB (30 MHz to 6 GHz)

Phantom

Phantom	SAM Twin Phantom (V5.0)
Shell Material	Composite
Thickness	2.0 ± 0.2 mm

Figure 2.2 DASY5 Test System

5. SAR MEASUREMENT PROCEDURE

5.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r03 and IEEE 1528-2013:

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 865664 D01v01r03 (See Table 5-1) and IEEE 1528-2013.

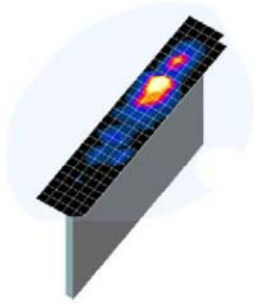


Figure 5.1
Sample SAR Area Scan

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 D01v01r03 (See Table 5-1) and IEEE 1528-2013. 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. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 3-1. 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*$\Delta z_{zoom}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 22

Table 5.1 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r03*
*Also compliant to IEEE 1528-2013 Table 6

6. DEFINITION OF REFERENCE POINTS

6.1 Ear Reference Point

Figure 6.1 shows the front, back and side views of the SAM Twin Phantom. The point"M" is the reference point for the center of the mouth, "LE" is the left ear reference point(ERP), and "RE" is the right ERP. The ERPs are 15mm posterior to the entrance to the Ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 6.5. The plane Passing, through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck- Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 6.1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning.

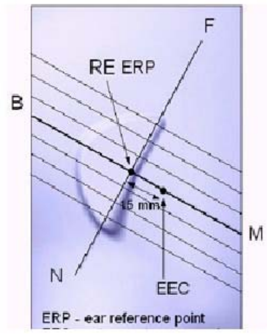


Figure 6.1 Close-up side view of ERP

6.2 Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Fig. 6.3). The "test device reference point" was than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at it's top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

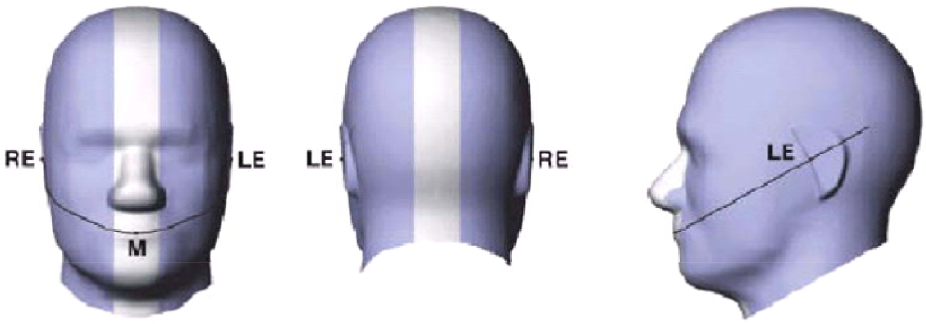


Figure 6.2 Front, back and side view SAM Twin Phantom

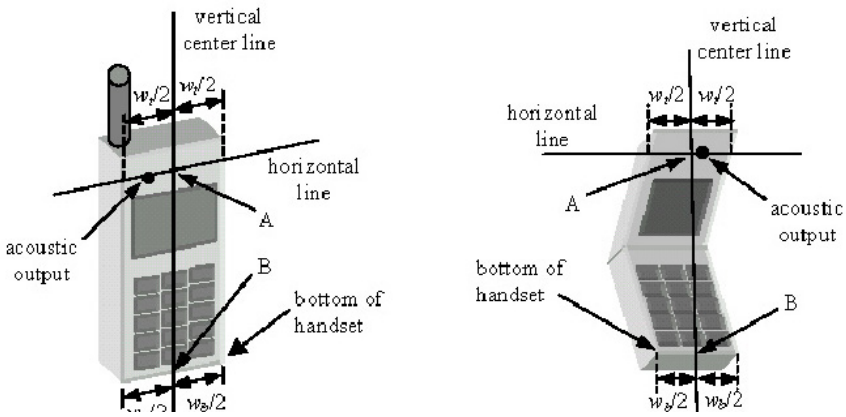


Figure 6.3 Handset Vertical Center & Horizontal Line Reference Points

7. TEST CONFIGURATION POSITIONS FOR HANDSETS

7.1 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.

7.2 Positioning for Cheek/Touch

1. The test device was positioned with the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 7.1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

Figure 7.1 Front, Side and Top View of Cheek/Touch Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).
4. The phone was hen rotated around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek). (See Figure 7.2)

7.3 Positioning for Ear / 15 ° Tilt

With the test device aligned in the "Cheek/Touch Position":

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15degree.
2. The phone was then rotated around the horizontal line by 15 degree.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 7.3).

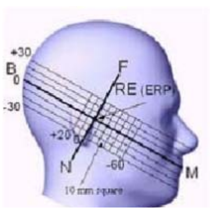


Figure 7.2 Side view w/relevant markings

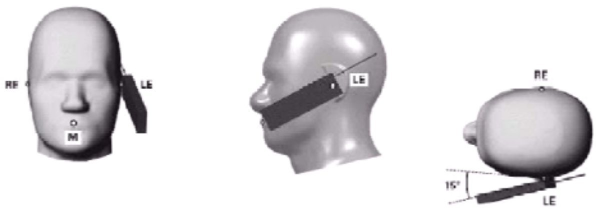


Figure 7.3 Front, Side and Top View of Ear/15°Position

7.4 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6.7). Per FCC KDB Publication 648474 D04v01r02, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v05r02 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

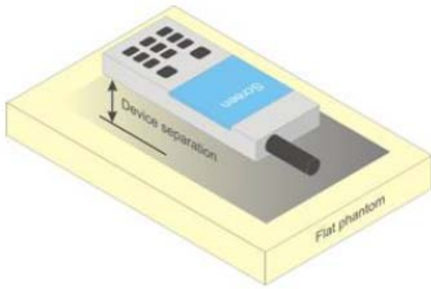


Figure 6.7 Sample Body-Worn Diagram

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented.
Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

7.5 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01v05r02 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v05r02, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

7.6 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 D06v02 where SAR test considerations for handsets (L x W $\geq$ 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.

When the user enables the personal wireless router functions for the handset, actual operations include 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 D01v05r02 publication procedures. The “Portable Hotspot” feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

8. 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 8.1.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).

9. FCC MEASUREMENT PROCEDURES

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

9.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v05r02, 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 D01v01r03.

9.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01 “SAR Measurement Procedures” v03, October 2014.

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.

9.3 SAR Measurement Conditions for WCDMA (UMTS)

9.3.1 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.

9.3.2 Head SAR Measurements for Handsets

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all “1s”. SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than 0.25 dB higher than that measured in 12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a 3.4 kbps SRB (signaling radio bearer) using the exposure configuration that resulted in the highest SAR for that RF channel in the 12.2 kbps RMC mode.

9.3.3 Body SAR Measurements

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

9.3.4 SAR Measurements for Handsets with Rel 5 HSDPA

Body SAR for HSDPA is not required for handsets with HSDPA capabilities when the maximum average output power of each RF channel with HSDPA active is less than 0.25 dB higher than that measured without HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is ≤ 75% of the SAR limit. Otherwise, SAR is measured for HSDPA, using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration measured in 12.2 kbps RMC without HSDPA, on the maximum output channel with the body exposure configuration that resulted in the highest SAR in 12.2 kbps RMC mode for that RF channel.

The H-set used in FRC for HSDPA should be configured according to the UE category of a test device. The number of HS-DSCH/HSPDSCHs, HARQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the applicable H-set. To maintain a consistent test configuration and stable transmission conditions, QPSK is used in the FRC for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 2 ms to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors of βc=9 and βd=15, and power offset parameters of ΔACK= ΔNACK =5 and ΔCQI=2 is used. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the FRC.

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} = 8 ⇔ $A_{hs} = \beta_{hs}/\beta_c = 30/15$ ⇔ $\beta_{hs} = 30/15 * \beta_c$.
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, Δ_{ACK} and Δ_{NACK} = 8 ($A_{hs} = 30/15$) with $\beta_{hs} = 30/15 * \beta_c$, and Δ_{CQI} = 7 ($A_{hs} = 24/15$) with $\beta_{hs} = 24/15 * \beta_c$.
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.

Figure 9.1 Table C.10.1.4 of TS 234.121-1

9.3.5 SAR Measurements for Handsets with Rel 6 HSUPA

Body SAR for HSUPA is not required when the maximum average output of each RF channel with HSUPA/HSDPA active is less than 0.25 dB higher than as measured without HSUPA/HSDPA using 12.2 kbps RMC and maximum SAR for 12.2 kbps RMC is ≤ 75 % of the SAR limit. Otherwise SAR is measured on the maximum output channel for the body exposure configuration produced highest SAR in 12.2 kbps RMC for that RF channel, using the additional procedures under “Release 6 HSPA data devices”

Head SAR for VOIP operations under HSPA is not required when maximum average output of each RF channel with HSPA is less than 0.25 dB higher than as measured using 12.2 kbps RMC. Otherwise SAR is measured using same HSPA configuration as used for body SAR.

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

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

9.3.6 SAR Measurements Conditions for DC-HSDPA

This function is not supported.

9.4 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05v02 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR. The R&S CMW500 was used for LTE output power measurement and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

9.4.1 Spectrum Plots for RB Configurations

A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.

9.4.2 MPR

MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36. 101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.

9.4.3 A-MPR

This device does not support A-MPR.
(When a device support A-MPR, A-MPR shall be disabled for all SAR tests by setting NS=01 on the base station simulator.)

9.4.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r03:

a. Per Section 4.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
   i. The required channel and offset combination with the highest maximum output power is required for SAR.
   ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channel is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
   iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
b. Per Section 4.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 4.2.1.
c. Per Section 4.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
d. Per Section 4.2.4 and 4.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 4.2.1 through 4.2.3 is less than or equal to 0.5 dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is < 1.45 W/kg.

9.5 SAR Testing with 802.11 Transmitters

Normal network operating configurations are not suitable for measuring the SAR of 802.11 b/g/n 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.

9.5.1 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.

9.5.2 Frequency Channel Configurations

802.11 a/b/g/n operating modes are tested independently according to the service requirements in each frequency band. 802.11 b/g/n modes are tested on channels 1, 6 and 11. 802.11 a is tested for UNII operations on channels 36 and 48 in the 5.15-5.25 GHz band; channels 52 and 64 in the 5.25-5.35 GHz band; channels 104, 116 and 136 in the 5.470-5.725 GHz band; and channels 149 and 161 in the 5.8 GHz. When 5.8 GHz §15.247 is also available, channels 149, 157 and 165 should be tested instead of the UNII channels. These are referred to as the “default test channels”. For 2.4 GHz, 802.11g/n modes were evaluated only if the output power was 0.25 dB higher than the 802.11 mode. For 5 GHz, 802.11n modes were evaluated only if the output power was 0.25 dB higher than the 802.11a mode. When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is < 1.6 W/kg and the 1g averaged SAR is < 0.8 W/kg, SAR testing in other channels is not required. Otherwise, the other default (or corresponding required) test channels were additionally tested using the lowest data rate.

Mode		GHz	Channel	Turbo Channel	"Default Test Channels"			
					§15.247		UNII	
					802.11b	802.11g		
802.11 b/g		2.412	1[#]		√	∇		
		2.437	6	6	√	∇		
		2.462	11[#]		√	∇		
802.11a	UNII	5.18	36				√	
		5.20	40	42 (5.21 GHz)				*
		5.22	44					*
		5.24	48	50 (5.25 GHz)			√	
		5.26	52				√	
		5.28	56	58 (5.29 GHz)				*
		5.30	60					*
		5.32	64				√	
		5.500	100	Unknown				*
		5.520	104				√	
		5.540	108					*
		5.560	112					*
		5.580	116				√	
		5.600	120					*
		5.620	124				√	
		5.640	128					*
		5.660	132					*
		5.680	136				√	
		5.700	140					*
	UNII or §15.247	5.745	149		√		√	
		5.765	153	152 (5.76 GHz)		*		*
		5.785	157		√			*
		5.805	161	160 (5.80 GHz)		*	√	
	§15.247	5.825	165		√			

Table 9.1 802.11 Test channels per FCC Requirements

10. RF CONDUCTED POWERS

10.1 GSM Conducted Powers

Band	Channel	Maximum Burst-Averaged Output Power (dBm)								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
		GSM CS 1 Slot	GPRS 1 TX Slot	GPRS 2 TX Slot	GPRS 3 TX Slot	GPRS 4 TX Slot	EDGE 1 TX Slot	EDGE 2 TX Slot	EDGE 3 TX Slot	EDGE 4 TX Slot
GSM 850	128	33.1	33.1	31.7	29.6	27.1	27.5	27.5	26.3	25.5
	190	33.2	33.2	31.7	29.6	27.2	27.5	27.4	26.2	25.4
	251	33.2	33.2	31.6	29.5	27.2	27.5	27.4	26.1	25.4
PCS 1900	512	30.4	30.4	28.5	27.5	26.6	26.4	26.4	25.3	24.5
	661	30.3	30.3	28.5	27.3	26.6	26.4	26.4	25.2	24.5
	810	30.1	30.1	28.3	27.1	26.4	26.2	26.2	25.1	24.4
Band	Channel	Calculated Maximum Frame-Averaged Output Power (dBm)								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
		GSM CS 1 Slot	GPRS 1 TX Slot	GPRS 2 TX Slot	GPRS 3 TX Slot	GPRS 4 TX Slot	EDGE 1 TX Slot	EDGE 2 TX Slot	EDGE 3 TX Slot	EDGE 4 TX Slot
GSM 850	128	24.07	24.07	**25.68**	25.34	24.09	18.47	21.48	22.04	22.49
	190	24.17	24.17	**25.68**	25.34	24.19	18.47	21.38	21.94	22.39
	251	24.17	24.17	**25.58**	25.24	24.19	18.47	21.38	21.84	22.39
PCS 1900	512	21.37	21.37	22.48	23.24	**23.59**	17.37	20.38	21.04	21.49
	661	21.27	21.27	22.48	23.04	**23.59**	17.37	20.38	20.94	21.49
	810	21.07	21.07	22.28	22.84	**23.39**	17.17	20.18	20.84	21.39
GSM 850	Frame Avg. Targets:	24.17	24.17	**25.18**	24.84	24.19	18.17	21.18	21.94	22.19
PCS 1900		21.17	21.17	22.18	22.94	**23.19**	17.17	20.18	20.94	21.19

Table 10.1 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 source-based frame-averaged output power was evaluated for all GPRS slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
3. GPRS (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. EDGE (8-PSK) output power were measured with MCS7 on the base station simulator. MCS7 coding scheme was used to measure the output powers for EDGE since investigation has shown that choosing MCS7 coding scheme will ensure 8-PSK modulation. It has been shown that MCS levels that produce 8PSK modulation do not have an impact on output power.

