

TEST REPORT



DT&C Co., Ltd.

42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRRFCC1711-0136(1)
2. Customer
 - Name : LG Electronics MobileComm USA, Inc.
 - Address : 1000 Sylvan Ave., Englewood Cliffs, New Jersey, United States, 07632
3. Use of Report : FCC Original Grant
4. Product Name / Model Name : Mobile Phone / DM-01K
FCC ID : ZNFDM01K
5. Test Method Used : IEEE 1528-2013 , FCC SAR KDB Publications (Details in test report)
Test Specification : CFR §2.1093
6. Date of Test : 2017.10.13 ~ 2017.10.19, 2017.11.30
7. Testing Environment : Refer to attached test report.
8. Test Result : Refer to attached test report.

Affirmation	Tested by		Technical Manager	
	Name : ChangWon Lee			

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DT&C Co., Ltd.

2017 . 11 . 30 .

DT&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description
DRRFCC1711-0136	Nov. 16, 2017	Initial issue
DRRFCC1711-0136(1)	Nov. 30, 2017	GPRS Band Retest.

Table of Contents

1. DESCRIPTION OF DEVICE	5
1.1 Guidance Applied	7
1.2 DUT Antenna Locations	7
1.3 Near Field Communications (NFC) Antenna	7
1.4 SAR Test Exclusions Applied	7
1.5 Power Reduction for SAR	7
1.6 Device Serial Numbers	7
2. INTROCUCTION	8
3. DESCRIPTION OF TEST EQUIPMENT	9
3.1 SAR MEASUREMENT SETUP	9
3.2 ES3DV3/EX3DV4Probe Specification	10
3.3 Probe Calibration Process	11
3.3.1 E-Probe Calibration	11
3.4 Data Extrapolation	12
3.5 SAM Twin PHANTOM	13
3.6 Device Holder for Transmitters	13
3.7 Brain & Muscle Simulation Mixture Characterization	14
3.8 SAR TEST EQUIPMENT	15
4. TEST SYSTEM SPECIFICATIONS	16
5. SAR MEASUREMENT PROCEDURE	17
5.1 Measurement Procedure	17
6. DEFINITION OF REFERENCE POINTS	19
6.1 Ear Reference Point	19
6.2 Handset Reference Points	19
7. TEST CONFIGURATION POSITIONS FOR HANDSETS	20
7.1 Device Holder	20
7.2 Positioning for Cheek/Touch	20
7.3 Positioning for Ear / 15 ° Tilt	20
7.4 Body-Worn Accessory Configurations	21
7.5 Wireless Router Configurations	21
8. RF EXPOSURE LIMITS	22
9. FCC MEASUREMENT PROCEDURES	23
9.1 Measured and Reported SAR	23
9.2 Procedures Used to Establish RF Signal for SAR	23
9.3 SAR Measurement Conditions for WCDMA (UMTS)	23
9.3.1 Output Power Verification	23
9.3.2 Head SAR Measurements for Handsets	23
9.3.3 Body SAR Measurements	24
9.3.4 Release 5 HSDPA Data Devices	24
9.3.5 Release 6 HSUPA Data Devices	24
9.4 SAR Testing with 802.11 Transmitters	25
9.4.1 General Device Setup	25
9.4.2 U-NII and U-NII-2A	25
9.4.3 U-NII-2C and U-NII-3	26
9.4.4 Initial Test Position Procedure	26
9.4.5 2.4 GHz SAR Test Requirements	26
9.4.6 OFDM Transmission Mode and SAR Test Channel Selection	26
9.4.7 Initial Test Configuration Procedure	27
9.4.8 Subsequent Test Configuration Procedures	27

10. Nominal and Maximum Output Power Spec and RF Conducted Powers	28
10.1 GSM Nominal and Maximum Output Power Spec and Conducted Powers.....	28
10.2 WCDMA Nominal and Maximum Output Power Spec and Conducted Powers	29
10.3 WLAN Nominal and Maximum Output Power Spec and Conducted Powers.....	30
10.4 Bluetooth Nominal and Maximum Output Power Spec and Conducted Powers.....	34
11. SYSTEM VERIFICATION	36
11.1 Tissue Verification	36
11.2 Test System Verification	38
12. SAR TEST RESULTS	39
12.1 Head SAR Results.....	39
12.2 Standalone Body-Worn SAR Worn SAR Results.....	42
12.3 Standalone Hotspot SAR Results.....	44
12.4 SAR Test Notes	47
13. FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS	49
13.1 Introduction.....	49
13.2 Simultaneous Transmission Procedures.....	49
13.3 Simultaneous Transmission Capabilities	49
13.4 Head SAR Simultaneous Transmission Analysis.....	51
13.5 Body-Worn Simultaneous Transmission Analysis.....	60
13.6 Hotspot SAR Simultaneous Transmission Analysis	69
13.7 Simultaneous Transmission Conclusion	75
14. MEASUREMENT UNCERTAINTIES.....	76
15. CONCLUSION	92
16. REFERENCES	93
Attachment 1. – Probe Calibration Data	95
Attachment 2. – Dipole Calibration Data.....	182
Attachment 3. – SAR SYSTEM VALIDATION	223

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	Mobile Phone				
FCC ID	ZNFD01K				
Equipment model name	DM-01K				
Equipment add model name	N/A				
Equipment serial no.	Identical prototype				
Mode(s) of Operation	GSM 850, GSM 1900, WCDMA 850, 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), Bluetooth, NFC				
TX Frequency Range	Band	Mode	Operating Modes	Bandwidth	Frequency
	GSM 850	GSM/GPRS	Voice/Data	-	824.2 ~ 848.8 MHz
	GSM 1900	GSM/GPRS	Voice/Data	-	1850.2 ~ 1909.8 MHz
	WCDMA 850	WCDMA	Voice/Data	-	826.4 ~ 846.6 MHz
	2.4 GHz W-LAN	802.11b/g/n	Voice/Data	HT20	2412 ~ 2462 MHz
	5.2 GHz W-LAN	802.11a/n/ac	Voice/Data	HT20/VHT20	5180 ~ 5240 MHz
		802.11n/ac	Voice/Data	HT40/VHT40	5190 ~ 5230 MHz
		802.11ac	Voice/Data	VHT80	5210 MHz
	5.3 GHz W-LAN	802.11a/n/ac	Voice/Data	HT20/VHT20	5260 ~ 5320 MHz
		802.11n/ac	Voice/Data	HT40/VHT40	5270 ~ 5310 MHz
		802.11ac	Voice/Data	VHT80	5290 MHz
	5.6 GHz W-LAN	802.11a/n/ac	Voice/Data	HT20/VHT20	5500 ~ 5700 MHz
		802.11n/ac	Voice/Data	HT40/VHT40	5510 ~ 5670 MHz
		802.11ac	Voice/Data	VHT80	5530 MHz
	5.8 GHz W-LAN	802.11a/n/ac	Voice/Data	HT20/VHT20	5745 ~ 5825 MHz
		802.11n/ac	Voice/Data	HT40/VHT40	5755 ~ 5795 MHz
		802.11ac	Voice/Data	VHT80	5775 MHz
	Bluetooth	-	Data	-	2402 ~ 2480 MHz
	NFC	-	Data	-	13.56 MHz
RX Frequency Range	GSM 850	GSM/GPRS		-	869.2 ~ 893.8 MHz
	GSM 1900	GSM/GPRS	Voice/Data	-	1930.2 ~ 1989.8 MHz
	WCDMA 850	WCDMA	Voice/Data	-	871.4 ~ 891.6 MHz
	2.4 GHz W-LAN	802.11b/g/n	Voice/Data	HT20	2412 ~ 2462 MHz
	5.2 GHz W-LAN	802.11a/n/ac	Voice/Data	HT20/VHT20	5180 ~ 5240 MHz
		802.11n/ac	Voice/Data	HT40/VHT40	5190 ~ 5230 MHz
		802.11ac	Voice/Data	VHT80	5210 MHz
	5.3 GHz W-LAN	802.11a/n/ac	Voice/Data	HT20/VHT20	5260 ~ 5320 MHz
		802.11n/ac	Voice/Data	HT40/VHT40	5270 ~ 5310 MHz
		802.11ac	Voice/Data	VHT80	5290 MHz
	5.6 GHz W-LAN	802.11a/n/ac	Voice/Data	HT20/VHT20	5500 ~ 5700 MHz
		802.11n/ac	Voice/Data	HT40/VHT40	5510 ~ 5670 MHz
		802.11ac	Voice/Data	VHT80	5530 MHz
	5.8 GHz W-LAN	802.11a/n/ac	Voice/Data	HT20/VHT20	5745 ~ 5825 MHz
		802.11n/ac	Voice/Data	HT40/VHT40	5755 ~ 5795 MHz
		802.11ac	Voice/Data	VHT80	5775 MHz
	Bluetooth	-	Data	-	2402 ~ 2480 MHz
	NFC	-	Data	-	13.56 MHz

Equipment Class	Band	Reported SAR		
		1g SAR (W/kg)		
		Head	Body-Worn	Hotspot
PCE	GSM 850	0.20	0.46	-
PCE	GPRS 850	0.23	0.69	0.69
PCE	GSM 1900	0.13	0.26	-
PCE	GPRS 1900	0.18	0.47	0.47
PCE	WCDMA 850	0.21	0.51	0.51
DTS	2.4 GHz W-LAN	0.80	0.13	0.19
U-NII-1	5.2 GHz W-LAN	-	-	0.51
U-NII-2A	5.3 GHz W-LAN	0.10	0.43	-
U-NII-2C	5.6 GHz W-LAN	< 0.1	0.13	-
U-NII-3	5.8 GHz W-LAN	0.16	0.13	0.13
DSS	Bluetooth	0.25	< 0.1	< 0.1
Simultaneous SAR per KDB 690783 D01v01r03		0.99	1.15	1.22
FCC Equipment Class	Licensed Portable Transmitter Held to Ear (PCE) Part 15 Spread Spectrum Transmitter(DSS) Digital Transmission System(DTS) Unlicensed National Information Infrastructure (UNII)			
Date(s) of Tests	2017.10.13 ~ 2017.10.19, 2017.11.30			
Antenna Type	Internal Type Antenna			
Functions	- GSM/GPRS (GPRS 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 / GSM, WCDMA voice & BT / GPRS, WCDMA & WLAN / GPRS, WCDMA & BT. - VoIP is supported. - W-LAN 2.4GHz is supported Hotspot. - W-LAN 5 GHz is supported Hotspot in UNII B1, B3.			

1.1 Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D01v03r01 (3G SAR Procedures)
- FCC KDB Publication 941225 D06v02r01 (Hotspot Mode)
- FCC KDB Publication 248227 D01v02r02 (802.11 Wi-Fi SAR)
- FCC KDB Publication 447498 D01v06 (General RF Exposure Guidance)
- FCC KDB Publication 648474 D04v01r03 (Handset SAR)
- FCC KDB Publication 690783 D01v01r03 (SAR Listings on Grants)
- FCC KDB Publication 865664 D01v01r04 (SAR Measurement 100 MHz to 6 GHz)
- FCC KDB Publication 865664 D02v01r02 (RF Exposure Reporting)
- October 2013 TCB Workshop Notes (GPRS testing criteria)
- April 2015 TCB Workshop Notes (Simultaneous transmission summation clarified)
- October 2016 TCB Workshop Notes (Bluetooth Duty Factor)

1.2 DUT Antenna Locations

The overall dimensions of this device are > 9 x 5 cm. A diagram showing the location of the device of the device antenna can be found in ZNFD01K_Antenna Location.pdf. Since the diagonal dimension of this device is < 160 mm and the diagonal display is < 150 mm, it is not considered a “phablet”.

Mode	Device Sides for SAR Testing (Front View)					
	Top	Bottom	Front	Rear	Right	Left
GSM 850	X	O	O	O	O	X
GSM 1900	X	O	O	O	X	O
WCDMA 850	X	O	O	O	O	X
2.4G W-LAN	O	X	O	O	X	O
5G W-LAN	O	X	O	O	X	O

Note 1: Particular DUT edges were not required to be evaluated for Hotspot SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v02r01. The antenna document shows the distances between the transmit antennas and the edges of the device.

Note 2: WLAN Hotspot UNII-1, 3 supported.

1.3 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the back side. The SAR tests were performed with NFC antenna already incorporated. A diagram showing the location of the device of the device antenna can be found in ZNFD01K_Antenna Location.pdf.

1.4 SAR Test Exclusions Applied

(A) 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 Data.

1.5 Power Reduction for SAR

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

1.6 Device Serial Numbers

Band & Mode	Head Serial Number	Body 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
2.4 GHz WLAN	FCC #2	FCC #2	FCC #2
5 GHz WLAN	FCC #2	FCC #2	FCC #2
Bluetooth	FCC #2	FCC #2	-

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 C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. The measurement procedure described in IEEE/ANSI C95.3-2002 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/m³)
- 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 each 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 7 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.

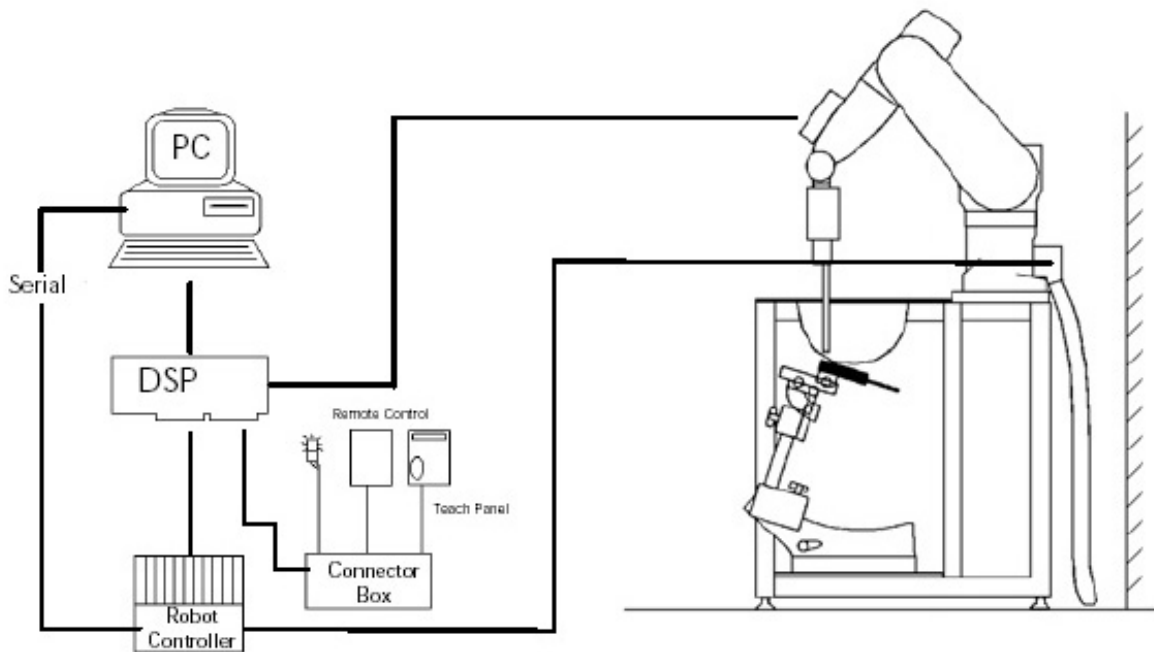


Figure 3.1 SAR Measurement System Setup

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 ES3DV3/EX3DV4Probe Specification

Calibration	In air from 10 MHz to 4 GHz/10 MHz to 6 GHz In brain and muscle simulating tissue at Frequencies of 750 MHz, 835 MHz, 900 MHz, 1750 MHz, 1900 MHz, 2450 MHz, 2600 MHz/ 2450 MHz, 2600 MHz, 5200 MHz, 5300 MHz, 5500 MHz, 5600 MHz, 5800 MHz
Frequency	10 MHz to 4 GHz/10 MHz to 6 GHz
Linearity	± 0.2 dB(30 MHz to 4 GHz/30 MHz to 6 GHz)
Dynamic	10 μ W/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	3.9 mm/2.5 mm
Distance from probe tip to sensor center	2.0 mm/1.0 mm
Application	SAR Dosimetry Testing Compliance tests of mobile phones

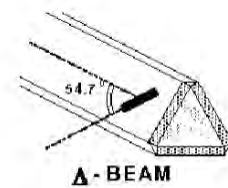


Figure 3.2 Triangular Probe Configurations



Figure 3.3 Probe Thick-Film Technique

The SAR measurements were conducted with the dosimetric probe ES3DV3 and 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.

DAE System

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 (Norm X, Norm Y, Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a waveguide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees.

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/cm³ for brain tissue)

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

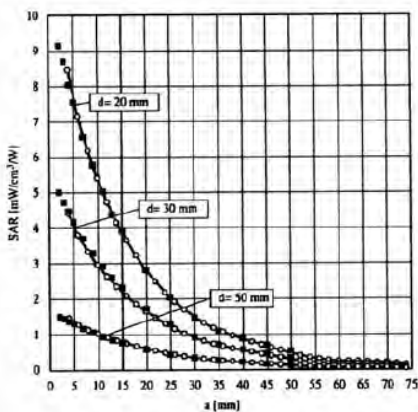


Figure 3.4 E-Field and Temperature Measurements at 900MHz

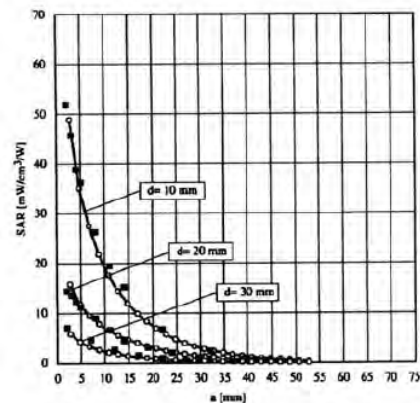


Figure 3.5 E-Field and Temperature Measurements at 1800MHz

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/cm³

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

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

with P_{free} = equivalent power density of a plane wave in W/cm²
 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 along the mid-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.