GPRS Multislot class: 33 (max 4 TX Uplink slots)
EDGE Multislot class: 33 (max 4 TX Uplink slots)
DTM Multislot Class: N/A

Figure 10.1 Power Measurement Setup

10.2 WCDMA Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band (dBm)			PCS Band (dBm)			3GPP MPR (dB)
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	23.9	24.0	23.9	23.9	23.8	23.8	-
99		12.2 kbps AMR	23.9	24.0	23.8	23.9	23.7	23.8	-
5	HSDPA	Subtest 1	23.9	23.9	23.9	23.9	23.7	23.8	0
5		Subtest 2	23.9	24.0	23.9	23.9	23.7	23.7	0
5		Subtest 3	23.6	23.5	23.4	23.3	23.3	23.3	0.5
5		Subtest 4	23.6	23.4	23.4	23.4	23.2	23.3	0.5
6	HSUPA	Subtest 1	23.4	23.5	23.4	22.7	22.9	22.8	0
6		Subtest 2	22.2	22.2	22.1	21.9	21.8	21.8	2
6		Subtest 3	22.8	23.0	22.9	22.5	22.3	22.3	1
6		Subtest 4	22.3	22.3	22.2	21.8	21.8	21.8	2
6		Subtest 5	23.4	23.4	23.4	23.5	22.7	22.7	0

Table 10.2 The power was measured by E5515C

WCDMA SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03. 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.

The manufacturer declares that the HSUPA transmitter's power will not exceed the R99 maximum transmit power in devices based on Qualcomm's HSPA chipset solutions.

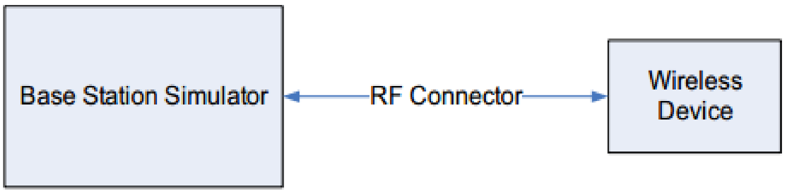


Figure 10.2 Power Measurement Setup

10.3 LTE Conducted Powers

- LTE Band 5

Mode	Freq. (MHz)	Channel	LTE Band 5 Conducted Power – 10 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	829	20450	10	QPSK	1	0	**24.08**	0	0
	829	20450	10	QPSK	1	25	24.06	0	0
	829	20450	10	QPSK	1	49	23.83	0	0
	829	20450	10	QPSK	25	0	**22.68**	0-1	1
	829	20450	10	QPSK	25	12	22.56	0-1	1
	829	20450	10	QPSK	25	25	22.54	0-1	1
	829	20450	10	QPSK	50	0	22.44	0-1	1
	829	20450	10	16QAM	1	0	22.80	0-1	1
	829	20450	10	16QAM	1	25	22.92	0-1	1
	829	20450	10	16QAM	1	49	22.68	0-1	1
	829	20450	10	16QAM	25	0	21.78	0-2	2
	829	20450	10	16QAM	25	12	21.69	0-2	2
	829	20450	10	16QAM	25	25	21.66	0-2	2
	829	20450	10	16QAM	50	0	21.56	0-2	2
Mid	836.5	20525	10	QPSK	1	0	23.78	0	0
	836.5	20525	10	QPSK	1	25	23.71	0	0
	836.5	20525	10	QPSK	1	49	23.66	0	0
	836.5	20525	10	QPSK	25	0	22.51	0-1	1
	836.5	20525	10	QPSK	25	12	22.49	0-1	1
	836.5	20525	10	QPSK	25	25	22.48	0-1	1
	836.5	20525	10	QPSK	50	0	22.35	0-1	1
	836.5	20525	10	16QAM	1	0	22.79	0-1	1
	836.5	20525	10	16QAM	1	25	22.74	0-1	1
	836.5	20525	10	16QAM	1	49	22.69	0-1	1
	836.5	20525	10	16QAM	25	0	21.72	0-2	2
	836.5	20525	10	16QAM	25	12	21.71	0-2	2
	836.5	20525	10	16QAM	25	25	21.66	0-2	2
	836.5	20525	10	16QAM	50	0	21.58	0-2	2

Table 10.3.1 The power was measured by CMW500

Mode	Freq. (MHz)	Channel	LTE Band 5 Conducted Power – 10 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
High	844	20600	10	QPSK	1	0	24.06	0	0
	844	20600	10	QPSK	1	25	23.85	0	0
	844	20600	10	QPSK	1	49	23.70	0	0
	844	20600	10	QPSK	25	0	22.52	0-1	1
	844	20600	10	QPSK	25	12	22.48	0-1	1
	844	20600	10	QPSK	25	25	22.45	0-1	1
	844	20600	10	QPSK	50	0	22.41	0-1	1
	844	20600	10	16QAM	1	0	22.84	0-1	1
	844	20600	10	16QAM	1	25	22.81	0-1	1
	844	20600	10	16QAM	1	49	22.65	0-1	1
	844	20600	10	16QAM	25	0	21.66	0-2	2
	844	20600	10	16QAM	25	12	21.64	0-2	2
	844	20600	10	16QAM	25	25	21.62	0-2	2
	844	20600	10	16QAM	50	0	21.55	0-2	2

Table 10.3.2 The power was measured by CMW500

Mode	Freq. (MHz)	Channel	LTE Band 5 Conducted Power – 5 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	826.5	20425	5	QPSK	1	0	23.84	0	0
	826.5	20425	5	QPSK	1	12	23.79	0	0
	826.5	20425	5	QPSK	1	24	23.79	0	0
	826.5	20425	5	QPSK	12	0	22.56	0-1	1
	826.5	20425	5	QPSK	12	6	22.51	0-1	1
	826.5	20425	5	QPSK	12	13	22.49	0-1	1
	826.5	20425	5	QPSK	25	0	22.41	0-1	1
	826.5	20425	5	16QAM	1	0	22.73	0-1	1
	826.5	20425	5	16QAM	1	12	22.68	0-1	1
	826.5	20425	5	16QAM	1	24	22.65	0-1	1
	826.5	20425	5	16QAM	12	0	21.69	0-2	2
	826.5	20425	5	16QAM	12	6	21.64	0-2	2
	826.5	20425	5	16QAM	12	13	21.64	0-2	2
	826.5	20425	5	16QAM	25	0	21.58	0-2	2
Mid	836.5	20525	5	QPSK	1	0	23.95	0	0
	836.5	20525	5	QPSK	1	12	23.72	0	0
	836.5	20525	5	QPSK	1	24	23.72	0	0
	836.5	20525	5	QPSK	12	0	22.53	0-1	1
	836.5	20525	5	QPSK	12	6	22.51	0-1	1
	836.5	20525	5	QPSK	12	13	22.50	0-1	1
	836.5	20525	5	QPSK	25	0	22.48	0-1	1
	836.5	20525	5	16QAM	1	0	22.92	0-1	1
	836.5	20525	5	16QAM	1	12	22.78	0-1	1
	836.5	20525	5	16QAM	1	24	22.73	0-1	1
	836.5	20525	5	16QAM	12	0	21.69	0-2	2
	836.5	20525	5	16QAM	12	6	21.67	0-2	2
	836.5	20525	5	16QAM	12	13	21.64	0-2	2
	836.5	20525	5	16QAM	25	0	21.59	0-2	2

Table 10.4.1 The power was measured by CMW500

Mode	Freq. (MHz)	Channel	LTE Band 5 Conducted Power – 5 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
High	846.5	20625	5	QPSK	1	0	23.78	0	0
	846.5	20625	5	QPSK	1	12	23.71	0	0
	846.5	20625	5	QPSK	1	24	23.69	0	0
	846.5	20625	5	QPSK	12	0	22.51	0-1	1
	846.5	20625	5	QPSK	12	6	22.44	0-1	1
	846.5	20625	5	QPSK	12	13	22.42	0-1	1
	846.5	20625	5	QPSK	25	0	22.39	0-1	1
	846.5	20625	5	16QAM	1	0	22.71	0-1	1
	846.5	20625	5	16QAM	1	12	22.69	0-1	1
	846.5	20625	5	16QAM	1	24	22.69	0-1	1
	846.5	20625	5	16QAM	12	0	21.65	0-2	2
	846.5	20625	5	16QAM	12	6	21.63	0-2	2
	846.5	20625	5	16QAM	12	13	21.62	0-2	2
	846.5	20625	5	16QAM	25	0	21.58	0-2	2

Table 10.4.2 The power was measured by CMW500

Mode	Freq. (MHz)	Channel	LTE Band 5 Conducted Power – 3 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	825.5	20415	3	QPSK	1	0	23.88	0	0
	825.5	20415	3	QPSK	1	8	23.79	0	0
	825.5	20415	3	QPSK	1	14	23.82	0	0
	825.5	20415	3	QPSK	6	0	22.51	0-1	1
	825.5	20415	3	QPSK	6	4	22.47	0-1	1
	825.5	20415	3	QPSK	6	9	22.49	0-1	1
	825.5	20415	3	QPSK	15	0	22.41	0-1	1
	825.5	20415	3	16QAM	1	0	22.85	0-1	1
	825.5	20415	3	16QAM	1	8	22.65	0-1	1
	825.5	20415	3	16QAM	1	14	22.71	0-1	1
	825.5	20415	3	16QAM	6	0	21.71	0-2	2
	825.5	20415	3	16QAM	6	4	21.65	0-2	2
	825.5	20415	3	16QAM	6	9	21.66	0-2	2
	825.5	20415	3	16QAM	15	0	21.61	0-2	2
Mid	836.5	20525	3	QPSK	1	0	23.75	0	0
	836.5	20525	3	QPSK	1	8	23.71	0	0
	836.5	20525	3	QPSK	1	14	23.73	0	0
	836.5	20525	3	QPSK	6	0	22.54	0-1	1
	836.5	20525	3	QPSK	6	4	22.48	0-1	1
	836.5	20525	3	QPSK	6	9	22.52	0-1	1
	836.5	20525	3	QPSK	15	0	22.44	0-1	1
	836.5	20525	3	16QAM	1	0	22.89	0-1	1
	836.5	20525	3	16QAM	1	8	22.84	0-1	1
	836.5	20525	3	16QAM	1	14	22.86	0-1	1
	836.5	20525	3	16QAM	6	0	21.68	0-2	2
	836.5	20525	3	16QAM	6	4	21.65	0-2	2
	836.5	20525	3	16QAM	6	9	21.66	0-2	2
	836.5	20525	3	16QAM	15	0	21.59	0-2	2

Table 10.5.1 The power was measured by CMW500

Mode	Freq. (MHz)	Channel	LTE Band 5 Conducted Power – 3 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
High	847.5	20635	3	QPSK	1	0	23.85	0	0
	847.5	20635	3	QPSK	1	8	23.74	0	0
	847.5	20635	3	QPSK	1	14	23.81	0	0
	847.5	20635	3	QPSK	6	0	22.51	0-1	1
	847.5	20635	3	QPSK	6	4	22.45	0-1	1
	847.5	20635	3	QPSK	6	9	22.47	0-1	1
	847.5	20635	3	QPSK	15	0	22.35	0-1	1
	847.5	20635	3	16QAM	1	0	22.61	0-1	1
	847.5	20635	3	16QAM	1	8	22.69	0-1	1
	847.5	20635	3	16QAM	1	14	22.72	0-1	1
	847.5	20635	3	16QAM	6	0	21.63	0-2	2
	847.5	20635	3	16QAM	6	4	21.66	0-2	2
	847.5	20635	3	16QAM	6	9	21.68	0-2	2
	847.5	20635	3	16QAM	15	0	21.57	0-2	2

Table 10.5.2 The power was measured by CMW500

Mode	Freq. (MHz)	Channel	LTE Band 5 Conducted Power – 1.4 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	824.7	20407	1.4	QPSK	1	0	24.03	0	0
	824.7	20407	1.4	QPSK	1	3	24.01	0	0
	824.7	20407	1.4	QPSK	1	5	23.95	0	0
	824.7	20407	1.4	QPSK	3	0	23.89	0-1	1
	824.7	20407	1.4	QPSK	3	1	23.85	0-1	1
	824.7	20407	1.4	QPSK	3	3	23.81	0-1	1
	824.7	20407	1.4	QPSK	6	0	22.71	0-1	1
	824.7	20407	1.4	16QAM	1	0	22.94	0-1	1
	824.7	20407	1.4	16QAM	1	3	22.89	0-1	1
	824.7	20407	1.4	16QAM	1	5	22.84	0-1	1
	824.7	20407	1.4	16QAM	3	0	22.78	0-2	2
	824.7	20407	1.4	16QAM	3	1	22.76	0-2	2
	824.7	20407	1.4	16QAM	3	3	22.72	0-2	2
	824.7	20407	1.4	16QAM	6	0	21.68	0-2	2
Mid	836.5	20525	1.4	QPSK	1	0	23.75	0	0
	836.5	20525	1.4	QPSK	1	3	23.73	0	0
	836.5	20525	1.4	QPSK	1	5	23.71	0	0
	836.5	20525	1.4	QPSK	3	0	23.60	0-1	1
	836.5	20525	1.4	QPSK	3	1	23.57	0-1	1
	836.5	20525	1.4	QPSK	3	3	23.56	0-1	1
	836.5	20525	1.4	QPSK	6	0	22.42	0-1	1
	836.5	20525	1.4	16QAM	1	0	22.87	0-1	1
	836.5	20525	1.4	16QAM	1	3	22.85	0-1	1
	836.5	20525	1.4	16QAM	1	5	22.82	0-1	1
	836.5	20525	1.4	16QAM	3	0	22.58	0-2	2
	836.5	20525	1.4	16QAM	3	1	22.57	0-2	2
	836.5	20525	1.4	16QAM	3	3	22.55	0-2	2
	836.5	20525	1.4	16QAM	6	0	21.68	0-2	2

Table 10.6.1 The power was measured by CMW500

Mode	Freq. (MHz)	Channel	LTE Band 5 Conducted Power – 1.4 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
High	848.3	20643	1.4	QPSK	1	0	23.68	0	0
	848.3	20643	1.4	QPSK	1	3	23.67	0	0
	848.3	20643	1.4	QPSK	1	5	23.64	0	0
	848.3	20643	1.4	QPSK	3	0	23.58	0-1	1
	848.3	20643	1.4	QPSK	3	1	23.53	0-1	1
	848.3	20643	1.4	QPSK	3	3	23.49	0-1	1
	848.3	20643	1.4	QPSK	6	0	22.57	0-1	1
	848.3	20643	1.4	16QAM	1	0	22.86	0-1	1
	848.3	20643	1.4	16QAM	1	3	22.79	0-1	1
	848.3	20643	1.4	16QAM	1	5	22.76	0-1	1
	848.3	20643	1.4	16QAM	3	0	22.71	0-2	2
	848.3	20643	1.4	16QAM	3	1	22.65	0-2	2
	848.3	20643	1.4	16QAM	3	3	22.45	0-2	2
	848.3	20643	1.4	16QAM	6	0	21.65	0-2	2

Table 10.6.2 The power was measured by CMW500

10.4 WLAN Conducted Powers

Mode	Freq. (MHz)	Channel	802.11b (2.4 GHz) Conducted Power (dBm) Data Rate (Mbps) 1	2	5.5	11
802.11b	2412	1	16.72	16.56	16.71	16.66
	2437	6	16.83	16.77	16.81	16.75
	2462	11	**16.96**	16.76	16.95	16.81

Table 10.7 IEEE 802.11b Average RF Power

Mode	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	10.12	10.08	10.01	9.98	9.96	10.00	9.97	9.99
	2437	6	10.33	10.26	10.17	10.29	10.19	10.24	10.15	10.28
	2462	11	10.26	10.12	10.20	10.09	10.07	10.10	10.14	10.12

Table 10.8 IEEE 802.11g Average RF Power

Mode	Freq. (MHz)	Channel	802.11n HT20 (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	9.58	9.32	9.51	9.52	9.40	9.41	9.49	9.46
	2437	6	9.35	9.19	9.31	9.21	9.21	9.28	9.17	9.11
	2462	11	9.52	9.37	9.41	9.39	9.28	9.49	9.44	9.38

Table 10.9 IEEE 802.11n HT20 Average RF Power

Mode	Freq. (MHz)	Channel	802.11a (5 GHz) Conducted Power (dBm) Data Rate (Mbps) 6	9	12	18	24	36	48	54
802.11a	5180	36	10.36	10.12	10.2	10.31	10.32	10.26	10.22	10.22
	5200	40	10.41	10.26	10.24	10.34	10.36	10.27	10.32	10.29
	5240	48	**10.43**	10.22	10.37	10.35	10.36	10.17	10.24	10.19
	5260	52	10.42	10.21	10.35	10.28	10.34	10.29	10.24	10.17
	5300	60	10.48	10.32	10.45	10.22	10.34	10.32	10.19	10.34
	5320	64	**10.51**	10.31	10.45	10.37	10.24	10.35	10.36	10.46
	5500	100	10.15	9.98	10.11	10.06	10.09	10.09	10.13	10.11
	5580	116	**10.22**	9.91	10.03	10.07	9.99	9.97	10.11	10.07
	5700	140	10.16	10.02	9.88	10.03	10.01	10.02	10.09	10.03
	5745	149	**10.23**	10.11	10.08	9.97	10.02	10.03	9.98	10.09
	5785	157	10.21	10.13	10.19	10.08	10.06	9.99	10.18	10.19
	5825	165	10.14	10.06	10.09	9.91	9.98	10.05	10.07	10.12

Table 10.10 IEEE 802.11a Average RF Power

Mode	Freq.	Channel	802.11n HT20 (5 GHz) Conducted Power (dBm)							
			Data Rate (Mbps)							
	(MHz)		6.5	13	19.5	26	39	52	58.5	65
802.11n (HT-20)	5180	36	9.37	9.25	9.21	9.24	9.23	9.13	9.22	9.24
	5200	40	9.42	9.38	9.27	9.36	9.20	9.17	9.29	9.26
	5240	48	9.30	9.14	9.17	9.25	9.26	9.16	9.12	9.15
	5260	52	9.43	9.26	9.15	9.41	9.27	9.39	9.27	9.3
	5300	60	9.34	9.28	9.18	9.2	9.17	9.23	9.10	9.16
	5320	64	9.38	9.31	9.26	9.22	9.32	9.30	9.13	9.22
	5500	100	9.24	9.21	9.10	9.12	9.17	9.11	9.10	9.05
	5580	116	9.18	9.13	9.09	9.04	8.90	9.12	9.14	8.93
	5700	140	9.17	9.05	8.98	9.08	9.12	9.12	9.06	9.03
	5745	149	9.18	9.06	9.02	8.99	9.13	9.16	9.10	9.14
	5785	157	9.26	8.98	9.24	9.08	9.24	9.12	9.13	9.15
	5825	165	9.20	9.13	9.06	9.18	9.06	9.04	9.14	9.12

Table 10.11 IEEE 802.11n HT20 Average RF Power

Mode	Freq.	Channel	802.11n HT40 (5 GHz) Conducted Power (dBm)							
			Data Rate (Mbps)							
	(MHz)		13.5	27	40.5	54	81	108	121.5	135
802.11n (HT-40)	5190	38	8.81	8.74	8.65	8.77	8.67	8.72	8.63	8.76
	5230	46	9.02	8.94	8.85	8.86	8.93	8.83	8.86	9.01
	5270	54	8.90	8.76	8.84	8.73	8.71	8.74	8.78	8.76
	5310	62	8.92	8.66	8.85	8.86	8.74	8.75	8.83	8.80
	5510	102	8.71	8.58	8.68	8.64	8.69	8.65	8.52	8.47
	5550	110	8.60	8.44	8.55	8.46	8.46	8.53	8.42	8.35
	5670	134	8.52	8.37	8.40	8.40	8.28	8.49	8.50	8.38
	5755	151	8.64	8.47	8.52	8.60	8.50	8.59	8.50	8.60
	5795	159	8.54	8.36	8.26	8.38	8.42	8.42	8.42	8.43

Table 10.12 IEEE 802.11n HT40 Average RF Power

Mode	Freq. (MHz)	Channel	802.11ac VHT20 (5 GHz) Conducted Power (dBm)							
			Data Rate (Mbps)							
			6.5	13	19.5	26	39	52	58.5	65
802.11ac (VHT-20)	5180	36	8.81	8.67	8.68	8.73	8.79	8.69	8.67	8.55
	5200	40	8.75	8.63	8.59	8.62	8.61	8.51	8.60	8.62
	5240	48	9.12	9.08	8.97	9.06	8.90	8.87	8.99	8.96
	5260	52	9.25	9.09	9.12	9.20	9.21	9.11	9.07	9.10
	5300	60	9.11	8.94	8.83	9.09	8.95	9.07	8.95	8.98
	5320	64	9.14	9.08	8.98	9.04	8.97	9.03	8.90	8.96
	5500	100	8.84	8.77	8.72	8.68	8.78	8.76	8.59	8.68
	5580	116	8.81	8.78	8.67	8.69	8.74	8.68	8.67	8.57
	5700	140	8.45	8.40	8.36	8.31	8.17	8.39	8.41	8.20
	5745	149	8.23	8.11	8.04	8.14	8.18	8.18	8.12	8.09
	5785	157	7.95	7.83	7.77	7.76	7.90	7.93	7.87	7.91
	5825	165	7.61	7.33	7.59	7.43	7.59	7.47	7.48	7.50

Table 10.13 IEEE 802.11ac VHT20 Average RF Power

Mode	Freq. (MHz)	Channel	802.11ac VHT40 (5 GHz) Conducted Power (dBm)							
			Data Rate (Mbps)							
			13.5	27	40.5	54	81	108	121.5	135
802.11ac (VHT-40)	5190	38	7.84	7.72	7.66	7.65	7.79	7.82	7.76	7.80
	5230	46	7.81	7.53	7.79	7.63	7.79	7.67	7.68	7.70
	5270	54	7.89	7.82	7.75	7.87	7.75	7.73	7.83	7.81
	5310	62	7.92	7.88	7.80	7.78	7.76	7.80	7.77	7.79
	5510	102	7.22	7.17	7.18	7.10	6.91	7.08	7.09	7.16
	5550	110	7.11	7.04	6.95	7.07	6.97	7.02	6.93	7.06
	5670	134	6.84	6.76	6.67	6.68	6.75	6.65	6.68	6.82
	5755	151	6.55	6.41	6.49	6.38	6.36	6.39	6.43	6.41
	5795	159	6.14	5.88	6.07	6.08	5.96	5.97	6.05	6.02

Table 10.14 IEEE 802.11ac VHT40 Average RF Power

Mode	Freq. (MHz)	Channel	802.11ac VHT80 (5 GHz) Conducted Power (dBm)									
			Data Rate (Mbps)									
			29.3	58.5	87.8	117	175.5	234	263.3	292.5	351	390
802.11ac (VHT-80)	5210	42	9.14	9.06	8.97	8.98	9.05	8.95	8.98	9.12	9.05	8.99
	5290	58	9.19	9.05	9.13	9.02	9.11	9.03	9.07	9.05	8.98	9.07
	5530	106	9.02	8.74	8.93	8.94	8.82	8.83	8.91	8.88	8.92	8.94
	5775	155	8.85	8.72	8.82	8.78	8.83	8.79	8.66	8.61	8.72	8.76

Table 10.15 IEEE 802.11ac VHT80 Average RF Power

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 / April 2013 FCC/TCB Meeting Notes:

- For 2.4 GHz, highest average RF output power channel for the lowest data rate for IEEE 802.11b were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
- For 5 GHz, highest average RF output channel for the lowest data for IEEE 802.11a were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
- When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6 W/kg and the reported 1g averaged SAR is <0.8 W/kg, SAR testing on other channels is not required. Otherwise, the other default (or corresponding required) test channels were additionally tested using the lowest data rate.
- The underlined data rate and channel above were tested for SAR.

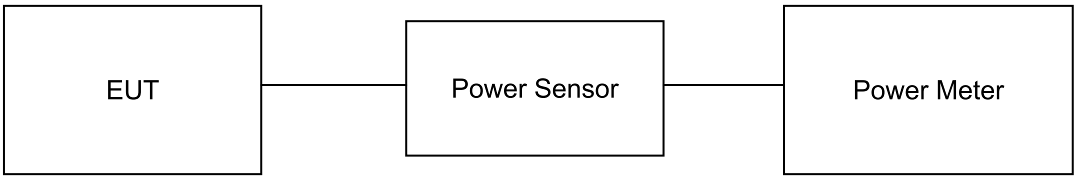


Figure 10.3 Average Power Measurement Setup

10.5 Bluetooth Conducted Powers

Channel	Frequency	Frame AVG Output Power (1Mbps)		Frame AVG Output Power (2Mbps)		Frame AVG Output Power (3Mbps)	
	(MHz)	(dBm)	(mW)	(dBm)	(mW)	(dBm)	(mW)
Low	2402	3.53	2.25	1.15	1.30	1.13	1.30
Mid	**2441**	**6.18**	**4.15**	3.82	2.41	3.81	2.40
High	2480	4.65	2.92	2.30	1.70	2.30	1.70

Table 10.16 Bluetooth Frame Average RF Power

Channel	Frequency	Frame AVG Output Power (LE)	
	(MHz)	(dBm)	(mW)
Low	2402	-1.05	0.79
Mid	**2441**	**1.53**	**1.42**
High	2480	-0.39	0.91

Table 10.17 Bluetooth LE Frame Average RF Power

- **Bluetooth Conducted Powers procedures**

1. Bluetooth (BDR, EDR)
 1) Enter DUT mode in EUT and operate it.
 When it operating, The EUT is transmitting at maximum power level and duty cycle fixed.
 2) Instruments and EUT were connected like Figure 10.4(A).
 3) The maximum output powers of BDR(1 Mbps), EDR(2, 3 Mbps) and each frequency were set by a Bluetooth Tester.
 4) Power levels were measured by a Power Meter.