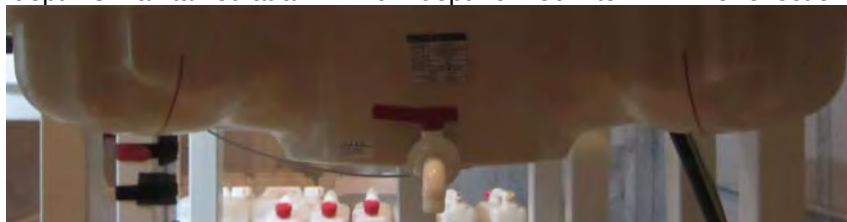


Figure 3.7 Sam Twin Phantom shell

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
☒	SEMITEC Engineering	SEMITEC	N/A	N/A	N/A	Shield Room
☒	Robot	SCHMID	TX90XL	N/A	N/A	F13/5P9GA1/A/01
☒	Robot	SCHMID	TX90XL	N/A	N/A	F13/5RR2A1/A/01
☒	Robot Controller	SCHMID	CS8C	N/A	N/A	F13/5P9GA1/C/01
☒	Robot Controller	SCHMID	CS8C	N/A	N/A	F13/5RR2A1/C/01
☒	Joystick	SCHMID	N/A	N/A	N/A	S-12450905
☒	Joystick	SCHMID	N/A	N/A	N/A	S-13200990
☒	IntelCorei7-3770 3.40 GHz Windows 7 Professional	N/A	N/A	N/A	N/A	N/A
☒	IntelCorei7-3770 3.40 GHz 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
☒	Probe Alignment Unit LB	N/A	N/A	N/A	N/A	SE UKS 030 AA
☒	Device Holder	SCHMID	Holder	N/A	N/A	SD000H01HA
☒	Device Holder	SCHMID	Holder	N/A	N/A	SD000H01HA
☒	Twin SAM Phantom	SCHMID	QD000P40CD	N/A	N/A	1783
☒	Twin SAM Phantom	SCHMID	QD000P40CD	N/A	N/A	1782
☒	Twin SAM Phantom	SCHMID	QD000P40CD	N/A	N/A	1786
☒	Data Acquisition Electronics	SCHMID	DAE3V1	2017-01-20	2018-01-20	519
☒	Data Acquisition Electronics	SCHMID	DAE4V1	2017-07-24	2018-07-24	1335
☒	Data Acquisition Electronics	SCHMID	DAE4V1	2017-08-16	2018-08-16	1396
☒	Dosimetric E-Field Probe	SCHMID	ES3DV3	2017-03-21	2018-03-21	3328
☒	Dosimetric E-Field Probe	SCHMID	EX3DV4	2017-07-26	2018-07-26	3930
☒	Dosimetric E-Field Probe	SCHMID	ES3DV3	2017-09-18	2018-09-18	3327
☒	835MHz SAR Dipole	SCHMID	D835V2	2017-09-21	2019-09-21	464
☒	1900MHz SAR Dipole	SCHMID	D1900V2	2017-09-20	2019-09-20	5d029
☒	2450MHz SAR Dipole	SCHMID	D2450V2	2017-09-19	2019-09-19	726
☒	5GHz SAR Dipole	SCHMID	D5GHzV2	2017-03-17	2019-03-17	1103
☒	Network Analyzer	Agilent	E5071C	2016-12-02	2017-12-02	MY46111534
☒	Signal Generator	Agilent	E4438C	2017-09-05	2018-09-05	US41461520
☒	Amplifier	EMPOWER	BBS3Q7ELU	2017-09-06	2018-09-06	1020
☒	High Power RF Amplifier	EMPOWER	BBS3Q8CCJ	2017-09-05	2018-09-05	1005
☒	Power Meter	HP	EPM-442A	2017-01-04	2018-01-04	GB37170267
☒	Power Meter	HP	EPM-442A	2017-04-11	2018-04-11	GB37170413
☒	Power Sensor	HP	8481A	2017-01-04	2018-01-04	3318A96566
☒	Power Sensor	HP	8481A	2017-01-04	2018-01-04	2702A65976
☒	Power Sensor	HP	8481A	2017-04-11	2018-04-11	3318A96332
☒	Dual Directional Coupler	Agilent	778D-012	2017-01-05	2018-01-05	50228
☒	Directional Coupler	HP	772D	2017-07-26	2018-07-26	2889A01064
☒	Low Pass Filter 1.5GHz	Micro LAB	LA-15N	2017-01-04	2018-01-04	N/A
☒	Low Pass Filter 3.0GHz	Micro LAB	LA-30N	2017-09-05	2018-09-05	N/A
☒	Low Pass Filter 6.0GHz	Micro LAB	LA-60N	2017-01-04	2018-01-04	03942
☒	Attenuators(3 dB)	Agilent	8491B	2017-04-11	2018-04-11	MY39260700
☒	Attenuators(10 dB)	WEINSCHL	23-10-34	2017-01-04	2018-01-04	BP4387
☒	Dielectric Probe kit	SCHMID	DAK-3.5	2016-11-17	2017-11-17	1092
☒	Dielectric Probe kit	SCHMID	DAK-3.5	2017-07-26	2018-07-26	1046
☒	8960 Series 10 Wireless Comms. Test Set	Agilent	E5515C	2017-09-05	2018-09-05	GB41321164
☒	Power Splitter	Anritsu	K241B	2017-01-11	2018-01-11	1301183
☒	Bluetooth Tester	TESCOM	TC-3000B	2017-01-04	2018-01-04	3000B770243

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: TX90XL
Repeatability	0.02 mm
No. of axis	6

Data Acquisition Electronic (DAE) System

Cell Controller

Processor	Intel Core i7-3770
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 DAE3 / 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	ES3DV3 S/N: 3328, 3327 / EX3DV4 S/N: 3930
Construction	Triangular core fiber optic detection system
Frequency	10 MHz to 4 GHz/10 MHz to 6 GHz
Linearity	± 0.2 dB (30 MHz to 4 GHz/30 MHz to 6 GHz)

Phantom

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



Figure 4.1 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 D01v01r04 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 D01v01r04 (See Table 5.1) and IEEE1528-2013.
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 D01v01r04 (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 5.1. 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.

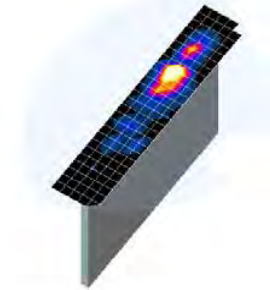


Figure 5.1
Sample SAR Area Scan

			$\leq 3 \text{ GHz}$	$> 3 \text{ GHz}$
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			$5 \text{ mm} \pm 1 \text{ mm}$	$\frac{1}{2} \cdot \delta \cdot \ln(2) \text{ mm} \pm 0.5 \text{ mm}$
Maximum probe angle from probe axis to phantom surface normal at the measurement location			$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$			$\leq 2 \text{ GHz}: \leq 15 \text{ mm}$ $2 - 3 \text{ GHz}: \leq 12 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 12 \text{ mm}$ $4 - 6 \text{ GHz}: \leq 10 \text{ mm}$
			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$			$\leq 2 \text{ GHz}: \leq 8 \text{ mm}$ $2 - 3 \text{ GHz}: \leq 5 \text{ mm}^*$	$3 - 4 \text{ GHz}: \leq 5 \text{ mm}^*$ $4 - 6 \text{ GHz}: \leq 4 \text{ mm}^*$
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{\text{Zoom}}(n)$		$\leq 5 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 4 \text{ mm}$ $4 - 5 \text{ GHz}: \leq 3 \text{ mm}$ $5 - 6 \text{ GHz}: \leq 2 \text{ mm}$
	graded grid	$\Delta z_{\text{Zoom}}(1)$: between 1 st two points closest to phantom surface	$\leq 4 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 3 \text{ mm}$ $4 - 5 \text{ GHz}: \leq 2.5 \text{ mm}$ $5 - 6 \text{ GHz}: \leq 2 \text{ mm}$
		$\Delta z_{\text{Zoom}}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1) \text{ mm}$	
Minimum zoom scan volume	x, y, z		$\geq 30 \text{ mm}$	$3 - 4 \text{ GHz}: \geq 28 \text{ mm}$ $4 - 5 \text{ GHz}: \geq 25 \text{ mm}$ $5 - 6 \text{ GHz}: \geq 22 \text{ mm}$
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.				
* When zoom scan is required and the <u>reported</u> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB Publication 447498 is $\leq 1.4 \text{ W/kg}$, $\leq 8 \text{ mm}$, $\leq 7 \text{ mm}$ and $\leq 5 \text{ mm}$ zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

Table 5.1 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04^{*}

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 6.1. 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.

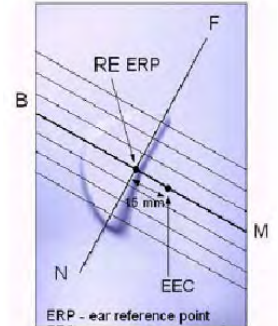


Figure 6.1
Close-up side view
of ERP

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 then 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

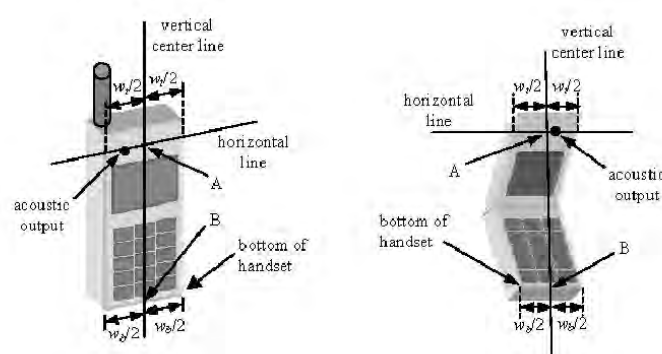


Figure 6.3 Handset Vertical Center & Horizontal Line Reference Points

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 $\epsilon = 3$ and loss tangent $\delta = 0.02$.

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 then rotated around the vertical centerline until the phone (horizontal line) was symmetrical with 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 15 degree.
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).

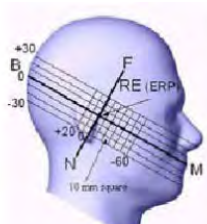


Figure 7.2 Side view w/relevant markings



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 7.4). Per FCC KDB Publication 648474 D04v01r03, 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 D01v06 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 $> 1.2 \text{ W/kg}$, 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.

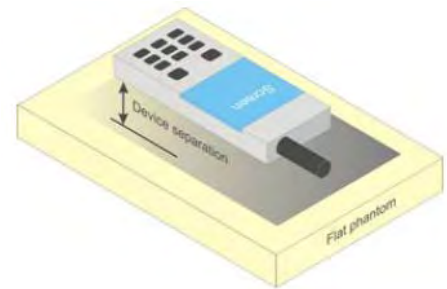


Figure 7.4 Sample Body-Worn Diagram

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 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 D06v02r01 where SAR test considerations for handsets ($L \times W \geq 9 \text{ cm} \times 5 \text{ cm}$) are based on a composite test separation distance of 10 mm from the front, rear 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 transmitter 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 KDB Publication 447498 D01v06 procedures. The "Portable Hotspot" feature on the handset was not activated during SAR assessment, 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 C95.1-1992

	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 D01v06, 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 D01v03r01.

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 Release 5 HSDPA Data Devices

The following procedures are applicable to HSDPA data devices operating under 3GPP Release 5. SAR is required for devices in body-worn accessory and other body exposure conditions, including handsets and data modems operating in various electronic devices. HSDPA operates in conjunction with WCDMA and requires an active DPCCH. The default test configuration is to measure SAR in WCDMA with HSDPA remain inactive, to establish a radio link between the test device and a communication test set using a 12.2 kbps RMC configured in Test Loop Mode 1. SAR for HSDPA is selectively measured using the highest reported SAR configuration in WCDMA, with an FRC in H-set 1 and a 12.2 kbps RMC. SAR is selectively confirmed for other physical channel configurations (DPCCH & DPDCHn) according to exposure conditions, device operating capabilities and maximum output power specified for production units, including tune-up tolerance by applying the 3G SAR test reduction procedures. Maximum output power is verified according to the applicable versions of 3GPP TS 34.121. SAR must be measured based on these maximum output conditions and requirements in KDB Publication 447498, with respect to the UE Categories, and explained in the SAR report. When Maximum Power Reduction (MPR) applies, the implementations must be clearly identified in the SAR report to support test results according to Cubic Metric (CM) and, as appropriate, Enhanced MPR (E-MPR) requirements.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	$\beta_{hs}^{(1)}$	CM (dB) ⁽²⁾
1	2/15	15/15	64	2/15	4/15	0.0
2	12/15 ⁽³⁾	15/15 ⁽³⁾	64	12/15 ⁽³⁾	24/15	1.0
3	15/15	8/15	64	15/8	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5
Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$ Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. Note 3: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$.						

Figure 9.1 Table 1

9.3.5 Release 6 HSUPA Data Devices

The following procedures are applicable to HSPA (HSUPA/HSDPA) data devices operating under 3GPP Release 6. SAR is required for devices in body-worn accessory and other body exposure conditions, including handsets and data modems operating in various electronic devices. HSUPA operates in conjunction with WCDMA and HSDPA. SAR is initially measured in WCDMA test configurations with HSPA remain inactive. The default test configuration is to establish a radio link between the test device and a communication test set to configure a 12.2 kbps RMC in Test Loop Mode 1. SAR for HSPA is selectively measured with HS-DPCCH, E-DPCCH and E-DPDCH, all enabled, along with a 12.2 kbps RMC using the highest reported SAR configuration in WCDMA with 12.2 kbps RMC only.

An FRC is configured according to HS-DPCCH Sub-test 1 using H-set 1 and QPSK. HSPA is configured according to E-DCH Sub-test 5 requirements. SAR for other HSPA sub-test configurations is confirmed selectively according to exposure conditions, E-DCH UE Category and maximum output power of production units, including tune-up tolerance by applying the 3G SAR test reduction procedure. Maximum output power is verified according to procedures in applicable versions of 3GPP TS 34.121. SAR must be measured based on these maximum output conditions and requirements in KDB Publication 447498, with respect to the UE Categories for HS-DPCCH and HSPA, and explained in the SAR report. When Maximum Power Reduction (MPR) applies, the implementations must be clearly identified in the SAR report to support test results according to Cubic Metric (CM) and, as appropriate, Enhanced MPR (E-MPR) requirements.

Sub-test	β_c	β_d	β_a (SF)	β_c/β_d	$\beta_{hs}^{(1)}$	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	$\beta_{ed}: 47/15$ $\beta_{ed}: 47/15$	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 ⁽⁴⁾	15/15 ⁽⁴⁾	64	15/15 ⁽⁴⁾	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.

Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.

Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 14/15$ and $\beta_d = 15/15$.

Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.

Note 6: β_{ed} cannot be set directly; it is set by Absolute Grant Value.

Figure 9.2 Table 2

9.4 SAR Testing with 802.11 Transmitters

The 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 D01v02r02 for more details.

9.4.1 General Device Setup

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

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92-96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

9.4.2 U-NII and U-NII-2A

For devices that operate in only one of the U-NII-1 and U-NII-2A bands, the normally required SAR procedures for OFDM configurations are applied. For devices that operate in both U-NII bands using the same transmitter and antenna(s), SAR test reduction is determined according to the following, with respect to the highest reported SAR and maximum output power specified for production units. The procedures are applied independently to each exposure configuration; for example, head, body, hotspot mode etc.

- 1) When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
- 2) When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.

9.4.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements.

When Terminal Doppler Weather Rader (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification.

Unless band gap channels are permanently disabled, SAR must be considered for these channels. When band gap channels are disabled, each band is tested independently according to the normally required OFDM SAR measurements and probe calibration frequency points requirements.

9.4.4 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all position in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8 W/kg or all test position are measured.

9.4.5 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

- 1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
- 2) When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

9.4.6 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 GHz and 5 GHz bands, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a and 802.11n or 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n or 802.11g then 802.11n is used for SAR measurement. When the maximum output power were the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

9.4.7 Initial Test Configuration Procedure

For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. The channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required.

Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured.

9.4.8 Subsequent Test Configuration Procedures

For OFDM configurations, in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure, when applicable. When the highest reported SAR for the initial test configuration, adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power is ≤ 1.2 W/kg, no additional SAR testing for the subsequent test configurations is required.

10. Nominal and Maximum Output Power Spec and RF Conducted Powers

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 D01v06

10.1 GSM Nominal and Maximum Output Power Spec and Conducted Powers

Band & Mode		Voice[dBm]	Burst Average GMSK [dBm]			
		1 TX Slot	1 TX Slot	2 TX Slot	3 TX Slot	4 TX Slot
GSM/GPRS 850	Maximum	33.7	33.7	32.7	30.7	29.2
	Nominal	33.2	33.2	32.2	30.2	28.7
GSM/GPRS 1900	Maximum	30.7	30.7	29.7	27.7	26.2
	Nominal	30.2	30.2	29.2	27.2	25.7

Table 10.1.1 GSM Nominal and Maximum Output Power Spec

Band	Channel	Maximum Burst-Averaged Output Power(dBm)				
		Voice	GPRS Data (GMSK)			
		GSM CS 1 Slot	GPRS 1 TX Slot	GPRS 2 TX Slot	GPRS 3 TX Slot	GPRS 4 TX Slot
GSM850	128	33.4	33.4	32.7	30.6	29.1
	190	33.5	33.5	32.7	30.5	29.0
	251	33.6	33.6	32.6	30.4	29.0
PCS 1900	512	30.2	30.2	29.2	27.3	25.6
	661	30.3	30.3	29.3	27.4	25.7
	810	30.4	30.4	29.4	27.4	25.8
Band	Channel	Calculated Maximum Frame-Averaged Output Power(dBm)				
		Voice	GPRS Data (GMSK)			
		GSM CS 1 Slot	GPRS 1 TX Slot	GPRS 2 TX Slot	GPRS 3 TX Slot	GPRS 4 TX Slot
GSM850	128	24.37	24.37	26.68	26.34	26.09
	190	24.47	24.47	26.68	26.24	25.99
	251	24.57	24.57	26.58	26.14	25.99
PCS 1900	512	21.17	21.17	23.18	23.04	22.59
	661	21.27	21.27	23.28	23.14	22.69
	810	21.37	21.37	23.38	23.14	22.79
GSM850	Frame Avg. Targets:	24.17	24.17	26.18	25.94	25.69
PCS 1900		21.17	21.17	23.18	22.94	22.69

Table 10.1.2 GSM Conducted Power

Note:

- 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.
- 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.

GPRS Multislot class: 12 (max 4 TX Uplink slots)
DTM Multislot Class: N/A

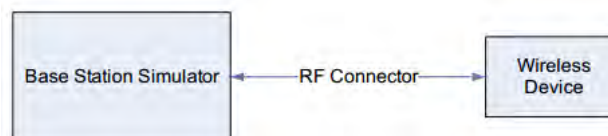


Figure 10.1 Power Measurement Setup

10.2 WCDMA Nominal and Maximum Output Power Spec and Conducted Powers

Band & Mode		Modulated Average [dBm]									
		3GPP WCDMA	3GPP HSDPA				3GPP HSUPA				
		Rel. 99	Subtest 1	Subtest 2	Subtest 3	Subtest 4	Subtest 1	Subtest 2	Subtest 3	Subtest 4	Subtest 5
WCDMA 850	Maximum	25.2	25.2	25.2	24.7	24.7	25.2	23.2	24.2	23.2	25.2
	Nominal	24.7	24.7	24.7	24.2	24.2	24.7	22.7	23.7	22.7	24.7

Table 10.2.1 WCDMA Nominal and Maximum Output Power Spec

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band (dBm)			3GPP MPR (dB)
			4132	4183	4233	
99	WCDMA	12.2 kbps RMC	25.09	25.08	25.05	-
99		12.2 kbps AMR	25.05	25.07	25.02	-
5	HSDPA	Subtest 1	25.07	25.07	25.04	0
5		Subtest 2	25.06	25.07	25.02	0
5		Subtest 3	24.56	24.57	24.53	0.5
5		Subtest 4	24.54	24.58	24.53	0.5
6	HSUPA	Subtest 1	24.97	24.99	24.98	0
6		Subtest 2	23.09	23.10	23.06	2
6		Subtest 3	24.09	24.10	24.05	1
6		Subtest 4	23.10	23.10	23.05	2
6		Subtest 5	25.06	25.07	25.04	0

Table 10.2.2 WCDMA Conducted Power

WCDMA SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03r01. 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.



Figure 10.2 Power Measurement Setup

10.3 WLAN Nominal and Maximum Output Power Spec and Conducted Powers

Band (GHz)	Mode	Ch	Modulated Average[dBm]	
			Maximum	Nominal
2.4	802.11b	1	17.5	16.5
		2	17.5	16.5
		3~9	17.5	16.5
		10	17.5	16.5
		11	17.5	16.5
	802.11g	1	15.5	14.5
		2	16.0	15.0
		3~9	16.5	15.5
		10	15.5	14.5
		11	15.0	14.0
	802.11n	1	14.5	13.5
		2	15.0	14.0
		3~9	15.5	14.5
		10	14.5	13.5
		11	14.0	13.0

Table 10.3.1 WLAN 2.4GHz Nominal and Maximum Output Power Spec

Mode	Freq.	Channel	IEEE 802.11 (2.4 GHz) Conducted Power
	(MHz)		(dBm)
802.11b	2412	1	16.85
	2437	6	<u>17.10</u>
	2462	11	16.90
802.11g	2412	1	15.13
	2437	6	15.85
	2462	11	14.74
802.11n (HT-20)	2412	1	14.15
	2437	6	14.81
	2462	11	13.53

Table 10.3.2 IEEE 802.11 Average RF Power

Band (GHz)	Mode	Ch	Modulated Average[dBm]	
			Maximum	Nominal
5	802.11a	36	15.5	14.5
		40-48	15.5	14.5
		52-60	15.5	14.5
		64	15.5	14.5
		100	15.5	14.5
		104-140	15.5	14.5
		149-165	15.5	14.5
	802.11n/ac (20MHz)	36	14.5	13.5
		40-48	14.5	13.5
		52-60	14.5	13.5
		64	14.5	13.5
		100	14.5	13.5
		104-140	14.5	13.5
		149-165	14.5	13.5
	802.11n/ac (40MHz)	38	13.5	12.5
		46	13.5	12.5
		54	13.5	12.5
		62	13.5	12.5
		102	13.5	12.5
		110	13.5	12.5
		134	13.5	12.5
		151~159	13.5	12.5
	802.11ac (80MHz)	42	12.5	11.5
		58	12.5	11.5
		106	12.5	11.5
		155	12.5	11.5

Table 10.3.3 WLAN 5GHz Nominal and Maximum Output Power Spec

Mode	Freq.	Channel	IEEE 802.11a (5 GHz) Conducted Power
	(MHz)		(dBm)
802.11a	5180	36	<u>15.45</u>
	5200	40	15.32
	5220	44	15.19
	5240	48	15.31
	5260	52	<u>15.45</u>
	5280	56	15.37
	5300	60	15.41
	5320	64	15.43
	5500	100	<u>15.39</u>
	5580	116	15.35
	5660	132	15.29
	5700	140	15.21
	5745	149	15.35
	5785	157	<u>15.42</u>
	5825	165	15.37

Table 10.3.4 IEEE 802.11a Average RF Power

Mode	Freq.	Channel	IEEE 802.11n HT20 (5 GHz) Conducted Power
	(MHz)		(dBm)
802.11n (HT-20)	5180	36	14.41
	5200	40	14.38
	5220	44	14.32
	5240	48	14.37
	5260	52	14.23
	5280	56	14.31
	5300	60	14.37
	5320	64	14.39
	5500	100	14.11
	5580	116	14.45
	5660	132	14.14
	5700	140	14.19
	5745	149	14.34
	5785	157	14.22
	5825	165	13.97

Table 10.3.5 IEEE 802.11n HT20 Average RF Power

Mode	Freq.	Channel	IEEE 802.11ac VHT20 (5 GHz) Conducted Power
	(MHz)		(dBm)
802.11ac (VHT-20)	5180	36	14.46
	5200	40	14.44
	5220	44	14.40
	5240	48	14.46
	5260	52	14.46
	5280	56	14.41
	5300	60	14.46
	5320	64	14.49
	5500	100	14.29
	5580	116	14.42
	5660	132	14.19
	5700	140	14.15
	5745	149	14.48
	5785	157	14.41
	5825	165	14.40

Table 10.3.6 IEEE 802.11ac VHT20 Average RF Power

Mode	Freq.	Channel	IEEE 802.11n HT40 (5 GHz) Conducted Power
	(MHz)		(dBm)
802.11n (HT-40)	5190	38	13.44
	5230	46	13.45
	5270	54	13.38
	5310	62	13.46
	5510	102	13.33
	5550	110	13.37
	5670	134	13.20
	5755	151	13.44
	5795	159	13.40

Table 10.3.7 IEEE 802.11n HT40 Average RF Power

Mode	Freq.	Channel	IEEE 802.11ac VHT40 (5 GHz) Conducted Power
	(MHz)		(dBm)
802.11ac (VHT-40)	5190	38	13.45
	5230	46	13.49
	5270	54	13.43
	5310	62	13.31
	5510	102	13.27
	5550	110	13.34
	5670	134	12.93
	5755	151	13.21
	5795	159	13.50

Table 10.3.8 IEEE 802.11ac VHT40 Average RF Power

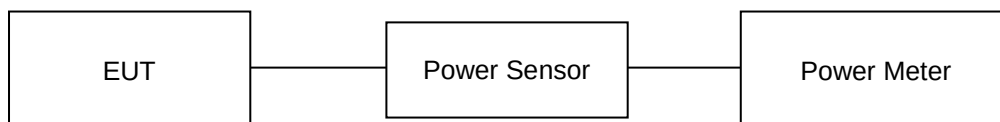
Mode	Freq.	Channel	IEEE 802.11ac VHT80 (5 GHz) Conducted Power
	(MHz)		(dBm)
802.11ac (VHT-80)	5210	42	12.26
	5290	58	12.30
	5530	106	12.30
	5775	155	12.32

Table 10.3.9 IEEE 802.11ac VHT80 Average RF Power

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v02r02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.
- Output Power and SAR is not required for 802.11 g/n HT20 channels when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjust SAR is ≤ 1.2 W/kg.
- The underlined data rate and channel above were tested for SAR.

The average output powers of this device were tested by below configuration.


Figure 10.3 Power Measurement Setup

10.4 Bluetooth Nominal and Maximum Output Power Spec and Conducted Powers

Modulated Average[dBm]		
Bluetooth 1 Mbps	Maximum	11.5
	Nominal	10.5
Bluetooth 2 Mbps	Maximum	11.0
	Nominal	10.0
Bluetooth 3 Mbps	Maximum	11.0
	Nominal	10.0
Bluetooth LE	Maximum	2.0
	Nominal	1.0

Table 10.4.1 Bluetooth Nominal and Maximum Output Power Spec

Channel	Frequency	Burst AVG Output Power (1Mbps)	Frame AVG Output Power (1Mbps)	Burst AVG Output Power (2Mbps)	Frame AVG Output Power (2Mbps)	Burst AVG Output Power (3Mbps)	Frame AVG Output Power (3Mbps)
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)
Low	2402	10.16	9.01	9.56	8.41	9.56	8.41
Mid	2441	11.40	10.25	10.83	9.68	10.81	9.66
High	2480	10.16	9.01	9.58	8.43	9.55	8.40

Table 10.4.2 Bluetooth Average RF Power

Channel	Frequency	Burst AVG Output Power(LE)	Frame AVG Output Power(LE)
	(MHz)	(dBm)	(dBm)
Low	2402	0.84	-1.20
Mid	2440	1.94	-0.10
High	2480	0.51	-1.53

Table 10.4.3 Bluetooth LE 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.

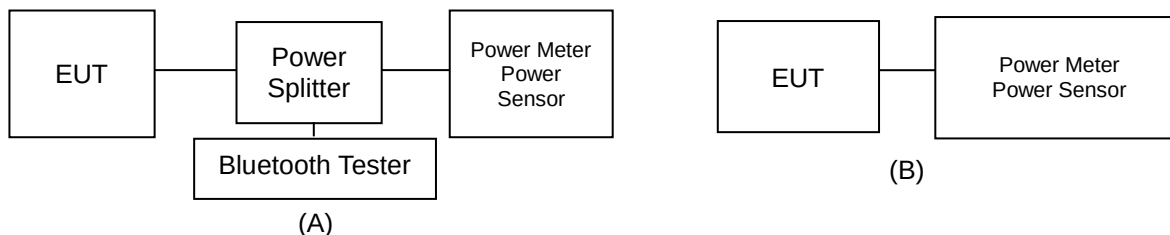


Figure 10.4 Average Power Measurement Setup

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.

- Bluetooth Transmission Plot

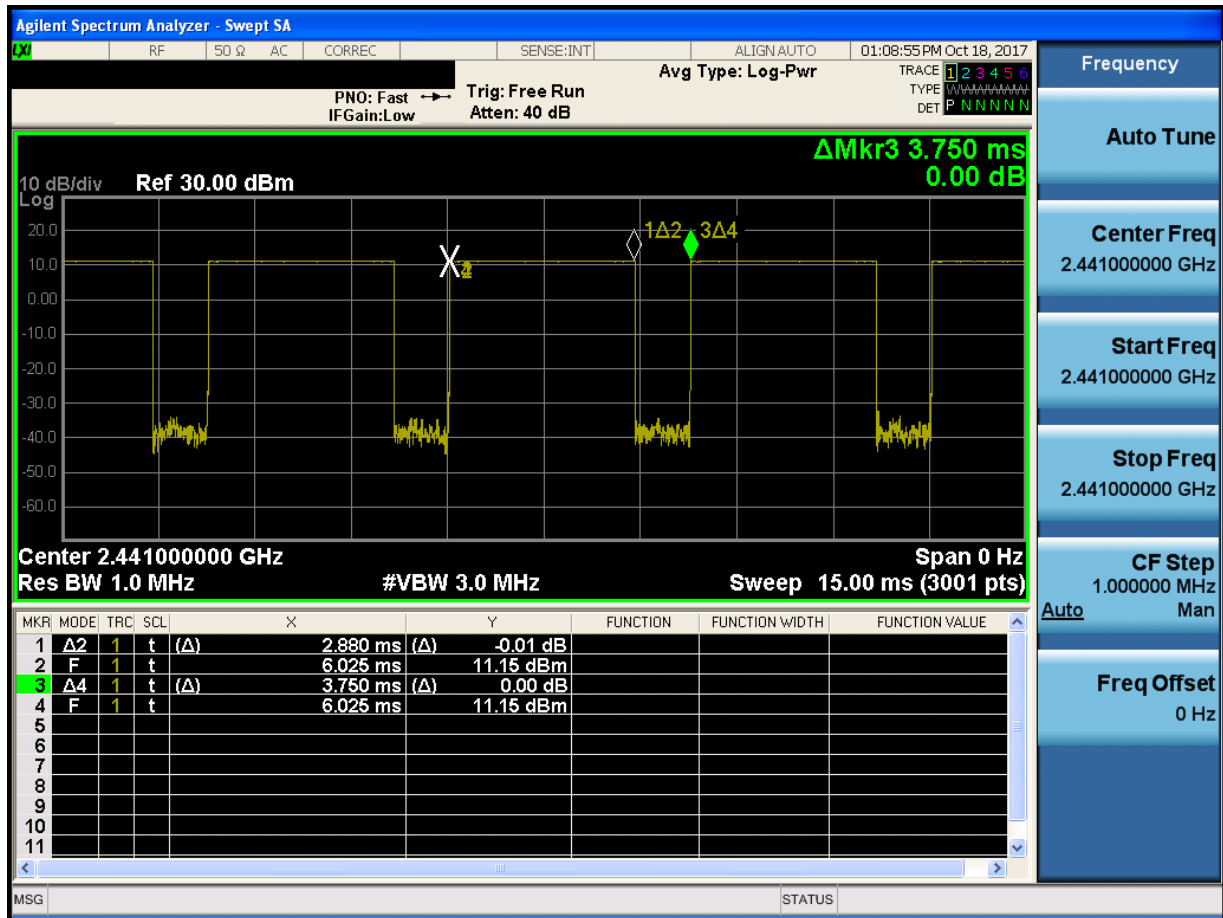


Figure 10.4 Bluetooth Transmission Plot

- Bluetooth Duty Cycle Calculation

$$\text{Duty Cycle} = \text{Pulse/Period} * 100\% = (2.880/3.750) * 100 = 76.8\%$$

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, ϵ_r	Target Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ_r	Measured Conductivity, σ (S/m)	Er Deviation [%]	σ Deviation [%]
Oct. 16. 2017	835 Head	22.3	22.1	824.2	41.552	0.899	40.670	0.869	-2.12	-3.34
				826.4	41.542	0.899	40.657	0.871	-2.13	-3.11
				835.0	41.500	0.900	40.613	0.877	-2.14	-2.56
				836.6	41.500	0.901	40.598	0.879	-2.17	-2.44
				846.6	41.500	0.912	40.521	0.887	-2.36	-2.74
Nov. 30. 2017	835 Head	20.9	20.8	848.8	41.500	0.914	40.506	0.888	-2.40	-2.84
				824.2	41.552	0.899	40.336	0.886	-2.93	-1.45
				835.0	41.500	0.900	40.222	0.897	-3.08	-0.33
				836.6	41.500	0.901	40.207	0.898	-3.12	-0.33
				848.8	41.500	0.914	40.067	0.910	-3.45	-0.44
Oct. 17. 2017	835 Body	21.1	21.0	824.2	55.243	0.969	53.472	0.993	-3.21	2.48
				826.4	55.235	0.969	53.456	0.994	-3.22	2.58
				835.0	55.200	0.970	53.406	1.002	-3.25	3.30
				836.6	55.197	0.971	53.405	1.003	-3.25	3.30
				846.6	55.166	0.984	53.354	1.014	-3.28	3.05
Nov. 30. 2017	835 Body	20.9	21.1	848.8	55.160	0.986	53.337	1.016	-3.30	3.04
				824.2	55.243	0.969	53.336	0.984	-3.45	1.55
				835.0	55.200	0.970	53.223	0.995	-3.58	2.58
				836.6	55.197	0.971	53.207	0.996	-3.61	2.57
				848.8	55.160	0.986	53.086	1.008	-3.76	2.23
Oct. 18. 2017	1900 Head	21.4	21.2	1850.2	40.000	1.400	40.495	1.398	1.24	-0.14
				1880.0	40.000	1.400	40.454	1.427	1.14	1.93
				1900.0	40.000	1.400	40.399	1.447	1.00	3.36
				1909.8	40.000	1.400	40.372	1.457	0.93	4.07
Nov. 30. 2017	1900 Head	21.6	22.4	1850.2	40.000	1.400	41.086	1.396	2.72	-0.29
				1880.0	40.000	1.400	41.055	1.425	2.64	1.79
				1900.0	40.000	1.400	41.010	1.444	2.53	3.14
				1909.8	40.000	1.400	40.987	1.454	2.47	3.86
Oct. 18. 2017	1900 Body	21.4	21.3	1850.2	53.300	1.520	52.886	1.495	-0.78	-1.64
				1880.0	53.300	1.520	52.813	1.525	-0.91	0.33
				1900.0	53.300	1.520	52.746	1.546	-1.04	1.71
				1909.8	53.300	1.520	52.712	1.556	-1.10	2.37
Nov. 30. 2017	1900 Body	21.6	22.2	1850.2	53.300	1.520	52.508	1.513	-1.49	-0.46
				1880.0	53.300	1.520	52.450	1.540	-1.59	1.32
				1900.0	53.300	1.520	52.393	1.557	-1.70	2.43
				1909.8	53.300	1.520	52.362	1.566	-1.76	3.03
Oct. 13. 2017	2450 Head	21.3	21.8	2402.0	39.282	1.757	38.783	1.733	-1.27	-1.37
				2412.0	39.265	1.766	38.753	1.744	-1.30	-1.25
				2437.0	39.222	1.788	38.675	1.772	-1.39	-0.89
				2441.0	39.215	1.792	38.664	1.776	-1.41	-0.89
				2450.0	39.200	1.800	38.636	1.786	-1.44	-0.78
				2462.0	39.184	1.813	38.607	1.798	-1.47	-0.83
Oct. 13. 2017	2450 Body	21.3	22.0	2480.0	39.160	1.832	38.544	1.816	-1.57	-0.87
				2402.0	52.764	1.904	52.608	1.927	-0.30	1.21
				2412.0	52.751	1.914	52.584	1.939	-0.32	1.31
				2437.0	52.717	1.938	52.522	1.970	-0.37	1.65
				2441.0	52.712	1.941	52.512	1.974	-0.38	1.70
				2450.0	52.700	1.950	52.492	1.986	-0.39	1.85
				2462.0	52.685	1.967	52.473	1.999	-0.40	1.63
				2480.0	52.662	1.993	52.422	2.021	-0.46	1.40