2. Bluetooth (LE)
 1) Enter LE mode in EUT and operate it.
 When it operating, The EUT is transmitting at maximum power level and duty cycle fixed.
 2) Instruments and EUT were connected like Figure 10.4(B).
 3) The average conducted output powers of LE and each frequency can measurement according to setting program in EUT.
 4) Power levels were measured by a Power Meter.

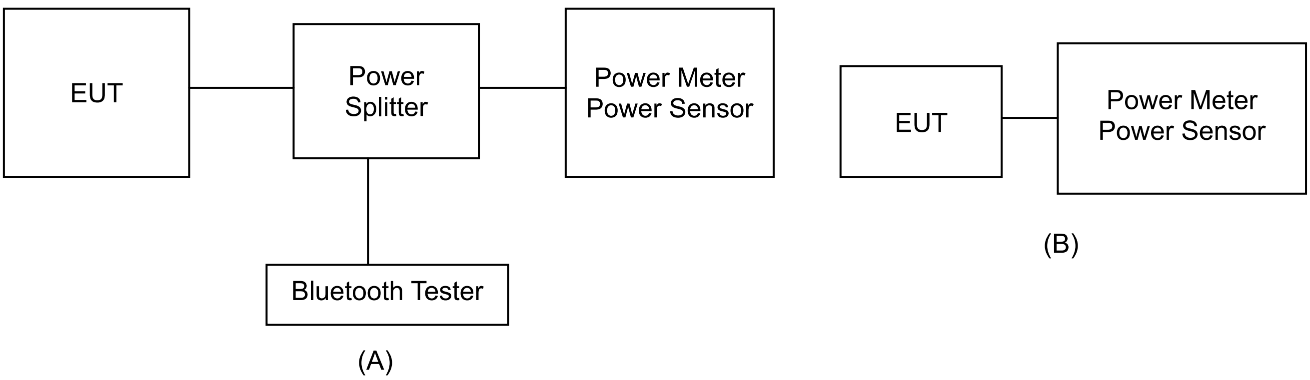


Figure 10.4 Average Power Measurement Setup

The average conducted output powers of Bluetooth were measured using above test setup and a wideband gated RF power meter when the EUT is transmitting at its maximum power level.

11. SYSTEM VERIFICATION

11.1 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 [%]
Nov. 06. 2014	835 Head	21.2	21.5	826.4	41.540	0.899	42.651	0.886	2.67	-1.45
				835.0	41.500	0.900	42.569	0.894	2.58	-0.67
				836.6	41.500	0.902	42.557	0.896	2.55	-0.67
				846.6	41.500	0.912	42.437	0.905	2.26	-0.77
Nov. 07. 2014	835 Body	21.0	21.3	826.4	55.230	0.969	53.389	0.973	-3.33	0.41
				835.0	55.200	0.970	53.297	0.978	-3.45	0.82
				836.6	55.195	0.972	53.282	0.980	-3.47	0.82
				846.6	55.160	0.984	53.198	0.990	-3.56	0.61
Nov. 08. 2014	1900 Head	21.1	21.6	1852.4	40.000	1.400	40.963	1.375	2.41	-1.79
				1880.0	40.000	1.400	40.896	1.402	2.24	0.14
				1900.0	40.000	1.400	40.838	1.421	2.10	1.50
				1909.8	40.000	1.400	40.810	1.430	2.03	2.14
Nov. 10. 2014	1900 Body	20.7	21.0	1852.4	53.300	1.520	51.824	1.500	-2.77	-1.32
				1880.0	53.300	1.520	51.787	1.529	-2.84	0.59
				1900.0	53.300	1.520	51.745	1.549	-2.92	1.91
				1909.8	53.300	1.520	51.725	1.558	-2.95	2.50
Nov. 11. 2014	835 Head	21.3	21.7	824.2	41.551	0.899	42.488	0.883	2.26	-1.78
				835.0	41.500	0.900	42.369	0.893	2.09	-0.78
				836.6	41.500	0.902	42.354	0.894	2.06	-0.89
				848.8	41.500	0.915	42.206	0.906	1.70	-0.98
Nov. 11. 2014	835 Body	21.3	21.9	824.2	55.240	0.969	54.201	0.978	-1.88	0.93
				835.0	55.200	0.970	54.097	0.985	-2.00	1.55
				836.6	55.195	0.972	54.083	0.987	-2.01	1.54
				848.8	55.158	0.987	53.976	0.999	-2.14	1.22
Nov. 12. 2014	1900 Head	21.4	21.8	1850.2	40.000	1.400	41.488	1.380	3.72	-1.43
				1880.0	40.000	1.400	41.422	1.409	3.55	0.64
				1900.0	40.000	1.400	41.358	1.427	3.39	1.93
				1907.6	40.000	1.400	41.335	1.434	3.34	2.43
Nov. 12. 2014	1900 Body	21.4	21.7	1850.2	53.300	1.520	51.330	1.479	-3.70	-2.70
				1880.0	53.300	1.520	51.293	1.505	-3.77	-0.99
				1900.0	53.300	1.520	51.260	1.525	-3.83	0.33
				1907.6	53.300	1.520	51.249	1.532	-3.85	0.79
Nov. 13. 2014	835 Head	20.6	20.9	829.0	41.530	0.900	42.760	0.893	2.96	-0.78
				835.0	41.500	0.900	42.709	0.899	2.91	-0.11
				836.5	41.500	0.900	42.692	0.900	2.87	0.00
				844.0	41.500	0.910	42.616	0.907	2.69	-0.33
Nov. 14. 2014	835 Body	21.0	21.2	829.0	55.220	0.970	54.240	0.967	-1.77	-0.31
				835.0	55.200	0.970	54.180	0.972	-1.85	0.21
				836.5	55.200	0.970	54.172	0.974	-1.86	0.41
				844.0	55.170	0.980	54.095	0.980	-1.95	0.00
Nov. 15. 2014	2450 Head	21.5	21.9	2412	39.268	1.766	38.708	1.749	-1.43	-0.96
				2437	39.223	1.788	38.627	1.776	-1.52	-0.67
				2450	39.200	1.800	38.591	1.791	-1.55	-0.50
				2462	39.184	1.813	38.558	1.803	-1.60	-0.55
Nov. 16. 2014	2450 Body	21.2	21.6	2412	52.751	1.914	50.915	1.906	-3.48	-0.42
				2437	52.717	1.938	50.846	1.934	-3.55	-0.21
				2450	52.700	1.950	50.811	1.950	-3.58	0.00
				2462	52.685	1.967	50.780	1.962	-3.62	-0.25

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 [%]**
Nov. 17. 2014	5200-5800 Head	21.7	22.0	5200	36.000	4.660	35.700	4.499	-0.83	-3.45
				5210	35.980	4.670	35.681	4.512	-0.83	-3.38
				5240	35.960	4.700	35.635	4.543	-0.90	-3.34
				5290	35.910	4.750	35.554	4.603	-0.99	-3.09
				5300	35.900	4.760	35.533	4.612	-1.02	-3.11
				5320	35.880	4.780	35.491	4.638	-1.08	-2.97
				5500	35.650	4.970	35.192	4.844	-1.28	-2.54
				5530	35.610	5.000	35.128	4.873	-1.35	-2.54
				5580	35.530	5.050	35.042	4.931	-1.37	-2.36
				5600	35.500	5.070	35.011	4.959	-1.38	-2.19
				5745	35.360	5.220	34.766	5.117	-1.68	-1.97
				5775	35.330	5.250	34.718	5.152	-1.73	-1.87
				5800	35.300	5.270	34.665	5.182	-1.80	-1.67
Nov. 18. 2014	5200-5800 Body	21.4	21.7	5200	49.010	5.300	48.474	5.230	-1.09	-1.32
				5210	49.000	5.310	48.451	5.246	-1.12	-1.21
				5240	48.960	5.350	48.393	5.285	-1.16	-1.21
				5290	48.890	5.400	48.325	5.353	-1.16	-0.87
				5300	48.880	5.420	48.301	5.363	-1.18	-1.05
				5320	48.850	5.440	48.252	5.392	-1.22	-0.88
				5500	48.610	5.650	47.944	5.635	-1.37	-0.27
				5530	48.570	5.680	47.880	5.671	-1.42	-0.16
				5580	48.500	5.740	47.786	5.740	-1.47	0.00
				5600	48.470	5.770	47.757	5.772	-1.47	0.03
				5745	48.270	5.940	47.509	5.962	-1.58	0.37
				5775	48.230	5.971	47.455	6.005	-1.61	0.57
				5800	48.200	6.000	47.408	6.043	-1.64	0.72

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 KDB 865664 and IEEE 1528-2013 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 $j = \sqrt{-1}$.

11.2 Test System Verification

Prior to assessment, the system is verified to the± 10 % of the specifications at 835 MHz, 1900 MHz and 2450 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)	Tissue Type	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 [%]
B	835	D835V2, SN:464	Nov. 06. 2014	Head	21.2	21.5	3916	250	9.28	2.46	9.84	6.03
B	835	D835V2, SN: 464	Nov. 07. 2014	Body	21.0	21.3	3916	250	9.35	2.50	10.00	6.95
B	1900	D1900V2, SN:5d029	Nov. 08. 2014	Head	21.1	21.6	3916	250	38.50	10.20	40.80	5.97
B	1900	D1900V2, SN: 5d029	Nov. 10. 2014	Body	20.7	21.0	3916	250	38.30	9.12	36.48	-4.75
B	835	D835V2, SN:464	Nov. 11. 2014	Head	21.3	21.7	3916	250	9.28	2.50	10.00	7.76
B	835	D835V2, SN: 464	Nov. 11. 2014	Body	21.3	21.9	3916	250	9.35	2.38	9.52	1.82
B	1900	D1900V2, SN:5d029	Nov. 12. 2014	Head	21.4	21.8	3916	250	38.50	9.60	38.40	-0.26
B	1900	D1900V2, SN: 5d029	Nov. 12. 2014	Body	21.4	21.7	3916	250	38.30	9.01	36.04	-5.90
B	835	D835V2, SN:464	Nov. 13. 2014	Head	20.6	20.9	3916	250	9.28	2.42	9.68	4.31
B	835	D835V2, SN: 464	Nov. 14. 2014	Body	21.0	21.2	3916	250	9.35	2.45	9.80	4.81
B	2450	D2450V2, SN:726	Nov. 15. 2014	Head	21.5	21.9	3916	250	52.2	13.8	55.20	5.75
B	2450	D2450V2, SN: 726	Nov. 16. 2014	Body	21.2	21.6	3916	250	48.6	12.7	50.80	4.53
B	5200	D5GV2, SN:1103	Nov. 17. 2014	Head	21.7	22.0	3916	100	79.4	7.74	77.4	-2.52
B	5300	D5GV2, SN:1103	Nov. 17. 2014	Head	21.7	22.0	3916	100	85.1	8.30	83.0	-2.47
B	5500	D5GV2, SN:1103	Nov. 17. 2014	Head	21.7	22.0	3916	100	87.5	8.6	86.0	-1.71
B	5600	D5GV2, SN:1103	Nov. 17. 2014	Head	21.7	22.0	3916	100	83.6	8.29	82.9	-0.84
B	5800	D5GV2, SN:1103	Nov. 17. 2014	Head	21.7	22.0	3916	100	80.8	7.56	75.6	-6.44
B	5200	D5GV2, SN:1103	Nov. 18. 2014	Body	21.4	21.7	3916	100	75.5	7.70	77.0	1.99
B	5300	D5GV2, SN:1103	Nov. 18. 2014	Body	21.4	21.7	3916	100	78.6	7.66	76.6	-2.54
B	5500	D5GV2, SN:1103	Nov. 18. 2014	Body	21.4	21.7	3916	100	81.9	8.03	80.3	-1.95
B	5600	D5GV2, SN:1103	Nov. 18. 2014	Body	21.4	21.7	3916	100	82.0	7.81	78.1	-4.76
B	5800	D5GV2, SN:1103	Nov. 18. 2014	Body	21.4	21.7	3916	100	77.2	7.61	76.1	-1.42

Note1 : System Verification was measured with input 250 mW, 100 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.