MEASURED TISSUE PARAMETERS										
Date(s)	Tissue Type	Ambient Temp.[°C]	Liquid Temp.[°C]	Measured Frequency [MHz]	Target Dielectric Constant, ϵ_r	Target Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ_r	Measured Conductivity, σ (S/m)	Er Deviation [%]	σ Deviation [%]
Oct. 16. 2017	5200 Body	21.8	22.0	5180.0	49.041	5.276	47.305	5.468	-3.54	3.64
				5190.0	49.028	5.288	47.281	5.484	-3.56	3.71
				5200.0	49.014	5.299	47.261	5.500	-3.58	3.79
				5210.0	49.001	5.311	47.243	5.515	-3.59	3.84
				5220.0	48.987	5.323	47.225	5.530	-3.60	3.89
				5230.0	48.974	5.334	47.206	5.544	-3.61	3.94
Oct. 17. 2017	5300 Head	21.8	22.0	5240.0	48.960	5.346	47.183	5.558	-3.63	3.97
				5260.0	35.940	4.720	35.593	4.706	-0.97	-0.30
				5270.0	35.930	4.730	35.576	4.715	-0.99	-0.32
				5280.0	35.920	4.740	35.557	4.725	-1.01	-0.32
				5290.0	35.910	4.750	35.540	4.735	-1.03	-0.32
				5300.0	35.900	4.760	35.522	4.745	-1.05	-0.32
Oct. 17. 2017	5300 Body	21.8	22.1	5310.0	35.890	4.770	35.502	4.755	-1.08	-0.31
				5320.0	35.880	4.780	35.483	4.766	-1.11	-0.29
				5260.0	48.933	5.369	49.519	5.419	1.20	0.93
				5270.0	48.919	5.381	49.500	5.433	1.19	0.97
				5280.0	48.906	5.393	49.479	5.449	1.17	1.04
				5290.0	48.892	5.404	49.461	5.463	1.16	1.09
Oct. 18. 2017	5600 Head	21.6	21.9	5300.0	48.879	5.416	49.441	5.477	1.15	1.13
				5310.0	48.865	5.428	49.420	5.492	1.14	1.18
				5320.0	48.851	5.439	49.401	5.505	1.13	1.21
				5500.0	35.650	4.965	34.602	4.872	-2.94	-1.87
				5510.0	35.635	4.976	34.589	4.885	-2.94	-1.83
				5530.0	35.605	4.997	34.557	4.910	-2.94	-1.74
				5550.0	35.575	5.018	34.530	4.933	-2.94	-1.69
				5580.0	35.530	5.049	34.481	4.968	-2.95	-1.60
Oct. 18. 2017	5600 Body	21.6	22.0	5600.0	35.500	5.070	34.450	4.991	-2.96	-1.56
				5660.0	35.440	5.130	34.357	5.058	-3.06	-1.40
				5670.0	35.430	5.140	34.340	5.067	-3.08	-1.42
				5700.0	35.400	5.170	34.290	5.101	-3.14	-1.33
				5500.0	48.607	5.650	47.572	5.701	-2.13	0.90
				5510.0	48.594	5.661	47.563	5.715	-2.12	0.95
				5530.0	48.566	5.685	47.529	5.745	-2.14	1.06
				5550.0	48.539	5.708	47.504	5.773	-2.13	1.14
Oct. 19. 2017	5800 Head	21.9	22.4	5580.0	48.499	5.743	47.458	5.816	-2.15	1.27
				5600.0	48.471	5.766	47.429	5.845	-2.15	1.37
				5660.0	48.390	5.836	47.342	5.927	-2.17	1.56
				5670.0	48.376	5.848	47.322	5.941	-2.18	1.59
				5700.0	48.336	5.883	47.274	5.984	-2.20	1.72
				5745.0	35.355	5.215	34.217	5.144	-3.22	-1.36
				5755.0	35.345	5.225	34.202	5.157	-3.23	-1.30
Oct. 19. 2017	5800 Body	21.9	22.2	5775.0	35.325	5.245	34.175	5.180	-3.26	-1.24
				5785.0	35.315	5.255	34.156	5.191	-3.28	-1.22
				5795.0	35.305	5.265	34.142	5.202	-3.29	-1.20
				5800.0	35.300	5.270	34.134	5.208	-3.30	-1.18
				5825.0	35.275	5.296	34.092	5.236	-3.35	-1.13
				5745.0	48.275	5.936	47.512	6.081	-1.58	2.44
				5755.0	48.261	5.947	47.497	6.094	-1.58	2.47
Oct. 19. 2017	5800 Body	21.9	22.2	5775.0	48.234	5.971	47.466	6.122	-1.59	2.53
				5785.0	48.220	5.982	47.451	6.136	-1.59	2.57
				5795.0	48.207	5.994	47.437	6.152	-1.60	2.64
				5800.0	48.200	6.000	47.432	6.159	-1.59	2.65
				5825.0	48.166	6.029	47.398	6.195	-1.59	2.75

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 Mtsra).

$$Y = \frac{j2\omega\epsilon_r\epsilon_0}{\ln(b/a)} \int_a^b \int_0^\pi \cos\phi' \frac{\exp[-j\omega r(\mu_0\epsilon_r\epsilon_0)^{1/2}]}{r} d\phi' d\rho' d\rho$$

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 $\pm 10\%$ of the specifications at 835 MHz, 1900 MHz, 2450 MHz and 5GHz by using the SAR Dipole kit(s). (Graphic Plots Attached)

Table 11.2.1 System Verification Results (1g)

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 [%]
C	835	D835V2, SN:464	Oct. 16. 2017	Head	22.3	22.1	3328	250	9.38	2.33	9.32	-0.64
C	835	D835V2, SN:464	Nov. 30. 2017	Head	20.9	20.8	3327	250	9.38	2.48	9.92	5.76
C	835	D835V2, SN:464	Oct. 17. 2017	Body	21.1	21.0	3328	250	9.45	2.39	9.56	1.16
C	835	D835V2, SN:464	Nov. 30. 2017	Body	20.9	21.1	3327	250	9.45	2.53	10.12	7.09
C	1900	D1900V2, SN:5d029	Oct. 18. 2017	Head	21.4	21.2	3328	250	39.2	9.75	39.00	-0.51
D	1900	D1900V2, SN:5d029	Nov. 30. 2017	Head	21.6	22.4	3328	250	39.2	9.73	38.92	-0.71
C	1900	D1900V2, SN: 5d029	Oct. 18. 2017	Body	21.4	21.3	3328	250	39.6	9.31	37.24	-5.96
D	1900	D1900V2, SN: 5d029	Nov. 30. 2017	Body	21.6	22.2	3328	250	39.6	9.38	37.52	-5.25
D	2450	D2450V2, SN: 726	Oct. 13. 2017	Head	21.3	21.8	3930	250	51.9	12.40	49.60	-4.43
D	2450	D2450V2, SN: 726	Oct. 13. 2017	Body	21.3	22.0	3930	250	50.3	13.10	52.40	4.17
D	5200	D5GHzV2, SN:1103	Oct. 16. 2017	Body	21.6	22.2	3930	100	74.1	7.50	75.00	1.21
D	5300	D5GHzV2, SN:1103	Oct. 17. 2017	Head	21.8	22.0	3930	100	84.1	7.98	79.80	-5.11
D	5300	D5GHzV2, SN:1103	Oct. 17. 2017	Body	21.8	22.1	3930	100	76.7	8.01	80.10	4.43
D	5500	D5GHzV2, SN:1103	Oct. 18. 2017	Head	21.6	21.9	3930	100	83.2	7.90	79.00	-5.05
D	5500	D5GHzV2, SN:1103	Oct. 18. 2017	Body	21.6	22.0	3930	100	81.0	8.58	85.80	5.93
D	5800	D5GHzV2, SN:1103	Oct. 19. 2017	Head	21.9	22.4	3930	100	81.1	8.17	81.70	0.74
D	5800	D5GHzV2, SN:1103	Oct. 19. 2017	Body	21.9	22.2	3930	100	77.5	7.90	79.00	1.94

Note1 : System Verification was measured with input 250 mW, 100 mW (5200-5800 MHz) 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.

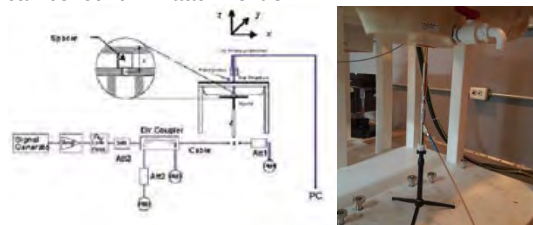


Figure 11.1 Dipole Verification Test Setup Diagram & Photo

12. SAR TEST RESULTS

12.1 Head SAR Results

Table 12.1.1 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	33.7	33.50	0.170	Left Touch	FCC #1	1	1:8.3	0.188	1.047	0.197	A1
836.6	190	GSM850	GSM	33.7	33.50	0.110	Right Touch	FCC #1	1	1:8.3	0.135	1.047	0.141	
836.6	190	GSM850	GSM	33.7	33.50	0.120	Left Tilt	FCC #1	1	1:8.3	0.099	1.047	0.104	
836.6	190	GSM850	GSM	33.7	33.50	0.120	Right Tilt	FCC #1	1	1:8.3	0.088	1.047	0.092	
836.6	190	GSM850	GPRS	30.7	30.50	0.160	Left Touch	FCC #1	3	1:2.77	0.216	1.047	0.226	A2
836.6	190	GSM850	GPRS	30.7	30.50	0.000	Right Touch	FCC #1	3	1:2.77	0.179	1.047	0.187	
836.6	190	GSM850	GPRS	30.7	30.50	0.120	Left Tilt	FCC #1	3	1:2.77	0.088	1.047	0.092	
836.6	190	GSM850	GPRS	30.7	30.50	0.060	Right Tilt	FCC #1	3	1:2.77	0.098	1.047	0.103	
ANSI / IEEE C95.1-1992- SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Head 1.6 W/kg (mW/g) averaged over 1 gram						

Table 12.1.2 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	30.7	30.30	0.130	Left Touch	FCC #1	1	1:8.3	0.117	1.096	0.128	A3
1880.0	661	PCS1900	PCS	30.7	30.30	0.160	Right Touch	FCC #1	1	1:8.3	0.061	1.096	0.067	
1880.0	661	PCS1900	PCS	30.7	30.30	-0.020	Left Tilt	FCC #1	1	1:8.3	0.056	1.096	0.061	
1880.0	661	PCS1900	PCS	30.7	30.30	0.140	Right Tilt	FCC #1	1	1:8.3	0.048	1.096	0.053	
1880.0	661	PCS1900	GPRS	27.7	27.40	0.110	Left Touch	FCC #1	3	1:2.77	0.164	1.072	0.176	A4
1880.0	661	PCS1900	GPRS	27.7	27.40	0.120	Right Touch	FCC #1	3	1:2.77	0.097	1.072	0.104	
1880.0	661	PCS1900	GPRS	27.7	27.40	0.170	Left Tilt	FCC #1	3	1:2.77	0.078	1.072	0.084	
1880.0	661	PCS1900	GPRS	27.7	27.40	0.160	Right Tilt	FCC #1	3	1:2.77	0.072	1.072	0.077	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Head 1.6 W/kg (mW/g) averaged over 1 gram						

Table 12.1.3 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	25.2	25.08	0.130	Left Touch	FCC #1	1:1	0.204	1.028	0.210	A5
836.6	4183	WCDMA 850	RMC	25.2	25.08	0.190	Right Touch	FCC #1	1:1	0.154	1.028	0.158	
836.6	4183	WCDMA 850	RMC	25.2	25.08	-0.040	Left Tilt	FCC #1	1:1	0.098	1.028	0.101	
836.6	4183	WCDMA 850	RMC	25.2	25.08	-0.060	Right Tilt	FCC #1	1:1	0.089	1.028	0.091	
ANSI / IEEE C95.1-1992- SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Head 1.6 W/kg (mW/g) averaged over 1 gram					

Table 12.1.4 DTS Head SAR

MEASUREMENT RESULTS

FREQUENCY		Mode (Antenna)	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch														
2437	6	802.11b	17.5	17.10	-0.010	Left Touch	FCC #2	0.509	1	99.9	0.460	1.096	1.001	0.505	
2437	6	802.11b	17.5	17.10	0.080	Right Touch	FCC #2	0.737	1	99.9	0.727	1.096	1.001	0.798	A6
2437	6	802.11b	17.5	17.10	0.060	Left Tilt	FCC #2	0.198	1	99.9	0.207	1.096	1.001	0.227	
2437	6	802.11b	17.5	17.10	0.050	Right Tilt	FCC #2	0.360	1	99.9	0.384	1.096	1.001	0.421	
ANSI / IEEE C95.1-1992- SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Head 1.6 W/kg (mW/g) averaged over 1 gram							

Note(s):

- Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.
- Highest reported SAR is > 0.4 W/kg. Due to the highest reported SAR for this test position, other test position is Head exposure condition were evaluated until a SAR ≤ 0.8 W/kg was reported.

Adjusted SAR results for OFDM SAR

FREQUENCY		Model/ Antenna	Service	Maximum Allowed Power [dBm]	1g Scaled SAR (W/kg)	FREQUENCY [MHz]	Mode	Service	Maximum Allowed Power [dBm]	Ratio of OFDM to DSSS	1g Adjusted SAR (W/kg)	Determine OFDM SAR
MHz	Ch											
2437	6	802.11b (Ant.1)	DSSS	17.5	0.798	2437	802.11g	OFDM	16.5	0.794	0.633	X
2437	6	802.11b (Ant.1)	DSSS	17.5	0.798	2437	802.11n	OFDM	15.5	0.631	0.503	X
ANSI / IEEE C95.1-1992- SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Head 1.6 W/kg (mW/g) averaged over 1 gram				

Note: SAR is not required for the following 2.4 GHz OFDM conditions. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Table 12.1.5 UNII Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode (Antenna)	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch														
5260	52	802.11a	15.5	15.45	0.000	Left Touch	FCC #2	0.053	6	98.5	0.046	1.012	1.015	0.047	
5260	52	802.11a	15.5	15.45	0.090	Right Touch	FCC #2	0.115	6	98.5	0.099	1.012	1.015	0.102	A7
5260	52	802.11a	15.5	15.45	0.000	Left Tilt	FCC #2	0.064	6	98.5	0.059	1.012	1.015	0.061	
5260	52	802.11a	15.5	15.45	-0.180	Right Tilt	FCC #2	0.098	6	98.5	0.091	1.012	1.015	0.093	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure									Head 1.6 W/kg (mW/g) averaged over 1 gram						

Note(s):

- Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.
- U-NII-1 and U-NII-2A Bands: When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition).

Table 12.1.6 UNII Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode (Antenna)	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch														
5500	100	802.11a	15.5	15.39	0.000	Left Touch	FCC #2	0.026	6	98.5	0.013	1.026	1.015	0.014	
5500	100	802.11a	15.5	15.39	0.000	Right Touch	FCC #2	0.119	6	98.5	0.091	1.026	1.015	0.095	A8
5500	100	802.11a	15.5	15.39	0.000	Left Tilt	FCC #2	0.021	6	98.5	0.011	1.026	1.015	0.011	
5500	100	802.11a	15.5	15.39	0.000	Right Tilt	FCC #2	0.036	6	98.5	0.029	1.026	1.015	0.030	
5785	157	802.11a	15.5	15.42	0.000	Left Touch	FCC #2	0.011	6	98.5	0.018	1.019	1.015	0.019	
5785	157	802.11a	15.5	15.42	0.000	Right Touch	FCC #2	0.185	6	98.5	0.154	1.019	1.015	0.159	A9
5785	157	802.11a	15.5	15.42	0.000	Left Tilt	FCC #2	0.022	6	98.5	0.00888	1.019	1.015	0.009	
5785	157	802.11a	15.5	15.42	0.000	Right Tilt	FCC #2	0.030	6	98.5	0.026	1.019	1.015	0.027	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Head 1.6 W/kg (mW/g) averaged over 1 gram							

Note(s):

- Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.

Table 12.1.7 Bluetooth Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Rate [Mbps]	Duty Cycle (%)	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
2441	39	Bluetooth	11.5	10.25	-0.030	Left Touch	FCC #2	1	76.8	0.079	1.334	1.302	0.137	
2441	39	Bluetooth	11.5	10.25	-0.190	Right Touch	FCC #2	1	76.8	0.141	1.334	1.302	0.245	A10
2441	39	Bluetooth	11.5	10.25	-0.070	Left Tilt	FCC #2	1	76.8	0.030	1.334	1.302	0.052	
2441	39	Bluetooth	11.5	10.25	0.090	Right Tilt	FCC #2	1	76.8	0.074	1.334	1.302	0.129	
ANSI / IEEE C95.1-1992- 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 12.2.1 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 Slot s	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
836.6	190	GSM850	GSM	33.7	33.50	-0.110	10 mm [Front]	FCC #1	1	1:8.3	0.437	1.047	0.458	A11
836.6	190	GSM850	GSM	33.7	33.50	0.030	10 mm [Rear]	FCC #1	1	1:8.3	0.429	1.047	0.449	
836.6	190	GSM850	GPRS	30.7	30.50	-0.030	10 mm [Front]	FCC #1	3	1:2.77	0.662	1.047	0.693	A12
836.6	190	GSM850	GPRS	30.7	30.50	0.040	10 mm [Rear]	FCC #1	3	1:2.77	0.653	1.047	0.684	
1880.0	661	PCS1900	PCS	30.7	30.30	0.010	10 mm [Front]	FCC #1	1	1:8.3	0.227	1.096	0.249	
1880.0	661	PCS1900	PCS	30.7	30.30	0.040	10 mm [Rear]	FCC #1	1	1:8.3	0.236	1.096	0.259	A13
1880.0	661	PCS1900	GPRS	27.7	27.40	-0.040	10 mm [Front]	FCC #1	3	1:2.77	0.356	1.072	0.382	
1880.0	661	PCS1900	GPRS	27.7	27.40	0.010	10 mm [Rear]	FCC #1	3	1:2.77	0.434	1.072	0.465	A14
836.6	4183	WCDMA 850	RMC	25.2	25.08	-0.040	10 mm [Front]	FCC #1	N/A	1:1	0.496	1.028	0.510	A15
836.6	4183	WCDMA 850	RMC	25.2	25.08	-0.030	10 mm [Rear]	FCC #1	N/A	1:1	0.450	1.028	0.463	
ANSI / IEEE C95.1-1992- SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram						

Table 12.2.2 DTS Body-Worn SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	SAR (W/kg)	Plots #
MHz	Ch														
2437	6	802.11b	17.5	17.10	-0.070	10 mm [Front]	FCC #2	0.120	1	99.9	0.122	1.096	1.001	0.134	A16
2437	6	802.11b	17.5	17.10	0.020	10 mm [Rear]	FCC #2	0.102	1	99.9	0.109	1.096	1.001	0.120	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram							

Note(s):

1. Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.

Adjusted SAR results for OFDM SAR												
FREQUENCY		Model/ Antenna	Service	Maximum Allowed Power [dBm]	1g Scaled SAR (W/kg)	FREQUENCY [MHz]	Mode	Service	Maximum Allowed Power [dBm]	Ratio of OFDM to DSSS	1g Adjusted SAR (W/kg)	Determine OFDM SAR
MHz	Ch											
2437	6	802.11b (Ant.1)	DSSS	17.5	0.134	2437	802.11g	OFDM	16.5	0.794	0.106	X
2437	6	802.11b (Ant.1)	DSSS	17.5	0.134	2437	802.11n	OFDM	15.5	0.631	0.084	X
ANSI / IEEE C95.1-1992- SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram				

Note: SAR is not required for the following 2.4 GHz OFDM conditions. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Table 12.2.3 UNII Body-Worn SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch														
5260	52	802.11a	15.5	15.45	-0.160	10 mm [Front]	FCC #2	0.015	6	98.5	0.012	1.012	1.015	0.012	
5260	52	802.11a	15.5	15.45	-0.040	10 mm [Rear]	FCC #2	0.382	6	98.5	0.420	1.012	1.015	0.431	A17
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram							

- Note(s):
- Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.
 - Highest reported SAR is > 0.4 W/kg. Due to the highest reported SAR for this test position, other test position is Head exposure condition were evaluated until a SAR ≤ 0.8 W/kg was reported.
 - U-NII-1 and U-NII-2A Bands: When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition).

Table 12.2.4 UNII Body-Worn SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch														
5500	100	802.11a	15.5	15.39	0.000	10 mm [Front]	FCC #2	0.00772	6	98.5	0.00423	1.026	1.015	0.004	
5500	100	802.11a	15.5	15.39	-0.180	10 mm [Rear]	FCC #2	0.125	6	98.5	0.125	1.026	1.015	0.130	A18
5785	157	802.11a	15.5	15.42	0.000	10 mm [Front]	FCC #2	0.012	6	98.5	0.011	1.019	1.015	0.011	
5785	157	802.11a	15.5	15.42	-0.010	10 mm [Rear]	FCC #2	0.116	6	98.5	0.122	1.019	1.015	0.126	A19
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure									Body 1.6 W/kg (mW/g) averaged over 1 gram						

- Note(s):
- Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.

Table 12.2.5 Bluetooth Body-Worn SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Rate [Mbps]	Duty Cycle (%)	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
2441	39	Bluetooth	11.5	10.25	-0.070	10 mm [Front]	FCC #2	1	76.8	0.024	1.334	1.302	0.042	A20
2441	39	Bluetooth	11.5	10.25	0.000	10 mm [Rear]	FCC #2	1	76.8	0.019	1.334	1.302	0.033	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram						

12.3 Standalone Hotspot SAR Results

Table 12.3.1 GPRS Hotspot SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	# of Time Slot s	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
836.6	190	GSM850	GPRS	30.7	30.50	-0.090	10 mm [Bottom]	FCC #1	3	1:2.77	0.269	1.047	0.282	
836.6	190	GSM850	GPRS	30.7	30.50	-0.030	10 mm [Front]	FCC #1	3	1:2.77	0.662	1.047	0.693	A12
836.6	190	GSM850	GPRS	30.7	30.50	0.040	10 mm [Rear]	FCC #1	3	1:2.77	0.653	1.047	0.684	
836.6	190	GSM850	GPRS	30.7	30.50	0.030	10 mm [Right]	FCC #1	3	1:2.77	0.182	1.047	0.191	
1880.0	661	PCS1900	GPRS	27.7	27.40	-0.100	10 mm [Bottom]	FCC #1	3	1:2.77	0.392	1.072	0.420	
1880.0	661	PCS1900	GPRS	27.7	27.40	-0.040	10 mm [Front]	FCC #1	3	1:2.77	0.356	1.072	0.382	
1880.0	661	PCS1900	GPRS	27.7	27.40	0.010	10 mm [Rear]	FCC #1	3	1:2.77	0.434	1.072	0.465	A14
1880.0	661	PCS1900	GPRS	27.7	27.40	-0.130	10 mm [Left]	FCC #1	3	1:2.77	0.325	1.072	0.348	
ANSI / IEEE C95.1-1992- SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram						

Table 12.3.2 WCDMA Hotspot SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	# of Time Slot s	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
836.6	4183	WCDMA 850	RMC	25.2	25.08	0.050	10 mm [Bottom]	FCC #1	N/A	1:1	0.243	1.028	0.250	
836.6	4183	WCDMA 850	RMC	25.2	25.08	-0.040	10 mm [Front]	FCC #1	N/A	1:1	0.496	1.028	0.510	A15
836.6	4183	WCDMA 850	RMC	25.2	25.08	-0.030	10 mm [Rear]	FCC #1	N/A	1:1	0.450	1.028	0.463	
836.6	4183	WCDMA 850	RMC	25.2	25.08	-0.030	10 mm [Right]	FCC #1	N/A	1:1	0.114	1.028	0.117	
ANSI / IEEE C95.1-1992- SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram						

Table 12.3.3 DTS Hotspot SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	SAR (W/kg)	Plots #
MHz	Ch														
2437	6	802.11b	17.5	17.10	0.000	10 mm [Top]	FCC #2	0.087	1	99.9	0.085	1.096	1.001	0.093	
2437	6	802.11b	17.5	17.10	-0.070	10 mm [Front]	FCC #2	0.120	1	99.9	0.122	1.096	1.001	0.134	
2437	6	802.11b	17.5	17.10	0.020	10 mm [Rear]	FCC #2	0.102	1	99.9	0.109	1.096	1.001	0.120	
2437	6	802.11b	17.5	17.10	0.130	10 mm [Left]	FCC #2	0.170	1	99.9	0.175	1.096	1.001	0.192	A21
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram							

Note(s):

- Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.

Adjusted SAR results for OFDM SAR												
FREQUENCY		Model/ Antenna	Service	Maximum Allowed Power [dBm]	1g Scaled SAR (W/kg)	FREQUENCY [MHz]	Mode	Service	Maximum Allowed Power [dBm]	Ratio of OFDM to DSSS	1g Adjusted SAR (W/kg)	Determine OFDM SAR
MHz	Ch											
2437	6	802.11b (Ant.1)	DSSS	17.5	0.192	2437	802.11g	OFDM	16.5	0.794	0.152	X
2437	6	802.11b (Ant.1)	DSSS	17.5	0.192	2437	802.11n	OFDM	15.5	0.631	0.121	X
ANSI / IEEE C95.1-1992- SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram				

Note: SAR is not required for the following 2.4 GHz OFDM conditions. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Table 12.3.4 UNII Hotspot SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch														
5180	36	802.11a	15.5	15.45	-0.000	10 mm [Top]	FCC #2	0.058	6	98.5	0.044	1.012	1.015	0.045	
5180	36	802.11a	15.5	15.45	-0.030	10 mm [Front]	FCC #2	0.022	6	98.5	0.014	1.012	1.015	0.014	
5180	36	802.11a	15.5	15.45	-0.050	10 mm [Rear]	FCC #2	0.441	6	98.5	0.494	1.012	1.015	0.507	A22
5180	36	802.11a	15.5	15.45	-0.170	10 mm [Left]	FCC #2	0.174	6	98.5	0.164	1.012	1.015	0.168	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure									Body 1.6 W/kg (mW/g) averaged over 1 gram						

Note(s):

- Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.
- Highest reported SAR is > 0.4 W/kg. Due to the highest reported SAR for this test position, other test position is Head exposure condition were evaluated until a SAR ≤ 0.8 W/kg was reported.

Table 12.3.5 UNII Hotspot SAR

MEASUREMENT RESULTS

FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch														
5785	157	802.11a	15.5	15.42	0.110	10 mm [Top]	FCC #2	0.018	6	98.5	0.014	1.019	1.015	0.014	
5785	157	802.11a	15.5	15.42	0.000	10 mm [Front]	FCC #2	0.012	6	98.5	0.011	1.019	1.015	0.011	
5785	157	802.11a	15.5	15.42	-0.010	10 mm [Rear]	FCC #2	0.116	6	98.5	0.122	1.019	1.015	0.126	A19
5785	157	802.11a	15.5	15.42	-0.180	10 mm [Left]	FCC #2	0.051	6	98.5	0.047	1.019	1.015	0.049	
ANSI / IEEE C95.1-1992- SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram							

Note(s):

- Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.

Table 12.3.6 Bluetooth Hotspot SAR

MEASUREMENT RESULTS

MEASUREMENT RESULTS														
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Rate [Mbps]	Duty Cycle (%)	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
2441	39	Bluetooth	11.5	10.25	-0.130	10 mm [Top]	FCC #2	1	76.8	0.016	1.334	1.302	0.028	
2441	39	Bluetooth	11.5	10.25	-0.070	10 mm [Front]	FCC #2	1	76.8	0.024	1.334	1.302	0.042	
2441	39	Bluetooth	11.5	10.25	0.000	10 mm [Rear]	FCC #2	1	76.8	0.019	1.334	1.302	0.033	
2441	39	Bluetooth	11.5	10.25	-0.140	10 mm [Left]	FCC #2	1	76.8	0.034	1.334	1.302	0.059	A23
ANSI / IEEE C95.1-1992– 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 1528-2013, and FCC KDB Publication 447498 D01v06.
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 D01v06.
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 D04v01r03, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported body-worn SAR was not > 1.2 W/kg, no additional body-worn SAR evaluations using a headset cable were performed.
8. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v02r01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated.
9. SAR measurements were performed using the DASY5 automated system. The procedure for spatial peak SAR evaluation has been implemented according to the IEEE 1528 standard. During a maximum search, global and local maxima searches are automatically performed in 2-D after each area scan measurement. The algorithm will find the global maximum and all local maxima within 2 dB of the global maxima for all SAR distributions. All local maxima within 2 dB of the global maximum were searched and passed for the Zoom Scan measurement.

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 D01v03r01 and October 2013 TCB Workshop Notes: 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.
4. Per FCC KDB Publication 447498 D01v06, 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 > $\frac{1}{2}$ 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 D01v03r01. AMR and 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 D01v06, 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 $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel was used.

WLAN Notes:

1. The initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output and the adjust SAR is ≤ 1.2 W/kg.
3. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg.
4. When the maximum reported 1g averaged SAR ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
5. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor to determine compliance.

Bluetooth Notes:

1. Bluetooth SAR was measured with the device connected to a call simulator with hopping disabled with DH5 operation. Per October 2016 TCB Workshop Notes, the reported SAR was scaled to the 100% transmission duty factor to determine compliance. Refer to section 10.4 for the time-domain plot and calculation for the duty factor of the device.

13. FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

13.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to handsets with built-in unlicensed transmitters such as 802.11 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 D01v06 4.3.2 and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the sum 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤ 1.6 W/kg. The different test position in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1-g or 10-g SAR.

13.3 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, 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.

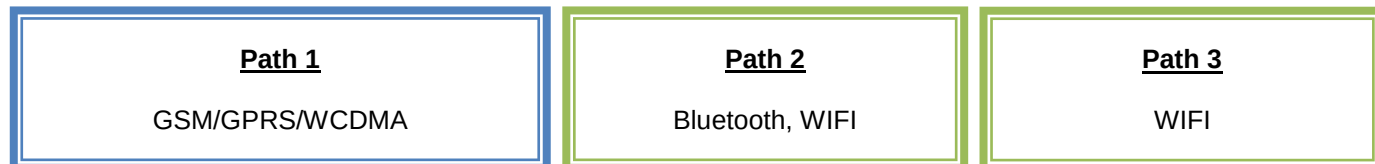


Figure 13.1 Simultaneous Transmission Paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06.

Table 13.3.1 Simultaneous Transmission Scenarios

No.	Capable TX Configuration	GSM850/1900 voice	GPRS 850/1900	WCDMA850 Voice	WCDMA 850 data (HSDPA, HSUPA)	WIFI 2.4GHz 802.11b/g/n	WIFI 5GHz 802.11a/n/ac	Bluetooth 2.4GHz
1	GSM850/1900 voice		No	No	No	Yes	Yes	Yes
2	GPRS 850/1900	No		No	No	Yes	Yes	Yes
3	WCDMA850 Voice	No	No		No	Yes	Yes	Yes
4	WCDMA 850 data (HSDPA, HSUPA)	No	No	No		Yes	Yes	Yes
5	WIFI 2.4GHz 802.11b/g/n	Yes	Yes	Yes	Yes		No	No
6	WIFI 5GHz 802.11a/n/ac	Yes	Yes	Yes	Yes	No		Yes
7	Bluetooth 2.4GHz	Yes	Yes	Yes	Yes	No	Yes	

Table 13.3.2 Simultaneous SAR Cases

No.	Capable Transmit Configuration	Head SAR	Body-Worn SAR	Hotspot SAR	Note
1	GSM 850 Voice + WiFi 2.4GHz	yes	yes	N/A	GSM voice + WiFi 2.4GHz
2	GSM 1900 Voice + WiFi 2.4GHz	yes	yes	N/A	
3	GSM 850 Voice + WiFi 5 GHz	yes	yes	N/A	GSM voice + WiFi 5GHz
4	GSM 1900 Voice + WiFi GHz	yes	yes	N/A	
5	GSM 850 Voice + Bluetooth 2.4GHz	yes	yes	N/A	GSM voice + Bluetooth 2.4GHz
6	GSM 1900 Voice + Bluetooth 2.4GHz	yes	yes	N/A	
7	GSM 850 Voice + Bluetooth 2.4GHz + WiFi 5GHz	yes	yes	N/A	GSM voice + Bluetooth 2.4GHz + WiFi 5GHz
8	GSM 1900 Voice + Bluetooth 2.4GHz + WiFi 5GHz	yes	yes	N/A	
9	GSM 850 GPRS + WiFi 2.4GHz	yes	yes	yes	GSM GPRS + WiFi 2.4GHz
10	GSM 1900 GPRS + WiFi 2.4GHz	yes	yes	yes	
11	GSM 850 GPRS + WiFi 5GHz	yes	yes	yes	GSM GPRS + WiFi 5GHz
12	GSM 1900 GPRS + WiFi 5GHz	yes	yes	yes	
13	GSM 850 GPRS + Bluetooth 2.4GHz	yes	yes	yes	GSM GPRS + Bluetooth 2.4GHz
14	GSM 1900 GPRS + Bluetooth 2.4GHz	yes	yes	yes	
15	GSM 850 GPRS + Bluetooth 2.4GHz + WiFi 5GHz	yes	yes	yes	GSM GPRS + Bluetooth 2.4GHz + WiFi 5GHz
16	GSM 1900 GPRS + Bluetooth 2.4GHz + WiFi 5GHz	yes	yes	yes	
17	WCDMA 850 + WiFi 2.4GHz	yes	yes	yes	WCDMA + WiFi 2.4GHz
18	WCDMA 850 + WiFi 5GHz	yes	yes	yes	WCDMA + WiFi 5GHz
19	WCDMA 850 + Bluetooth 2.4Ghz	yes	yes	yes	WCDMA + Bluetooth 2.4GHz
20	WCDMA 850 + Bluetooth 2.4GHz + WiFi GHz	yes	yes	yes	WCDMA + Bluetooth 2.4GHz + WiFi 5GHz

Notes:

- WiFi 2.4GHz is supported Hotspot and WiFi-Direct(GO/GC).
- WiFi 5GHz is supported Hotspot in UNII B1,B3 and WiFi-Direct(GO/GC) in UNII B1,B3.
- WCDMA, GPRS is supported Hotspot.
- VoIP is supported in WCDMA, GSM (e.g. 3rd part VoIP).
- Bluetooth and WiFi can not transmit simultaneously since they share the same chip in 2.4GHz.
- GSM and WCDMA can not transmit simultaneously since they share the same chip.
- 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 13.4.1 Simultaneous Transmission Scenario for 2G/3G with 2.4 GHz W-LAN (Held to Ear)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.197	0.505	0.702
	Right Touch	0.141	0.798	0.939
	Left Tilt	0.104	0.227	0.331
	Right Tilt	0.092	0.421	0.513
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.226	0.505	0.731
	Right Touch	0.187	0.798	0.985
	Left Tilt	0.092	0.227	0.319
	Right Tilt	0.103	0.421	0.524
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.128	0.505	0.633
	Right Touch	0.067	0.798	0.865
	Left Tilt	0.061	0.227	0.288
	Right Tilt	0.053	0.421	0.474
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.176	0.505	0.681
	Right Touch	0.104	0.798	0.902
	Left Tilt	0.084	0.227	0.311
	Right Tilt	0.077	0.421	0.498
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.210	0.505	0.715
	Right Touch	0.158	0.798	0.956
	Left Tilt	0.101	0.227	0.328
	Right Tilt	0.091	0.421	0.512

Table 13.4.2 Simultaneous Transmission Scenario for 2G/3G with 5.3 GHz W-LAN (Held to Ear)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.197	0.047	0.244
	Right Touch	0.141	0.102	0.243
	Left Tilt	0.104	0.061	0.165
	Right Tilt	0.092	0.093	0.185
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.226	0.047	0.273
	Right Touch	0.187	0.102	0.289
	Left Tilt	0.092	0.061	0.153
	Right Tilt	0.103	0.093	0.196
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.128	0.047	0.175
	Right Touch	0.067	0.102	0.169
	Left Tilt	0.061	0.061	0.122
	Right Tilt	0.053	0.093	0.146
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.176	0.047	0.223
	Right Touch	0.104	0.102	0.206
	Left Tilt	0.084	0.061	0.145
	Right Tilt	0.077	0.093	0.170
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.210	0.047	0.257
	Right Touch	0.158	0.102	0.260
	Left Tilt	0.101	0.061	0.162
	Right Tilt	0.091	0.093	0.184

Table 13.4.3 Simultaneous Transmission Scenario for 2G/3G with 5.6 GHz W-LAN (Held to Ear)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.197	0.014	0.211
	Right Touch	0.141	0.095	0.236
	Left Tilt	0.104	0.011	0.115
	Right Tilt	0.092	0.030	0.122
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.226	0.014	0.240
	Right Touch	0.187	0.095	0.282
	Left Tilt	0.092	0.011	0.103
	Right Tilt	0.103	0.030	0.133
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.128	0.014	0.142
	Right Touch	0.067	0.095	0.162
	Left Tilt	0.061	0.011	0.072
	Right Tilt	0.053	0.030	0.083
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.176	0.014	0.190
	Right Touch	0.104	0.095	0.199
	Left Tilt	0.084	0.011	0.095
	Right Tilt	0.077	0.030	0.107
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.210	0.014	0.224
	Right Touch	0.158	0.095	0.253
	Left Tilt	0.101	0.011	0.112
	Right Tilt	0.091	0.030	0.121

Table 13.4.4 Simultaneous Transmission Scenario for 2G/3G with 5.8 GHz W-LAN (Held to Ear)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.197	0.019	0.216
	Right Touch	0.141	0.159	0.300
	Left Tilt	0.104	0.009	0.113
	Right Tilt	0.092	0.027	0.119
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.226	0.019	0.245
	Right Touch	0.187	0.159	0.346
	Left Tilt	0.092	0.009	0.101
	Right Tilt	0.103	0.027	0.130
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.128	0.019	0.147
	Right Touch	0.067	0.159	0.226
	Left Tilt	0.061	0.009	0.070
	Right Tilt	0.053	0.027	0.080
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.176	0.019	0.195
	Right Touch	0.104	0.159	0.263
	Left Tilt	0.084	0.009	0.093
	Right Tilt	0.077	0.027	0.104
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.210	0.019	0.229
	Right Touch	0.158	0.159	0.317
	Left Tilt	0.101	0.009	0.110
	Right Tilt	0.091	0.027	0.118

Table 13.4.5 Simultaneous Transmission Scenario for 2G/3G with Bluetooth (Held to Ear)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.197	0.137	0.334
	Right Touch	0.141	0.245	0.386
	Left Tilt	0.104	0.052	0.156
	Right Tilt	0.092	0.129	0.221
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.226	0.137	0.363
	Right Touch	0.187	0.245	0.432
	Left Tilt	0.092	0.052	0.144
	Right Tilt	0.103	0.129	0.232
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.128	0.137	0.265
	Right Touch	0.067	0.245	0.312
	Left Tilt	0.061	0.052	0.113
	Right Tilt	0.053	0.129	0.182
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.176	0.137	0.313
	Right Touch	0.104	0.245	0.349
	Left Tilt	0.084	0.052	0.136
	Right Tilt	0.077	0.129	0.206
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.210	0.137	0.347
	Right Touch	0.158	0.245	0.403
	Left Tilt	0.101	0.052	0.153
	Right Tilt	0.091	0.129	0.220

Table 13.4.6 Simultaneous Transmission Scenario for 2G/3G with Bluetooth and 5.3 GHz W-LAN (Held to Ear)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.197	0.137	0.047	0.334	0.244	0.381
	Right Touch	0.141	0.245	0.102	0.386	0.243	0.488
	Left Tilt	0.104	0.052	0.061	0.156	0.165	0.217
	Right Tilt	0.092	0.129	0.093	0.221	0.185	0.314
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.226	0.137	0.047	0.363	0.273	0.410
	Right Touch	0.187	0.245	0.102	0.432	0.289	0.534
	Left Tilt	0.092	0.052	0.061	0.144	0.153	0.205
	Right Tilt	0.103	0.129	0.093	0.232	0.196	0.325
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.128	0.137	0.047	0.265	0.175	0.312
	Right Touch	0.067	0.245	0.102	0.312	0.169	0.414
	Left Tilt	0.061	0.052	0.061	0.113	0.122	0.174
	Right Tilt	0.053	0.129	0.093	0.182	0.146	0.275
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.176	0.137	0.047	0.313	0.223	0.360
	Right Touch	0.104	0.245	0.102	0.349	0.206	0.451
	Left Tilt	0.084	0.052	0.061	0.136	0.145	0.197
	Right Tilt	0.077	0.129	0.093	0.206	0.170	0.299
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.210	0.137	0.047	0.347	0.257	0.394
	Right Touch	0.158	0.245	0.102	0.403	0.260	0.505
	Left Tilt	0.101	0.052	0.061	0.153	0.162	0.214
	Right Tilt	0.091	0.129	0.093	0.220	0.184	0.313

Table 13.4.7 Simultaneous Transmission Scenario for 2G/3G with Bluetooth and 5.6 GHz W-LAN (Held to Ear)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.197	0.137	0.014	0.334	0.211	0.348
	Right Touch	0.141	0.245	0.095	0.386	0.236	0.481
	Left Tilt	0.104	0.052	0.011	0.156	0.115	0.167
	Right Tilt	0.092	0.129	0.030	0.221	0.122	0.251
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.226	0.137	0.014	0.363	0.240	0.377
	Right Touch	0.187	0.245	0.095	0.432	0.282	0.527
	Left Tilt	0.092	0.052	0.011	0.144	0.103	0.155
	Right Tilt	0.103	0.129	0.030	0.232	0.133	0.262
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.128	0.137	0.014	0.265	0.142	0.279
	Right Touch	0.067	0.245	0.095	0.312	0.162	0.407
	Left Tilt	0.061	0.052	0.011	0.113	0.072	0.124
	Right Tilt	0.053	0.129	0.030	0.182	0.083	0.212
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.176	0.137	0.014	0.313	0.190	0.327
	Right Touch	0.104	0.245	0.095	0.349	0.199	0.444
	Left Tilt	0.084	0.052	0.011	0.136	0.095	0.147
	Right Tilt	0.077	0.129	0.030	0.206	0.107	0.236
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.210	0.137	0.014	0.347	0.224	0.361
	Right Touch	0.158	0.245	0.095	0.403	0.253	0.498
	Left Tilt	0.101	0.052	0.011	0.153	0.112	0.164
	Right Tilt	0.091	0.129	0.030	0.220	0.121	0.250

Table 13.4.8 Simultaneous Transmission Scenario for 2G/3G with Bluetooth and 5.8 GHz W-LAN (Held to Ear)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.197	0.137	0.019	0.334	0.216	0.353
	Right Touch	0.141	0.245	0.159	0.386	0.300	0.545
	Left Tilt	0.104	0.052	0.009	0.156	0.113	0.165
	Right Tilt	0.092	0.129	0.027	0.221	0.119	0.248
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.226	0.137	0.019	0.363	0.245	0.382
	Right Touch	0.187	0.245	0.159	0.432	0.346	0.591
	Left Tilt	0.092	0.052	0.009	0.144	0.101	0.153
	Right Tilt	0.103	0.129	0.027	0.232	0.130	0.259
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.128	0.137	0.019	0.265	0.147	0.284
	Right Touch	0.067	0.245	0.159	0.312	0.226	0.471
	Left Tilt	0.061	0.052	0.009	0.113	0.070	0.122
	Right Tilt	0.053	0.129	0.027	0.182	0.080	0.209
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.176	0.137	0.019	0.313	0.195	0.332
	Right Touch	0.104	0.245	0.159	0.349	0.263	0.508
	Left Tilt	0.084	0.052	0.009	0.136	0.093	0.145
	Right Tilt	0.077	0.129	0.027	0.206	0.104	0.233
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Left Touch	0.210	0.137	0.019	0.347	0.229	0.366
	Right Touch	0.158	0.245	0.159	0.403	0.317	0.562
	Left Tilt	0.101	0.052	0.009	0.153	0.110	0.162
	Right Tilt	0.091	0.129	0.027	0.220	0.118	0.247

Table 13.4.9 Simultaneous Transmission Scenario for Bluetooth and 5 GHz W-LAN (Held to Ear)

Simul Tx	Configuration	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.137	0.047	0.184
	Right Touch	0.245	0.102	0.347
	Left Tilt	0.052	0.061	0.113
	Right Tilt	0.129	0.093	0.222
Simul Tx	Configuration	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.137	0.014	0.151
	Right Touch	0.245	0.095	0.340
	Left Tilt	0.052	0.011	0.063
	Right Tilt	0.129	0.030	0.159
Simul Tx	Configuration	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Left Touch	0.137	0.019	0.156
	Right Touch	0.245	0.159	0.404
	Left Tilt	0.052	0.009	0.061
	Right Tilt	0.129	0.027	0.156

13.5 Body-Worn Simultaneous Transmission Analysis

Table 13.5.1 Simultaneous Transmission Scenario for 2G/3G with 2.4 GHz W-LAN (Body-Worn at 10 mm)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.458	0.134	0.592
	Rear	0.449	0.120	0.569
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.693	0.134	0.827
	Rear	0.684	0.120	0.804
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.249	0.134	0.383
	Rear	0.259	0.120	0.379
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.382	0.134	0.516
	Rear	0.465	0.120	0.585
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.510	0.134	0.644
	Rear	0.463	0.120	0.583

Table 13.5.2 Simultaneous Transmission Scenario for 2G/3G with 5.3 GHz W-LAN (Body-Worn at 10 mm)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.458	0.012	0.470
	Rear	0.449	0.431	0.880
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.693	0.012	0.705
	Rear	0.684	0.431	1.115
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.249	0.012	0.261
	Rear	0.259	0.431	0.690
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.382	0.012	0.394
	Rear	0.465	0.431	0.896
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.510	0.012	0.522
	Rear	0.463	0.431	0.894

Table 13.5.3 Simultaneous Transmission Scenario for 2G/3G with 5.6 GHz W-LAN (Body-Worn at 10 mm)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.458	0.004	0.462
	Rear	0.449	0.130	0.579
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.693	0.004	0.697
	Rear	0.684	0.130	0.814
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.249	0.004	0.253
	Rear	0.259	0.130	0.389
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.382	0.004	0.386
	Rear	0.465	0.130	0.595
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.510	0.004	0.514
	Rear	0.463	0.130	0.593

Table 13.5.4 Simultaneous Transmission Scenario for 2G/3G with 5.8 GHz W-LAN (Body-Worn at 10 mm)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.458	0.011	0.469
	Rear	0.449	0.126	0.575
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.693	0.011	0.704
	Rear	0.684	0.126	0.810
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.249	0.011	0.260
	Rear	0.259	0.126	0.385
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.382	0.011	0.393
	Rear	0.465	0.126	0.591
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.510	0.011	0.521
	Rear	0.463	0.126	0.589

Table 13.5.5 Simultaneous Transmission Scenario for 2G/3G with Bluetooth (Body-Worn at 10 mm)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.458	0.042	0.500
	Rear	0.449	0.033	0.482
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.693	0.042	0.735
	Rear	0.684	0.033	0.717
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.249	0.042	0.291
	Rear	0.259	0.033	0.292
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.382	0.042	0.424
	Rear	0.465	0.033	0.498
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.510	0.042	0.552
	Rear	0.463	0.033	0.496

Table 13.5.6 Simultaneous Transmission Scenario for 2G/3G with Bluetooth and 5.3 GHz W-LAN (Body-Worn at 10 mm)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.458	0.042	0.012	0.500	0.470	0.512
	Rear	0.449	0.033	0.431	0.482	0.880	0.913
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.693	0.042	0.012	0.735	0.705	0.747
	Rear	0.684	0.033	0.431	0.717	1.115	1.148
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.249	0.042	0.012	0.291	0.261	0.303
	Rear	0.259	0.033	0.431	0.292	0.690	0.723
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.382	0.042	0.012	0.424	0.394	0.436
	Rear	0.465	0.033	0.431	0.498	0.896	0.929
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.510	0.042	0.012	0.552	0.522	0.564
	Rear	0.463	0.033	0.431	0.496	0.894	0.927

Table 13.5.7 Simultaneous Transmission Scenario for 2G/3G with Bluetooth and 5.6 GHz W-LAN (Body-Worn at 10 mm)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.458	0.042	0.004	0.500	0.462	0.504
	Rear	0.449	0.033	0.130	0.482	0.579	0.612
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.693	0.042	0.004	0.735	0.697	0.739
	Rear	0.684	0.033	0.130	0.717	0.814	0.847
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.249	0.042	0.004	0.291	0.253	0.295
	Rear	0.259	0.033	0.130	0.292	0.389	0.422
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.382	0.042	0.004	0.424	0.386	0.428
	Rear	0.465	0.033	0.130	0.498	0.595	0.628
Simul Tx	Configuration	WCDMA 850 SAR (W/kg))	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.510	0.042	0.004	0.552	0.514	0.556
	Rear	0.463	0.033	0.130	0.496	0.593	0.626

Table 13.5.8 Simultaneous Transmission Scenario for 2G/3G with Bluetooth and 5.8 GHz W-LAN (Body-Worn at 10 mm)

Simul Tx	Configuration	GSM 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.458	0.042	0.011	0.500	0.469	0.511
	Rear	0.449	0.033	0.126	0.482	0.575	0.608
Simul Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.693	0.042	0.011	0.735	0.704	0.746
	Rear	0.684	0.033	0.126	0.717	0.810	0.843
Simul Tx	Configuration	GSM 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.249	0.042	0.011	0.291	0.260	0.302
	Rear	0.259	0.033	0.126	0.292	0.385	0.418
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.382	0.042	0.011	0.424	0.393	0.435
	Rear	0.465	0.033	0.126	0.498	0.591	0.624
Simul Tx	Configuration	WCDMA 850 SAR (W/kg))	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn SAR	Front	0.510	0.042	0.011	0.552	0.521	0.563
	Rear	0.463	0.033	0.126	0.496	0.589	0.622

Table 13.5.9 Simultaneous Transmission Scenario for Bluetooth and 5 GHz W-LAN (Body-Worn at 10 mm)

Simul Tx	Configuration	Bluetooth SAR (W/kg)	5.3G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.042	0.012	0.054
	Rear	0.033	0.431	0.464
Simul Tx	Configuration	Bluetooth SAR (W/kg)	5.6G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.042	0.004	0.046
	Rear	0.033	0.130	0.163
Simul Tx	Configuration	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	Front	0.042	0.011	0.053
	Rear	0.033	0.126	0.159

13.6 Hotspot SAR Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D06v02r01, the device edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR ("-").