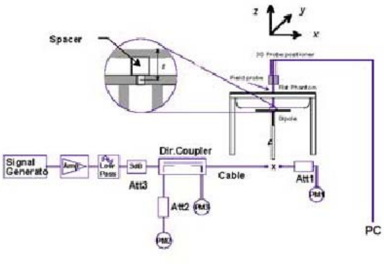


Figure 11.1 Dipole Verification Test Setup Diagram & Photo

12. SAR TEST RESULTS

12.1 Head SAR Results

Table 12.1 GSM/GPRS 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	# of Time Slots	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
836.6	190	GSM850	GSM	33.70	33.20	-0.120	Left Touch	FCC #1	1	1:8.3	0.130	1.122	0.146	
836.6	190	GSM850	GSM	33.70	33.20	-0.140	Right Touch	FCC #1	1	1:8.3	0.184	1.122	0.206	
836.6	190	GSM850	GSM	33.70	33.20	-0.010	Left Tilt	FCC #1	1	1:8.3	0.104	1.122	0.117	
836.6	190	GSM850	GSM	33.70	33.20	0.170	Right Tilt	FCC #1	1	1:8.3	0.101	1.122	0.113	
836.6	190	GSM850	GPRS	31.70	31.70	-0.010	Left Touch	FCC #1	2	1:4.15	0.165	1.000	0.165	
836.6	190	GSM850	GPRS	33.70	33.20	0.160	Right Touch	FCC #1	1	1:8.3	0.187	1.122	0.210	
836.6	190	GSM850	GPRS	31.70	31.70	0.100	Right Touch	FCC #1	2	1:4.15	0.216	1.000	**0.216**	A1
836.6	190	GSM850	GPRS	29.60	29.60	0.070	Right Touch	FCC #1	3	1:2.77	0.204	1.000	0.204	
836.6	190	GSM850	GPRS	27.70	27.20	-0.100	Right Touch	FCC #1	4	1:2.075	0.183	1.122	0.205	
836.6	190	GSM850	GPRS	31.70	31.70	-0.000	Left Tilt	FCC #1	2	1:4.15	0.144	1.000	0.144	
836.6	190	GSM850	GPRS	31.70	31.70	-0.080	Right Tilt	FCC #1	2	1:4.15	0.126	1.000	0.126	
ANSI / IEEE C95.1-2005– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Head** **1.6 W/kg (mW/g)** averaged over 1 gram						

Table 12.2 PCS/GPRS 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	# of Time Slots	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
1880.0	661	PCS1900	PCS	30.70	30.30	0.050	Left Touch	FCC #1	1	1:8.3	0.096	1.096	0.105	
1880.0	661	PCS1900	PCS	30.70	30.30	-0.160	Right Touch	FCC #1	1	1:8.3	0.168	1.096	0.184	
1880.0	661	PCS1900	PCS	30.70	30.30	-0.070	Left Tilt	FCC #1	1	1:8.3	0.096	1.096	0.105	
1880.0	661	PCS1900	PCS	30.70	30.30	-0.120	Right Tilt	FCC #1	1	1:8.3	0.077	1.096	0.084	
1880.0	661	PCS1900	GPRS	26.70	26.60	0.170	Left Touch	FCC #1	4	1:2.075	0.116	1.023	0.119	
1880.0	661	PCS1900	GPRS	30.70	30.30	0.050	Right Touch	FCC #1	1	1:8.3	0.169	1.096	0.185	
1880.0	661	PCS1900	GPRS	28.70	28.50	-0.010	Right Touch	FCC #1	2	1:4.15	0.177	1.047	0.185	
1880.0	661	PCS1900	GPRS	27.70	27.30	0.040	Right Touch	FCC #1	3	1:2.77	0.198	1.096	0.217	
1880.0	661	PCS1900	GPRS	26.70	26.60	0.110	Right Touch	FCC #1	4	1:2.075	0.231	1.023	**0.236**	A2
1880.0	661	PCS1900	GPRS	26.70	26.60	-0.000	Left Tilt	FCC #1	4	1:2.075	0.098	1.023	0.100	
1880.0	661	PCS1900	GPRS	26.70	26.60	0.020	Right Tilt	FCC #1	4	1:2.075	0.084	1.023	0.086	
ANSI / IEEE C95.1-2005– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Head** **1.6 W/kg (mW/g)** averaged over 1 gram						

Table 12.3 WCDMA 850 Head SAR

MEASUREMENT RESULTS													
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch												
836.6	4183	WCDMA 850	RMC	24.70	24.00	0.070	Left Touch	FCC #1	1:1	0.120	1.175	0.141	
836.6	4183	WCDMA 850	RMC	24.70	24.00	0.000	Right Touch	FCC #1	1:1	0.134	1.175	**0.157**	A3
836.6	4183	WCDMA 850	RMC	24.70	24.00	-0.000	Left Tilt	FCC #1	1:1	0.089	1.175	0.105	
836.6	4183	WCDMA 850	RMC	24.70	24.00	-0.050	Right Tilt	FCC #1	1:1	0.079	1.175	0.093	
ANSI / IEEE C95.1-2005– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Head** **1.6 W/kg (mW/g)** averaged over 1 gram					

Table 12.4 WCDMA 1900 Head SAR

MEASUREMENT RESULTS													
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch												
1880.0	9400	WCDMA 1900	RMC	24.20	23.80	0.140	Left Touch	FCC #1	1:1	0.137	1.096	0.150	
1880.0	9400	WCDMA 1900	RMC	24.20	23.80	0.060	Right Touch	FCC #1	1:1	0.251	1.096	**0.275**	A4
1880.0	9400	WCDMA 1900	RMC	24.20	23.80	0.070	Left Tilt	FCC #1	1:1	0.128	1.096	0.140	
1880.0	9400	WCDMA 1900	RMC	24.20	23.80	0.060	Right Tilt	FCC #1	1:1	0.120	1.096	0.132	
ANSI / IEEE C95.1-2005– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Head** **1.6 W/kg (mW/g)** averaged over 1 gram					

Table 12.5 LTE Band 5 (Cell) Head SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
829.0	20450	LTE B5	10	24.70	24.08	0.170	0	Left Touch	FCC #1	QPSK	1	0	1:1	0.106	1.153	0.122	
829.0	20450	LTE B5	10	23.70	22.68	-0.020	1	Left Touch	FCC #1	QPSK	25	0	1:1	0.090	1.265	0.114	
829.0	20450	LTE B5	10	24.70	24.08	0.180	0	Right Touch	FCC #1	QPSK	1	0	1:1	0.140	1.153	**0.161**	A5
829.0	20450	LTE B5	10	23.70	22.68	0.180	1	Right Touch	FCC #1	QPSK	25	0	1:1	0.116	1.265	0.147	
829.0	20450	LTE B5	10	24.70	24.08	0.020	0	Left Tilt	FCC #1	QPSK	1	0	1:1	0.086	1.153	0.099	
829.0	20450	LTE B5	10	23.70	22.68	-0.060	1	Left Tilt	FCC #1	QPSK	25	0	1:1	0.070	1.265	0.089	
829.0	20450	LTE B5	10	24.70	24.08	-0.080	0	Right Tilt	FCC #1	QPSK	1	0	1:1	0.094	1.153	0.108	
829.0	20450	LTE B5	10	23.70	22.68	-0.150	1	Right Tilt	FCC #1	QPSK	25	0	1:1	0.069	1.265	0.087	
ANSI / IEEE C95.1-2005– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**									**Head** **1.6 W/kg (mW/g)** averaged over 1 gram								

Table 12.6 DTS Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
2412	1	802.11b	DSSS	17.00	16.72	0.130	Left Touch	FCC #1	1	1:1	0.194	1.067	0.207	
2437	6	802.11b	DSSS	17.00	16.83	0.150	Left Touch	FCC #1	1	1:1	0.246	1.040	0.256	
2462	11	802.11b	DSSS	17.00	16.96	0.110	Left Touch	FCC #1	1	1:1	0.286	1.009	**0.289**	A6
2462	11	802.11b	DSSS	17.00	16.96	0.030	Right Touch	FCC #1	1	1:1	0.168	1.009	0.170	
2462	11	802.11b	DSSS	17.00	16.96	0.160	Left Tilt	FCC #1	1	1:1	0.243	1.009	0.245	
2462	11	802.11b	DSSS	17.00	16.96	-0.000	Right Tilt	FCC #1	1	1:1	0.158	1.009	0.159	
ANSI / IEEE C95.1-2005– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Head** **1.6 W/kg (mW/g)** averaged over 1 gram						

Table 12.7 NII Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
5240	48	802.11a	OFDM	11.00	10.43	0.060	Left Touch	FCC #1	6	1:1	0.144	1.140	0.164	
5240	48	802.11a	OFDM	11.00	10.43	0.140	Right Touch	FCC #1	6	1:1	0.134	1.140	0.153	
5240	48	802.11a	OFDM	11.00	10.43	0.150	Left Tilt	FCC #1	6	1:1	0.177	1.140	**0.202**	A7
5240	48	802.11a	OFDM	11.00	10.43	-0.010	Right Tilt	FCC #1	6	1:1	0.170	1.140	0.194	
5210	42	802.11ac	OFDM	9.50	9.14	-0.070	Left Tilt	FCC #1	29.3	1:1	0.090	1.086	0.098	
5320	64	802.11a	OFDM	11.00	10.51	0.080	Left Touch	FCC #1	6	1:1	0.168	1.119	0.188	
5320	64	802.11a	OFDM	11.00	10.51	-0.000	Right Touch	FCC #1	6	1:1	0.220	1.119	**0.246**	A8
5320	64	802.11a	OFDM	11.00	10.51	-0.100	Left Tilt	FCC #1	6	1:1	0.200	1.119	0.224	
5320	64	802.11a	OFDM	11.00	10.51	-0.100	Right Tilt	FCC #1	6	1:1	0.196	1.119	0.219	
5290	58	802.11ac	OFDM	9.50	9.19	-0.030	Right Touch	FCC #1	29.3	1:1	0.133	1.074	0.143	
5580	116	802.11a	OFDM	11.00	10.22	0.160	Left Touch	FCC #1	6	1:1	0.185	1.197	0.221	
5580	116	802.11a	OFDM	11.00	10.22	0.070	Right Touch	FCC #1	6	1:1	0.167	1.197	0.200	
5580	116	802.11a	OFDM	11.00	10.22	0.070	Left Tilt	FCC #1	6	1:1	0.184	1.197	0.220	
5580	116	802.11a	OFDM	11.00	10.22	0.050	Right Tilt	FCC #1	6	1:1	0.245	1.197	**0.293**	A9
5530	106	802.11ac	OFDM	9.50	9.02	-0.020	Right Tilt	FCC #1	29.3	1:1	0.160	1.117	0.179	
5745	149	802.11a	OFDM	11.00	10.23	-0.060	Left Touch	FCC #1	6	1:1	0.170	1.194	0.203	
5745	149	802.11a	OFDM	11.00	10.23	-0.090	Right Touch	FCC #1	6	1:1	0.161	1.194	0.192	
5745	149	802.11a	OFDM	11.00	10.23	0.110	Left Tilt	FCC #1	6	1:1	0.188	1.194	**0.224**	A10
5745	149	802.11a	OFDM	11.00	10.23	0.110	Right Tilt	FCC #1	6	1:1	0.178	1.194	0.213	
5775	155	802.11ac	OFDM	9.50	8.85	-0.050	Left Tilt	FCC #1	29.3	1:1	0.099	1.161	0.115	
ANSI / IEEE C95.1-2005– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Head** **1.6 W/kg (mW/g)** averaged over 1 gram						

12.2 Standalone Body-Worn SAR Worn SAR Results

Table 12.8 GSM/PCS/GPRS/WCDMA Body-Worn 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)	Plots #
MHz	Ch													
836.6	190	GSM 850	GSM	33.70	33.20	0.100	10 mm [Rear]	FCC #1	1	1:8.3	0.246	1.122	**0.276**	A11
836.6	190	GSM 850	GPRS	31.70	31.70	-0.100	10 mm [Rear]	FCC #1	2	1:4.15	0.290	1.000	**0.290**	A12
1880.0	661	PCS1900	PCS	30.70	30.30	-0.040	10 mm [Rear]	FCC #1	1	1:8.3	0.585	1.096	**0.641**	A13
1880.0	661	PCS1900	GPRS	26.70	26.60	0.020	10 mm [Rear]	FCC #1	4	1:2.075	0.730	1.023	**0.747**	A14
836.6	4183	WCDMA 850	RMC	24.70	24.00	-0.040	10 mm [Rear]	FCC #1	N/A	1:1	0.265	1.175	**0.311**	A15
1907.6	9538	WCDMA 1900	RMC	24.20	23.80	-0.190	10 mm [Rear]	FCC #1	N/A	1:1	1.060	1.096	**1.162**	A16
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						

Table 12.9 LTE Band 5 (Cell) Body-Worn SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
829.0	20450	LTE B5	10	24.70	24.08	-0.010	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	0.310	1.153	**0.357**	A17
829.0	20450	LTE B5	10	23.70	22.68	-0.020	1	10 mm [Rear]	FCC #1	QPSK	25	0	1:1	0.257	1.265	0.325	
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								

Table 12.10 DTS Body-Worn SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
2462	11	802.11b	DSSS	17.0	16.96	0.160	10 mm [Rear]	FCC #1	1	1:1	0.193	1.009	**0.195**	A18
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						

Table 12.11 NII Body-Worn SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
5240	48	802.11a	OFDM	11.0	10.43	-0.130	10 mm [Rear]	FCC #1	6	1:1	0.174	1.140	**0.198**	A19
5210	42	802.11ac	OFDM	9.5	9.14	0.140	10 mm [Rear]	FCC #1	29.3	1:1	0.067	1.086	0.073	
5320	64	802.11a	OFDM	11.0	10.51	0.100	10 mm [Rear]	FCC #1	6	1:1	0.163	1.119	**0.182**	A20
5290	58	802.11ac	OFDM	9.5	9.19	0.170	10 mm [Rear]	FCC #1	29.3	1:1	0.080	1.074	0.086	
5580	116	802.11a	OFDM	11.0	10.22	-0.090	10 mm [Rear]	FCC #1	6	1:1	0.174	1.197	**0.208**	A21
5530	106	802.11ac	OFDM	9.5	9.02	-0.150	10 mm [Rear]	FCC #1	29.3	1:1	0.096	1.117	0.107	
5745	149	802.11a	OFDM	11.0	10.23	0.110	10 mm [Rear]	FCC #1	6	1:1	0.160	1.194	**0.191**	A22
5775	155	802.11ac	OFDM	9.5	8.85	0.110	10 mm [Rear]	FCC #1	29.3	1:1	0.090	1.161	0.104	
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						

12.3 Standalone Wireless router SAR Results

Table 12.12 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)	Plots #
MHz	Ch													
836.6	190	GSM 850	GPRS	31.70	31.70	-0.130	10 mm [Bottom]	FCC #1	2	1:4.15	0.203	1.000	0.203	
836.6	190	GSM 850	GPRS	31.70	31.70	-0.010	10 mm [Front]	FCC #1	2	1:4.15	0.198	1.000	0.198	
836.6	190	GSM 850	GPRS	33.70	33.20	-0.160	10 mm [Rear]	FCC #1	1	1:8.3	0.255	1.122	0.286	
836.6	190	GSM 850	GPRS	31.70	31.70	-0.100	10 mm [Rear]	FCC #1	2	1:4.15	0.290	1.000	**0.290**	A12
836.6	190	GSM 850	GPRS	29.60	29.60	-0.130	10 mm [Rear]	FCC #1	3	1:2.77	0.198	1.000	0.198	
836.6	190	GSM 850	GPRS	27.70	27.20	0.110	10 mm [Rear]	FCC #1	4	1:2.075	0.154	1.122	0.173	
836.6	190	GSM 850	GPRS	31.70	31.70	-0.010	10 mm [Right]	FCC #1	2	1:4.15	0.287	1.000	0.287	
836.6	190	GSM 850	GPRS	31.70	31.70	-0.060	10 mm [Left]	FCC #1	2	1:4.15	0.157	1.000	0.157	
1880.0	661	PCS1900	GPRS	26.70	26.60	-0.010	10 mm [Bottom]	FCC #1	4	1:2.075	0.568	1.023	0.581	
1880.0	661	PCS1900	GPRS	26.70	26.60	0.100	10 mm [Front]	FCC #1	4	1:2.075	0.371	1.023	0.380	
1880.0	661	PCS1900	GPRS	30.70	30.30	0.020	10 mm [Rear]	FCC #1	1	1:8.3	0.609	1.096	0.667	
1880.0	661	PCS1900	GPRS	28.70	28.50	-0.090	10 mm [Rear]	FCC #1	2	1:4.15	0.630	1.047	0.660	
1880.0	661	PCS1900	GPRS	27.70	27.30	0.070	10 mm [Rear]	FCC #1	3	1:2.77	0.662	1.096	0.726	
1880.0	661	PCS1900	GPRS	26.70	26.60	0.020	10 mm [Rear]	FCC #1	4	1:2.075	0.730	1.023	**0.747**	A14
1880.0	661	PCS1900	GPRS	26.70	26.60	-0.090	10 mm [Right]	FCC #1	4	1:2.075	0.130	1.023	0.133	
1880.0	661	PCS1900	GPRS	26.70	26.60	-0.100	10 mm [Left]	FCC #1	4	1:2.075	0.039	1.023	0.040	
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						

Table 12.13 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)	Plots #
MHz	Ch													
836.6	4183	WCDMA 850	RMC	24.70	24.00	0.020	10 mm [Bottom]	FCC #1	N/A	1:1	0.160	1.175	0.188	
836.6	4183	WCDMA 850	RMC	24.70	24.00	-0.030	10 mm [Front]	FCC #1	N/A	1:1	0.176	1.175	0.207	
836.6	4183	WCDMA 850	RMC	24.70	24.00	-0.040	10 mm [Rear]	FCC #1	N/A	1:1	0.265	1.175	**0.311**	A15
836.6	4183	WCDMA 850	RMC	24.70	24.00	-0.150	10 mm [Right]	FCC #1	N/A	1:1	0.254	1.175	0.298	
836.6	4183	WCDMA 850	RMC	24.70	24.00	-0.010	10 mm [Left]	FCC #1	N/A	1:1	0.204	1.175	0.240	
1907.6	9538	WCDMA 1900	RMC	24.20	23.80	0.100	10 mm [Bottom]	FCC #1	N/A	1:1	1.020	1.096	1.118	
1880.0	9400	WCDMA 1900	RMC	24.20	23.80	0.110	10 mm [Front]	FCC #1	N/A	1:1	0.507	1.096	0.556	
1907.6	9538	WCDMA 1900	RMC	24.20	23.80	0.170	10 mm [Rear]	FCC #1	N/A	1:1	1.060	1.096	**1.162**	A16
1880.0	9400	WCDMA 1900	RMC	24.20	23.80	0.060	10 mm [Right]	FCC #1	N/A	1:1	0.214	1.096	0.235	
1880.0	9400	WCDMA 1900	RMC	24.20	23.80	-0.060	10 mm [Left]	FCC #1	N/A	1:1	0.085	1.096	0.093	
1907.6	9538	WCDMA 1900	RMC	24.20	23.80	-0.070	10 mm [Rear]	FCC #1	N/A	1:1	1.030	1.096	1.129	
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 represent variability measurements.

Table 12.14 LTE Band 5 (Cell) Hotspot SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
829.0	20450	LTE B5	10	24.70	24.08	0.050	0	10 mm [Bot.]	FCC #1	QPSK	1	0	1:1	0.185	1.153	0.213	
829.0	20450	LTE B5	10	23.70	22.68	-0.000	1	10 mm [Bot.]	FCC #1	QPSK	25	0	1:1	0.152	1.265	0.192	
829.0	20450	LTE B5	10	24.70	24.08	0.020	0	10 mm [Front]	FCC #1	QPSK	1	0	1:1	0.150	1.153	0.173	
829.0	20450	LTE B5	10	23.70	22.68	0.030	1	10 mm [Front]	FCC #1	QPSK	25	0	1:1	0.115	1.265	0.145	
829.0	20450	LTE B5	10	24.70	24.08	-0.010	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	0.310	1.153	**0.357**	A17
829.0	20450	LTE B5	10	23.70	22.68	-0.020	1	10 mm [Rear]	FCC #1	QPSK	25	0	1:1	0.257	1.265	0.325	
829.0	20450	LTE B5	10	24.70	24.08	-0.150	0	10 mm [Right]	FCC #1	QPSK	1	0	1:1	0.254	1.153	0.293	
829.0	20450	LTE B5	10	23.70	22.68	0.030	1	10 mm [Right]	FCC #1	QPSK	25	0	1:1	0.203	1.265	0.257	
829.0	20450	LTE B5	10	24.70	24.08	-0.050	0	10 mm [Left]	FCC #1	QPSK	1	0	1:1	0.175	1.153	0.202	
829.0	20450	LTE B5	10	23.70	22.68	-0.010	1	10 mm [Left]	FCC #1	QPSK	25	0	1:1	0.136	1.265	0.172	
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								

Table 12.15 W-LAN Hotspot SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
2462	11	802.11b	DSSS	17.0	16.96	-0.010	10 mm [Top]	FCC #1	1	1:1	0.053	1.009	0.053	
2462	11	802.11b	DSSS	17.0	16.96	0.110	10 mm [Front]	FCC #1	1	1:1	0.069	1.009	0.070	
2412	1	802.11b	DSSS	17.0	16.72	-0.130	10 mm [Rear]	FCC #1	1	1:1	0.146	1.067	0.156	
2437	6	802.11b	DSSS	17.0	16.83	-0.090	10 mm [Rear]	FCC #1	1	1:1	0.175	1.040	0.182	
2462	11	802.11b	DSSS	17.0	16.96	0.160	10 mm [Rear]	FCC #1	1	1:1	0.193	1.009	**0.195**	A18
2462	11	802.11b	DSSS	17.0	16.96	0.060	10 mm [Right]	FCC #1	1	1:1	0.035	1.009	0.035	
2462	11	802.11b	DSSS	17.0	16.96	0.180	10 mm [Left]	FCC #1	1	1:1	0.015	1.009	0.015	
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						

12.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, and FCC KDB Publication447498 D01v05r02.
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 D01v05r02.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01r02, SAR was evaluated without a headset connected to the device. Since the standalone reported SAR was not > 1.2 W/kg, no additional SAR evaluations using a headset cable were performed.
8. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v02, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.7 for more details).
9. Per FCC KDB 865664 D01v01r03, 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. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
2. This device supports GSM VOIP in the head and body-worn configurations; therefore GPRS was additionally evaluated for head and body-worn compliance.
3. Justification for reduced test configurations per KDB Publication 941225 D01v03 and October 2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
4. Per FCC KDB Publication 447498 D01v05r02, 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). Since the maximum output power variation across the required test channels is not > ½ dB, the middle channel was used for testing.

WCDMA (UMTS) Notes:

1. WCDMA (UMTS) mode in was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03. 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 D01v05r02, 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.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r03. The general test procedures used for testing can be found in Section 4.1.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36. 101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. Per FCC Guidance, LTE CA SAR was not needed for testing since the data sent by uplink on uplink physical channels does not change between Rel 8 and Rel 10.

WLAN Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 5 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11a. Other IEEE 802.11 modes (including 802.11n 20MHz and 40 MHz bandwidths) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
3. WIFI transmission was verified using a spectrum analyzer.
4. Since the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6 W/kg and the reported 1g averaged SAR is <0.8 W/kg, SAR testing on other default channels was not required.

13. FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

13.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05r02 are applicable to handsets with built-in unlicensed transmitters such as 802.11b/g/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

13.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05r02 IV.C.1.iii and IEEE 1528-2013 Section 6.3.4.1.2, 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 $\leq$ 1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05r02 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 13.1 Estimated SAR

Mode	Frequency	Maximum Allowed Power		Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mW]	[mm]	[W/kg]
Bluetooth	2441	6.18	4	10	0.086

Note : Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

13.3 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v05r02, 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.

Path 1	Path 2
GSM/GPRS/EDGE/WCDMA/LTE	Bluetooth, WIFI

Figure 13.1 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 D01v05r02.

Table 13.2 Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router	Note
1	GSM850 Voice + 2.4 GHz WIFI	Yes	Yes	N/A	GSM voice + WiFi 2.4GHz
2	PCS1900 Voice + 2.4 GHz WIFI	Yes	Yes	N/A	
3	GSM850 Voice + 5 GHz WIFI	Yes	Yes	N/A	GSM voice + WiFi 5GHz
4	PCS1900 Voice + 5 GHz WIFI	Yes	Yes	N/A	
5	GSM850 GPRS/EDGE + 2.4 GHz WIFI	Yes	Yes	Yes	GSM GPRS/EDGE + WiFi 2.4GHz
6	PCS1900 GPRS/EDGE + 2.4 GHz WIFI	Yes	Yes	Yes	
7	GSM850 GPRS/EDGE + 5 GHz WIFI	Yes	Yes	No	GSM GPRS/EDGE + WiFi 5GHz Hotspot in WiFi 5G is not supported
8	PCS1900 GPRS/EDGE + 5 GHz WIFI	Yes	Yes	No	
9	WCDMA 850 + 2.4 GHz WIFI	Yes	Yes	Yes	WCDMA + WiFi 2.4GHz
10	WCDMA 1900 + 2.4 GHz WIFI	Yes	Yes	Yes	
11	WCDMA 850 + 5 GHz WIFI	Yes	Yes	No	WCDMA + WiFI 5GHz Hotspot in WiFi 5G is not supported
12	WCDMA 1900 + 5 GHz WIFI	Yes	Yes	No	
13	LTE Band 5 + 2.4 GHz WIFI	Yes	Yes	Yes	LTE + WiFi 2.4GHz
14	LTE Band 5 + 5 GHz WIFI	Yes	Yes	No	LTE + WiFi 5GHz
15	WCDMA 850 + Bluetooth	N/A	Yes	N/A	
16	WCDMA 1900 + Bluetooth	N/A	Yes	N/A	
17	GSM850 GPRS/EDGE + Bluetooth	N/A	Yes	N/A	
18	GPRS1900 GPRS/EDGE + Bluetooth	N/A	Yes	N/A	
19	LTE Band 5 + Bluetooth	N/A	Yes	N/A	

Notes:

1. 2.4 GHz WIFI Hotspot is supported. 5 GHz WIFI Hotspot is not supported.
2. GPRS, WCDMA and LTE Hotspot are supported.
3. Bluetooth and WIFI can not transmit simultaneously since they share the same chip.
4. GSM,WCDMA and LTE can not transmit simultaneously since they share the same chip.
5. VOIP is supported.

Note:

- When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.

- Per the manufacturer, WIFI Direct is not expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Therefore, there are no simultaneous transmission scenarios involving WIFI direct beyond that listed in the above table.

13.4 Head SAR Simultaneous Transmission Analysis

Table 13.3 Simultaneous Transmission Scenario for GSM with 2.4 GHz W-LAN (Held to Ear)

Simult TX	Configuration	GSM850 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	PCS1900 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Head SAR	Left Touch	0.146	0.289	0.435	Head SAR	Left Touch	0.105	0.289	0.394
	Right Touch	0.206	0.170	0.376		Right Touch	0.184	0.170	0.354
	Left Tilt	0.117	0.245	0.362		Left Tilt	0.105	0.245	0.350
	Right Tilt	0.113	0.159	0.272		Right Tilt	0.084	0.159	0.243

Table 13.4 Simultaneous Transmission Scenario for GPRS with 2.4 GHz W-LAN (Held to Ear)

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)
Head SAR	Left Touch	0.165	0.289	0.454	Head SAR	Left Touch	0.119	0.289	0.408
	Right Touch	0.216	0.170	0.386		Right Touch	0.236	0.170	0.406
	Left Tilt	0.144	0.245	0.389		Left Tilt	0.100	0.245	0.345
	Right Tilt	0.126	0.159	0.285		Right Tilt	0.086	0.159	0.245

Table 13.5 Simultaneous Transmission Scenario for WCDMA with 2.4 GHz W-LAN (Held to Ear)

Simult TX	Configuration	WCDMA 850 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	WCDMA 1900 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Head SAR	Left Touch	0.141	0.289	0.430	Head SAR	Left Touch	0.150	0.289	0.439
	Right Touch	0.157	0.170	0.327		Right Touch	0.275	0.170	0.445
	Left Tilt	0.105	0.245	0.350		Left Tilt	0.14	0.245	0.385
	Right Tilt	0.093	0.159	0.252		Right Tilt	0.132	0.159	0.291

Table 13.6 Simultaneous Transmission Scenario for LTE with 2.4 GHz W-LAN (Held to Ear)

Simult TX	Configuration	LTE Band 5 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Head SAR	Left Touch	0.122	0.289	0.411
	Right Touch	0.161	0.170	0.331
	Left Tilt	0.099	0.245	0.344
	Right Tilt	0.108	0.159	0.267

Table 13.7 Simultaneous Transmission Scenario for GSM with 5 GHz W-LAN (Held to Ear)

Simult TX	Configuration	GSM850 SAR (W/kg)	5G W-LAN (802.11a) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	PCS1900 SAR (W/kg)	5G W-LAN (802.11a) SAR (W/kg)	ΣSAR (W/kg)
Head SAR	Left Touch	0.146	0.221	0.367	Head SAR	Left Touch	0.105	0.221	0.326
	Right Touch	0.206	0.200	0.406		Right Touch	0.184	0.200	0.384
	Left Tilt	0.117	0.220	0.337		Left Tilt	0.105	0.220	0.325
	Right Tilt	0.113	0.293	0.406		Right Tilt	0.084	0.293	0.377

Table 13.8 Simultaneous Transmission Scenario for GPRS with 5 GHz W-LAN (Held to Ear)

Simult TX	Configuration	GPRS 850 SAR (W/kg)	5G W-LAN (802.11a) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	GPRS 1900 SAR (W/kg)	5G W-LAN (802.11a) SAR (W/kg)	ΣSAR (W/kg)
Head SAR	Left Touch	0.165	0.221	0.386	Head SAR	Left Touch	0.119	0.221	0.340
	Right Touch	0.216	0.200	0.416		Right Touch	0.236	0.200	0.436
	Left Tilt	0.144	0.220	0.364		Left Tilt	0.100	0.22	0.320
	Right Tilt	0.126	0.293	0.419		Right Tilt	0.086	0.293	0.379

Table 13.9 Simultaneous Transmission Scenario for WCDMA with 5 GHz W-LAN (Held to Ear)

Simult TX	Configuration	WCDMA 850 SAR (W/kg)	5G W-LAN (802.11a) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	WCDMA 1900 SAR (W/kg)	5G W-LAN (802.11a) SAR (W/kg)	ΣSAR (W/kg)
Head SAR	Left Touch	0.141	0.221	0.362	Head SAR	Left Touch	0.150	0.221	0.371
	Right Touch	0.157	0.200	0.357		Right Touch	0.275	0.200	**0.475**
	Left Tilt	0.105	0.220	0.325		Left Tilt	0.140	0.220	0.360
	Right Tilt	0.093	0.293	0.386		Right Tilt	0.132	0.293	0.425

Table 13.10 Simultaneous Transmission Scenario for LTE with 5 GHz W-LAN (Held to Ear)

Simult TX	Configuration	LTE Band 5 SAR (W/kg)	5G W-LAN (802.11a) SAR (W/kg)	ΣSAR (W/kg)
Head SAR	Left Touch	0.122	0.221	0.343
	Right Touch	0.161	0.200	0.361
	Left Tilt	0.099	0.220	0.319
	Right Tilt	0.108	0.293	0.401

13.5 Body-Worn Simultaneous Transmission Analysis

Table 13.11 Simultaneous Transmission Scenario with 2.4 GHz W-LAN (Body-Worn at 10 mm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Rear Side	GSM 850	0.276	0.195	0.471
Rear Side	GPRS 850	0.290	0.195	0.485
Rear Side	PCS 1900	0.641	0.195	0.836
Rear Side	GPRS 1900	0.747	0.195	0.942
Rear Side	WCDMA 850	0.311	0.195	0.506
Rear Side	WCDMA 1900	1.162	0.195	1.357
Rear Side	LTE Band 5	0.357	0.195	0.552

Table 13.12 Simultaneous Transmission Scenario with 5 GHz W-LAN (Body-Worn at 10 mm)

Configuration	Mode	2G/3G SAR (W/kg)	5G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Rear Side	GSM 850	0.276	0.208	0.484
Rear Side	GPRS 850	0.290	0.208	0.498
Rear Side	PCS 1900	0.641	0.208	0.849
Rear Side	GPRS 1900	0.747	0.208	0.955
Rear Side	WCDMA 850	0.311	0.208	0.519
Rear Side	WCDMA 1900	1.162	0.208	**1.370**
Rear Side	LTE Band 5	0.357	0.208	0.565

Table 13.13 Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 10 mm)

Configuration	Mode	2G/3G SAR (W/kg)	Bluetooth SAR (W/kg)	ΣSAR (W/kg)
Rear Side	GSM 850	0.276	0.086	0.362
Rear Side	GPRS 850	0.290	0.086	0.376
Rear Side	PCS 1900	0.641	0.086	0.727
Rear Side	GPRS 1900	0.747	0.086	0.833
Rear Side	WCDMA 850	0.311	0.086	0.397
Rear Side	WCDMA 1900	1.162	0.086	1.248
Rear Side	LTE Band 5	0.357	0.086	0.443

Note: Bluetooth SAR was not required to be measured per FCC KDB 447498 D01v05r02. Estimated SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

13.6 Hotspot SAR Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D06v02, the device edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR ("-").

Table 13.14 Simultaneous Transmission Scenario for GPRS with 2.4GHz W-LAN (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	-	0.053	0.053	Body SAR	Top	-	0.053	0.053
	Bottom	0.203	-	0.203		Bottom	0.581	-	0.581
	Front	0.198	0.070	0.268		Front	0.380	0.070	0.450
	Rear	0.290	0.195	0.485		Rear	0.747	0.195	0.942
	Right	0.287	0.035	0.322		Right	0.133	0.035	0.168
	Left	0.157	0.015	0.172		Left	0.040	0.015	0.055

Table 13.15 Simultaneous Transmission Scenario for WCDMA with 2.4GHz W-LAN (Hotspot at 10 mm)

Simult TX	Configuration	WCDMA 850 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	WCDMA 1900 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Body SAR	Top	-	0.053	0.053	Body SAR	Top	-	0.053	0.053
	Bottom	0.188	-	0.188		Bottom	1.118	-	1.118
	Front	0.207	0.070	0.277		Front	0.556	0.070	0.626
	Rear	0.311	0.195	0.506		Rear	1.162	0.195	**1.357**
	Right	0.298	0.035	0.333		Right	0.235	0.035	0.270
	Left	0.240	0.015	0.255		Left	0.093	0.015	0.108

Table 13.16 Simultaneous Transmission Scenario for LTE with 2.4GHz W-LAN (Hotspot at 10 mm)

Simult TX	Configuration	LTE Band 5 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Body SAR	Top	-	0.053	0.053
	Bottom	0.213	-	0.213
	Front	0.173	0.070	0.243
	Rear	0.357	0.195	0.552
	Right	0.293	0.035	0.328
	Left	0.202	0.015	0.217

13.7 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 D01v05r02 and IEEE 1528-2013 Section 6.3.4.1.2.

14. SAR MEASUREMENT VARIABILITY

14.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r03, 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 14.1 Body SAR Measurement Variability Results

Frequency		Mode	Service	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)	
1907.6	9538	WCDMA 1900	RMC	10 mm [Rear]	1.060	1.030	1.03	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					

14.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01r03, the standard measurement uncertainty analysis per IEEE 1528-2003 was not required.

15. IEEE P1528 –MEASUREMENT UNCERTAINTIES

835 MHz Head

Error Description	Uncertainty 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.)	± 4.2	Normal	1	0.6	± 4.2 %	∞
Combined Standard Uncertainty					**± 12.2 %**	330
Expanded Uncertainty (k=2)					**± 24.4 %**	

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

835 MHz Body

Error Description	Uncertainty 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.)	± 4.5	Normal	1	0.64	± 4.5 %	∞
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.887 %	∞
Liquid permittivity (Meas.)	± 4.2	Normal	1	0.6	± 4.2 %	∞
Combined Standard Uncertainty					**± 12.1 %**	330
Expanded Uncertainty (k=2)					**± 24.2 %**	

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

1900 MHz Head

Error Description	Uncertainty 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.)	± 4.2	Normal	1	0.64	± 4.2 %	∞
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					**± 12.2 %**	330
Expanded Uncertainty (k=2)					**± 24.4 %**	

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

1900 MHz Body

Error Description	Uncertainty 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)

2450 MHz Head

Error Description	Uncertainty 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.)	± 4.4	Normal	1	0.64	± 4.4 %	∞
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.887 %	∞
Liquid permittivity (Meas.)	± 4.7	Normal	1	0.6	± 4.7 %	∞
Combined Standard Uncertainty					**± 12.2 %**	330
Expanded Uncertainty (k=2)					**± 24.4 %**	

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

2450 MHz Body

Error Description	Uncertainty 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.)	± 4.5	Normal	1	0.64	± 4.5 %	∞
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.887 %	∞
Liquid permittivity (Meas.)	± 4.4	Normal	1	0.6	± 4.4 %	∞
Combined Standard Uncertainty					**± 12.2 %**	330
Expanded Uncertainty (k=2)					**± 24.4 %**	

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

5200 MHz Head

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	± 6.55 %	∞
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	± 0.145 %	∞
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	± 2.31 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 4.4	Normal	1	0.64	± 4.4 %	∞
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					**± 12.5 %**	330
Expanded Uncertainty (k=2)					**± 25.0 %**	

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

5200 MHz Body

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	± 6.55 %	∞
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	± 0.145 %	∞
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	± 2.31 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 4.2	Normal	1	0.64	± 4.2 %	∞
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.887 %	∞
Liquid permittivity (Meas.)	± 4.1	Normal	1	0.6	± 4.1 %	∞
Combined Standard Uncertainty					**± 12.4 %**	330
Expanded Uncertainty (k=2)					**± 24.8 %**	

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

5300 MHz Head

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	± 6.55 %	∞
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	± 0.145 %	∞
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	± 2.31 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 4.6	Normal	1	0.64	± 4.6 %	∞
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					**± 12.5 %**	330
Expanded Uncertainty (k=2)					**± 25.0 %**	

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

5300 MHz Body

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	± 6.55 %	∞
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	± 0.145 %	∞
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	± 2.31 %	∞
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					**± 12.4 %**	330
Expanded Uncertainty (k=2)					**± 24.8 %**	

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

5600 MHz Head

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	± 6.55 %	∞
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	± 0.145 %	∞
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	± 2.31 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 4.8	Normal	1	0.64	± 4.8 %	∞
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					**± 12.5 %**	330
Expanded Uncertainty (k=2)					**± 25.0 %**	

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

5600 MHz Body

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	± 6.55 %	∞
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	± 0.145 %	∞
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	± 2.31 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 4.6	Normal	1	0.64	± 4.6 %	∞
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.887 %	∞
Liquid permittivity (Meas.)	± 4.8	Normal	1	0.6	± 4.8 %	∞
Combined Standard Uncertainty					**± 12.5 %**	330
Expanded Uncertainty (k=2)					**± 25.0 %**	

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

5800 MHz Head

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	± 6.55 %	∞
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	± 0.145 %	∞
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	± 2.31 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 4.7	Normal	1	0.64	± 4.7 %	∞
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.887 %	∞
Liquid permittivity (Meas.)	± 4.1	Normal	1	0.6	± 4.1 %	∞
Combined Standard Uncertainty					**± 12.4 %**	330
Expanded Uncertainty (k=2)					**± 24.8 %**	

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

5800 MHz Body

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	± 6.55 %	∞
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	± 0.145 %	∞
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	± 2.31 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 4.6	Normal	1	0.64	± 4.6 %	∞
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					**± 12.5 %**	330
Expanded Uncertainty (k=2)					**± 25.0 %**	

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

16.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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Attachment 1. – Probe Calibration Data

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Digital EMC (Dymstec)**

Certificate No: **EX3-3916_Apr14**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3916
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	April 24, 2014

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 24, 2014

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3916

Manufactured: December 18, 2012
Calibrated: April 24, 2014

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3916

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μV/(V/m)^2)[A]	0.58	0.49	0.53	± 10.1 %
DCP (mV)[B]	99.0	100.0	99.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	149.7	±3.8 %
		Y	0.0	0.0	1.0		142.3	
		Z	0.0	0.0	1.0		140.3	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3916

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
300	45.3	0.87	11.59	11.59	11.59	0.08	1.10	± 13.3 %
450	43.5	0.87	10.80	10.80	10.80	0.18	1.20	± 13.3 %
600	42.7	0.88	10.17	10.17	10.17	0.10	1.10	± 13.3 %
750	41.9	0.89	10.22	10.22	10.22	0.24	1.21	± 12.0 %
835	41.5	0.90	9.79	9.79	9.79	0.42	0.85	± 12.0 %
900	41.5	0.97	9.59	9.59	9.59	0.26	1.08	± 12.0 %
1750	40.1	1.37	8.21	8.21	8.21	0.80	0.59	± 12.0 %
1900	40.0	1.40	7.96	7.96	7.96	0.31	0.88	± 12.0 %
2300	39.5	1.67	7.57	7.57	7.57	0.30	0.87	± 12.0 %
2450	39.2	1.80	7.18	7.18	7.18	0.28	0.99	± 12.0 %
2600	39.0	1.96	6.99	6.99	6.99	0.40	0.79	± 12.0 %
3500	37.9	2.91	7.17	7.17	7.17	0.58	0.86	± 13.1 %
5200	36.0	4.66	5.09	5.09	5.09	0.35	1.80	± 13.1 %
5250	35.9	4.71	4.99	4.99	4.99	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.86	4.86	4.86	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.94	4.94	4.94	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.62	4.62	4.62	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.83	4.83	4.83	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.68	4.68	4.68	0.40	1.80	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3916

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
300	58.2	0.92	11.72	11.72	11.72	0.08	1.10	± 13.3 %
450	56.7	0.94	11.59	11.59	11.59	0.10	1.10	± 13.3 %
600	56.1	0.95	10.15	10.15	10.15	0.02	1.05	± 13.3 %
750	55.5	0.96	10.04	10.04	10.04	0.40	0.93	± 12.0 %
835	55.2	0.97	9.94	9.94	9.94	0.62	0.71	± 12.0 %
900	55.0	1.05	9.74	9.74	9.74	0.40	0.94	± 12.0 %
1750	53.4	1.49	8.12	8.12	8.12	0.50	0.74	± 12.0 %
1900	53.3	1.52	7.69	7.69	7.69	0.32	0.91	± 12.0 %
2300	52.9	1.81	7.52	7.52	7.52	0.60	0.65	± 12.0 %
2450	52.7	1.95	7.24	7.24	7.24	0.80	0.50	± 12.0 %
2600	52.5	2.16	7.01	7.01	7.01	0.80	0.50	± 12.0 %
3500	51.3	3.31	6.84	6.84	6.84	0.42	1.09	± 13.1 %
5200	49.0	5.30	4.61	4.61	4.61	0.40	1.90	± 13.1 %
5250	48.9	5.36	4.43	4.43	4.43	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.27	4.27	4.27	0.45	1.90	± 13.1 %
5500	48.6	5.65	4.05	4.05	4.05	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.07	4.07	4.07	0.40	1.90	± 13.1 %
5750	48.3	5.94	4.24	4.24	4.24	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.21	4.21	4.21	0.50	1.90	± 13.1 %

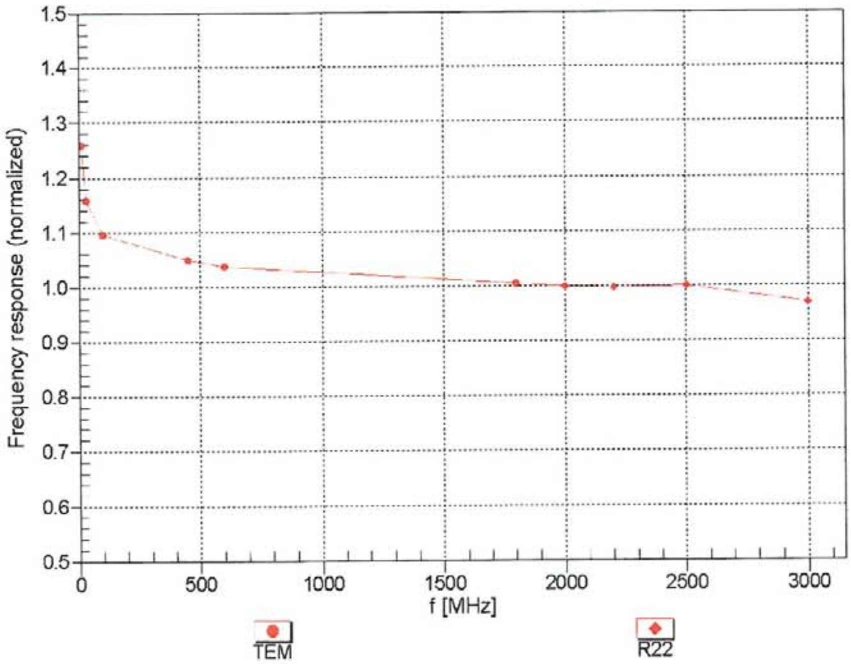
[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4– SN:3916

April 24, 2014

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

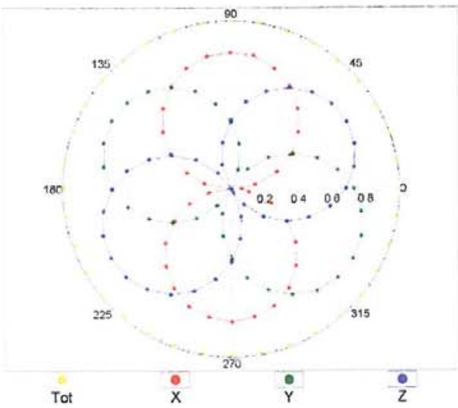
Certificate No: EX3-3916_Apr14

Page 7 of 11

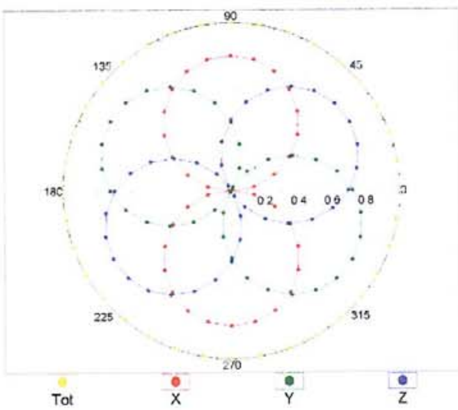
EX3DV4– SN:3916 April 24, 2014

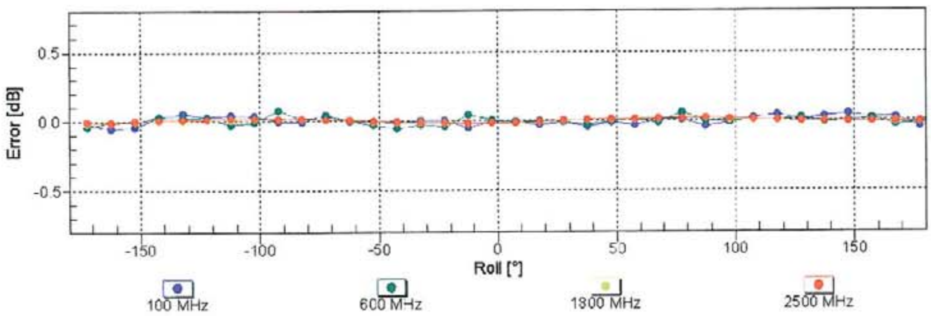
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

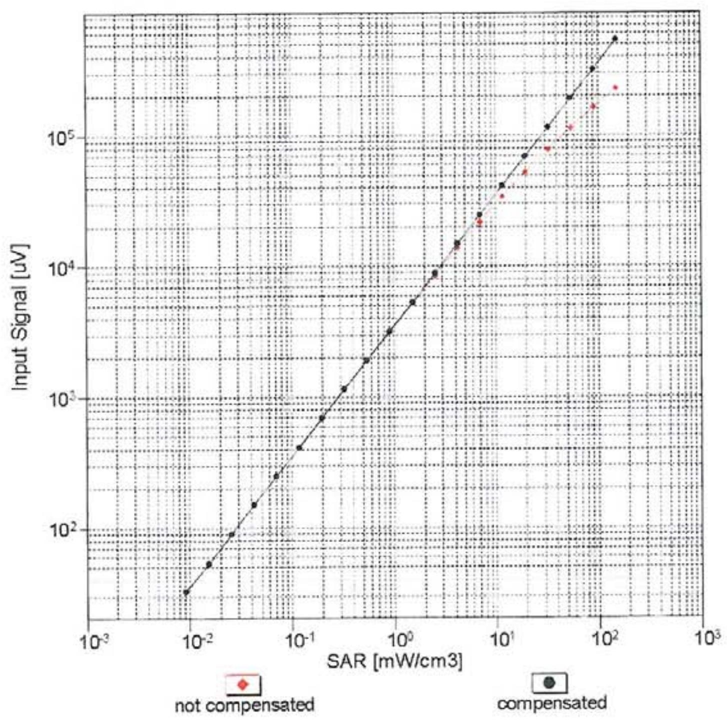


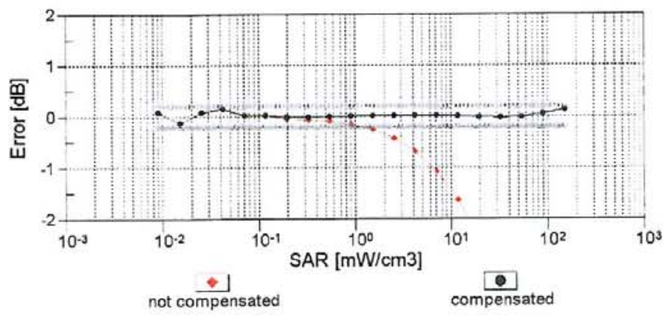


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Certificate No: EX3-3916_Apr14 Page 8 of 11

Dynamic Range f(SAR$_{head}$)
(TEM cell , f_{eval}= 1900 MHz)



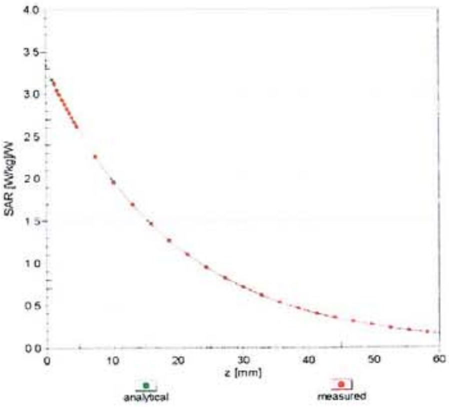


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

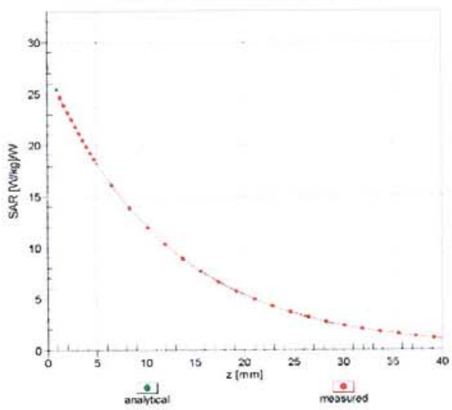
EX3DV4– SN:3916 April 24, 2014

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

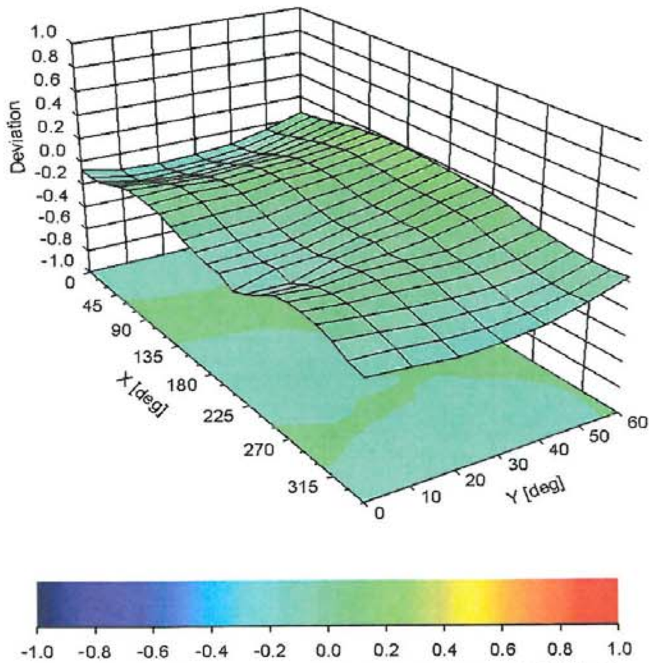


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3916

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-92.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

Attachment 2. – Dipole Calibration Data

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Digital EMC (Dymstec)**

Certificate No: **D835V2-464_Jan14**

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 464
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 22, 2014

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 22, 2014

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Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.6 ± 6 %	0.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.28 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.02 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.6 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.35 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.12 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 Ω - 0.6 jΩ
Return Loss	- 40.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.3 Ω - 2.9 jΩ
Return Loss	- 26.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.382 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 27, 2002