Table 13.6.1 Simultaneous Transmission Scenario for 2G/3G with 2.4 GHz W-LAN (Hotspot at 10 mm)

Simul Tx	Configuration	GPRS 850 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.093	0.093
	Bottom	0.282	-	0.282
	Front	0.693	0.134	0.827
	Rear	0.684	0.120	0.804
	Right	0.191	-	0.191
	Left	-	0.192	0.192
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.093	0.093
	Bottom	0.420	-	0.420
	Front	0.382	0.134	0.516
	Rear	0.465	0.120	0.585
	Right	-	-	-
	Left	0.348	0.192	0.540
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	2.4G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.093	0.093
	Bottom	0.250	-	0.250
	Front	0.510	0.134	0.644
	Rear	0.463	0.120	0.583
	Right	0.117	-	0.117
	Left	-	0.192	0.192

Table 13.6.2 Simultaneous Transmission Scenario for 2G/3G with 5.2 GHz W-LAN (Hotspot at 10 mm)

Simul Tx	Configuration	GPRS 850 SAR (W/kg)	5.2G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.045	0.045
	Bottom	0.282	-	0.282
	Front	0.693	0.014	0.707
	Rear	0.684	0.507	1.191
	Right	0.191	-	0.191
	Left	-	0.168	0.168
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	5.2G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.045	0.045
	Bottom	0.420	-	0.420
	Front	0.382	0.014	0.396
	Rear	0.465	0.507	0.972
	Right	-	-	-
	Left	0.348	0.168	0.516
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	5.2G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.045	0.045
	Bottom	0.250	-	0.250
	Front	0.510	0.014	0.524
	Rear	0.463	0.507	0.970
	Right	0.117	-	0.117
	Left	-	0.168	0.168

Table 13.6.3 Simultaneous Transmission Scenario for 2G/3G with 5.8 GHz W-LAN (Hotspot at 10 mm)

Simul Tx	Configuration	GPRS 850 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.014	0.014
	Bottom	0.282	-	0.282
	Front	0.693	0.011	0.704
	Rear	0.684	0.126	0.810
	Right	0.191	-	0.191
	Left	-	0.049	0.049
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.014	0.014
	Bottom	0.420	-	0.420
	Front	0.382	0.011	0.393
	Rear	0.465	0.126	0.591
	Right	-	-	-
	Left	0.348	0.049	0.397
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.014	0.014
	Bottom	0.250	-	0.250
	Front	0.510	0.011	0.521
	Rear	0.463	0.126	0.589
	Right	0.117	-	0.117
	Left	-	0.049	0.049

Table 13.6.4 Simultaneous Transmission Scenario for 2G/3G with Bluetooth (Hotspot at 10 mm)

Simul Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.028	0.028
	Bottom	0.282	-	0.282
	Front	0.693	0.042	0.735
	Rear	0.684	0.033	0.717
	Right	0.191	-	0.191
	Left	-	0.059	0.059
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.028	0.028
	Bottom	0.420	-	0.420
	Front	0.382	0.042	0.424
	Rear	0.465	0.033	0.498
	Right	-	-	-
	Left	0.348	0.059	0.407
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	-	0.028	0.028
	Bottom	0.250	-	0.250
	Front	0.510	0.042	0.552
	Rear	0.463	0.033	0.496
	Right	0.117	-	0.117
	Left	-	0.059	0.059

Table 13.6.5 Simultaneous Transmission Scenario for 2G/3G with Bluetooth and 5.2 GHz W-LAN (Hotspot at 10 mm)

Simul Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.2G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Hotspot SAR	Top	-	0.028	0.045	0.028	0.045	0.073
	Bottom	0.282	-	-	0.282	0.282	0.282
	Front	0.693	0.042	0.014	0.735	0.707	0.749
	Rear	0.684	0.033	0.507	0.717	1.191	1.224
	Right	0.191	-	-	0.191	0.191	0.191
	Left	-	0.059	0.168	0.059	0.168	0.227
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.2G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Hotspot SAR	Top	-	0.028	0.045	0.028	0.045	0.073
	Bottom	0.420	-	-	0.420	0.420	0.420
	Front	0.382	0.042	0.014	0.424	0.396	0.438
	Rear	0.465	0.033	0.507	0.498	0.972	1.005
	Right	-	-	-	-	-	-
	Left	0.348	0.059	0.168	0.407	0.516	0.575
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.2G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Hotspot SAR	Top	-	0.028	0.045	0.028	0.045	0.073
	Bottom	0.250	-	-	0.250	0.250	0.250
	Front	0.510	0.042	0.014	0.552	0.524	0.566
	Rear	0.463	0.033	0.507	0.496	0.970	1.003
	Right	0.117	-	-	0.117	0.117	0.117
	Left	-	0.059	0.168	0.059	0.168	0.227

Table 13.6.6 Simultaneous Transmission Scenario for 2G/3G with Bluetooth and 5.8 GHz W-LAN (Hotspot at 10 mm)

Simul Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Hotspot SAR	Top	-	0.028	0.014	0.028	0.014	0.042
	Bottom	0.282	-	-	0.282	0.282	0.282
	Front	0.693	0.042	0.011	0.735	0.704	0.746
	Rear	0.684	0.033	0.126	0.717	0.810	0.843
	Right	0.191	-	-	0.191	0.191	0.191
	Left	-	0.059	0.049	0.059	0.049	0.108
Simul Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Hotspot SAR	Top	-	0.028	0.014	0.028	0.014	0.042
	Bottom	0.420	-	-	0.420	0.420	0.420
	Front	0.382	0.042	0.011	0.424	0.393	0.435
	Rear	0.465	0.033	0.126	0.498	0.591	0.624
	Right	-	-	-	-	-	-
	Left	0.348	0.059	0.049	0.407	0.397	0.456
Simul Tx	Configuration	WCDMA 850 SAR (W/kg)	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Hotspot SAR	Top	-	0.028	0.014	0.028	0.014	0.042
	Bottom	0.250	-	-	0.250	0.250	0.250
	Front	0.510	0.042	0.011	0.552	0.521	0.563
	Rear	0.463	0.033	0.126	0.496	0.589	0.622
	Right	0.117	-	-	0.117	0.117	0.117
	Left	-	0.059	0.049	0.059	0.049	0.108

Table 13.6.7 Simultaneous Transmission Scenario for Bluetooth and 5 GHz W-LAN (Hotspot at 10 mm)

Simul Tx	Configuration	Bluetooth SAR (W/kg)	5.2G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	0.028	0.045	0.073
	Bottom	-	-	-
	Front	0.042	0.014	0.056
	Rear	0.033	0.507	0.540
	Right	-	-	-
	Left	0.059	0.168	0.227
Simul Tx	Configuration	Bluetooth SAR (W/kg)	5.8G W-LAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	Top	0.028	0.014	0.042
	Bottom	-	-	-
	Front	0.042	0.011	0.053
	Rear	0.033	0.126	0.159
	Right	-	-	-
	Left	0.059	0.049	0.108

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 D01v06 and IEEE 1528-2013 Section 6.3.4.1.2.

14. MEASUREMENT UNCERTAINTIES

835 MHz Head (SN: 3328)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	$\pm 6.0 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 4.0	Normal	1	0.64	$\pm 4.0 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 3.8	Normal	1	0.6	$\pm 3.8 \%$	∞
Temp. unc. - Conductivity	± 1.7	Rectangular	$\sqrt{3}$	0.78	$\pm 1.0 \%$	∞
Temp. unc. - Permittivity	± 1.8	Rectangular	$\sqrt{3}$	0.23	$\pm 1.0 \%$	∞
Combined Standard Uncertainty					$\pm 12 \%$	330
Expanded Uncertainty (k=2)					$\pm 24 \%$	

The above measurement uncertainties are according to IEEE Std 1528

835 MHz Body (SN: 3328)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	$\pm 6.0 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 4.3	Normal	1	0.64	$\pm 4.3 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 3.7	Normal	1	0.6	$\pm 3.7 \%$	∞
Temp. unc. - Conductivity	± 1.7	Rectangular	$\sqrt{3}$	0.78	$\pm 1.0 \%$	∞
Temp. unc. - Permittivity	± 1.9	Rectangular	$\sqrt{3}$	0.23	$\pm 1.1 \%$	∞
Combined Standard Uncertainty					$\pm 12 \%$	330
Expanded Uncertainty (k=2)					$\pm 24 \%$	

The above measurement uncertainties are according to IEEE Std 1528

1900 MHz Head (SN: 3328)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	$\pm 6.0 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 3.9	Normal	1	0.64	$\pm 3.9 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 4.2	Normal	1	0.6	$\pm 4.2 \%$	∞
Temp. unc. - Conductivity	± 1.7	Rectangular	$\sqrt{3}$	0.78	$\pm 1.0 \%$	∞
Temp. unc. - Permittivity	± 1.9	Rectangular	$\sqrt{3}$	0.23	$\pm 1.1 \%$	∞
Combined Standard Uncertainty					$\pm 12 \%$	330
Expanded Uncertainty (k=2)					$\pm 24 \%$	

The above measurement uncertainties are according to IEEE Std 1528

1900 MHz Body (SN: 3328)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	$\pm 6.0 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 4.1	Normal	1	0.64	$\pm 4.1 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 3.9	Normal	1	0.6	$\pm 3.9 \%$	∞
Temp. unc. - Conductivity	± 1.9	Rectangular	$\sqrt{3}$	0.78	$\pm 1.1 \%$	∞
Temp. unc. - Permittivity	± 1.8	Rectangular	$\sqrt{3}$	0.23	$\pm 1.0 \%$	∞
Combined Standard Uncertainty					$\pm 12 \%$	330
Expanded Uncertainty (k=2)					$\pm 24 \%$	

The above measurement uncertainties are according to IEEE Std 1528

2450 MHz Head (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	$\pm 6.0 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 4.0	Normal	1	0.64	$\pm 4.0 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 3.9	Normal	1	0.6	$\pm 3.9 \%$	∞
Temp. unc. - Conductivity	± 1.9	Rectangular	$\sqrt{3}$	0.78	$\pm 1.1 \%$	∞
Temp. unc. - Permittivity	± 1.9	Rectangular	$\sqrt{3}$	0.23	$\pm 1.1 \%$	∞
Combined Standard Uncertainty					$\pm 12 \%$	330
Expanded Uncertainty (k=2)					$\pm 24 \%$	

The above measurement uncertainties are according to IEEE Std 1528

2450 MHz Body (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	$\pm 6.0 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 4.0	Normal	1	0.64	$\pm 4.0 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 3.8	Normal	1	0.6	$\pm 3.8 \%$	∞
Temp. unc. - Conductivity	± 1.9	Rectangular	$\sqrt{3}$	0.78	$\pm 1.1 \%$	∞
Temp. unc. - Permittivity	± 2.0	Rectangular	$\sqrt{3}$	0.23	$\pm 1.2 \%$	∞
Combined Standard Uncertainty					$\pm 12 \%$	330
Expanded Uncertainty (k=2)					$\pm 24 \%$	

The above measurement uncertainties are according to IEEE Std 1528

5200 MHz Head (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	$\pm 6.6 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 4.1	Normal	1	0.64	$\pm 4.1 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 3.9	Normal	1	0.6	$\pm 3.9 \%$	∞
Temp. unc. - Conductivity	± 1.9	Rectangular	$\sqrt{3}$	0.78	$\pm 1.1 \%$	∞
Temp. unc. - Permittivity	± 1.9	Rectangular	$\sqrt{3}$	0.23	$\pm 1.1 \%$	∞
Combined Standard Uncertainty					$\pm 13 \%$	330
Expanded Uncertainty (k=2)					$\pm 26 \%$	

The above measurement uncertainties are according to IEEE Std 1528

5200 MHz Body (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	$\pm 6.6 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 4.0	Normal	1	0.64	$\pm 4.0 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 3.8	Normal	1	0.6	$\pm 3.8 \%$	∞
Temp. unc. - Conductivity	± 1.8	Rectangular	$\sqrt{3}$	0.78	$\pm 1.0 \%$	∞
Temp. unc. - Permittivity	± 1.7	Rectangular	$\sqrt{3}$	0.23	$\pm 1.0 \%$	∞
Combined Standard Uncertainty					$\pm 13 \%$	330
Expanded Uncertainty (k=2)					$\pm 26 \%$	

The above measurement uncertainties are according to IEEE Std 1528

5300 MHz Head (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	$\pm 6.6 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 3.7	Normal	1	0.64	$\pm 3.7 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 4.0	Normal	1	0.6	$\pm 4.0 \%$	∞
Temp. unc. - Conductivity	± 1.7	Rectangular	$\sqrt{3}$	0.78	$\pm 1.0 \%$	∞
Temp. unc. - Permittivity	± 1.8	Rectangular	$\sqrt{3}$	0.23	$\pm 1.0 \%$	∞
Combined Standard Uncertainty					$\pm 13 \%$	330
Expanded Uncertainty (k=2)					$\pm 26 \%$	

The above measurement uncertainties are according to IEEE Std 1528

5300 MHz Body (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	$\pm 6.6 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 3.9	Normal	1	0.64	$\pm 3.9 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 4.1	Normal	1	0.6	$\pm 4.1 \%$	∞
Temp. unc. - Conductivity	± 1.9	Rectangular	$\sqrt{3}$	0.78	$\pm 1.1 \%$	∞
Temp. unc. - Permittivity	± 1.9	Rectangular	$\sqrt{3}$	0.23	$\pm 1.1 \%$	∞
Combined Standard Uncertainty					$\pm 13 \%$	330
Expanded Uncertainty (k=2)					$\pm 26 \%$	

The above measurement uncertainties are according to IEEE Std 1528

5500 MHz Head (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	$\pm 6.6 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 4.1	Normal	1	0.64	$\pm 4.1 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 3.9	Normal	1	0.6	$\pm 3.9 \%$	∞
Temp. unc. - Conductivity	± 1.8	Rectangular	$\sqrt{3}$	0.78	$\pm 1.0 \%$	∞
Temp. unc. - Permittivity	± 1.9	Rectangular	$\sqrt{3}$	0.23	$\pm 1.1 \%$	∞
Combined Standard Uncertainty					$\pm 13 \%$	330
Expanded Uncertainty (k=2)					$\pm 26 \%$	

The above measurement uncertainties are according to IEEE Std 1528

5500 MHz Body (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	$\pm 6.6 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 3.8	Normal	1	0.64	$\pm 3.8 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 3.9	Normal	1	0.6	$\pm 3.9 \%$	∞
Temp. unc. - Conductivity	± 1.7	Rectangular	$\sqrt{3}$	0.78	$\pm 1.0 \%$	∞
Temp. unc. - Permittivity	± 1.8	Rectangular	$\sqrt{3}$	0.23	$\pm 1.0 \%$	∞
Combined Standard Uncertainty					$\pm 13 \%$	330
Expanded Uncertainty (k=2)					$\pm 26 \%$	

The above measurement uncertainties are according to IEEE Std 1528

5600 MHz Head (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	$\pm 6.6 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 3.9	Normal	1	0.64	$\pm 3.9 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 4.2	Normal	1	0.6	$\pm 4.2 \%$	∞
Temp. unc. - Conductivity	± 2.0	Rectangular	$\sqrt{3}$	0.78	$\pm 1.2 \%$	∞
Temp. unc. - Permittivity	± 1.9	Rectangular	$\sqrt{3}$	0.23	$\pm 1.1 \%$	∞
Combined Standard Uncertainty					$\pm 13 \%$	330
Expanded Uncertainty (k=2)					$\pm 26 \%$	

The above measurement uncertainties are according to IEEE Std 1528

5600 MHz Body (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	$\pm 6.6 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 3.9	Normal	1	0.64	$\pm 3.9 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 4.1	Normal	1	0.6	$\pm 4.1 \%$	∞
Temp. unc. - Conductivity	± 1.9	Rectangular	$\sqrt{3}$	0.78	$\pm 1.1 \%$	∞
Temp. unc. - Permittivity	± 1.9	Rectangular	$\sqrt{3}$	0.23	$\pm 1.1 \%$	∞
Combined Standard Uncertainty					$\pm 13 \%$	330
Expanded Uncertainty (k=2)					$\pm 26 \%$	

The above measurement uncertainties are according to IEEE Std 1528

5800 MHz Head (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	$\pm 6.6 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 4.1	Normal	1	0.64	$\pm 4.1 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 3.8	Normal	1	0.6	$\pm 3.8 \%$	∞
Temp. unc. - Conductivity	± 1.8	Rectangular	$\sqrt{3}$	0.78	$\pm 1.0 \%$	∞
Temp. unc. - Permittivity	± 1.8	Rectangular	$\sqrt{3}$	0.23	$\pm 1.0 \%$	∞
Combined Standard Uncertainty					$\pm 13 \%$	330
Expanded Uncertainty (k=2)					$\pm 26 \%$	

The above measurement uncertainties are according to IEEE Std 1528

5800 MHz Body (SN: 3930)

Error Description	Uncertainty value $\pm\%$	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.55	Normal	1	1	$\pm 6.6 \%$	∞
Axial isotropy	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Hemispherical isotropy	± 9.6	Rectangular	$\sqrt{3}$	1	$\pm 5.5 \%$	∞
Boundary Effects	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Probe Linearity	± 4.7	Rectangular	$\sqrt{3}$	1	$\pm 2.7 \%$	∞
Probe modulation response	± 2.4	Rectangular	$\sqrt{3}$	1	$\pm 1.4 \%$	∞
Detection limits	± 0.25	Rectangular	$\sqrt{3}$	1	$\pm 0.14 \%$	∞
Readout Electronics	± 1.0	Normal	1	1	$\pm 1.0 \%$	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	$\pm 0.46 \%$	∞
Integration time	± 2.6	Rectangular	$\sqrt{3}$	1	$\pm 1.5 \%$	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Probe Positioner	± 0.4	Rectangular	$\sqrt{3}$	1	$\pm 0.23 \%$	∞
Probe Positioning	± 2.9	Rectangular	$\sqrt{3}$	1	$\pm 1.7 \%$	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	$\sqrt{3}$	1	$\pm 0.58 \%$	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	$\pm 2.9 \%$	145
Device Holder	± 3.6	Normal	1	1	$\pm 3.6 \%$	5
Power Drift	± 5.0	Rectangular	$\sqrt{3}$	1	$\pm 2.9 \%$	∞
SAR Scaling	± 2.0	Rectangular	$\sqrt{3}$	1	$\pm 1.2 \%$	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	$\sqrt{3}$	1	$\pm 2.3 \%$	∞
Liquid conductivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.64	$\pm 2.9 \%$	∞
Liquid conductivity (Meas.)	± 4.0	Normal	1	0.64	$\pm 4.0 \%$	∞
Liquid permittivity (Target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	$\pm 2.9 \%$	∞
Liquid permittivity (Meas.)	± 4.1	Normal	1	0.6	$\pm 4.1 \%$	∞
Temp. unc. - Conductivity	± 1.9	Rectangular	$\sqrt{3}$	0.78	$\pm 1.1 \%$	∞
Temp. unc. - Permittivity	± 1.8	Rectangular	$\sqrt{3}$	0.23	$\pm 1.0 \%$	∞
Combined Standard Uncertainty					$\pm 13 \%$	330
Expanded Uncertainty (k=2)					$\pm 26 \%$	

The above measurement uncertainties are according to IEEE Std 1528

15. CONCLUSION

Measurement Conclusion

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

Please note that the absorption and distribution of electromagnetic energy in the body are every 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.

16. REFERENCES

- [1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Aug. 1996.
- [2] ANSI/IEEE C95.1-2005, American National Standard safety levels with respect to human exposure to radiofrequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, 2006.
- [3] ANSI/IEEE C95.1-1992, American National Standard safety levels with respect to human exposure to radiofrequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, Sept. 1992.
- [4] ANSI/IEEE C95.3-2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, New York: IEEE, December 2002.
- [5] IEEE Standards Coordinating Committee 39 –Standards Coordinating Committee 34 – IEEE Std. 1528-2003, Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices.
- [6] NCRP, National Council on Radiation Protection and Measurements, Biological Effects and Exposure Criteria for Radio Frequency Electromagnetic Fields, NCRP Report No. 86, 1986. Reprinted Feb. 1995.
- [7] T. Schmid, O. Egger, N. Kuster, Automated E-field scanning system for dosimetric assessments, IEEE Transaction on Microwave Theory and Techniques, vol. 44, Jan. 1996, pp. 105-113.
- [8] K. Pokovic, T. Schmid, N. Kuster, Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies, ICECOM97, Oct. 1997, pp. -124.
- [9] K. Pokovic, T. Schmid, and N. Kuster, E-field Probe with improved isotropy in brain simulating liquids, Proceedings of the ELMAR, Zadar, Croatia, June 23-25, 1996, pp. 172-175.
- [10] Schmid & Partner Engineering AG, Application Note: Data Storage and Evaluation, June 1998, p2.
- [11] V. Hombach, K. Meier, M. Burkhardt, E. Kuhn, N. Kuster, The Dependence of EM Energy Absorption upon Human Modeling at 900 MHz, IEEE Transaction on Microwave Theory and Techniques, vol. 44 no. 10, Oct. 1996, pp. 1865-1873.
- [12] N. Kuster and Q. Balzano, Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.
- [13] G. Hartsgrrove, A. Kraszewski, A. Surowiec, Simulated Biological Materials for Electromagnetic Radiation Absorption Studies, University of Ottawa, Bio electromagnetics, Canada: 1987, pp. 29-36.
- [14] Q. Balzano, O. Garay, T. Manning Jr., Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.
- [15] W. Gander, Computer mathematick, Birkhaeuser, Basel, 1992.
- [16] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, Second edition, Cambridge University Press, 1992.
- [17] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.
- [18] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10kHz-300GHz, Jan. 1995.
- [19] Prof. Dr. Niels Kuster, ETH, Eidgenössische Technische Hochschule Zürich, Dosimetric Evaluation of the Cellular Phone.

- [20] IEC 62209-1, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3 GHz), Feb. 2005.
- [21] Industry Canada RSS-102 Radio Frequency Exposure Compliance of Radio communication Apparatus (All Frequency Bands) Issue 5, March 2015.
- [22] Health Canada Safety Code 6 Limits of Human Exposure to Radio Frequency Electromagnetic Fields in the Frequency Range from 3 kHz – 300 GHz, 2009
- [23] FCC SAR Test Procedures for 2G-3G Devices, Mobile Hotspot and UMPC Devices KDB Publications 941225,D01-D07
- [24] SAR Measurement procedures for IEEE 802.11a/b/g KDB Publication 248227 D01v02
- [25] FCC SAR Considerations for Handsets with Multiple Transmitters and Antennas, KDB Publications 648474D02-D04
- [26] FCC SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers, FCC KDB Publication 616217 D04
- [27] FCC SAR Measurement and Reporting Requirements for 100MHz – 6 GHz, KDB Publications 865664 D01-D02
- [28] FCC General RF Exposure Guidance and SAR Procedures for Dongles, KDB Publication 447498, D01-D02
- [29] 615223 D01 802 16e WI-Max SAR Guidance v01, Nov. 13, 2009
- [30] Anexo à Resolução No. 533, de 10 de September de 2009.
- [31] IEC 62209-2, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30 MHz to 6 GHz), Mar. 2010.

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
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 0108

Client **DT&C (Dymstec)**

Certificate No: **ES3-3328_Mar17**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3328**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6**
Calibration procedure for dosimetric E-field probes

Calibration date: **March 21, 2017**

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-16 (No. ES3-3013_Dec16)	Dec-17
DAE4	SN: 660	7-Dec-16 (No. DAE4-660_Dec16)	Dec-17
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
			Issued: March 21, 2017
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

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 0108**

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,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., $\vartheta = 0$ 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:

- 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
- 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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,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.
- DCP_{x,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
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,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 $f \leq 800$ 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 NORM_{x,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 NORM_x (no uncertainty required).

ES3DV3 – SN:3328

March 21, 2017

Probe ES3DV3

SN:3328

Manufactured: January 24, 2012
Calibrated: March 21, 2017

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

ES3DV3- SN:3328

March 21, 2017

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3328

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.02	1.04	1.07	$\pm 10.1 \%$
DCP (mV) ^B	105.3	104.3	103.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	199.5	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		190.4	
		Z	0.0	0.0	1.0		193.5	

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 Norm X,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.

ES3DV3– SN:3328

March 21, 2017

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3328

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)	Unc (k=2)
750	41.9	0.89	6.76	6.76	6.76	0.73	1.17	± 12.0 %
835	41.5	0.90	6.50	6.50	6.50	0.62	1.30	± 12.0 %
900	41.5	0.97	6.43	6.43	6.43	0.52	1.46	± 12.0 %
1750	40.1	1.37	5.50	5.50	5.50	0.32	1.88	± 12.0 %
1900	40.0	1.40	5.27	5.27	5.27	0.51	1.48	± 12.0 %
2450	39.2	1.80	4.72	4.72	4.72	0.66	1.35	± 12.0 %
2600	39.0	1.96	4.57	4.57	4.57	0.72	1.23	± 12.0 %

^c Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^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.

ES3DV3- SN:3328

March 21, 2017

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3328

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)	Unc (k=2)
750	55.5	0.96	6.46	6.46	6.46	0.80	1.18	± 12.0 %
835	55.2	0.97	6.35	6.35	6.35	0.80	1.15	± 12.0 %
900	55.0	1.05	6.44	6.44	6.44	0.80	1.15	± 12.0 %
1750	53.4	1.49	5.08	5.08	5.08	0.44	1.70	± 12.0 %
1900	53.3	1.52	4.91	4.91	4.91	0.50	1.62	± 12.0 %
2450	52.7	1.95	4.53	4.53	4.53	0.80	1.15	± 12.0 %
2600	52.5	2.16	4.28	4.28	4.28	0.80	1.12	± 12.0 %

^C Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

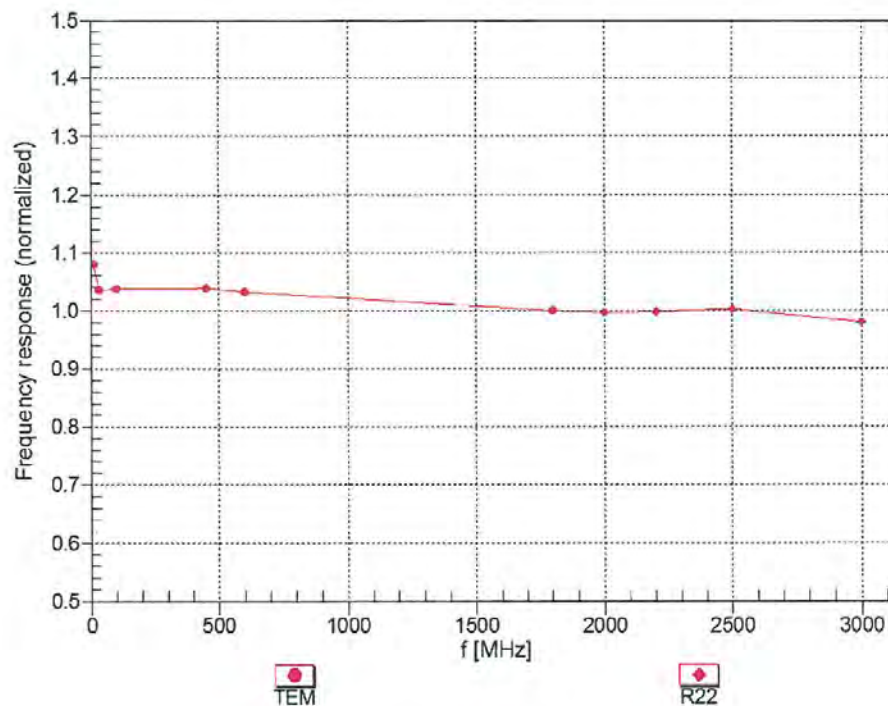
^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty 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.

ES3DV3- SN:3328

March 21, 2017

Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

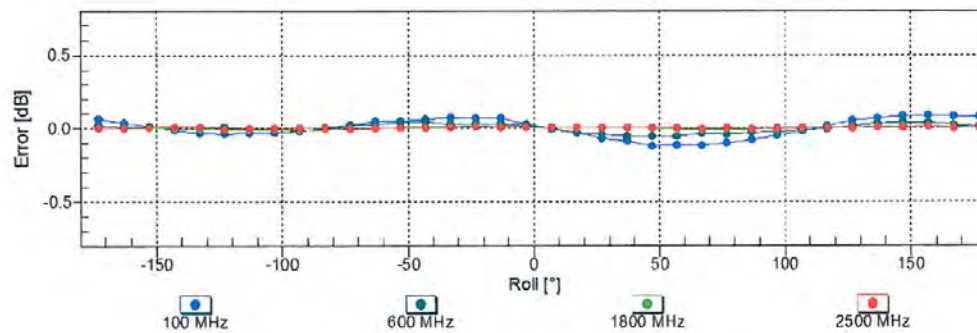
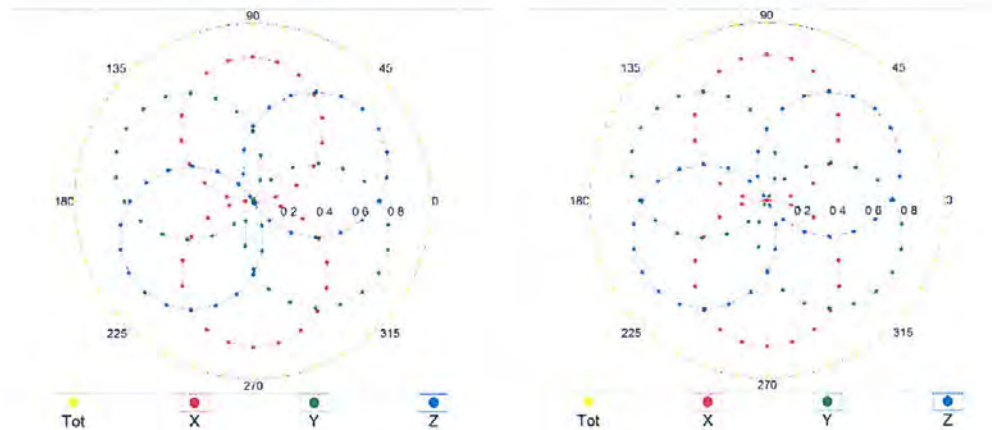
ES3DV3- SN:3328

March 21, 2017

Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz,TEM

f=1800 MHz,R22

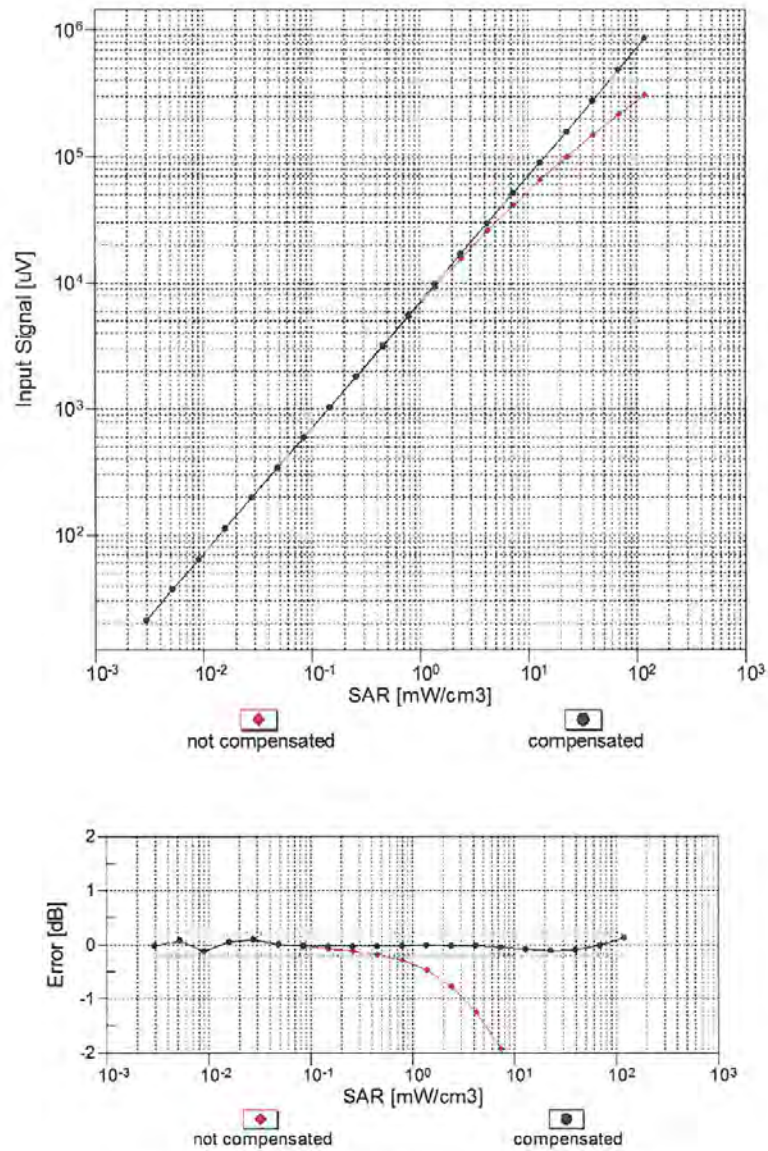


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

ES3DV3- SN:3328

March 21, 2017

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

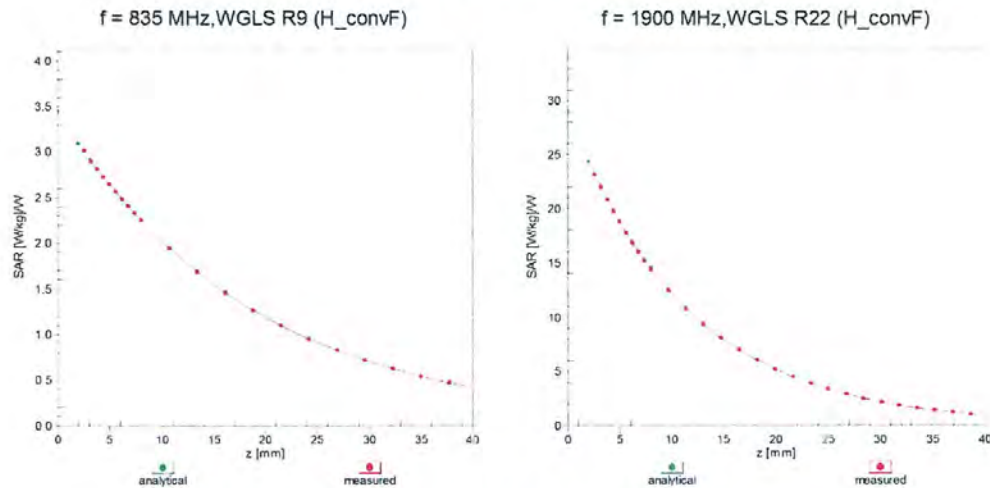


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

ES3DV3- SN:3328

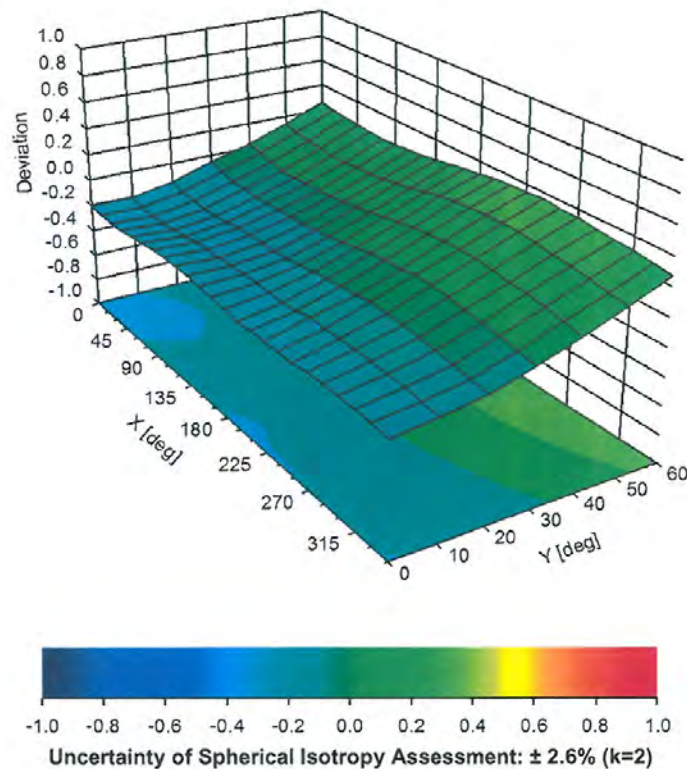
March 21, 2017

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), f = 900 MHz



ES3DV3- SN:3328

March 21, 2017

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3328

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-23
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm