TEST REPORT

Dt&C

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1. Report No : DRRFCC1712-0144
2. Customer
   - Name : Kyocera Corporation
   - Address : 2-1-1 Kagahara, Tsuzuki-ku Yokohama-shi, Kanagawa Japan 224-8502
3. Use of Report : FCC Original Grant
4. Product Name / Model Name : Mobile Phone / YKFA21
   FCC ID : JOYYKFA21
5. Test Method Used : IEEE 1528-2013 , FCC SAR KDB Publications (Details in test report)
   Test Specification : CFR §2.1093
6. Date of Test : 2017-11-23 ~ 2017-11-30
7. Testing Environment : Refer to the attached test report
8. Test Result : Refer to the attached test report

Affirmation	Tested by Name : ChangWon Lee	(Signature)	Technical Manager Name : HakMin Kim	(Signature)

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Test Report Version

Test Report No.	Date	Description
DRRFCC1712-0144	Dec. 08, 2017	Initial issue

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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	JOYYKFA21
Equipment model name	YKFA21
Equipment add model name	N/A
Equipment serial no.	Identical prototype
Mode(s) of Operation	PCS 1900, WCDMA1700, WCDMA1900, LTE Band 4, 2, 2.4 G W-LAN (802.11b/g/n HT20/n), Bluetooth

	Band	Mode	Operating Modes	Bandwidth	Frequency
TX Frequency Range	PCS1900	GSM/GPRS	Voice/Data	-	1850.2 ~ 1909.8 MHz
	WCDMA1700	WCDMA	Voice/Data	-	1712.4 ~ 1752.6 MHz
	WCDM1900	WCDMA	Voice/Data	-	1852.4 ~ 1907.6 MHz
	LTE Band 4	LTE	Voice/Data	1.4/3/5/10/15/20MHz	1710.7 ~ 1754.3 MHz
	LTE Band 2	LTE	Voice/Data	1.4/3/5/10/15/20MHz	1850.7 ~ 1909.3 MHz
	2.4 GHz W-LAN	802.11b/g/n	Voice/Data	HT20/ HT40	2412 ~ 2462 MHz
	Bluetooth	-	Data	-	2402 ~ 2480 MHz
RX Frequency Range	PCS1900	GSM/GPRS	Voice/Data	-	1930.2 ~ 1989.8 MHz
	WCDMA1700	WCDMA	Voice/Data	-	2112.4 ~ 2152.6 MHz
	WCDM1900	WCDMA	Voice/Data	-	1932.4 ~ 1987.6 MHz
	LTE Band 4	LTE	Voice/Data	1.4/3/5/10/15/20MHz	2110.7 ~ 2154.3 MHz
	LTE Band 2	LTE	Voice/Data	1.4/3/5/10/15/20MHz	1930.7 ~ 1989.3 MHz
	2.4 GHz W-LAN	802.11b/g/n	Voice/Data	HT20/ HT40	2412 ~ 2462 MHz
	Bluetooth	-	Data	-	2402 ~ 2480 MHz

Equipment Class	Band	Reported SAR 1g SAR (W/kg) Head	Body-Worn	Hotspot
PCE	PCS1900	0.29	0.46	-
PCE	GPRS1900	0.41	0.67	0.67
PCE	WCDMA1700	0.19	0.37	0.37
PCE	WCDMA1900	0.63	0.98	0.98
PCE	LTE Band 4	0.20	0.44	0.44
PCE	LTE Band 2	0.77	1.00	1.00
DTS	2.4 GHz W-LAN	0.24	< 0.1	< 0.1
DSS/DTS	Bluetooth	N/A	0.19[Note]	N/A
Simultaneous SAR per KDB 690783 D01v01r03		1.01	1.19	1.04

FCC Equipment Class	Licensed Portable Transmitter Held to Ear (PCE) Part 15 Spread Spectrum Transmitter(DSS) Digital Transmission System(DTS)
Date(s) of Tests	2017-11-23 ~ 2017-11-30
Antenna Type	Internal Type Antenna
Note	Bluetooth SAR was estimated.
Functions	● GSM/GPRS(GPRS Class: 33) supported. * DTM not supported. ● BT(2.4GHz) / W-LAN(2.4GHz 802.11b/g/n(HT20)/n(HT40)) supported. * No simultaneous transmission between BT & WLAN ● Simultaneous transmission between GSM, WCDMA voice & WLAN / GPRS, WCDMA & WLAN / LTE & WLAN. ● VoIP is supported. ● 2.4 GHz WLAN Hotspot supported.

1.1 Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D01 3G SAR Procedures v03r01
- FCC KDB Publication 941225 D05 SAR for LTE Devices v02r05
- FCC KDB Publication 941225 D06 Hot Spot SAR v02r01
- FCC KDB Publication 248227 D01v02r02 (802.11 Wi-Fi SAR)
- FCC KDB Publication 447498 D01v06 (General RF Exposure Guidance)
- FCC KDB Publication 648474 D04 Handset SAR v01r03
- FCC KDB Publication 690783 D01 SAR Listings on Grants v01r03
- FCC KDB Publication 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB Publication 865664 D02 RF Exposure Reporting v01r02

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 JOYYKFA21_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 Slides for SAR Testing					
	Top	Bottom	Front	Rear	Right	Left
GSM 1900	X	O	O	O	X	O
WCDMA 1700	X	O	O	O	X	O
WCDMA 1900	X	O	O	O	X	O
LTE Band 4	X	O	O	O	X	O
LTE Band 2	X	O	O	O	X	O
2.4G W-LAN(802.11b)	O	X	O	O	O	X

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 2.4GHz Hotspot supported.

1.3 SAR Test Exclusions Applied

(A) BT

Per FCC KDB 447498 D01v06, the SAR exclusion threshold for distances < 50 mm is defined by the following equation:

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

Table 1.1 SAR exclusion threshold for distances < 50 mm

Band	Mode	Equation	Result	SAR exclusion threshold	Required SAR
DSS	Bluetooth	[(9/10)* √2.480]	1.4	3.0	X
	Bluetooth LE	[(1/10)* √2.480]	0.2	3.0	X

Per KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

(B) Licensed Transmitter(s)

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

1.4 Power Reduction for SAR

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

1.5 Device Serial Numbers

Band & Mode	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
GSM/GPRS 1900	FCC #1	FCC #1	FCC #1
WCDMA 1700	FCC #1	FCC #1	FCC #1
WCDMA 1900	FCC #1	FCC #1	FCC #1
LTE Band 4	FCC #1	FCC #1	FCC #1
LTE Band 2	FCC #1	FCC #1	FCC #1
2.4 GHz WLAN	FCC #1	FCC #1	FCC #1

1.6 LTE Information

LTE Information			
FCC ID	**JOYYKFA21**		
Form Factor	Mobile Phone		
Frequency Range of each LTE transmission Band	LTE Band 4 (AWS) (1710.7 ~ 1754.3 MHz) LTE Band 2 (PCS) (1850.7 ~ 1909.3 MHz)		
Channel Bandwidths	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Channel Number and Frequencies(MHz)	Low	Mid	High
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	1732.5 (20175)	1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	1732.5 (20175)	1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	1732.5 (20175)	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715.0 (20000)	1732.5 (20175)	1750.0 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	1732.5 (20175)	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720.0 (20050)	1732.5 (20175) [Note1]	1745.0 (20300)
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	1880.0 (18900)	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	1880.0 (18900)	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	1880.0 (18900)	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855.0 (18650)	1880.0 (18900)	1905.0 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	1880.0 (18900)	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	1860.0 (18700)	1880.0 (18900)	1900.0 (19100)
UE Category / Modulations Supported	UE Category 4 / QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	Yes		
A-MPR (Additional MPR) disabled for SAR Testing?	LTE A-MPR is not supported.		
LTE Carrier Aggregation	This device does not support both UL and DL carrier aggregation.		

Note(s)
1. LTE Band 4(AWS) at 20 MHz bandwidth does not support three non-overlapping channels.
   Per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

2. INTROCUCTION

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

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95*.1-2005 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ) It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 2.1)

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

Fig. 2.1 SAR Mathematical Equation

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

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

where:

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

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

3. DESCRIPTION OF TEST EQUIPMENT

3.1 SAR MEASUREMENT SETUP

Measurements are performed using the DASY5 automated dosimetric assessment system. The DASY5 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 3.1).

A cell controller system contains the power supply, robot controller each pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the Intel Core i7-4770 3.40 GHz desktop computer with Windows 7 system and SAR Measurement Software DASY5,A/D interface card, monitor, mouse, and keyboard. The Staubli Robotis 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.

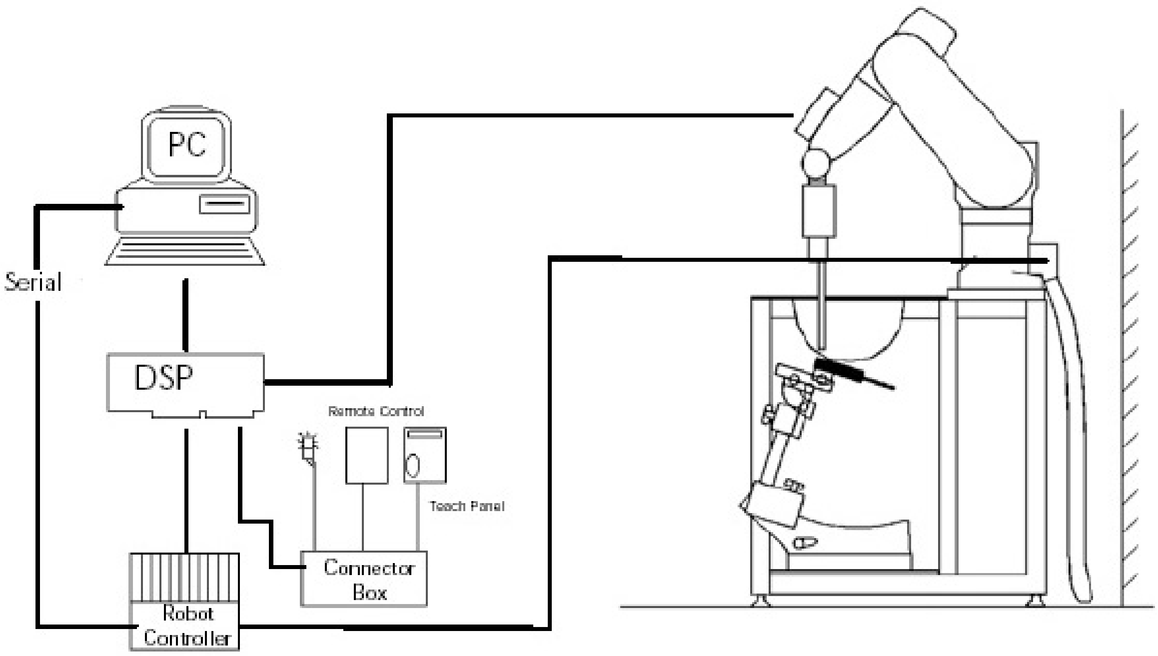


Figure 3.1 SAR Measurement System Setup

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 EX3DV4Probe Specification

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

Frequency 10 MHz to 6 GHz

Linearity ± 0.2 dB(30 MHz to 6 GHz)

Dynamic 10 µW/g to > 100 mW/g

Range Linearity : ±0.2dB

Dimensions Overall length : 337 mm

Tip length 20 mm

Body diameter 12 mm

Tip diameter 2.5 mm

Distance from probe tip to sensor center 1.0 mm

Application SAR Dosimetry Testing
Compliance tests of mobile phones

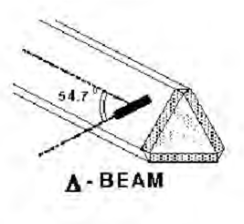


Figure 3.2 Triangular Probe Configurations

Figure 3.3 Probe Thick-Film Technique

DAE System

The SAR measurements were conducted with the dosimetric probe EX3DV4 designed in the classical triangular configuration(see Fig. 3.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multitier line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY5 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

3.3 Probe Calibration Process

3.3.1 E-Probe Calibration

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure and found to be better than +/-0.25dB. The sensitivity parameters (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/cm^3 for brain tissue)

SAR is proportional to ΔT / Δt , the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

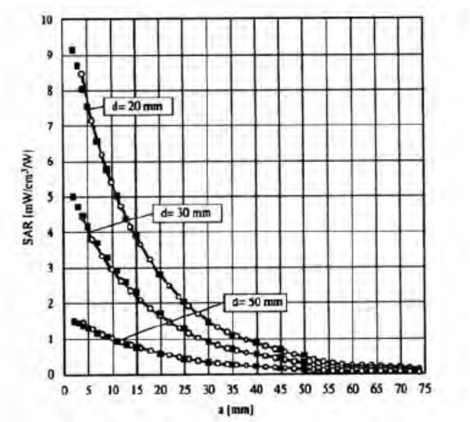


Figure 3.4 E-Field and Temperature Measurements at 900MHz

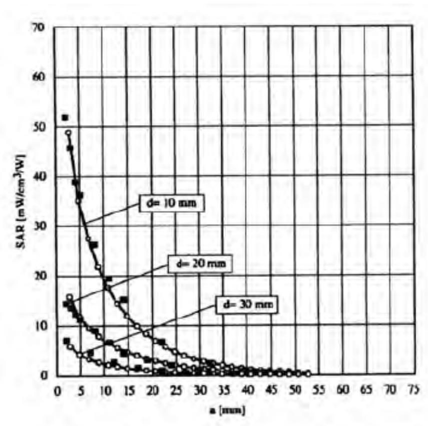


Figure 3.5 E-Field and Temperature Measurements at 1800MHz

3.4 Data Extrapolation

The DASY5 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given like below;

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

with V_i = compensated signal of channel i (i=x,y,z)
U_i = input signal of channel i (i=x,y,z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with V_i = compensated signal of channel i (i = x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i = x,y,z) $\mu V/(V/m)^2$ for E-field probes
ConvF = sensitivity of enhancement in solution
E_i = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermetian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with SAR = local specific absorption rate in W/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

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

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

with P_{pwe} = equivalent power density of a plane wave in W/cm^2
E_{tot} = total electric field strength in V/m

3.5 SAM Twin PHANTOM

The SAM Twin Phantom V5.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid.

Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 3.6)

Figure 3.6 SAM Twin Phantom

SAM Twin Phantom Specification:

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

Specific Anthropomorphic Mannequin (SAM) Specifications:

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected 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)			
	1900		2450	
Tissue Type	**Head**	**Body**	**Head**	**Body**
Water	55.24	55.24	65.52	80.00
Salt (NaCl)	0.310	0.310	-	-
Sugar	-	-	-	-
HEC	-	-	-	-
Bactericide	-	-	-	-
Triton X-100	-	-	17.24	-
DGBE	44.45	44.45	-	-
Diethylene glycol hexyl ether	-	-	17.24	-
Polysorbate (Tween) 80	-	-		20.00
Target for Dielectric Constant	40.0	40.0	-	-
Target for Conductivity (S/m)	1.40	1.40	-	-

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

Table 3.2 HSL/MSL1750 (Head and Body liquids for 1700 – 1800 MHz)

Item	Head Tissue Simulation Liquids HSL1750 Muscle (body) Tissue Simulation Liquids MSL1750
Type No	SL AAH 175, SL AAM 175
Manufacturer	SPEAG
The item is composed of the following ingredients:	
H^2O	Water, 52 – 75%
C8H18O3	Diethylene glycol monobutyl ether (DGBE), 25 – 48%
NaCl	Sodium Chloride, < 1.0%

3.8 SAR TEST EQUIPMENT

Table 3.2 Test Equipment Calibration

	Type	Manufacturer	Model	Cal.Date	Next.Cal.Date	S/N
☒	SEMITEC Engineering	SEMITEC	N/A	N/A	N/A	Shield Room
☒	Robot	SCHMID	TX60L	N/A	N/A	F14/5VR2A1/A/01
☒	Robot Controller	SCHMID	CS8C	N/A	N/A	F14/5VR2A1/C/01
☒	Joystick	SCHMID	N/A	N/A	N/A	D21142605A
☒	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
☒	Device Holder	SCHMID	SD000H01KA	N/A	N/A	N/A
☒	Twin SAM Phantom	SCHMID	TP1220	N/A	N/A	N/A
☒	Data Acquisition Electronics	SCHMID	DAE4V1	2017-09-19	2018-09-19	1453
☒	Dosimetric E-Field Probe	SCHMID	EX3DV4	2017-09-28	2018-09-28	3933
☒	1800MHz SAR Dipole	SCHMID	D1800V2	2017-05-23	2019-05-23	2d047
☒	1900MHz SAR Dipole	SCHMID	D1900V2	2017-09-20	2019-09-20	5d029
☒	2450MHz SAR Dipole	SCHMID	D2450V2	2017-09-19	2019-09-19	726
☒	Network Analyzer	Agilent	E5071C	2017-09-05	2018-09-05	MY46106970
☒	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
☒	Attenuators(3 dB)	Agilent	8491B	2017-04-11	2018-04-11	MY39260700
☒	Attenuators(10 dB)	WEINSCHEL	23-10-34	2017-01-04	2018-01-04	BP4387
☒	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	GB43461134
☒	Wideband Radio Communication Tester	Rohde Schwarz	CMW500	2017-08-04	2018-08-04	152048
☒	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 and muscle-equivalent material. Each equipment item was used solely within its respective calibration period.

4. TEST SYSTEM SPECIFICATIONS

Automated TEST SYSTEM SPECIFICATIONS:

Positioner

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

Data Acquisition Electronic (DAE) System

Cell Controller

Processor	Intel Core i7-4770
Clock Speed	3.40 GHz
Operating System	Windows 7 Professional
Data Card	DASY5 PC-Board

Data Converter

Features	Signal, multiplexer, A/D converter. & control logic
Software	DASY5
Connecting Lines	Optical downlink for data and status info Optical uplink for commands and clock

PC Interface Card

Function	24 bit (64 MHz) DSP for real time processing Link to DAE 4 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot

E-Field Probes

Model	EX3DV4 S/N: 3933
Construction	Triangular core fiber optic detection system
Frequency	10 MHz to 6 GHz
Linearity	± 0.2 dB (30 MHz to 6 GHz)

Phantom

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

Figure 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.

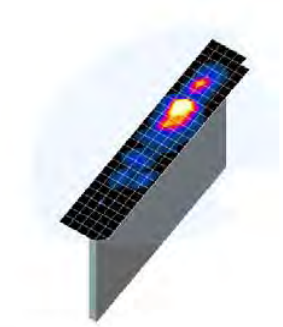


Figure 5.1
Sample SAR Area Scan

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 3-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 mm ± 1 mm</td><td>$\frac{1}{2} \cdot \delta \cdot \ln(2)$ mm ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">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 ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ $1.5 \cdot \Delta z_{Zoom}(n-1)$ mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">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 area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

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.

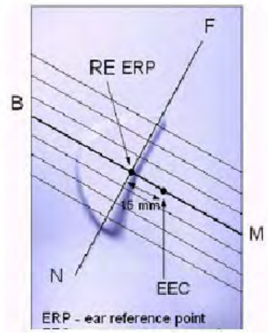


Figure 6.1 Close-up side view of ERP

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 than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at it's top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

Figure 6.2 Front, back and side view SAM Twin Phantom

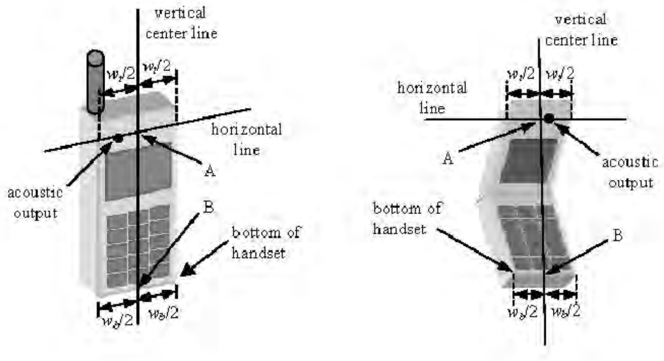


Figure 6.3 Handset Vertical Center & Horizontal Line Reference Points

7. TEST CONFIGURATION POSITIONS FOR HANDSETS

7.1 Device Holder

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

7.2 Positioning for Cheek/Touch

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

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

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

7.3 Positioning for Ear / 15 ° Tilt

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

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 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).

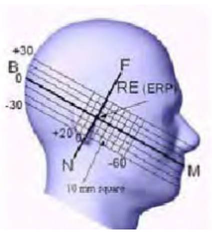


Figure 7.2 Side view w/relevant markings

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 6.7). 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 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.

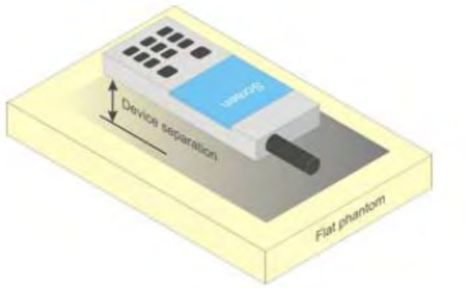


Figure 7.4 Sample Body-Worn Diagram

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 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 447498D01v06 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v06, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

7.6 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06v02r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes.

Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v06 publication procedures. The “Portable Hotspot” feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

8. RF EXPOSURE LIMITS

Uncontrolled Environment:

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

Controlled Environment:

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 8.1.SAR Human Exposure Specified in ANSI/IEEE C95.1-1992

	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 in12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a3.4 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	β_{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 β_c/β_d =12/15, β_{hs}/β_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 β_c = 11/15 and β_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_d (SF)	β_c/β_d	β_{hs} (1)	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM (2) (dB)	MPR (dB)	AG (4) Index	E-TFCI
1	11/15 (3)	15/15 (3)	64	11/15 (3)	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}: 47/15 β_{ed2}: 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (4)	15/15 (4)	64	15/15 (4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

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

Figure 9.2 Table 2

9.4 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05v02r05 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR. The R&S CMW500 was used for LTE output power measurement and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

9.4.1 Spectrum Plots for RB Configurations

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

9.4.2 MPR

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

9.4.3 A-MPR

A-MPR (Addition MPR) has been disable for all SAR tests by setting NS=01 on the base station simulator.

9.4.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r05:

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

9.5 SAR Testing with 802.11 Transmitters

Normal network operating configurations are not suitable for measuring the SAR of 802.11 b/g/n transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227D01v02r02 for more details.

9.5.1 General Device Setup

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

9.5.2 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.

9.5.3 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.

9.5.4 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 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, 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11g then 802.11n is used for SAR measurement. When the maximum output power ware 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.

9.5.5 Initial Test Configuration Procedure

For OFDM, in both 2.4 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.

9.5.6 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 1900	Maximum	31.0	31.0	29.5	27.5	25.5
	Nominal	29.5	29.5	28.0	26.0	24.0

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
PCS 1900	512	30.6	30.6	28.9	26.9	24.9
	661	30.6	30.6	28.9	26.9	24.9
	810	30.5	30.5	28.9	26.8	24.8
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**
PCS 1900	512	21.57	21.57	**22.88**	22.64	21.89
	661	21.57	21.57	**22.88**	22.64	21.89
	810	21.47	21.47	**22.88**	22.54	21.79
PCS 1900	**Frame Avg. Targets:**	20.47	20.47	**21.98**	21.74	20.99

Table 10.1.2 GSM Conducted Power

Note:

1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
2. 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.
3. This device does not support EDGE.
4. Frame Avg. Target Tolerance is ± 1.5 dB

GPRS Multislot class: 33 (max 4 TX Uplink slots)
EDGE Multislot class: N/A
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	3GPP 34.121 Subtest	AWS Band (dBm)		PCS Band (dBm)	
		Maximum	Nominal	Maximum	Nominal
WCDMA	12.2 kbps (RMC, AMR)	24.0	23.0	24.0	23.0
HSDPA	Subtest 1	23.0	22.0	24.0	23.0
	Subtest 2	23.0	22.0	24.0	23.0
	Subtest 3	22.5	21.5	23.5	22.5
	Subtest 4	22.5	21.5	23.5	22.5
HSUPA	Subtest 1	23.0	22.0	24.0	23.0
	Subtest 2	21.0	20.0	22.0	21.0
	Subtest 3	22.0	21.0	23.0	22.0
	Subtest 4	21.0	20.0	22.0	21.0
	Subtest 5	22.5	21.5	23.5	22.5

Table 10.2.1 WCDMA Nominal and Maximum Output Power Spec

3GPP Release Version	Mode	3GPP 34.121 Subtest	AWS Band (dBm)			PCS Band (dBm)			3GPP MPR (dB)
			1312	1412	1513	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	22.95	23.20	23.24	23.06	23.14	23.32	-
99		12.2 kbps AMR	22.91	23.16	23.22	23.04	23.11	23.29	-
5	HSDPA	Subtest 1	22.02	22.22	22.33	22.05	22.06	22.26	0
5		Subtest 2	22.05	22.16	22.40	22.05	22.07	22.21	0
5		Subtest 3	21.52	21.72	21.89	21.62	21.64	21.76	0.5
5		Subtest 4	21.52	21.72	21.79	21.62	21.63	21.76	0.5
6	HSUPA	Subtest 1	21.86	21.92	21.95	22.77	22.93	22.79	0
6		Subtest 2	20.88	20.85	20.93	21.10	21.09	21.31	2
6		Subtest 3	21.01	21.09	21.16	21.24	21.06	21.14	1
6		Subtest 4	20.68	20.93	20.89	21.37	21.41	21.59	2
6		Subtest 5	22.04	22.11	22.13	22.09	22.08	22.29	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.

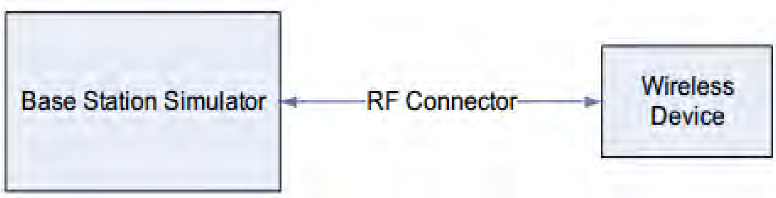


Figure 10.2 Power Measurement Setup

10.3 LTE Nominal and Maximum Output Power Spec and Conducted Powers

Band & Mode		Modulated Average [dBm]
LTE Band 4(AWS)	Maximum	24.0
	Nominal	22.0

Table 10.3.1 Nominal and Maximum Output Power Spec

1) LTE Band 4 (AWS)

Mode	Freq. (MHz)	Channel	LTE Band 4 (AWS) Conducted Power– 20 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Mid	1732.5	20175	20	QPSK	1	0	23.43	0	0
	1732.5	20175	20	QPSK	1	50	**23.65**	0	0
	1732.5	20175	20	QPSK	1	99	23.54	0	0
	1732.5	20175	20	QPSK	50	0	**22.59**	0-1	1
	1732.5	20175	20	QPSK	50	25	22.55	0-1	1
	1732.5	20175	20	QPSK	50	50	22.43	0-1	1
	1732.5	20175	20	QPSK	100	0	22.53	0-1	1
	1732.5	20175	20	16QAM	1	0	22.54	0-1	1
	1732.5	20175	20	16QAM	1	50	22.33	0-1	1
	1732.5	20175	20	16QAM	1	99	22.45	0-1	1
	1732.5	20175	20	16QAM	50	0	21.29	0-2	2
	1732.5	20175	20	16QAM	50	25	21.25	0-2	2
	1732.5	20175	20	16QAM	50	50	21.11	0-2	2
	1732.5	20175	20	16QAM	100	0	21.14	0-2	2

Table 10.3.2 LTE Conducted Power

Note 1: LTE Band 4(AWS) at 20 MHz bandwidth does not support three non-overlapping channels.
Per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Mode	Freq. (MHz)	Channel	LTE Band 4 (AWS) Conducted Power– 15 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	1717.5	20025	15	QPSK	1	0	23.56	0	0
	1717.5	20025	15	QPSK	1	36	23.38	0	0
	1717.5	20025	15	QPSK	1	74	23.30	0	0
	1717.5	20025	15	QPSK	36	0	22.35	0-1	1
	1717.5	20025	15	QPSK	36	18	22.33	0-1	1
	1717.5	20025	15	QPSK	36	37	22.36	0-1	1
	1717.5	20025	15	QPSK	75	0	22.35	0-1	1
	1717.5	20025	15	16QAM	1	0	22.58	0-1	1
	1717.5	20025	15	16QAM	1	36	22.42	0-1	1
	1717.5	20025	15	16QAM	1	74	22.40	0-1	1
	1717.5	20025	15	16QAM	36	0	21.01	0-2	2
	1717.5	20025	15	16QAM	36	18	21.07	0-2	2
	1717.5	20025	15	16QAM	36	37	20.95	0-2	2
	1717.5	20025	15	16QAM	75	0	20.94	0-2	2
Mid	1732.5	20175	15	QPSK	1	0	23.47	0	0
	1732.5	20175	15	QPSK	1	36	23.15	0	0
	1732.5	20175	15	QPSK	1	74	23.26	0	0
	1732.5	20175	15	QPSK	36	0	22.23	0-1	1
	1732.5	20175	15	QPSK	36	18	22.11	0-1	1
	1732.5	20175	15	QPSK	36	37	22.13	0-1	1
	1732.5	20175	15	QPSK	75	0	22.12	0-1	1
	1732.5	20175	15	16QAM	1	0	22.50	0-1	1
	1732.5	20175	15	16QAM	1	36	22.12	0-1	1
	1732.5	20175	15	16QAM	1	74	22.22	0-1	1
	1732.5	20175	15	16QAM	36	0	21.17	0-2	2
	1732.5	20175	15	16QAM	36	18	21.14	0-2	2
	1732.5	20175	15	16QAM	36	37	21.19	0-2	2
	1732.5	20175	15	16QAM	75	0	21.18	0-2	2
High	1747.5	20325	15	QPSK	1	0	23.47	0	0
	1747.5	20325	15	QPSK	1	36	23.30	0	0
	1747.5	20325	15	QPSK	1	74	23.22	0	0
	1747.5	20325	15	QPSK	36	0	22.39	0-1	1
	1747.5	20325	15	QPSK	36	18	22.30	0-1	1
	1747.5	20325	15	QPSK	36	37	22.21	0-1	1
	1747.5	20325	15	QPSK	75	0	22.21	0-1	1
	1747.5	20325	15	16QAM	1	0	22.49	0-1	1
	1747.5	20325	15	16QAM	1	36	22.35	0-1	1
	1747.5	20325	15	16QAM	1	74	22.31	0-1	1
	1747.5	20325	15	16QAM	36	0	21.14	0-2	2
	1747.5	20325	15	16QAM	36	18	21.08	0-2	2
	1747.5	20325	15	16QAM	36	37	20.90	0-2	2
	1747.5	20325	15	16QAM	75	0	20.93	0-2	2

Table 10.3.3 LTE Conducted Power

Mode	Freq. (MHz)	Channel	LTE Band 4 (AWS) Conducted Power– 10 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	1715.0	20000	10	QPSK	1	0	23.51	0	0
	1715.0	20000	10	QPSK	1	25	23.25	0	0
	1715.0	20000	10	QPSK	1	49	23.29	0	0
	1715.0	20000	10	QPSK	25	0	22.34	0-1	1
	1715.0	20000	10	QPSK	25	12	22.14	0-1	1
	1715.0	20000	10	QPSK	25	25	22.11	0-1	1
	1715.0	20000	10	QPSK	50	0	22.17	0-1	1
	1715.0	20000	10	16QAM	1	0	22.43	0-1	1
	1715.0	20000	10	16QAM	1	25	22.45	0-1	1
	1715.0	20000	10	16QAM	1	49	22.09	0-1	1
	1715.0	20000	10	16QAM	25	0	21.56	0-2	2
	1715.0	20000	10	16QAM	25	12	21.60	0-2	2
	1715.0	20000	10	16QAM	25	25	21.41	0-2	2
	1715.0	20000	10	16QAM	50	0	21.40	0-2	2
Mid	1732.5	20175	10	QPSK	1	0	23.41	0	0
	1732.5	20175	10	QPSK	1	25	23.52	0	0
	1732.5	20175	10	QPSK	1	49	23.43	0	0
	1732.5	20175	10	QPSK	25	0	22.45	0-1	1
	1732.5	20175	10	QPSK	25	12	22.30	0-1	1
	1732.5	20175	10	QPSK	25	25	22.25	0-1	1
	1732.5	20175	10	QPSK	50	0	22.35	0-1	1
	1732.5	20175	10	16QAM	1	0	22.46	0-1	1
	1732.5	20175	10	16QAM	1	25	22.13	0-1	1
	1732.5	20175	10	16QAM	1	49	22.30	0-1	1
	1732.5	20175	10	16QAM	25	0	21.61	0-2	2
	1732.5	20175	10	16QAM	25	12	21.54	0-2	2
	1732.5	20175	10	16QAM	25	25	21.50	0-2	2
	1732.5	20175	10	16QAM	50	0	21.50	0-2	2
High	1750.0	20350	10	QPSK	1	0	23.62	0	0
	1750.0	20350	10	QPSK	1	25	23.64	0	0
	1750.0	20350	10	QPSK	1	49	23.57	0	0
	1750.0	20350	10	QPSK	25	0	22.51	0-1	1
	1750.0	20350	10	QPSK	25	12	22.61	0-1	1
	1750.0	20350	10	QPSK	25	25	22.43	0-1	1
	1750.0	20350	10	QPSK	50	0	22.46	0-1	1
	1750.0	20350	10	16QAM	1	0	22.22	0-1	1
	1750.0	20350	10	16QAM	1	25	22.11	0-1	1
	1750.0	20350	10	16QAM	1	49	22.65	0-1	1
	1750.0	20350	10	16QAM	25	0	21.62	0-2	2
	1750.0	20350	10	16QAM	25	12	21.66	0-2	2
	1750.0	20350	10	16QAM	25	25	21.69	0-2	2
	1750.0	20350	10	16QAM	50	0	21.57	0-2	2

Table 10.3.4 LTE Conducted Power

Mode	Freq. (MHz)	Channel	LTE Band 4 (AWS) Conducted Power– 5 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	1712.5	19975	5	QPSK	1	0	23.29	0	0
	1712.5	19975	5	QPSK	1	12	23.24	0	0
	1712.5	19975	5	QPSK	1	24	23.24	0	0
	1712.5	19975	5	QPSK	12	0	22.37	0-1	1
	1712.5	19975	5	QPSK	12	6	22.45	0-1	1
	1712.5	19975	5	QPSK	12	13	22.14	0-1	1
	1712.5	19975	5	QPSK	25	0	22.39	0-1	1
	1712.5	19975	5	16QAM	1	0	22.06	0-1	1
	1712.5	19975	5	16QAM	1	12	22.10	0-1	1
	1712.5	19975	5	16QAM	1	24	21.74	0-1	1
	1712.5	19975	5	16QAM	12	0	21.43	0-2	2
	1712.5	19975	5	16QAM	12	6	21.17	0-2	2
	1712.5	19975	5	16QAM	12	13	21.26	0-2	2
	1712.5	19975	5	16QAM	25	0	21.59	0-2	2
Mid	1732.5	20175	5	QPSK	1	0	23.39	0	0
	1732.5	20175	5	QPSK	1	12	23.43	0	0
	1732.5	20175	5	QPSK	1	24	23.27	0	0
	1732.5	20175	5	QPSK	12	0	22.38	0-1	1
	1732.5	20175	5	QPSK	12	6	22.37	0-1	1
	1732.5	20175	5	QPSK	12	13	22.29	0-1	1
	1732.5	20175	5	QPSK	25	0	22.34	0-1	1
	1732.5	20175	5	16QAM	1	0	22.37	0-1	1
	1732.5	20175	5	16QAM	1	12	22.27	0-1	1
	1732.5	20175	5	16QAM	1	24	22.27	0-1	1
	1732.5	20175	5	16QAM	12	0	21.34	0-2	2
	1732.5	20175	5	16QAM	12	6	21.42	0-2	2
	1732.5	20175	5	16QAM	12	13	21.54	0-2	2
	1732.5	20175	5	16QAM	25	0	21.50	0-2	2
High	1752.5	20375	5	QPSK	1	0	23.53	0	0
	1752.5	20375	5	QPSK	1	12	23.58	0	0
	1752.5	20375	5	QPSK	1	24	23.42	0	0
	1752.5	20375	5	QPSK	12	0	22.48	0-1	1
	1752.5	20375	5	QPSK	12	6	22.53	0-1	1
	1752.5	20375	5	QPSK	12	13	22.59	0-1	1
	1752.5	20375	5	QPSK	25	0	22.58	0-1	1
	1752.5	20375	5	16QAM	1	0	22.08	0-1	1
	1752.5	20375	5	16QAM	1	12	22.20	0-1	1
	1752.5	20375	5	16QAM	1	24	22.48	0-1	1
	1752.5	20375	5	16QAM	12	0	21.72	0-2	2
	1752.5	20375	5	16QAM	12	6	21.66	0-2	2
	1752.5	20375	5	16QAM	12	13	21.71	0-2	2
	1752.5	20375	5	16QAM	25	0	21.72	0-2	2

Table 10.3.5 LTE Conducted Power

Mode	Freq. (MHz)	Channel	LTE Band 4 (AWS) Conducted Power– 3 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	1711.5	19965	3	QPSK	1	0	23.26	0	0
	1711.5	19965	3	QPSK	1	7	23.25	0	0
	1711.5	19965	3	QPSK	1	14	23.21	0	0
	1711.5	19965	3	QPSK	8	0	22.22	0-1	1
	1711.5	19965	3	QPSK	8	4	22.27	0-1	1
	1711.5	19965	3	QPSK	8	7	22.19	0-1	1
	1711.5	19965	3	QPSK	15	0	22.23	0-1	1
	1711.5	19965	3	16QAM	1	0	22.23	0-1	1
	1711.5	19965	3	16QAM	1	7	22.26	0-1	1
	1711.5	19965	3	16QAM	1	14	22.22	0-1	1
	1711.5	19965	3	16QAM	8	0	21.22	0-2	2
	1711.5	19965	3	16QAM	8	4	21.26	0-2	2
	1711.5	19965	3	16QAM	8	7	21.25	0-2	2
	1711.5	19965	3	16QAM	15	0	21.25	0-2	2
Mid	1732.5	20175	3	QPSK	1	0	23.49	0	0
	1732.5	20175	3	QPSK	1	7	23.39	0	0
	1732.5	20175	3	QPSK	1	14	23.39	0	0
	1732.5	20175	3	QPSK	8	0	22.34	0-1	1
	1732.5	20175	3	QPSK	8	4	22.39	0-1	1
	1732.5	20175	3	QPSK	8	7	22.31	0-1	1
	1732.5	20175	3	QPSK	15	0	22.33	0-1	1
	1732.5	20175	3	16QAM	1	0	22.34	0-1	1
	1732.5	20175	3	16QAM	1	7	22.32	0-1	1
	1732.5	20175	3	16QAM	1	14	22.25	0-1	1
	1732.5	20175	3	16QAM	8	0	21.38	0-2	2
	1732.5	20175	3	16QAM	8	4	21.40	0-2	2
	1732.5	20175	3	16QAM	8	7	21.35	0-2	2
	1732.5	20175	3	16QAM	15	0	21.31	0-2	2
High	1753.5	20385	3	QPSK	1	0	23.54	0	0
	1753.5	20385	3	QPSK	1	7	23.49	0	0
	1753.5	20385	3	QPSK	1	14	23.38	0	0
	1753.5	20385	3	QPSK	8	0	22.58	0-1	1
	1753.5	20385	3	QPSK	8	4	22.45	0-1	1
	1753.5	20385	3	QPSK	8	7	22.42	0-1	1
	1753.5	20385	3	QPSK	15	0	22.42	0-1	1
	1753.5	20385	3	16QAM	1	0	22.27	0-1	1
	1753.5	20385	3	16QAM	1	7	22.31	0-1	1
	1753.5	20385	3	16QAM	1	14	22.43	0-1	1
	1753.5	20385	3	16QAM	8	0	21.53	0-2	2
	1753.5	20385	3	16QAM	8	4	21.45	0-2	2
	1753.5	20385	3	16QAM	8	7	21.36	0-2	2
	1753.5	20385	3	16QAM	15	0	21.37	0-2	2

Table 10.3.6 LTE Conducted Power

Mode	Freq. (MHz)	Channel	LTE Band 4 (AWS) Conducted Power– 1.4 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	1710.7	19957	1.4	QPSK	1	0	23.37	0	0
	1710.7	19957	1.4	QPSK	1	2	23.43	0	0
	1710.7	19957	1.4	QPSK	1	5	23.34	0	0
	1710.7	19957	1.4	QPSK	3	0	23.29	0	0
	1710.7	19957	1.4	QPSK	3	2	23.31	0	0
	1710.7	19957	1.4	QPSK	3	3	23.35	0	0
	1710.7	19957	1.4	QPSK	6	0	22.34	0-1	1
	1710.7	19957	1.4	16QAM	1	0	22.30	0-1	1
	1710.7	19957	1.4	16QAM	1	2	22.28	0-1	1
	1710.7	19957	1.4	16QAM	1	5	22.28	0-1	1
	1710.7	19957	1.4	16QAM	3	0	22.27	0-1	1
	1710.7	19957	1.4	16QAM	3	2	22.35	0-1	1
	1710.7	19957	1.4	16QAM	3	3	22.30	0-1	1
	1710.7	19957	1.4	16QAM	6	0	21.39	0-2	2
Mid	1732.5	20175	1.4	QPSK	1	0	23.36	0	0
	1732.5	20175	1.4	QPSK	1	2	23.42	0	0
	1732.5	20175	1.4	QPSK	1	5	23.29	0	0
	1732.5	20175	1.4	QPSK	3	0	23.33	0	0
	1732.5	20175	1.4	QPSK	3	2	23.35	0	0
	1732.5	20175	1.4	QPSK	3	3	23.30	0	0
	1732.5	20175	1.4	QPSK	6	0	22.30	0-1	1
	1732.5	20175	1.4	16QAM	1	0	22.37	0-1	1
	1732.5	20175	1.4	16QAM	1	2	22.26	0-1	1
	1732.5	20175	1.4	16QAM	1	5	22.16	0-1	1
	1732.5	20175	1.4	16QAM	3	0	22.25	0-1	1
	1732.5	20175	1.4	16QAM	3	2	22.30	0-1	1
	1732.5	20175	1.4	16QAM	3	3	22.23	0-1	1
	1732.5	20175	1.4	16QAM	6	0	21.39	0-2	2
High	1754.3	20393	1.4	QPSK	1	0	23.39	0	0
	1754.3	20393	1.4	QPSK	1	2	23.47	0	0
	1754.3	20393	1.4	QPSK	1	5	23.35	0	0
	1754.3	20393	1.4	QPSK	3	0	23.35	0	0
	1754.3	20393	1.4	QPSK	3	2	23.38	0	0
	1754.3	20393	1.4	QPSK	3	3	23.35	0	0
	1754.3	20393	1.4	QPSK	6	0	22.36	0-1	1
	1754.3	20393	1.4	16QAM	1	0	22.39	0-1	1
	1754.3	20393	1.4	16QAM	1	2	22.34	0-1	1
	1754.3	20393	1.4	16QAM	1	5	22.26	0-1	1
	1754.3	20393	1.4	16QAM	3	0	22.22	0-1	1
	1754.3	20393	1.4	16QAM	3	2	22.34	0-1	1
	1754.3	20393	1.4	16QAM	3	3	22.22	0-1	1
	1754.3	20393	1.4	16QAM	6	0	21.40	0-2	2

Table 10.3.7 LTE Conducted Power

Band & Mode		Modulated Average [dBm]
LTE Band 2(PCS)	Maximum	24.0
	Nominal	22.0

Table 10.3.8 Nominal and Maximum Output Power Spec

2) LTE Band 2 (PCS)

Mode	Freq. (MHz)	Channel	LTE Band 2 (PCS) Conducted Power– 20 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	1860.0	18700	20	QPSK	1	0	23.22	0	0
	1860.0	18700	20	QPSK	1	50	**23.34**	0	0
	1860.0	18700	20	QPSK	1	99	23.22	0	0
	1860.0	18700	20	QPSK	50	0	22.28	0-1	1
	1860.0	18700	20	QPSK	50	25	22.26	0-1	1
	1860.0	18700	20	QPSK	50	50	22.17	0-1	1
	1860.0	18700	20	QPSK	100	0	22.20	0-1	1
	1860.0	18700	20	16QAM	1	0	21.96	0-1	1
	1860.0	18700	20	16QAM	1	50	22.76	0-1	1
	1860.0	18700	20	16QAM	1	99	22.01	0-1	1
	1860.0	18700	20	16QAM	50	0	21.30	0-2	2
	1860.0	18700	20	16QAM	50	25	21.18	0-2	2
	1860.0	18700	20	16QAM	50	50	21.22	0-2	2
	1860.0	18700	20	16QAM	100	0	21.17	0-2	2
Mid	1880.0	18900	20	QPSK	1	0	23.32	0	0
	1880.0	18900	20	QPSK	1	50	**23.36**	0	0
	1880.0	18900	20	QPSK	1	99	23.31	0	0
	1880.0	18900	20	QPSK	50	0	22.30	0-1	1
	1880.0	18900	20	QPSK	50	25	22.33	0-1	1
	1880.0	18900	20	QPSK	50	50	22.23	0-1	1
	1880.0	18900	20	QPSK	100	0	22.23	0-1	1
	1880.0	18900	20	16QAM	1	0	22.00	0-1	1
	1880.0	18900	20	16QAM	1	50	22.37	0-1	1
	1880.0	18900	20	16QAM	1	99	22.03	0-1	1
	1880.0	18900	20	16QAM	50	0	21.35	0-2	2
	1880.0	18900	20	16QAM	50	25	21.39	0-2	2
	1880.0	18900	20	16QAM	50	50	21.18	0-2	2
	1880.0	18900	20	16QAM	100	0	21.21	0-2	2
High	1900.0	19100	20	QPSK	1	0	23.41	0	0
	1900.0	19100	20	QPSK	1	50	**23.49**	0	0
	1900.0	19100	20	QPSK	1	99	23.26	0	0
	1900.0	19100	20	QPSK	50	0	**22.43**	0-1	1
	1900.0	19100	20	QPSK	50	25	22.41	0-1	1
	1900.0	19100	20	QPSK	50	50	22.36	0-1	1
	1900.0	19100	20	QPSK	100	0	22.38	0-1	1
	1900.0	19100	20	16QAM	1	0	22.12	0-1	1
	1900.0	19100	20	16QAM	1	50	22.28	0-1	1
	1900.0	19100	20	16QAM	1	99	22.37	0-1	1
	1900.0	19100	20	16QAM	50	0	21.48	0-2	2
	1900.0	19100	20	16QAM	50	25	21.29	0-2	2
	1900.0	19100	20	16QAM	50	50	21.36	0-2	2
	1900.0	19100	20	16QAM	100	0	21.43	0-2	2

Table 10.3.9 LTE Conducted Power

Mode	Freq. (MHz)	Channel	LTE Band 2 (PCS) Conducted Power– 15 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	1857.5	18675	15	QPSK	1	0	23.16	0	0
	1857.5	18675	15	QPSK	1	36	23.17	0	0
	1857.5	18675	15	QPSK	1	74	23.10	0	0
	1857.5	18675	15	QPSK	36	0	22.22	0-1	1
	1857.5	18675	15	QPSK	36	18	22.15	0-1	1
	1857.5	18675	15	QPSK	36	37	22.24	0-1	1
	1857.5	18675	15	QPSK	75	0	22.12	0-1	1
	1857.5	18675	15	16QAM	1	0	21.97	0-1	1
	1857.5	18675	15	16QAM	1	36	22.67	0-1	1
	1857.5	18675	15	16QAM	1	74	21.97	0-1	1
	1857.5	18675	15	16QAM	36	0	21.14	0-2	2
	1857.5	18675	15	16QAM	36	18	21.15	0-2	2
	1857.5	18675	15	16QAM	36	37	21.25	0-2	2
	1857.5	18675	15	16QAM	75	0	21.20	0-2	2
Mid	1880.0	18900	15	QPSK	1	0	23.29	0	0
	1880.0	18900	15	QPSK	1	36	23.28	0	0
	1880.0	18900	15	QPSK	1	74	23.29	0	0
	1880.0	18900	15	QPSK	36	0	22.36	0-1	1
	1880.0	18900	15	QPSK	36	18	22.30	0-1	1
	1880.0	18900	15	QPSK	36	37	22.27	0-1	1
	1880.0	18900	15	QPSK	75	0	22.20	0-1	1
	1880.0	18900	15	16QAM	1	0	22.16	0-1	1
	1880.0	18900	15	16QAM	1	36	22.00	0-1	1
	1880.0	18900	15	16QAM	1	74	22.05	0-1	1
	1880.0	18900	15	16QAM	36	0	21.30	0-2	2
	1880.0	18900	15	16QAM	36	18	21.23	0-2	2
	1880.0	18900	15	16QAM	36	37	21.20	0-2	2
	1880.0	18900	15	16QAM	75	0	21.26	0-2	2
High	1902.5	19125	15	QPSK	1	0	23.31	0	0
	1902.5	19125	15	QPSK	1	36	23.33	0	0
	1902.5	19125	15	QPSK	1	74	23.48	0	0
	1902.5	19125	15	QPSK	36	0	22.41	0-1	1
	1902.5	19125	15	QPSK	36	18	22.35	0-1	1
	1902.5	19125	15	QPSK	36	37	22.42	0-1	1
	1902.5	19125	15	QPSK	75	0	22.37	0-1	1
	1902.5	19125	15	16QAM	1	0	22.17	0-1	1
	1902.5	19125	15	16QAM	1	36	22.68	0-1	1
	1902.5	19125	15	16QAM	1	74	21.67	0-1	1
	1902.5	19125	15	16QAM	36	0	21.41	0-2	2
	1902.5	19125	15	16QAM	36	18	21.38	0-2	2
	1902.5	19125	15	16QAM	36	37	21.45	0-2	2
	1902.5	19125	15	16QAM	75	0	21.39	0-2	2

Table 10.3.10 LTE Conducted Power

Mode	Freq. (MHz)	Channel	LTE Band 2 (PCS) Conducted Power– 10 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	1855.0	18650	10	QPSK	1	0	23.18	0	0
	1855.0	18650	10	QPSK	1	25	23.22	0	0
	1855.0	18650	10	QPSK	1	49	23.15	0	0
	1855.0	18650	10	QPSK	25	0	22.18	0-1	1
	1855.0	18650	10	QPSK	25	12	22.12	0-1	1
	1855.0	18650	10	QPSK	25	25	22.18	0-1	1
	1855.0	18650	10	QPSK	50	0	22.04	0-1	1
	1855.0	18650	10	16QAM	1	0	22.11	0-1	1
	1855.0	18650	10	16QAM	1	25	21.96	0-1	1
	1855.0	18650	10	16QAM	1	49	21.80	0-1	1
	1855.0	18650	10	16QAM	25	0	21.17	0-2	2
	1855.0	18650	10	16QAM	25	12	21.29	0-2	2
	1855.0	18650	10	16QAM	25	25	21.28	0-2	2
	1855.0	18650	10	16QAM	50	0	21.22	0-2	2
Mid	1880.0	18900	10	QPSK	1	0	23.29	0	0
	1880.0	18900	10	QPSK	1	25	23.31	0	0
	1880.0	18900	10	QPSK	1	49	23.25	0	0
	1880.0	18900	10	QPSK	25	0	22.28	0-1	1
	1880.0	18900	10	QPSK	25	12	22.26	0-1	1
	1880.0	18900	10	QPSK	25	25	22.22	0-1	1
	1880.0	18900	10	QPSK	50	0	22.22	0-1	1
	1880.0	18900	10	16QAM	1	0	22.23	0-1	1
	1880.0	18900	10	16QAM	1	25	22.35	0-1	1
	1880.0	18900	10	16QAM	1	49	22.18	0-1	1
	1880.0	18900	10	16QAM	25	0	21.41	0-2	2
	1880.0	18900	10	16QAM	25	12	21.29	0-2	2
	1880.0	18900	10	16QAM	25	25	21.14	0-2	2
	1880.0	18900	10	16QAM	50	0	21.25	0-2	2
High	1905.0	19150	10	QPSK	1	0	23.31	0	0
	1905.0	19150	10	QPSK	1	25	23.45	0	0
	1905.0	19150	10	QPSK	1	49	23.45	0	0
	1905.0	19150	10	QPSK	25	0	22.32	0-1	1
	1905.0	19150	10	QPSK	25	12	22.38	0-1	1
	1905.0	19150	10	QPSK	25	25	22.34	0-1	1
	1905.0	19150	10	QPSK	50	0	22.34	0-1	1
	1905.0	19150	10	16QAM	1	0	22.29	0-1	1
	1905.0	19150	10	16QAM	1	25	22.44	0-1	1
	1905.0	19150	10	16QAM	1	49	22.40	0-1	1
	1905.0	19150	10	16QAM	25	0	21.38	0-2	2
	1905.0	19150	10	16QAM	25	12	21.55	0-2	2
	1905.0	19150	10	16QAM	25	25	21.51	0-2	2
	1905.0	19150	10	16QAM	50	0	21.39	0-2	2

Table 10.3.11 LTE Conducted Power

Mode	Freq. (MHz)	Channel	LTE Band 2 (PCS) Conducted Power– 5 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	1852.5	18625	5	QPSK	1	0	22.88	0	0
	1852.5	18625	5	QPSK	1	12	23.03	0	0
	1852.5	18625	5	QPSK	1	24	22.96	0	0
	1852.5	18625	5	QPSK	12	0	21.98	0-1	1
	1852.5	18625	5	QPSK	12	6	22.00	0-1	1
	1852.5	18625	5	QPSK	12	13	22.01	0-1	1
	1852.5	18625	5	QPSK	25	0	22.05	0-1	1
	1852.5	18625	5	16QAM	1	0	21.94	0-1	1
	1852.5	18625	5	16QAM	1	12	22.04	0-1	1
	1852.5	18625	5	16QAM	1	24	21.92	0-1	1
	1852.5	18625	5	16QAM	12	0	21.12	0-2	2
	1852.5	18625	5	16QAM	12	6	21.24	0-2	2
	1852.5	18625	5	16QAM	12	13	21.07	0-2	2
	1852.5	18625	5	16QAM	25	0	21.11	0-2	2
Mid	1880	18900	5	QPSK	1	0	23.10	0	0
	1880	18900	5	QPSK	1	12	23.15	0	0
	1880	18900	5	QPSK	1	24	23.14	0	0
	1880	18900	5	QPSK	12	0	22.22	0-1	1
	1880	18900	5	QPSK	12	6	22.14	0-1	1
	1880	18900	5	QPSK	12	13	22.25	0-1	1
	1880	18900	5	QPSK	25	0	22.18	0-1	1
	1880	18900	5	16QAM	1	0	22.44	0-1	1
	1880	18900	5	16QAM	1	12	22.10	0-1	1
	1880	18900	5	16QAM	1	24	22.05	0-1	1
	1880	18900	5	16QAM	12	0	21.25	0-2	2
	1880	18900	5	16QAM	12	6	21.33	0-2	2
	1880	18900	5	16QAM	12	13	21.27	0-2	2
	1880	18900	5	16QAM	25	0	21.32	0-2	2
High	1907.5	19175	5	QPSK	1	0	23.22	0	0
	1907.5	19175	5	QPSK	1	12	23.30	0	0
	1907.5	19175	5	QPSK	1	24	23.23	0	0
	1907.5	19175	5	QPSK	12	0	22.44	0-1	1
	1907.5	19175	5	QPSK	12	6	22.33	0-1	1
	1907.5	19175	5	QPSK	12	13	22.30	0-1	1
	1907.5	19175	5	QPSK	25	0	22.42	0-1	1
	1907.5	19175	5	16QAM	1	0	21.92	0-1	1
	1907.5	19175	5	16QAM	1	12	22.21	0-1	1
	1907.5	19175	5	16QAM	1	24	22.27	0-1	1
	1907.5	19175	5	16QAM	12	0	21.54	0-2	2
	1907.5	19175	5	16QAM	12	6	21.42	0-2	2
	1907.5	19175	5	16QAM	12	13	21.40	0-2	2
	1907.5	19175	5	16QAM	25	0	21.41	0-2	2

Table 10.3.12 LTE Conducted Power

Mode	Freq. (MHz)	Channel	LTE Band 2 (PCS) Conducted Power– 3 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	1851.5	18615	3	QPSK	1	0	22.85	0	0
	1851.5	18615	3	QPSK	1	7	23.01	0	0
	1851.5	18615	3	QPSK	1	14	22.94	0	0
	1851.5	18615	3	QPSK	8	0	22.05	0-1	1
	1851.5	18615	3	QPSK	8	4	22.03	0-1	1
	1851.5	18615	3	QPSK	8	7	22.04	0-1	1
	1851.5	18615	3	QPSK	15	0	22.07	0-1	1
	1851.5	18615	3	16QAM	1	0	21.91	0-1	1
	1851.5	18615	3	16QAM	1	7	22.02	0-1	1
	1851.5	18615	3	16QAM	1	14	21.91	0-1	1
	1851.5	18615	3	16QAM	8	0	21.15	0-2	2
	1851.5	18615	3	16QAM	8	4	21.31	0-2	2
	1851.5	18615	3	16QAM	8	7	21.10	0-2	2
	1851.5	18615	3	16QAM	15	0	21.13	0-2	2
Mid	1880	18900	3	QPSK	1	0	22.95	0	0
	1880	18900	3	QPSK	1	7	23.11	0	0
	1880	18900	3	QPSK	1	14	23.10	0	0
	1880	18900	3	QPSK	8	0	22.15	0-1	1
	1880	18900	3	QPSK	8	4	22.15	0-1	1
	1880	18900	3	QPSK	8	7	22.14	0-1	1
	1880	18900	3	QPSK	15	0	22.15	0-1	1
	1880	18900	3	16QAM	1	0	22.11	0-1	1
	1880	18900	3	16QAM	1	7	22.15	0-1	1
	1880	18900	3	16QAM	1	14	22.17	0-1	1
	1880	18900	3	16QAM	8	0	21.17	0-2	2
	1880	18900	3	16QAM	8	4	21.35	0-2	2
	1880	18900	3	16QAM	8	7	21.15	0-2	2
	1880	18900	3	16QAM	15	0	21.16	0-2	2
High	1908.5	19185	3	QPSK	1	0	23.11	0	0
	1908.5	19185	3	QPSK	1	7	23.22	0	0
	1908.5	19185	3	QPSK	1	14	23.34	0	0
	1908.5	19185	3	QPSK	8	0	22.21	0-1	1
	1908.5	19185	3	QPSK	8	4	22.24	0-1	1
	1908.5	19185	3	QPSK	8	7	22.19	0-1	1
	1908.5	19185	3	QPSK	15	0	22.17	0-1	1
	1908.5	19185	3	16QAM	1	0	22.25	0-1	1
	1908.5	19185	3	16QAM	1	7	22.24	0-1	1
	1908.5	19185	3	16QAM	1	14	22.31	0-1	1
	1908.5	19185	3	16QAM	8	0	21.19	0-2	2
	1908.5	19185	3	16QAM	8	4	21.41	0-2	2
	1908.5	19185	3	16QAM	8	7	21.34	0-2	2
	1908.5	19185	3	16QAM	15	0	21.25	0-2	2

Table 10.3.13 LTE Conducted Power

Mode	Freq. (MHz)	Channel	LTE Band 2 (PCS) Conducted Power– 1.4 MHz Bandwidth						
			Bandwidth (MHz)	Modulation	RB Size	RB Offset	Conducted Power(dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
Low	1850.7	18607	1.4	QPSK	1	0	22.97	0	0
	1850.7	18607	1.4	QPSK	1	2	23.05	0	0
	1850.7	18607	1.4	QPSK	1	5	22.99	0	0
	1850.7	18607	1.4	QPSK	3	0	22.94	0	0
	1850.7	18607	1.4	QPSK	3	2	22.97	0	0
	1850.7	18607	1.4	QPSK	3	3	22.97	0	0
	1850.7	18607	1.4	QPSK	6	0	22.02	0-1	1
	1850.7	18607	1.4	16QAM	1	0	22.11	0-1	1
	1850.7	18607	1.4	16QAM	1	2	22.05	0-1	1
	1850.7	18607	1.4	16QAM	1	5	22.09	0-1	1
	1850.7	18607	1.4	16QAM	3	0	22.08	0-1	1
	1850.7	18607	1.4	16QAM	3	2	22.05	0-1	1
	1850.7	18607	1.4	16QAM	3	3	22.09	0-1	1
	1850.7	18607	1.4	16QAM	6	0	21.11	0-2	2
Mid	1880	18900	1.4	QPSK	1	0	23.11	0	0
	1880	18900	1.4	QPSK	1	2	23.13	0	0
	1880	18900	1.4	QPSK	1	5	23.12	0	0
	1880	18900	1.4	QPSK	3	0	23.05	0	0
	1880	18900	1.4	QPSK	3	2	23.08	0	0
	1880	18900	1.4	QPSK	3	3	23.02	0	0
	1880	18900	1.4	QPSK	6	0	22.21	0-1	1
	1880	18900	1.4	16QAM	1	0	22.21	0-1	1
	1880	18900	1.4	16QAM	1	2	22.15	0-1	1
	1880	18900	1.4	16QAM	1	5	22.19	0-1	1
	1880	18900	1.4	16QAM	3	0	22.11	0-1	1
	1880	18900	1.4	16QAM	3	2	22.14	0-1	1
	1880	18900	1.4	16QAM	3	3	22.12	0-1	1
	1880	18900	1.4	16QAM	6	0	21.05	0-2	2
High	1909.3	19193	1.4	QPSK	1	0	23.22	0	0
	1909.3	19193	1.4	QPSK	1	2	23.19	0	0
	1909.3	19193	1.4	QPSK	1	5	23.25	0	0
	1909.3	19193	1.4	QPSK	3	0	23.19	0	0
	1909.3	19193	1.4	QPSK	3	2	23.15	0	0
	1909.3	19193	1.4	QPSK	3	3	23.17	0	0
	1909.3	19193	1.4	QPSK	6	0	22.21	0-1	1
	1909.3	19193	1.4	16QAM	1	0	22.33	0-1	1
	1909.3	19193	1.4	16QAM	1	2	22.28	0-1	1
	1909.3	19193	1.4	16QAM	1	5	22.31	0-1	1
	1909.3	19193	1.4	16QAM	3	0	22.29	0-1	1
	1909.3	19193	1.4	16QAM	3	2	22.31	0-1	1
	1909.3	19193	1.4	16QAM	3	3	22.28	0-1	1
	1909.3	19193	1.4	16QAM	6	0	21.22	0-2	2

Table 10.3.14 LTE Conducted Power

10.4 WLAN Nominal and Maximum Output Power Spec and Conducted Powers

Band & Mode		Modulated Average[dBm]
IEEE 802.11b	Maximum	15.0
	Nominal	13.0
IEEE 802.11g	Maximum	13.0
	Nominal	11.0
IEEE 802.11n HT20	Maximum	13.0
	Nominal	11.0
IEEE 802.11n HT40 (CH4-8)	Maximum	13.0
	Nominal	11.0
IEEE 802.11n HT40 (CH3, 9-11)	Maximum	11.0
	Nominal	9.0

Table 10.4.1 WLAN 2.4GHz Nominal and Maximum Output Power Spec

Mode	Freq. (MHz)	Channel	IEEE 802.11 Conducted Power (dBm)
802.11b	2412	1	**13.75**
	2437	6	13.31
	2462	11	13.74
802.11g	2412	1	11.64
	2437	6	11.39
	2462	11	11.71
802.11n (HT-20)	2412	1	11.63
	2437	6	11.39
	2462	11	11.72
802.11n (HT-40)	2422	3	9.35
	2437	6	11.58
	2452	9	9.11

Table 10.4.2 IEEE 802.11 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, duo to an even number of channels, both channels were measured.
- Output Power and SAR is not required for 802.11 g/n 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 10.4 Power Measurement Setup

10.5 Bluetooth Nominal and Maximum Output Power Spec and Conducted Powers

Band & Mode		Modulated Average[dBm]
Bluetooth 1 Mbps	Maximum	9.5
	Nominal	7.5
Bluetooth 2 Mbps	Maximum	8.0
	Nominal	6.0
Bluetooth 3 Mbps	Maximum	8.0
	Nominal	6.0
Bluetooth LE	Maximum	1.5
	Nominal	-0.5

Table 10.5.1 Bluetooth Nominal and Maximum Output Power Spec

Channel	Frequency	Frame AVG Output Power (1Mbps)		Frame AVG Output Power (2Mbps)		Frame AVG Output Power (3Mbps)	
	(MHz)	(dBm)	(mW)	(dBm)	(mW)	(dBm)	(mW)
Low	2402	7.47	5.59	6.07	4.05	6.08	4.06
Mid	2441	6.63	4.60	5.22	3.33	5.23	3.33
High	2480	6.24	4.21	4.82	3.03	4.83	3.04

Table 10.5.2 Bluetooth Frame Average RF Power

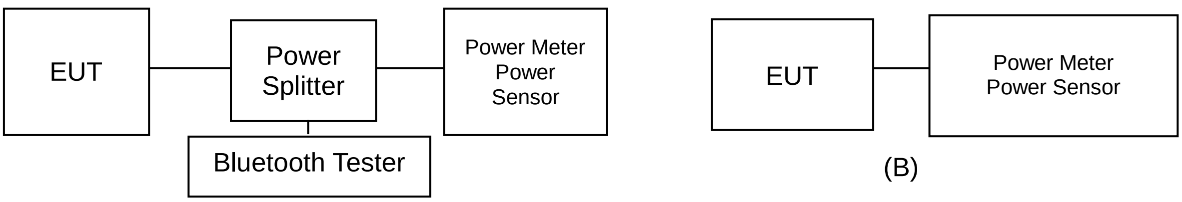
Channel	Frequency	Frame AVG Output Power (LE)	
	(MHz)	(dBm)	(mW)
Low	2402	-1.87	0.65
Mid	2440	-2.84	0.52
High	2480	-2.79	0.53

Table 10.5.3 Bluetooth LE Frame Average RF Power

- **Bluetooth Conducted Powers procedures**

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

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



(A) (B)

Figure 10.5 Average Power Measurement Setup

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

11. SYSTEM VERIFICATION

11.1 Tissue Verification

MEASURED TISSUE PARAMETERS										
Date(s)	Tissue Type	Ambient Temp.[°C]	Liquid Temp.[°C]	Measured Frequency [MHz]	Target Dielectric Constant, εr	Target Conductivity, σ (S/m)	Measured Dielectric Constant, εr	Measured Conductivity, σ (S/m)	Er Deviation [%]	σ Deviation [%]
Nov. 28, 2017	1800 Head	20.4	20.9	1712.4	40.126	1.350	40.171	1.341	0.11	-0.67
				1732.4	40.097	1.361	40.081	1.354	-0.04	-0.51
				1752.6	40.069	1.373	39.983	1.373	-0.21	0.00
				1800.0	40.000	1.400	39.739	1.417	-0.65	1.21
Nov. 28, 2017	1800 Body	20.4	20.7	1712.4	53.596	1.464	52.702	1.496	-1.67	2.19
				1732.4	53.556	1.477	52.666	1.514	-1.66	2.51
				1752.6	53.516	1.489	52.616	1.531	-1.68	2.82
				1800.0	53.300	1.520	52.476	1.572	-1.55	3.42
Nov. 29, 2017	1800 Head	21.2	21.4	1720.0	40.114	1.354	39.743	1.333	-0.92	-1.55
				1732.5	40.097	1.361	39.659	1.344	-1.09	-1.25
				1745.0	40.079	1.369	39.582	1.353	-1.24	-1.17
				1800.0	40.000	1.400	39.324	1.399	-1.69	-0.07
Nov. 29, 2017	1800 Body	21.2	21.1	1720.0	53.580	1.469	52.552	1.516	-1.92	3.20
				1732.5	53.556	1.477	52.510	1.524	-1.95	3.18
				1745.0	53.530	1.485	52.465	1.532	-1.99	3.16
				1800.0	53.300	1.520	52.292	1.577	-1.89	3.75
Nov. 23, 2017	1900 Head	20.9	21.0	1850.2	40.000	1.400	40.343	1.350	0.86	-3.57
				1880.0	40.000	1.400	40.231	1.375	0.58	-1.79
				1900.0	40.000	1.400	40.152	1.391	0.38	-0.64
				1909.8	40.000	1.400	40.117	1.399	0.29	-0.07
Nov. 23, 2017	1900 Body	20.9	20.7	1850.2	53.300	1.520	51.849	1.482	-2.72	-2.50
				1880.0	53.300	1.520	51.744	1.507	-2.92	-0.86
				1900.0	53.300	1.520	51.662	1.524	-3.07	0.26
				1909.8	53.300	1.520	51.630	1.533	-3.13	0.86
Nov. 27, 2017	1900 Head	20.3	20.6	1852.4	40.000	1.400	41.369	1.403	3.42	0.21
				1880.0	40.000	1.400	41.307	1.431	3.27	2.21
				1900.0	40.000	1.400	41.247	1.450	3.12	3.57
				1907.6	40.000	1.400	41.222	1.457	3.06	4.07
Nov. 27, 2017	1900 Body	20.3	20.4	1852.4	53.300	1.520	52.610	1.517	-1.29	-0.20
				1880.0	53.300	1.520	52.541	1.542	-1.42	1.45
				1900.0	53.300	1.520	52.478	1.559	-1.54	2.57
				1907.6	53.300	1.520	52.456	1.566	-1.58	3.03
Nov. 24, 2017	1900 Head	20.8	21.0	1860.0	40.000	1.400	39.570	1.403	-1.08	0.21
				1880.0	40.000	1.400	39.496	1.418	-1.26	1.29
				1900.0	40.000	1.400	39.422	1.433	-1.45	2.36
Nov. 24, 2017	1900 Body	20.8	20.9	1860.0	53.300	1.520	53.550	1.483	0.47	-2.43
				1880.0	53.300	1.520	53.474	1.497	0.33	-1.51
				1900.0	53.300	1.520	53.393	1.512	0.17	-0.53
Nov. 30, 2017	2450 Head	21.0	21.3	2412.0	39.265	1.766	38.819	1.716	-1.14	-2.83
				2437.0	39.222	1.788	38.736	1.743	-1.24	-2.52
				2450.0	39.200	1.800	38.694	1.757	-1.29	-2.39
				2462.0	39.184	1.813	38.655	1.770	-1.35	-2.37
Nov. 30, 2017	2450 Body	21.0	21.1	2412.0	52.751	1.914	51.185	1.875	-2.97	-2.04
				2437.0	52.717	1.938	51.136	1.903	-3.00	-1.81
				2450.0	52.700	1.950	51.102	1.917	-3.03	-1.69
				2462.0	52.685	1.967	51.068	1.931	-3.07	-1.83

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB 865664 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

Measurement Procedure for Tissue verification:

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

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

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

11.2 Test System Verification

Prior to assessment, the system is verified to the ± 10 % of the specifications at 1800 MHz, 1900 MHz and 2450 MHz 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 [%]
B	1800	D1800V2, SN:2d047	Nov. 28, 2017	Head	20.4	20.9	3933	100	39.9	3.89	38.90	-2.51
B	1800	D1800V2, SN:2d047	Nov. 28, 2017	Body	20.4	20.7	3933	100	39.2	3.91	39.10	-0.26
B	1800	D1800V2, SN:2d047	Nov. 29, 2017	Head	21.2	21.4	3933	100	39.9	3.96	39.60	-0.75
B	1800	D1800V2, SN:2d047	Nov. 29, 2017	Body	21.2	21.1	3933	100	39.2	3.92	39.20	0.00
B	1900	D1900V2, SN:5d029	Nov. 23, 2017	Head	20.9	21.0	3933	100	39.2	3.89	38.90	-0.77
B	1900	D1900V2, SN:5d029	Nov. 23, 2017	Body	20.9	20.7	3933	100	39.6	3.91	39.10	-1.26
B	1900	D1900V2, SN:5d029	Nov. 27, 2017	Head	20.3	20.6	3933	100	39.2	3.95	39.50	0.77
B	1900	D1900V2, SN:5d029	Nov. 27, 2017	Body	20.3	20.4	3933	100	39.6	3.97	39.70	0.25
B	1900	D1900V2, SN:5d029	Nov. 24, 2017	Head	20.8	21.0	3933	100	39.2	3.93	39.30	0.26
B	1900	D1900V2, SN:5d029	Nov. 24, 2017	Body	20.8	20.9	3933	100	39.6	3.95	39.50	-0.25
B	2450	D2450V2, SN: 726	Nov. 30, 2017	Head	21.0	21.3	3933	100	51.9	5.12	51.20	-1.35
B	2450	D2450V2, SN: 726	Nov. 30, 2017	Body	21.0	21.1	3933	100	50.3	4.91	49.10	-2.39

Note1 : System Verification was measured with input 250 mW and normalized to 1W.
Note2 : To confirm the proper SAR liquid depth, the z-axis plots from the system verifications were included since the system verifications were performed using the same liquid, probe and DAE as the SAR tests in the same time period.
Note3: Full system validation status and results can be found in Attachment 3.

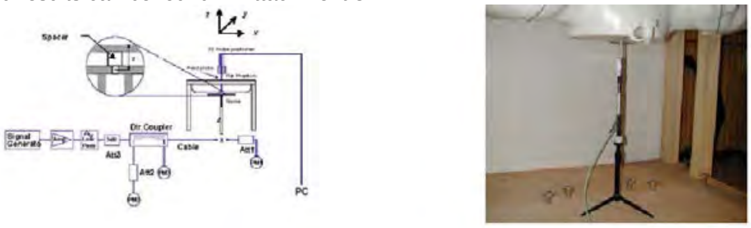


Figure 11.1 Dipole Verification Test Setup Diagram & Photo

12. SAR TEST RESULTS

12.1 Head SAR Results

Table 12.1.1 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	31.0	30.6	0.120	Left Touch	FCC #1	1	1:8.3	0.261	1.096	**0.286**	A1
1880.0	661	PCS1900	PCS	31.0	30.6	0.180	Right Touch	FCC #1	1	1:8.3	0.155	1.096	0.170	
1880.0	661	PCS1900	PCS	31.0	30.6	-0.010	Left Tilt	FCC #1	1	1:8.3	0.0731	1.096	0.080	
1880.0	661	PCS1900	PCS	31.0	30.6	0.110	Right Tilt	FCC #1	1	1:8.3	0.0495	1.096	0.054	
1880.0	661	PCS1900	GPRS	29.5	28.9	-0.140	Left Touch	FCC #1	2	1:4.15	0.361	1.148	**0.414**	A2
1880.0	661	PCS1900	GPRS	29.5	28.9	0.140	Right Touch	FCC #1	2	1:4.15	0.217	1.148	0.249	
1880.0	661	PCS1900	GPRS	29.5	28.9	0.080	Left Tilt	FCC #1	2	1:4.15	0.0992	1.148	0.114	
1880.0	661	PCS1900	GPRS	29.5	28.9	0.010	Right Tilt	FCC #1	2	1:4.15	0.0717	1.148	0.082	
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 WCDMA 1700 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												
1732.4	1412	WCDMA 1700	RMC	24.0	23.20	0.050	Left Touch	FCC #1	1:1	0.160	1.202	**0.192**	A3
1732.4	1412	WCDMA 1700	RMC	24.0	23.20	0.000	Right Touch	FCC #1	1:1	0.147	1.202	0.177	
1732.4	1412	WCDMA 1700	RMC	24.0	23.20	0.170	Left Tilt	FCC #1	1:1	0.0557	1.202	0.067	
1732.4	1412	WCDMA 1700	RMC	24.0	23.20	-0.060	Right Tilt	FCC #1	1:1	0.0369	1.202	0.044	
ANSI / IEEE C95.1-2005– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Head** **1.6 W/kg (mW/g)** averaged over 1 gram					

Table 12.1.3 WCDMA 1900 Head SAR

MEASUREMENT RESULTS													
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch												
1880.0	9400	WCDMA 1900	RMC	24.0	23.14	0.160	Left Touch	FCC #1	1:1	0.519	1.219	**0.633**	A4
1880.0	9400	WCDMA 1900	RMC	24.0	23.14	0.170	Right Touch	FCC #1	1:1	0.350	1.219	0.427	
1880.0	9400	WCDMA 1900	RMC	24.0	23.14	0.030	Left Tilt	FCC #1	1:1	0.144	1.219	0.176	
1880.0	9400	WCDMA 1900	RMC	24.0	23.14	0.170	Right Tilt	FCC #1	1:1	0.131	1.219	0.160	
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 LTE Band 4 (AWS) Head SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1732.5	20175	LTE B4	20	24.0	23.65	-0.140	0	Left Touch	FCC #1	QPSK	1	50	1:1	0.186	1.084	**0.202**	A5
1732.5	20175	LTE B4	20	23.0	22.59	-0.170	1	Left Touch	FCC #1	QPSK	50	0	1:1	0.134	1.099	0.147	
1732.5	20175	LTE B4	20	24.0	23.65	-0.180	0	Right Touch	FCC #1	QPSK	1	50	1:1	0.156	1.084	0.169	
1732.5	20175	LTE B4	20	23.0	22.59	0.100	1	Right Touch	FCC #1	QPSK	50	0	1:1	0.125	1.099	0.137	
1732.5	20175	LTE B4	20	24.0	23.65	-0.140	0	Left Tilt	FCC #1	QPSK	1	50	1:1	0.0589	1.084	0.064	
1732.5	20175	LTE B4	20	23.0	22.59	0.000	1	Left Tilt	FCC #1	QPSK	50	0	1:1	0.0397	1.099	0.044	
1732.5	20175	LTE B4	20	24.0	23.65	-0.060	0	Right Tilt	FCC #1	QPSK	1	50	1:1	0.0391	1.084	0.042	
1732.5	20175	LTE B4	20	23.0	22.59	0.020	1	Right Tilt	FCC #1	QPSK	50	0	1:1	0.0273	1.099	0.030	
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 12.1.5 LTE Band 2 (PCS) Head SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1900.0	19100	LTE B2	20	24.0	23.49	0.120	0	Left Touch	FCC #1	QPSK	1	50	1:1	0.680	1.125	**0.765**	A6
1900.0	19100	LTE B2	20	23.0	22.43	0.140	1	Left Touch	FCC #1	QPSK	50	0	1:1	0.519	1.140	0.592	
1900.0	19100	LTE B2	20	24.0	23.49	0.130	0	Right Touch	FCC #1	QPSK	1	50	1:1	0.380	1.125	0.428	
1900.0	19100	LTE B2	20	23.0	22.43	0.190	1	Right Touch	FCC #1	QPSK	50	0	1:1	0.310	1.140	0.353	
1900.0	19100	LTE B2	20	24.0	23.49	0.140	0	Left Tilt	FCC #1	QPSK	1	50	1:1	0.165	1.125	0.186	
1900.0	19100	LTE B2	20	23.0	22.43	0.160	1	Left Tilt	FCC #1	QPSK	50	0	1:1	0.124	1.140	0.141	
1900.0	19100	LTE B2	20	24.0	23.49	0.150	0	Right Tilt	FCC #1	QPSK	1	50	1:1	0.146	1.125	0.164	
1900.0	19100	LTE B2	20	23.0	22.43	0.190	1	Right Tilt	FCC #1	QPSK	50	0	1:1	0.126	1.140	0.144	
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 12.1.6 DTS Head 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														
2412	1	802.11b	15.0	13.75	0.010	Left Touch	FCC #1	0.169	1	99.2	0.180	1.334	1.008	**0.242**	A7
2412	1	802.11b	15.0	13.75	0.070	Right Touch	FCC #1	0.116	1	99.2	0.099	1.334	1.008	0.133	
2412	1	802.11b	15.0	13.75	-0.000	Left Tilt	FCC #1	0.097	1	99.2	0.098	1.334	1.008	0.132	
2412	1	802.11b	15.0	13.75	0.140	Right Tilt	FCC #1	0.074	1	99.2	0.065	1.334	1.008	0.087	
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):
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		Mode/ 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											
2412	1	802.11b	DSSS	15.0	0.242	2437	802.11g	OFDM	13.0	0.631	**0.153**	X
2412	1	802.11b	DSSS	15.0	0.242	2437	802.11n HT20	OFDM	13.0	0.631	**0.153**	X
2412	1	802.11b	DSSS	15.0	0.242	2437	802.11n HT40	OFDM	13.0	0.631	**0.153**	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.

12.2 Standalone Body-Worn SAR Worn SAR Results

Table 12.2.1 PCS/GPRS/WCDMA Body-Worn SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	# of Time Slots	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
1880.0	661	PCS1900	PCS	31.0	30.6	0.040	10 mm [Front]	FCC #1	1	1:8.3	0.374	1.096	0.410	
1880.0	661	PCS1900	PCS	31.0	30.6	0.080	10 mm [Rear]	FCC #1	1	1:8.3	0.417	1.096	**0.457**	A8
1880.0	661	PCS1900	GPRS	29.5	28.9	-0.020	10 mm [Front]	FCC #1	2	1:4.15	0.537	1.148	0.616	
1880.0	661	PCS1900	GPRS	29.5	28.9	0.050	10 mm [Rear]	FCC #1	2	1:4.15	0.582	1.148	**0.668**	A9
1732.4	1412	WCDMA 1700	RMC	24.0	23.20	0.100	10 mm [Front]	FCC #1	N/A	1:1	0.271	1.202	0.326	
1732.4	1412	WCDMA 1700	RMC	24.0	23.20	0.060	10 mm [Rear]	FCC #1	N/A	1:1	0.311	1.202	**0.374**	A10
1880.0	9400	WCDMA 1900	RMC	24.0	23.14	0.050	10 mm [Front]	FCC #1	N/A	1:1	0.638	1.219	0.778	
1852.4	9262	WCDMA 1900	RMC	24.0	23.06	0.110	10 mm [Rear]	FCC #1	N/A	1:1	0.774	1.242	0.961	
1880.0	9400	WCDMA 1900	RMC	24.0	23.14	0.090	10 mm [Rear]	FCC #1	N/A	1:1	0.762	1.219	0.929	
1907.6	9538	WCDMA 1900	RMC	24.0	23.32	0.110	10 mm [Rear]	FCC #1	N/A	1:1	0.835	1.169	**0.976**	A11
1907.6	9538	WCDMA 1900	RMC	24.0	23.32	0.080	10 mm [Rear]	FCC #1	N/A	1:1	0.830	1.169	0.970	
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: Blue entries represent variability measurements.

Table 12.2.2 LTE Body-Worn SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1732.5	20175	LTE B4	20	24.0	23.65	-0.040	0	10 mm [Front]	FCC #1	QPSK	1	50	1:1	0.332	1.084	0.360	
1732.5	20175	LTE B4	20	23.0	22.59	0.060	1	10 mm [Front]	FCC #1	QPSK	50	0	1:1	0.271	1.099	0.298	
1732.5	20175	LTE B4	20	24.0	23.65	0.020	0	10 mm [Rear]	FCC #1	QPSK	1	50	1:1	0.410	1.084	**0.444**	A12
1732.5	20175	LTE B4	20	23.0	22.59	0.010	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.328	1.099	0.360	
1860.0	18700	LTE B2	20	24.0	23.34	0.020	0	10 mm [Front]	FCC #1	QPSK	1	50	1:1	0.735	1.164	0.856	
1880.0	18900	LTE B2	20	24.0	23.36	-0.020	0	10 mm [Front]	FCC #1	QPSK	1	50	1:1	0.809	1.159	0.938	
1900.0	19100	LTE B2	20	24.0	23.49	-0.110	0	10 mm [Front]	FCC #1	QPSK	1	50	1:1	0.891	1.125	**1.002**	A13
1860.0	18700	LTE B2	20	23.0	22.43	0.100	1	10 mm [Front]	FCC #1	QPSK	50	0	1:1	0.664	1.140	0.757	
1860.0	18700	LTE B2	20	24.0	23.34	0.020	0	10 mm [Rear]	FCC #1	QPSK	1	50	1:1	0.692	1.164	0.805	
1880.0	18900	LTE B2	20	24.0	23.36	0.010	0	10 mm [Rear]	FCC #1	QPSK	1	50	1:1	0.711	1.159	0.824	
1900.0	19100	LTE B2	20	24.0	23.49	0.050	0	10 mm [Rear]	FCC #1	QPSK	1	50	1:1	0.781	1.125	0.879	
1860.0	18700	LTE B2	20	23.0	22.43	0.080	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.615	1.140	0.701	
1900.0	19100	LTE B2	20	24.0	23.49	0.020	0	10 mm [Front]	FCC #1	QPSK	1	50	1:1	0.865	1.125	0.973	
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: Blue entries represent variability measurements.

Table 12.2.3 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														
2412	1	802.11b	15.0	13.75	-0.190	10 mm [Front]	FCC #1	0.030	1	99.2	0.029	1.334	1.008	0.039	
2412	1	802.11b	15.0	13.75	-0.190	10 mm [Rear]	FCC #1	0.044	1	99.2	0.040	1.334	1.008	**0.054**	A14
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		Mode/ 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											
2412	1	802.11b	DSSS	15.0	0.054	2437	802.11g	OFDM	13.0	0.631	**0.034**	X
2412	1	802.11b	DSSS	15.0	0.054	2437	802.11n HT20	OFDM	13.0	0.631	**0.034**	X
2412	1	802.11b	DSSS	15.0	0.054	2437	802.11n HT40	OFDM	13.0	0.631	**0.034**	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.

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 Slots	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
1880.0	661	PCS1900	GPRS	29.5	28.9	-0.010	10 mm [Bottom]	FCC #1	2	1:4.15	0.171	1.148	0.196	
1880.0	661	PCS1900	GPRS	29.5	28.9	-0.020	10 mm [Front]	FCC #1	2	1:4.15	0.537	1.148	0.616	
1880.0	661	PCS1900	GPRS	29.5	28.9	0.050	10 mm [Rear]	FCC #1	2	1:4.15	0.582	1.148	**0.668**	A9
1880.0	661	PCS1900	GPRS	29.5	28.9	-0.180	10 mm [Left]	FCC #1	2	1:4.15	0.302	1.148	0.347	
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 Slots	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
1732.4	1412	WCDMA 1700	RMC	24.0	23.20	0.110	10 mm [Bottom]	FCC #1	N/A	1:1	0.110	1.202	0.132	
1732.4	1412	WCDMA 1700	RMC	24.0	23.20	0.100	10 mm [Front]	FCC #1	N/A	1:1	0.271	1.202	0.326	
1732.4	1412	WCDMA 1700	RMC	24.0	23.20	0.060	10 mm [Rear]	FCC #1	N/A	1:1	0.311	1.202	**0.374**	A10
1732.4	1412	WCDMA 1700	RMC	24.0	23.20	-0.030	10 mm [Left]	FCC #1	N/A	1:1	0.0967	1.202	0.116	
1880.0	9400	WCDMA 1900	RMC	24.0	23.14	-0.110	10 mm [Bottom]	FCC #1	N/A	1:1	0.225	1.219	0.274	
1880.0	9400	WCDMA 1900	RMC	24.0	23.14	0.050	10 mm [Front]	FCC #1	N/A	1:1	0.638	1.219	0.778	
1852.4	9262	WCDMA 1900	RMC	24.0	23.06	0.110	10 mm [Rear]	FCC #1	N/A	1:1	0.774	1.242	0.961	
1880.0	9400	WCDMA 1900	RMC	24.0	23.14	0.090	10 mm [Rear]	FCC #1	N/A	1:1	0.762	1.219	0.929	
1907.6	9538	WCDMA 1900	RMC	24.0	23.32	0.110	10 mm [Rear]	FCC #1	N/A	1:1	0.835	1.169	**0.976**	A11
1880.0	9400	WCDMA 1900	RMC	24.0	23.14	-0.090	10 mm [Left]	FCC #1	N/A	1:1	0.374	1.219	0.456	
1907.6	9538	WCDMA 1900	RMC	24.0	23.32	0.080	10 mm [Rear]	FCC #1	N/A	1:1	0.830	1.169	0.970	
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: Blue entries represent variability measurements.

Table 12.3.4 LTE Band 4 (AWS) Hotspot SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1732.5	20175	LTE B4	20	24.0	23.65	0.150	0	10 mm [Bot.]	FCC #1	QPSK	1	50	1:1	0.127	1.084	0.138	
1732.5	20175	LTE B4	20	23.0	22.59	0.040	1	10 mm [Bot.]	FCC #1	QPSK	50	0	1:1	0.0976	1.099	0.107	
1732.5	20175	LTE B4	20	24.0	23.65	-0.040	0	10 mm [Front]	FCC #1	QPSK	1	50	1:1	0.332	1.084	0.360	
1732.5	20175	LTE B4	20	23.0	22.59	0.060	1	10 mm [Front]	FCC #1	QPSK	50	0	1:1	0.271	1.099	0.298	
1732.5	20175	LTE B4	20	24.0	23.65	0.020	0	10 mm [Rear]	FCC #1	QPSK	1	50	1:1	0.410	1.084	**0.444**	A12
1732.5	20175	LTE B4	20	23.0	22.59	0.010	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.328	1.099	0.360	
1732.5	20175	LTE B4	20	24.0	23.65	0.100	0	10 mm [Left]	FCC #1	QPSK	1	50	1:1	0.096	1.084	0.104	
1732.5	20175	LTE B4	20	23.0	22.59	-0.160	1	10 mm [Left]	FCC #1	QPSK	50	0	1:1	0.0747	1.099	0.082	
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 12.3.5 LTE Band 2 (PCS) Hotspot SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1860.0	18700	LTE B2	20	24.0	23.49	0.160	0	10 mm [Bot.]	FCC #1	QPSK	1	50	1:1	0.246	1.125	0.277	
1860.0	18700	LTE B2	20	23.0	22.43	-0.070	1	10 mm [Bot.]	FCC #1	QPSK	50	0	1:1	0.196	1.140	0.223	
1860.0	18700	LTE B2	20	24.0	23.34	0.020	0	10 mm [Front]	FCC #1	QPSK	1	50	1:1	0.735	1.164	0.856	
1880.0	18900	LTE B2	20	24.0	23.36	-0.020	0	10 mm [Front]	FCC #1	QPSK	1	50	1:1	0.809	1.159	0.938	
1900.0	19100	LTE B2	20	24.0	23.49	-0.110	0	10 mm [Front]	FCC #1	QPSK	1	50	1:1	0.891	1.125	**1.002**	A13
1860.0	18700	LTE B2	20	23.0	22.43	0.100	1	10 mm [Front]	FCC #1	QPSK	50	0	1:1	0.664	1.140	0.757	
1860.0	18700	LTE B2	20	24.0	23.34	0.020	0	10 mm [Rear]	FCC #1	QPSK	1	50	1:1	0.692	1.164	0.805	
1880.0	18900	LTE B2	20	24.0	23.36	0.010	0	10 mm [Rear]	FCC #1	QPSK	1	50	1:1	0.711	1.159	0.824	
1900.0	19100	LTE B2	20	24.0	23.49	0.050	0	10 mm [Rear]	FCC #1	QPSK	1	50	1:1	0.781	1.125	0.879	
1860.0	18700	LTE B2	20	23.0	22.43	0.080	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.615	1.140	0.701	
1860.0	18700	LTE B2	20	24.0	23.49	-0.170	0	10 mm [Left]	FCC #1	QPSK	1	50	1:1	0.392	1.125	0.441	
1860.0	18700	LTE B2	20	23.0	22.43	-0.130	1	10 mm [Left]	FCC #1	QPSK	50	0	1:1	0.321	1.140	0.366	
1900.0	19100	LTE B2	20	24.0	23.49	0.020	0	10 mm [Front]	FCC #1	QPSK	1	50	1:1	0.865	1.125	0.973	
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: Blue entries represent variability measurements.

Table 12.3.6 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)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch														
2412	1	802.11b	15.0	13.75	0.140	10 mm [Top]	FCC #1	0.010	1	99.2	0.003	1.334	1.008	0.004	
2412	1	802.11b	15.0	13.75	-0.190	10 mm [Front]	FCC #1	0.030	1	99.2	0.029	1.334	1.008	0.039	
2412	1	802.11b	15.0	13.75	-0.190	10 mm [Rear]	FCC #1	0.044	1	99.2	0.040	1.334	1.008	**0.054**	A14
2412	1	802.11b	15.0	13.75	-0.060	10 mm [Right]	FCC #1	0.023	1	99.2	0.019	1.334	1.008	0.026	
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		Mode/ 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											
2412	1	802.11b	DSSS	15.0	0.054	2437	802.11g	OFDM	13.0	0.631	**0.034**	X
2412	1	802.11b	DSSS	15.0	0.054	2437	802.11n HT20	OFDM	13.0	0.631	**0.034**	X
2412	1	802.11b	DSSS	15.0	0.054	2437	802.11n HT40	OFDM	13.0	0.631	**0.034**	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.

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 Publication447498 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 FCCKDB Publication 447498 D01v06.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 15 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 boy-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. Per FCC KDB 865664 D01v01r04, variability SAR tests were performed when the measured SAR results for a frequency band were greater than or equal to 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for charity. Please see Section 14 for variability analysis.

GSM Notes:

1. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
2. This device supports GSM VOIP in the head and body-worn configurations; therefore GPRS was additionally evaluated for head and body-worn compliance.
3. Justification for reduced test configurations per KDB Publication 941225 D01v03r01 and October2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR.
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 > ½ dB, the middle channel was used for testing.

WCDMA(UMTS) Notes:

1. WCDMA (UMTS) mode in was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 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 > ½ dB, instead of the middle channel, the highest output power channel was used.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r05. The general test procedures used for testing can be found in Section 5.
2. According to FCC KDB 941225 D05v02r05.
   When the reported SAR is ≤ 0.8 W/kg, testing of the 100% RB allocation and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the 1 RB, 50% RB and 100% RB allocation with highest output power for that channel.
   Only one channel, and as reported SAR values for 1 RB allocation and 50% RB allocation were less than 1.45 W/kg only the highest power RB offset for each allocation was required.
3. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36. 101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
4. A-MPR was disabled for all SAR tests by setting NS=1 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).
5. SAR test reduction is applied using the following criteria:
   Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is > 0.8 W/kg, testing for other channels is performed at the highest output power level for 1 RB, and 50% RB configuration for that channel. Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High channel when the highest reported SAR for 1 RB and 50% RB are > 0.8 W/kg, Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation < 1.45 W/kg. Testing for 16QAM modulation is not required because the reported SAR for QPSK is < 1.45 W/kg and its output power is not more than 0.5 dB higher than that a QPSK. Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is < 1.45 W/kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.

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 duo 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. 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.
4. 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.

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 802.11b/g/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

13.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 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 $\leq$1.6 W/kg. The different test positon in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1-g or 10-g SAR.

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

Table 13.2.1 Estimated SAR (Body)

Mode	Frequency	Maximum Allowed Power		Separation Distance (Hand)	Estimated SAR (Body)
	[MHz]	[dBm]	[mW]	[mm]	[W/kg]
Bluetooth	2480	9.5	9	10	0.187

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.

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

Figure 13.1 Simultaneous Transmission Paths

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

Table 13.3.2 Simultaneous Transmission Scenarios

No.	Capable TX Configuration	PCS1900	WCDMA Band 5	WCDMA Band 2	LTE B4,B2	WIFI 2.4GHz	Bluetooth 2.4GHz
1	PCS1900		No	No	No	Yes	Yes
2	WCDMA Band 5	No		No	No	Yes	Yes
3	WCDMA Band 2	No	No		No	Yes	Yes
4	LTE B4,B2	No	No	No		Yes	Yes
5	WIFI 2.4GHz	Yes	Yes	Yes	Yes		No
6	Bluetooth 2.4GHz	Yes	Yes	Yes	Yes	No	

Table 13.3.3 Simultaneous SAR Cases

No.	Capable Transmit Configuration	Head SAR	Body-Worn SAR	Hotspot SAR	Note
1	PCS1900 Voice + WLAN 2.4GHz	Yes	Yes	N/A	
2	PCS1900 Voice + Bluetooth 2.4GHz	N/A	Yes	N/A	
3	PCS1900 GPRS + WLAN 2.4GHz	Yes	Yes*	Yes	* Pre-installed VOIP applications are considered
4	PCS1900 GPRS + Bluetooth 2.4GHz	N/A	Yes*	N/A	* Pre-installed VOIP applications are considered
5	WCDMA Band 4 + WLAN 2.4GHz	Yes	Yes	Yes	
6	WCDMA Band 2 + WLAN 2.4GHz	Yes	Yes	Yes	
7	WCDMA Band 4 + Bluetooth 2.4GHz	N/A	Yes	N/A	
8	WCDMA Band 2 + Bluetooth 2.4GHz	N/A	Yes	N/A	
9	LTE B2, B4 + WLAN 2.4GHz	Yes	Yes*	Yes	* Pre-installed VOIP applications are considered
10	LTE B2, B4 + Bluetooth 2.4GHz	N/A	Yes*	N/A	* Pre-installed VOIP applications are considered

Notes:

1. WiFi 2.4GHz supported Hotspot..
2. LTE, WCDMA, GPRS is supported Hotspot.
3. VoIP is supported in LTE, WCDMA, GSM
4. Bluetooth and WiFi can not transmit simultaneously at 2.4G band.
5. GSM, WCDMA and LTE can not transmit simultaneously since they share the same chip.
6. 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.
7. 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 GSM/GPRS with 2.4 GHz W-LAN (Held to Ear)

Simult TX	Configuration	PCS 1900 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	GPRS 1900 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Head SAR	Left Touch	0.286	0.242	0.528	Head SAR	Left Touch	0.414	0.242	0.656
	Right Touch	0.170	0.133	0.303		Right Touch	0.249	0.133	0.382
	Left Tilt	0.080	0.132	0.212		Left Tilt	0.114	0.132	0.246
	Right Tilt	0.054	0.087	0.141		Right Tilt	0.082	0.087	0.169

Table 13.4.2 Simultaneous Transmission Scenario for WCDMA with 2.4 GHz W-LAN (Held to Ear)

Simult TX	Configuration	WCDMA 1700 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	WCDMA 1900 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Head SAR	Left Touch	0.192	0.242	0.434	Head SAR	Left Touch	0.633	0.242	0.875
	Right Touch	0.177	0.133	0.310		Right Touch	0.427	0.133	0.560
	Left Tilt	0.067	0.132	0.199		Left Tilt	0.176	0.132	0.308
	Right Tilt	0.044	0.087	0.131		Right Tilt	0.160	0.087	0.247

Table 13.4.3 Simultaneous Transmission Scenario for LTE with 2.4 GHz W-LAN (Held to Ear)

Simult TX	Configuration	LTE Band 4 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	LTE Band 2 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Head SAR	Left Touch	0.202	0.242	0.444	Head SAR	Left Touch	0.765	0.242	**1.007**
	Right Touch	0.169	0.133	0.302		Right Touch	0.428	0.133	0.561
	Left Tilt	0.064	0.132	0.196		Left Tilt	0.186	0.132	0.318
	Right Tilt	0.042	0.087	0.129		Right Tilt	0.164	0.087	0.251

13.5 Body-Worn Simultaneous Transmission Analysis

Table 13.5.1 Simultaneous Transmission Scenario with 2.4 GHz W-LAN (Body-Worn at 10 mm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Front Side	PCS 1900	0.410	0.039	0.449
Rear Side	PCS 1900	0.457	0.054	0.511
Front Side	GPRS 1900	0.616	0.039	0.655
Rear Side	GPRS 1900	0.668	0.054	0.722
Front Side	WCDMA 1700	0.326	0.039	0.365
Rear Side	WCDMA 1700	0.374	0.054	0.428
Front Side	WCDMA 1900	0.778	0.039	0.817
Rear Side	WCDMA 1900	0.976	0.054	1.030
Front Side	LTE Band 4	0.360	0.039	0.399
Rear Side	LTE Band 4	0.444	0.054	0.498
Front Side	LTE Band 2	1.002	0.039	**1.041**
Rear Side	LTE Band 2	0.879	0.054	0.933

Table 13.5.2 Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 10 mm)

Configuration	Mode	2G/3G SAR (W/kg)	Bluetooth SAR (W/kg)	ΣSAR (W/kg)
Front Side	PCS 1900	0.410	0.187	0.597
Rear Side	PCS 1900	0.457	0.187	0.644
Front Side	GPRS 1900	0.616	0.187	0.803
Rear Side	PCS 1900	0.668	0.187	0.855
Front Side	WCDMA 1700	0.326	0.187	0.513
Rear Side	WCDMA 1700	0.374	0.187	0.561
Front Side	WCDMA 1900	0.778	0.187	0.965
Rear Side	WCDMA 1900	0.976	0.187	1.163
Front Side	LTE Band 4	0.360	0.187	0.547
Rear Side	LTE Band 4	0.444	0.187	0.631
Front Side	LTE Band 2	1.002	0.187	**1.189**
Rear Side	LTE Band 2	0.879	0.187	1.066

Note: Bluetooth SAR was not required to be measured per FCC KDB 447498 D01v06. Estimated SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

13.6 Hotspot Simultaneous Transmission Analysis

Table 13.6.1 Simultaneous Transmission Scenario for GPRS with 2.4 GHz W-LAN (10 mm)

Simult TX	Configuration	GPRS 1900 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Hotspot SAR	Top	-	0.004	0.004
	Bottom	0.196	-	0.196
	Front	0.616	0.039	0.655
	Rear	0.668	0.054	0.722
	Right	-	0.026	0.026
	Left	0.347	-	0.347

Table 13.6.2 Simultaneous Transmission Scenario for WCDMA with 2.4 GHz W-LAN (10 mm)

Simult TX	Configuration	WCDMA 1700 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	WCDMA 1900 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Hotspot SAR	Top	-	0.004	0.004	Hotspot SAR	Top	-	0.004	0.004
	Bottom	0.132	-	0.132		Bottom	0.274	-	0.274
	Front	0.326	0.039	0.365		Front	0.778	0.039	0.817
	Rear	0.374	0.054	0.428		Rear	0.976	0.054	1.030
	Right	-	0.026	0.026		Right	-	0.026	0.026
	Left	0.116	-	0.116		Left	0.456	-	0.456

Table 13.6.3 Simultaneous Transmission Scenario for LTE with 2.4 GHz W-LAN (10 mm)

Simult TX	Configuration	LTE Band 4 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)	Simult TX	Configuration	LTE Band 2 SAR (W/kg)	2.4G W-LAN (802.11b) SAR (W/kg)	ΣSAR (W/kg)
Hotspot SAR	Top	-	0.004	0.004	Hotspot SAR	Top	-	0.004	0.004
	Bottom	0.138	-	0.138		Bottom	0.272	-	0.272
	Front	0.360	0.039	0.399		Front	1.002	0.039	**1.041**
	Rear	0.444	0.054	0.498		Rear	0.879	0.054	0.933
	Right	-	0.026	0.026		Right	-	0.026	0.026
	Left	0.104	-	0.104		Left	0.441	-	0.441

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. SAR MEASUREMENT VARIABILITY

14.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

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

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

Table 14.1 Head SAR Measurement Variability Results

Frequency		Mode	Service	# of Time Slots	Spacing [Side]	Measured SAR (1g)	1st Repeated SAR(1g)	Ratio	2nd Repeated SAR(1g)	Ratio	3rd Repeated SAR(1g)	Ratio
MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
1907.6	9538	WCDMA 1900	RMC	-	10 mm [Rear]	0.835	0.830	1.01	-	-	-	-
1860.0	18700	LTE B2	-	-	10 mm [Front]	0.891	0.865	1.03	-	-	-	-
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					

14.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664D01v01r04, the standard measurement uncertainty analysis per IEEE 1528-2013 was not required.

15. MEASUREMENT UNCERTAINTIES

1800 MHz Head

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	± 6.0 %	∞
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Hemispherical isotropy	± 9.6	Rectangular	√3	1	± 5.5 %	∞
Boundary Effects	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Probe modulation response	± 2.4	Rectangular	√3	1	± 1.4 %	∞
Detection limits	± 0.25	Rectangular	√3	1	± 0.14 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.5 %	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	√3	1	± 1.7 %	∞
Probe Positioner	± 0.4	Rectangular	√3	1	± 0.23 %	∞
Probe Positioning	± 2.9	Rectangular	√3	1	± 1.7 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.58 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.9 %	∞
SAR Scaling	± 2.0	Rectangular	√3	1	± 1.2 %	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	√3	1	± 2.3 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.9 %	∞
Liquid conductivity (Meas.)	± 4.0	Normal	1	0.64	± 4.0 %	10
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.9 %	∞
Liquid permittivity (Meas.)	± 3.9	Normal	1	0.6	± 3.9 %	10
Temp. unc. - Conductivity	± 2.0	Rectangular	√3	0.78	± 1.2 %	∞
Temp. unc. - Permittivity	± 2.0	Rectangular	√3	0.23	± 1.2 %	∞
Combined Standard Uncertainty					**± 12 %**	330
Expanded Uncertainty (k=2)					**± 24 %**	

The above measurement uncertainties are according to IEEE Std 1528 (2013)

1800 MHz Body

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	± 6.0 %	∞
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Hemispherical isotropy	± 9.6	Rectangular	√3	1	± 5.5 %	∞
Boundary Effects	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Probe modulation response	± 2.4	Rectangular	√3	1	± 1.4 %	∞
Detection limits	± 0.25	Rectangular	√3	1	± 0.14 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.5 %	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	√3	1	± 1.7 %	∞
Probe Positioner	± 0.4	Rectangular	√3	1	± 0.23 %	∞
Probe Positioning	± 2.9	Rectangular	√3	1	± 1.7 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.58 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.9 %	∞
SAR Scaling	± 2.0	Rectangular	√3	1	± 1.2 %	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	√3	1	± 2.3 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.9 %	∞
Liquid conductivity (Meas.)	± 4.1	Normal	1	0.64	± 4.1 %	10
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.9 %	∞
Liquid permittivity (Meas.)	± 4.3	Normal	1	0.6	± 4.3 %	10
Temp. unc. - Conductivity	± 1.8	Rectangular	√3	0.78	± 1.0 %	∞
Temp. unc. - Permittivity	± 1.9	Rectangular	√3	0.23	± 1.1 %	∞
Combined Standard Uncertainty					**± 12 %**	330
Expanded Uncertainty (k=2)					**± 24 %**	

The above measurement uncertainties are according to IEEE Std 1528 (2013)

1900 MHz Head

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	± 6.0 %	∞
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Hemispherical isotropy	± 9.6	Rectangular	√3	1	± 5.5 %	∞
Boundary Effects	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Probe modulation response	± 2.4	Rectangular	√3	1	± 1.4 %	∞
Detection limits	± 0.25	Rectangular	√3	1	± 0.14 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.5 %	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	√3	1	± 1.7 %	∞
Probe Positioner	± 0.4	Rectangular	√3	1	± 0.23 %	∞
Probe Positioning	± 2.9	Rectangular	√3	1	± 1.7 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.58 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.9 %	∞
SAR Scaling	± 2.0	Rectangular	√3	1	± 1.2 %	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	√3	1	± 2.3 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.9 %	∞
Liquid conductivity (Meas.)	± 4.0	Normal	1	0.64	± 4.0 %	10
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.9 %	∞
Liquid permittivity (Meas.)	± 4.2	Normal	1	0.6	± 4.2 %	10
Temp. unc. - Conductivity	± 1.7	Rectangular	√3	0.78	± 1.0 %	∞
Temp. unc. - Permittivity	± 1.8	Rectangular	√3	0.23	± 1.0 %	∞
Combined Standard Uncertainty					**± 12 %**	330
Expanded Uncertainty (k=2)					**± 24 %**	

The above measurement uncertainties are according to IEEE Std 1528 (2013)

1900 MHz Body

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	± 6.0 %	∞
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Hemispherical isotropy	± 9.6	Rectangular	√3	1	± 5.5 %	∞
Boundary Effects	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Probe modulation response	± 2.4	Rectangular	√3	1	± 1.4 %	∞
Detection limits	± 0.25	Rectangular	√3	1	± 0.14 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.5 %	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	√3	1	± 1.7 %	∞
Probe Positioner	± 0.4	Rectangular	√3	1	± 0.23 %	∞
Probe Positioning	± 2.9	Rectangular	√3	1	± 1.7 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.58 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.9 %	∞
SAR Scaling	± 2.0	Rectangular	√3	1	± 1.2 %	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	√3	1	± 2.3 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.9 %	∞
Liquid conductivity (Meas.)	± 3.8	Normal	1	0.64	± 3.8 %	10
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.9 %	∞
Liquid permittivity (Meas.)	± 4.2	Normal	1	0.6	± 4.2 %	10
Temp. unc. - Conductivity	± 1.9	Rectangular	√3	0.78	± 1.1 %	∞
Temp. unc. - Permittivity	± 1.9	Rectangular	√3	0.23	± 1.1 %	∞
Combined Standard Uncertainty					**± 12 %**	330
Expanded Uncertainty (k=2)					**± 24 %**	

The above measurement uncertainties are according to IEEE Std 1528 (2013)

2450 MHz Head

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	± 6.0 %	∞
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Hemispherical isotropy	± 9.6	Rectangular	√3	1	± 5.5 %	∞
Boundary Effects	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Probe modulation response	± 2.4	Rectangular	√3	1	± 1.4 %	∞
Detection limits	± 0.25	Rectangular	√3	1	± 0.14 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.5 %	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	√3	1	± 1.7 %	∞
Probe Positioner	± 0.4	Rectangular	√3	1	± 0.23 %	∞
Probe Positioning	± 2.9	Rectangular	√3	1	± 1.7 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.58 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.9 %	∞
SAR Scaling	± 2.0	Rectangular	√3	1	± 1.2 %	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	√3	1	± 2.3 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.9 %	∞
Liquid conductivity (Meas.)	± 3.9	Normal	1	0.64	± 3.9 %	10
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.9 %	∞
Liquid permittivity (Meas.)	± 4.1	Normal	1	0.6	± 4.1 %	10
Temp. unc. - Conductivity	± 1.8	Rectangular	√3	0.78	± 1.0 %	∞
Temp. unc. - Permittivity	± 1.8	Rectangular	√3	0.23	± 1.0 %	∞
Combined Standard Uncertainty					**± 12 %**	330
Expanded Uncertainty (k=2)					**± 24 %**	

The above measurement uncertainties are according to IEEE Std 1528 (2013)

2450 MHz Body

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.0	Normal	1	1	± 6.0 %	∞
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Hemispherical isotropy	± 9.6	Rectangular	√3	1	± 5.5 %	∞
Boundary Effects	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Probe modulation response	± 2.4	Rectangular	√3	1	± 1.4 %	∞
Detection limits	± 0.25	Rectangular	√3	1	± 0.14 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.46 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.5 %	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	√3	1	± 1.7 %	∞
Probe Positioner	± 0.4	Rectangular	√3	1	± 0.23 %	∞
Probe Positioning	± 2.9	Rectangular	√3	1	± 1.7 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.58 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.9 %	∞
SAR Scaling	± 2.0	Rectangular	√3	1	± 1.2 %	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	√3	1	± 2.3 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.9 %	∞
Liquid conductivity (Meas.)	± 4.0	Normal	1	0.64	± 4.0 %	10
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.9 %	∞
Liquid permittivity (Meas.)	± 4.4	Normal	1	0.6	± 4.4 %	10
Temp. unc. - Conductivity	± 1.9	Rectangular	√3	0.78	± 1.1 %	∞
Temp. unc. - Permittivity	± 2.0	Rectangular	√3	0.23	± 1.2 %	∞
Combined Standard Uncertainty					**± 12 %**	330
Expanded Uncertainty (k=2)					**± 24 %**	

The above measurement uncertainties are according to IEEE Std 1528 (2013)

16. CONCLUSION

Measurement Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under the worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect 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.

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Attachment 1. – Probe Calibration Data

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

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

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

Accreditation No.: **SCS 0108**

Client **DT&C (Dymstec)**

Certificate No: **EX3-3933_Sep17**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3933
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	September 28, 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	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02525)	Apr-18
Reference 20 dB Attenuator	SN: S5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
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:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 28, 2017

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

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) 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
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3933

Manufactured: July 24, 2013
Calibrated: September 28, 2017

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3933

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.47	0.52	0.18	± 10.1 %
DCP (mV)[B]	98.6	98.1	89.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	153.6	±3.5 %
		Y	0.0	0.0	1.0		143.6	
		Z	0.0	0.0	1.0		155.0	

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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3933

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	11.05	11.05	11.05	0.43	0.80	± 12.0 %
835	41.5	0.90	10.55	10.55	10.55	0.39	0.80	± 12.0 %
900	41.5	0.97	10.31	10.31	10.31	0.45	0.80	± 12.0 %
1750	40.1	1.37	9.32	9.32	9.32	0.36	0.80	± 12.0 %
1900	40.0	1.40	8.95	8.95	8.95	0.33	0.80	± 12.0 %
2300	39.5	1.67	8.34	8.34	8.34	0.22	0.97	± 12.0 %
2450	39.2	1.80	7.98	7.98	7.98	0.34	0.86	± 12.0 %
2600	39.0	1.96	7.72	7.72	7.72	0.41	0.84	± 12.0 %
3500	37.9	2.91	7.68	7.68	7.68	0.25	1.25	± 13.1 %
5200	36.0	4.66	5.60	5.60	5.60	0.35	1.80	± 13.1 %
5300	35.9	4.76	5.36	5.36	5.36	0.35	1.80	± 13.1 %
5500	35.6	4.96	5.20	5.20	5.20	0.40	1.80	± 13.1 %
5600	35.5	5.07	5.00	5.00	5.00	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.95	4.95	4.95	0.40	1.80	± 13.1 %

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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3933

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	10.86	10.86	10.86	0.36	0.93	± 12.0 %
835	55.2	0.97	10.60	10.60	10.60	0.42	0.80	± 12.0 %
900	55.0	1.05	10.63	10.63	10.63	0.31	1.06	± 12.0 %
1750	53.4	1.49	8.87	8.87	8.87	0.45	0.80	± 12.0 %
1900	53.3	1.52	8.50	8.50	8.50	0.42	0.80	± 12.0 %
2300	52.9	1.81	8.26	8.26	8.26	0.37	0.94	± 12.0 %
2450	52.7	1.95	8.02	8.02	8.02	0.38	0.89	± 12.0 %
2600	52.5	2.16	7.79	7.79	7.79	0.40	0.86	± 12.0 %
3500	51.3	3.31	7.40	7.40	7.40	0.30	1.20	± 13.1 %
5200	49.0	5.30	5.25	5.25	5.25	0.35	1.90	± 13.1 %
5300	48.9	5.42	4.94	4.94	4.94	0.40	1.90	± 13.1 %
5500	48.6	5.65	4.64	4.64	4.64	0.40	1.90	± 13.1 %
5600	48.5	5.77	4.47	4.47	4.47	0.40	1.90	± 13.1 %
5800	48.2	6.00	4.56	4.56	4.56	0.40	1.90	± 13.1 %

[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.

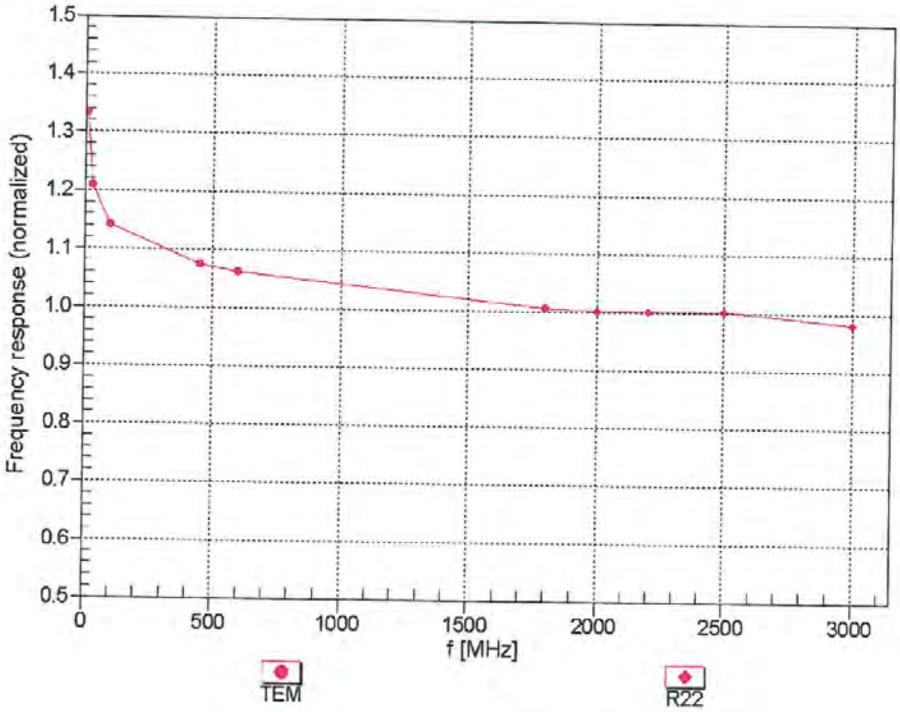
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF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

EX3DV4– SN:3933

September 28, 2017

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

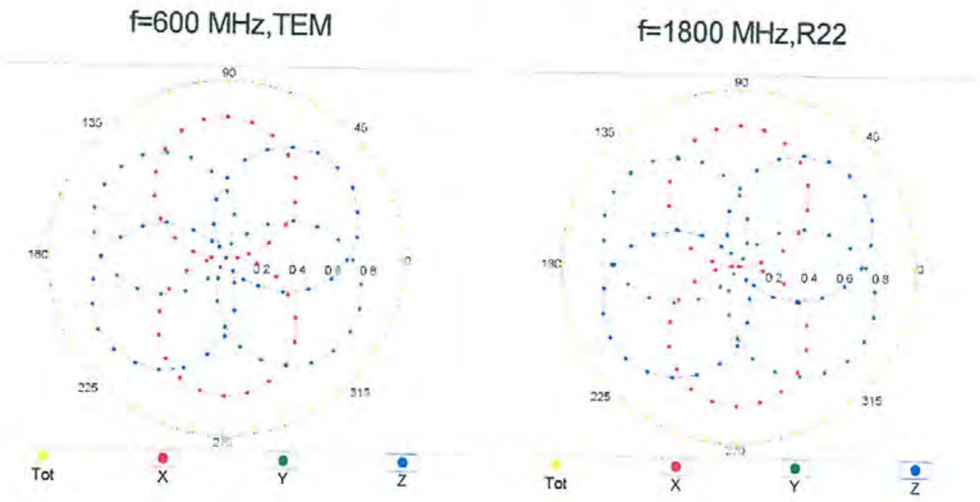


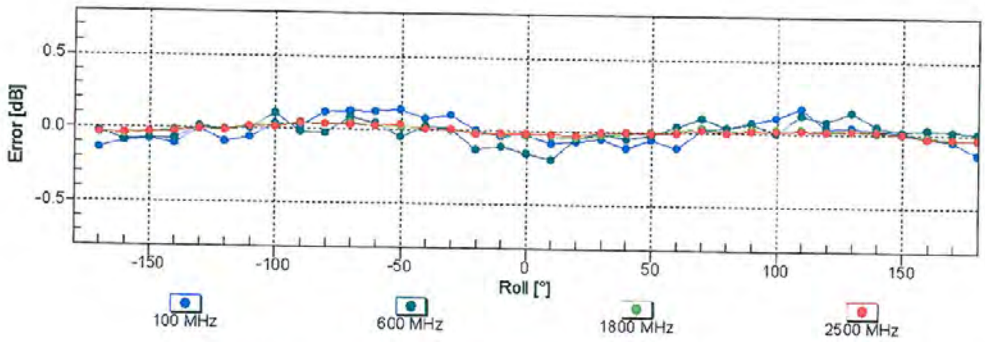
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

EX3DV4– SN:3933

September 28, 2017

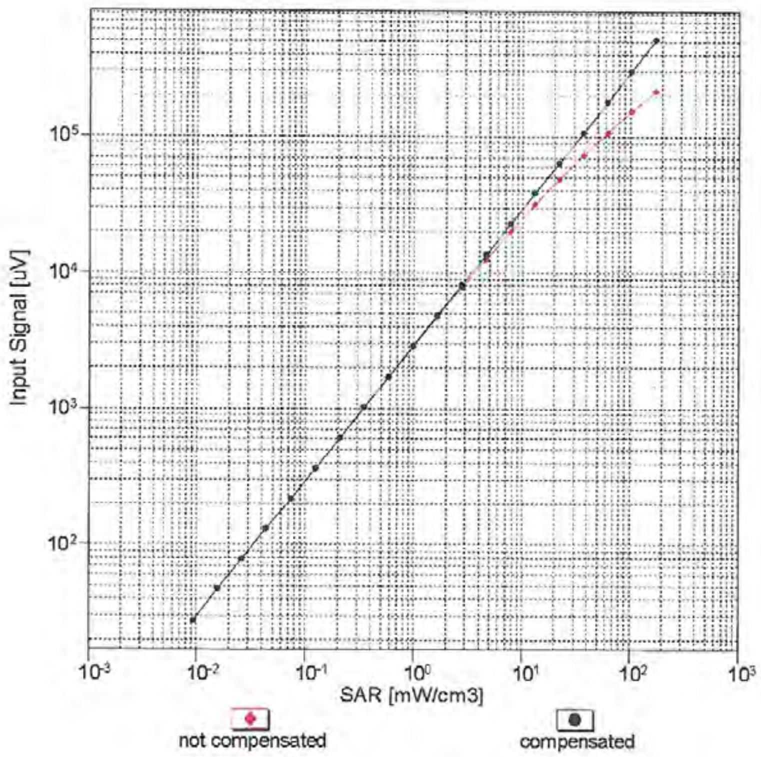
Receiving Pattern (ϕ), $\vartheta = 0°$

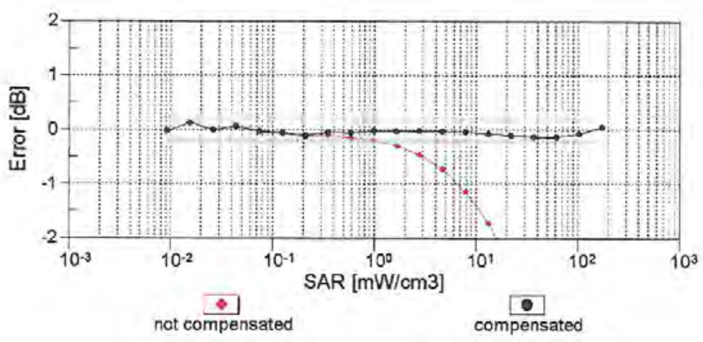




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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





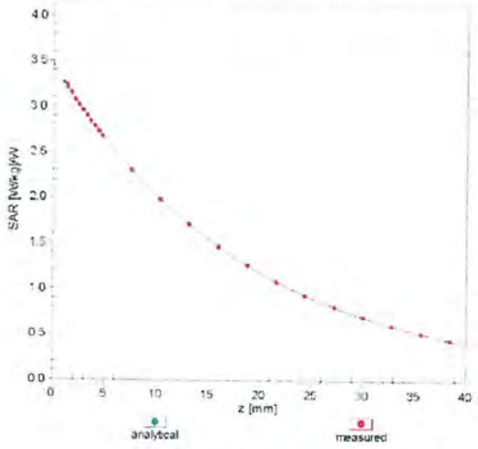
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

EX3DV4– SN:3933

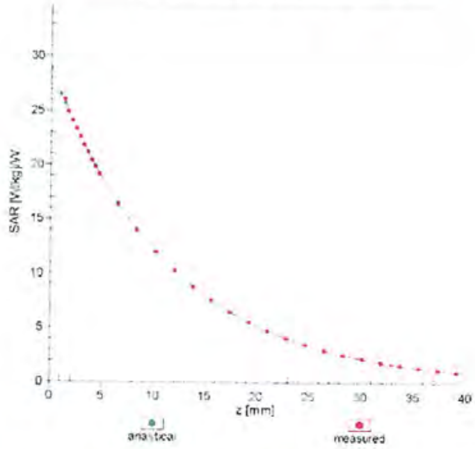
September 28, 2017

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

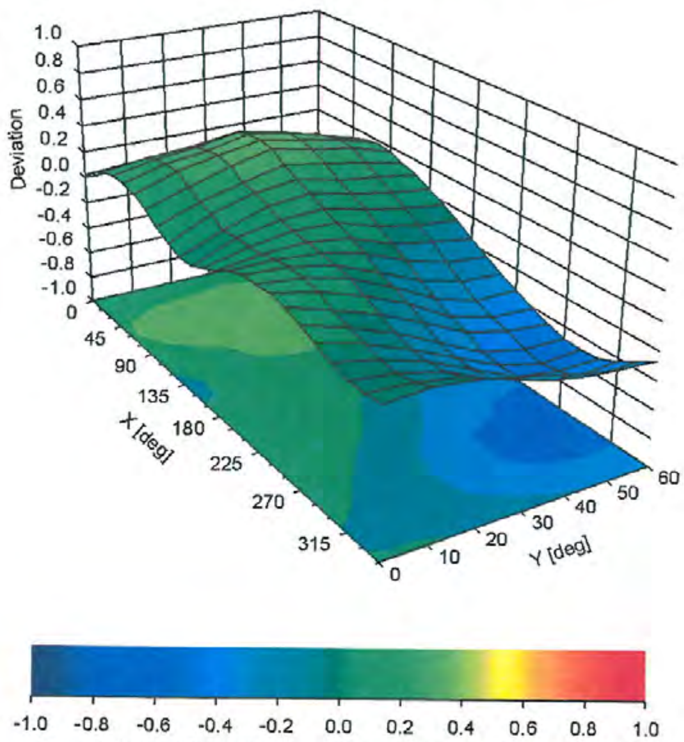


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3933

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	79.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Attachment 2. – Dipole Calibration Data

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

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Accreditation No.: SCS 0108

Client DT&C (Dymstec) **Certificate No: D1800V2-2d047_May17**

CALIBRATION CERTIFICATE

Object	D1800V2 - SN:2d047
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 23, 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	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7460	19-May-17 (No. EX3-7460_May17)	May-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-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:	Johannes Kurikka	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 30, 2017

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.39 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.7 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.6 ± 6 %	1.50 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.72 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.6 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.5 Ω - 5.8 jΩ
Return Loss	- 23.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.2 Ω - 5.4 jΩ
Return Loss	- 20.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.210 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	May 16, 2002

DASY5 Validation Report for Head TSL

Date: 23.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d047

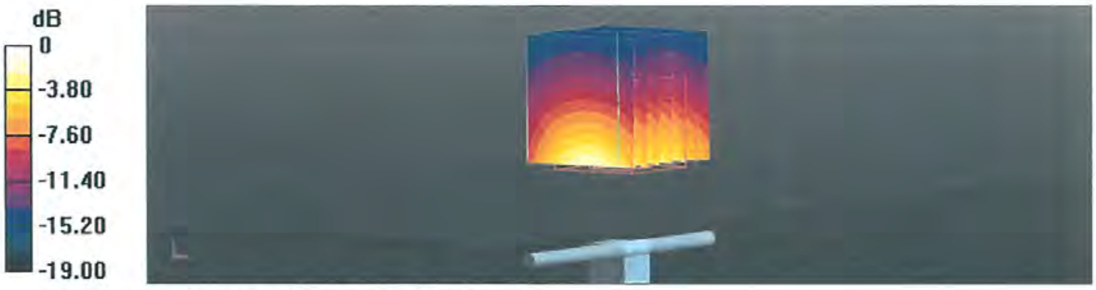
Communication System: UID 0 - CW; Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; σ = 1.39 S/m; ε_r = 38.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7460; ConvF(8.15, 8.15, 8.15); Calibrated: 19.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

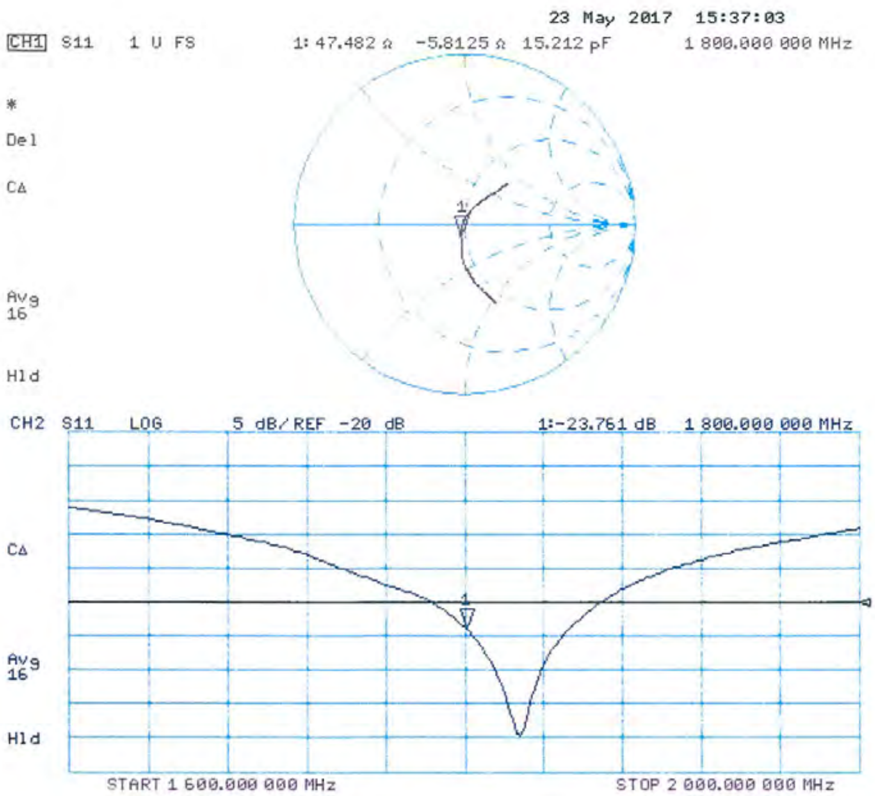
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 108.2 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 19.2 W/kg
SAR(1 g) = 9.99 W/kg; SAR(10 g) = 5.18 W/kg
Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.85 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d047

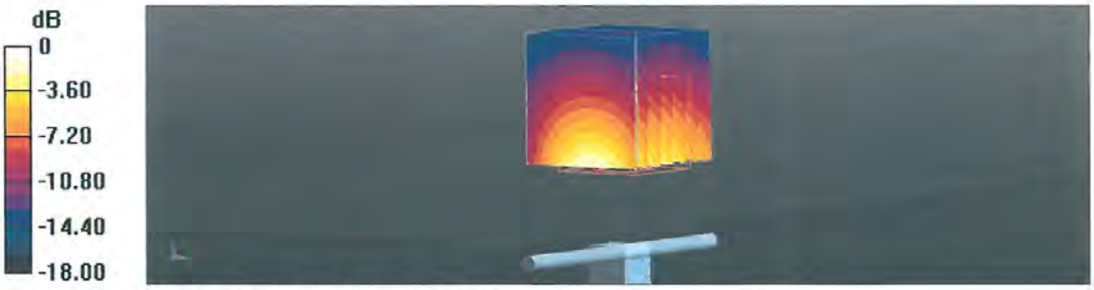
Communication System: UID 0 - CW; Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; σ = 1.5 S/m; ε_r = 53.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7460; ConvF(7.98, 7.98, 7.98); Calibrated: 19.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

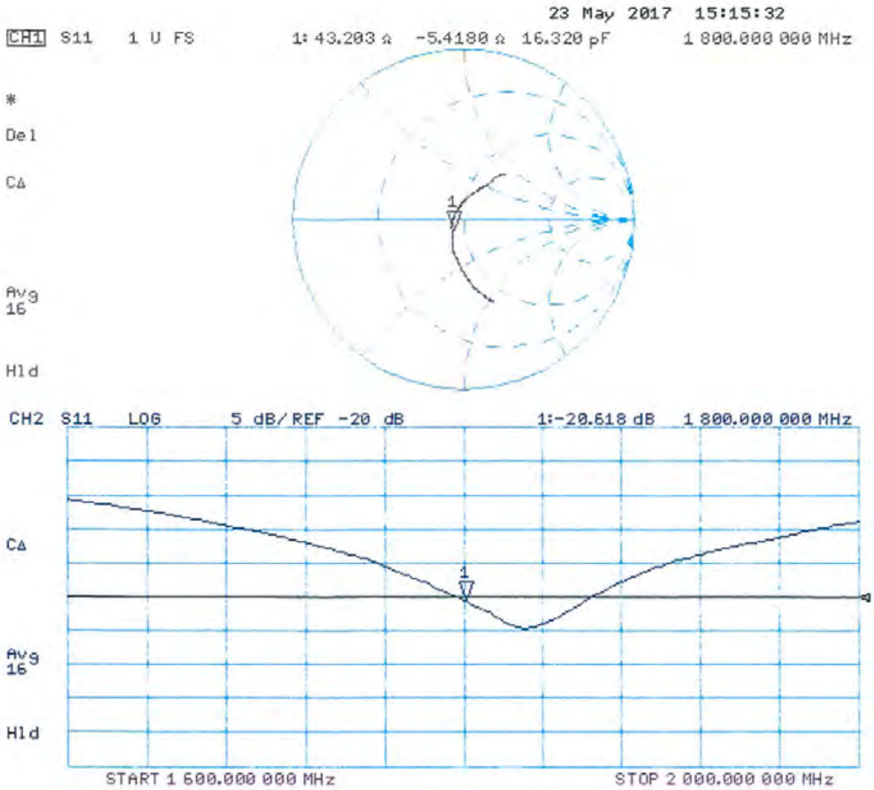
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.8 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 17.4 W/kg
SAR(1 g) = 9.72 W/kg; SAR(10 g) = 5.11 W/kg
Maximum value of SAR (measured) = 14.0 W/kg



0 dB = 14.0 W/kg = 11.46 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 0108**

Client **DT&C (Dymstec)**

Certificate No: **D1900V2-5d029_Sep17**

CALIBRATION CERTIFICATE

Object	D1900V2 - SN:5d029
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	September 20, 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	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-May-17 (No. EX3-7349_May17)	May-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 21, 2017

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) 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
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.0 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.6 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.3 ± 6 %	1.47 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.66 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.9 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.7 Ω + 3.4 jΩ
Return Loss	- 27.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.9 Ω + 5.8 jΩ
Return Loss	- 24.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 17, 2002

DASY5 Validation Report for Head TSL

Date: 20.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

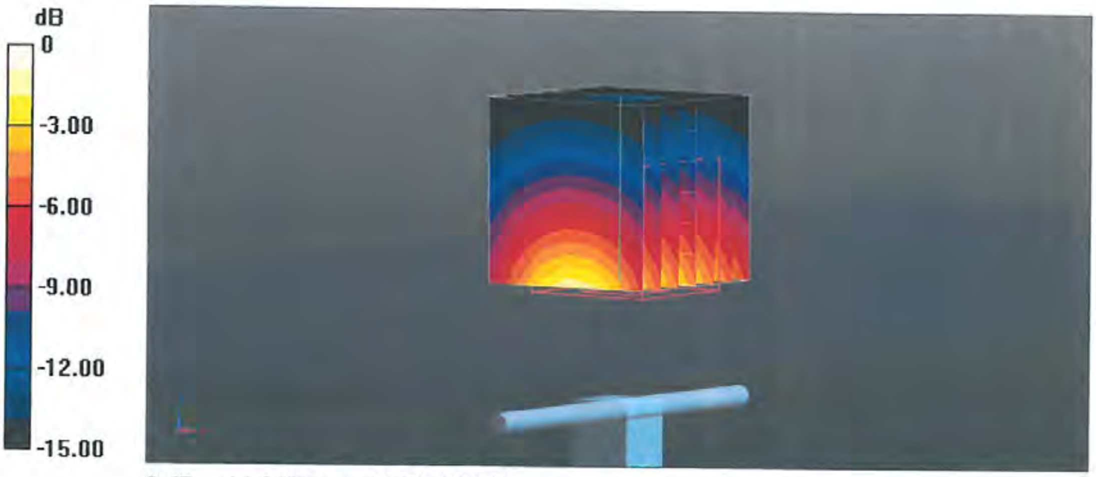
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d029

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 S/m; ε_r = 39; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

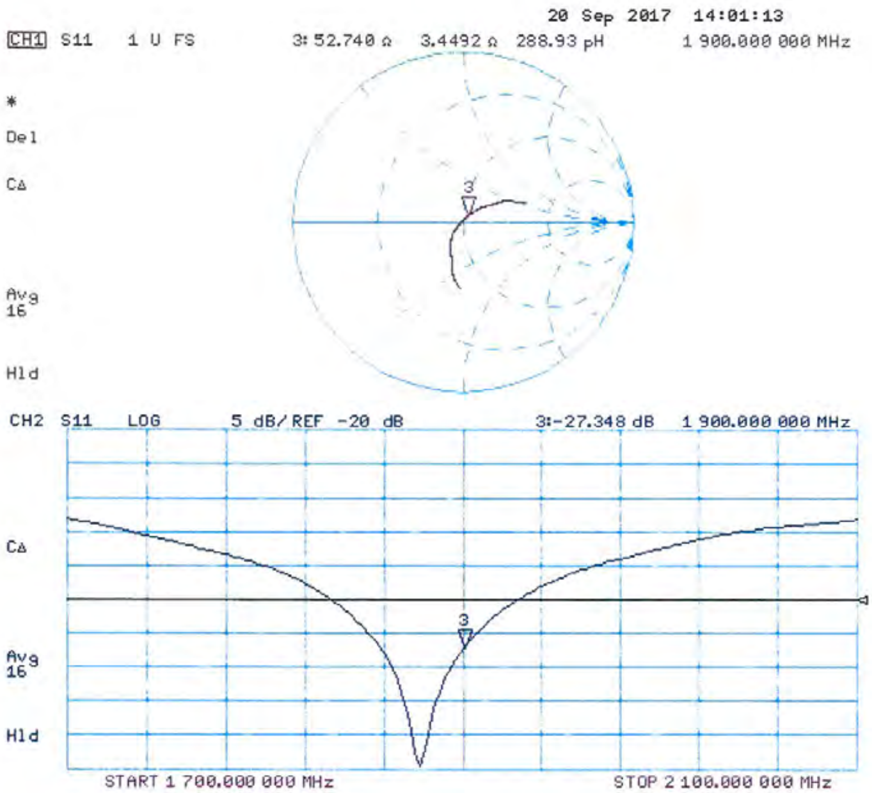
- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.6 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 18.3 W/kg
SAR(1 g) = 9.78 W/kg; SAR(10 g) = 5.13 W/kg
Maximum value of SAR (measured) = 14.8 W/kg



0 dB = 14.8 W/kg = 11.70 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 20.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

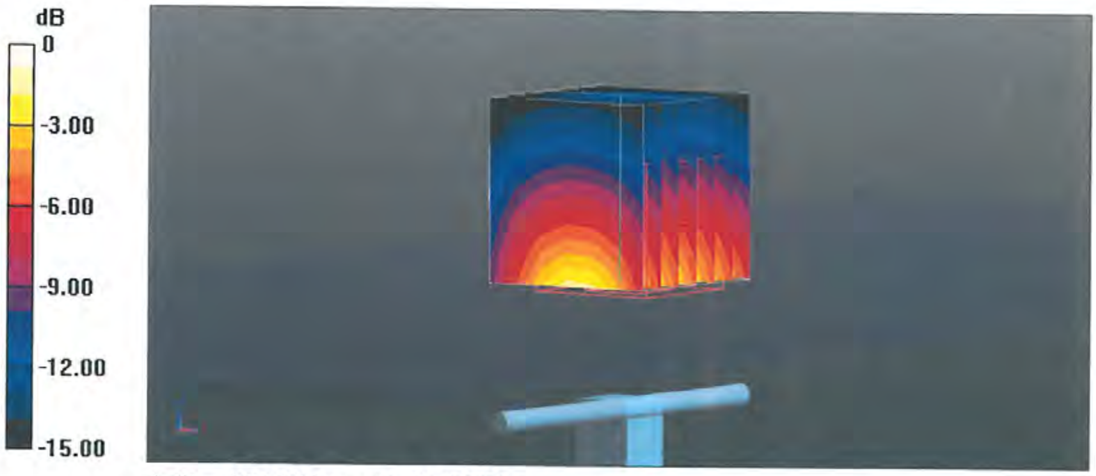
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d029

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.47 S/m; ε_r = 54.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

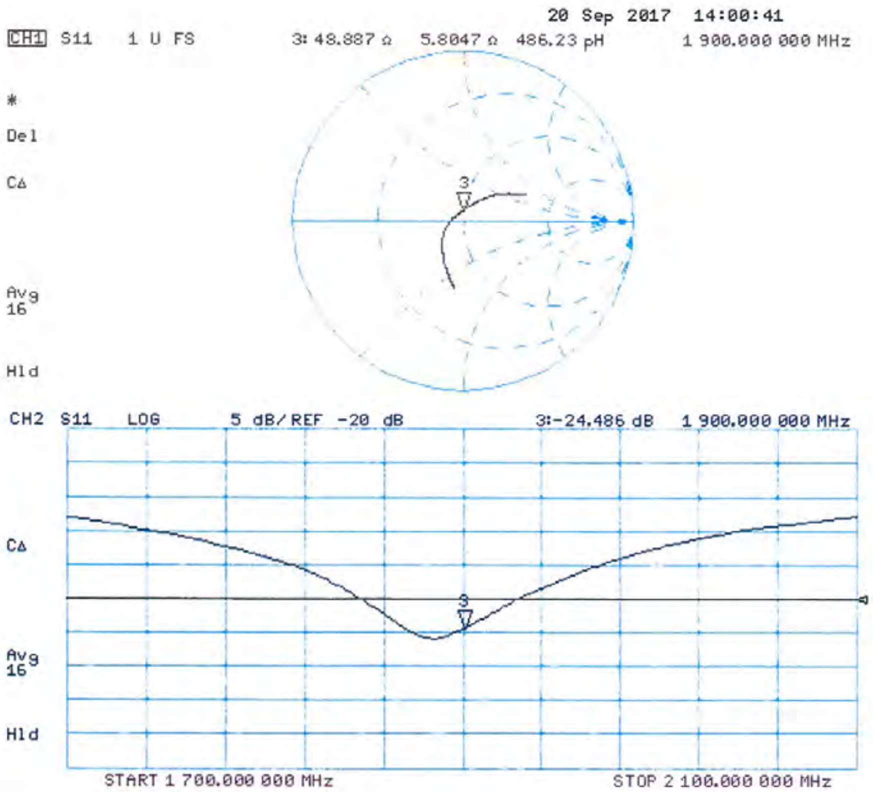
- Probe: EX3DV4 - SN7349; ConvF(8.2, 8.2, 8.2); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.8 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 17.0 W/kg
SAR(1 g) = 9.66 W/kg; SAR(10 g) = 5.15 W/kg
Maximum value of SAR (measured) = 14.1 W/kg



0 dB = 14.1 W/kg = 11.49 dBW/kg

Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d029_Sep17 Page 8 of 8

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Accreditation No.: SCS 0108

Client DT&C (Dymstec) **Certificate No: D2450V2-726_Sep17**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:726
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	September 19, 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	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-May-17 (No. EX3-7349_May17)	May-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 19, 2017

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) 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
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.8 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.5 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.9 ± 6 %	2.04 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.9 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.6 Ω + 4.0 jΩ
Return Loss	- 26.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.4 Ω + 6.5 jΩ
Return Loss	- 23.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 09, 2003

DASY5 Validation Report for Head TSL

Date: 19.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:726

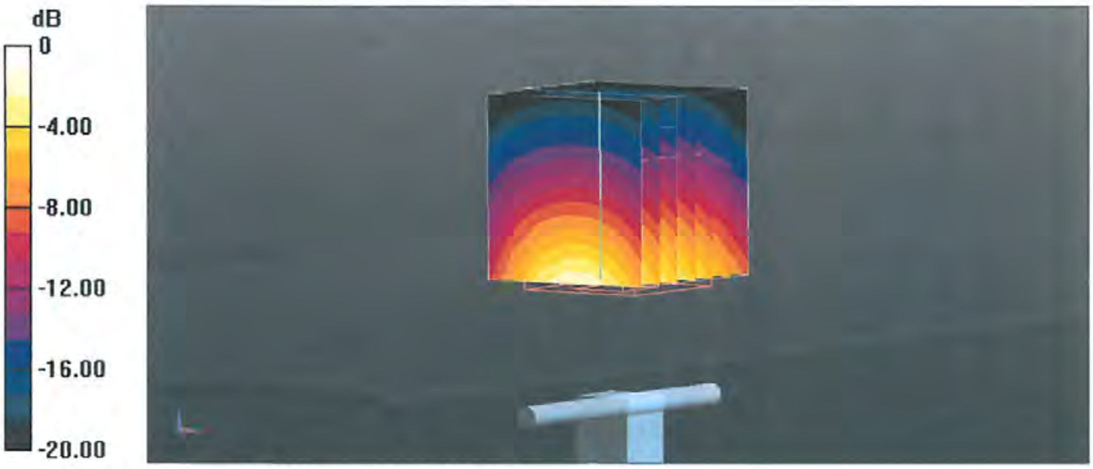
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 37.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.12, 8.12, 8.12); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

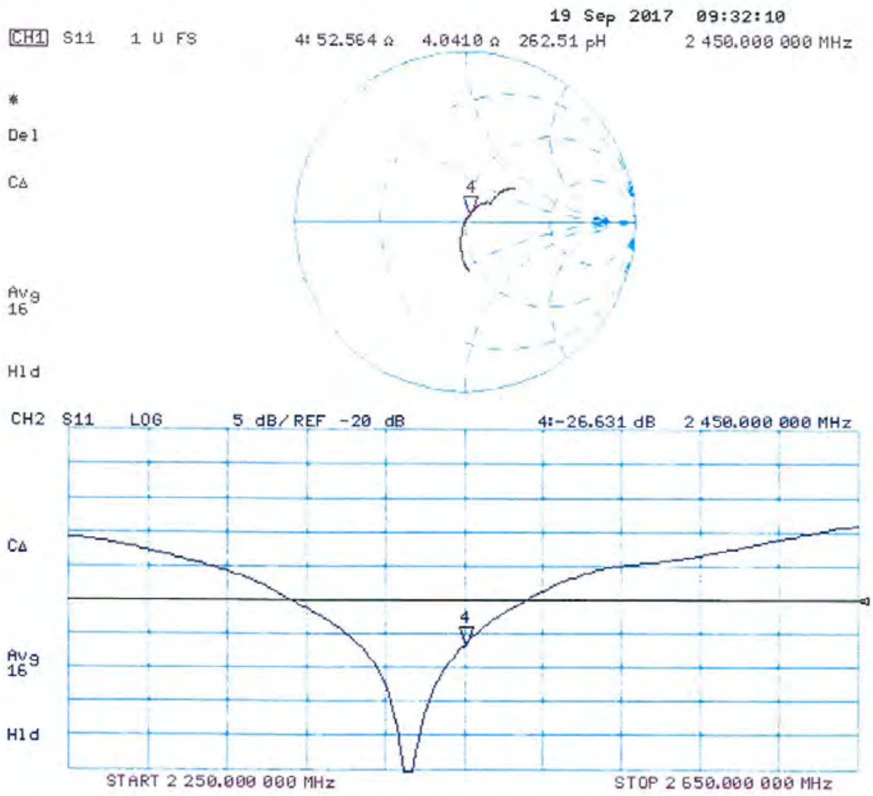
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 110.8 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 26.9 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.22 W/kg
Maximum value of SAR (measured) = 21.0 W/kg



0 dB = 21.0 W/kg = 13.22 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

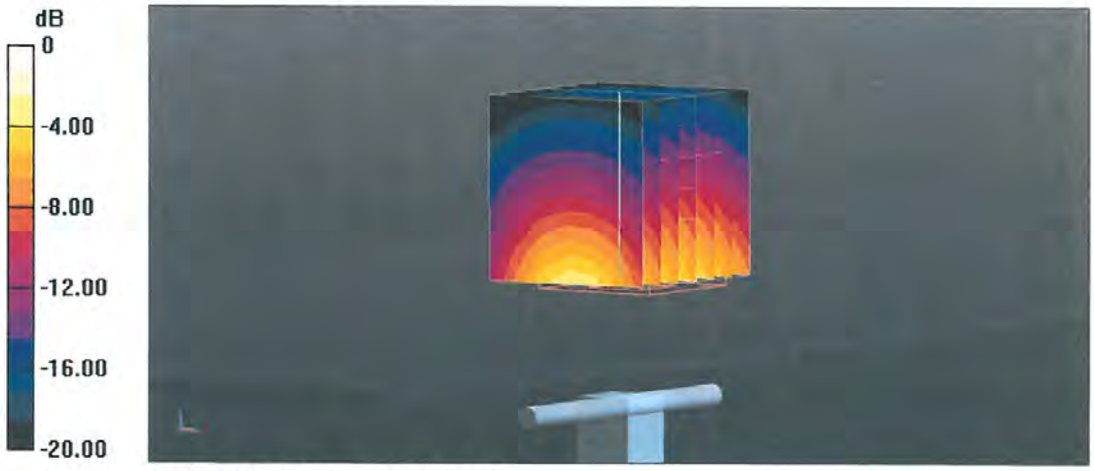
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:726

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.04 S/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.1, 8.1, 8.1); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

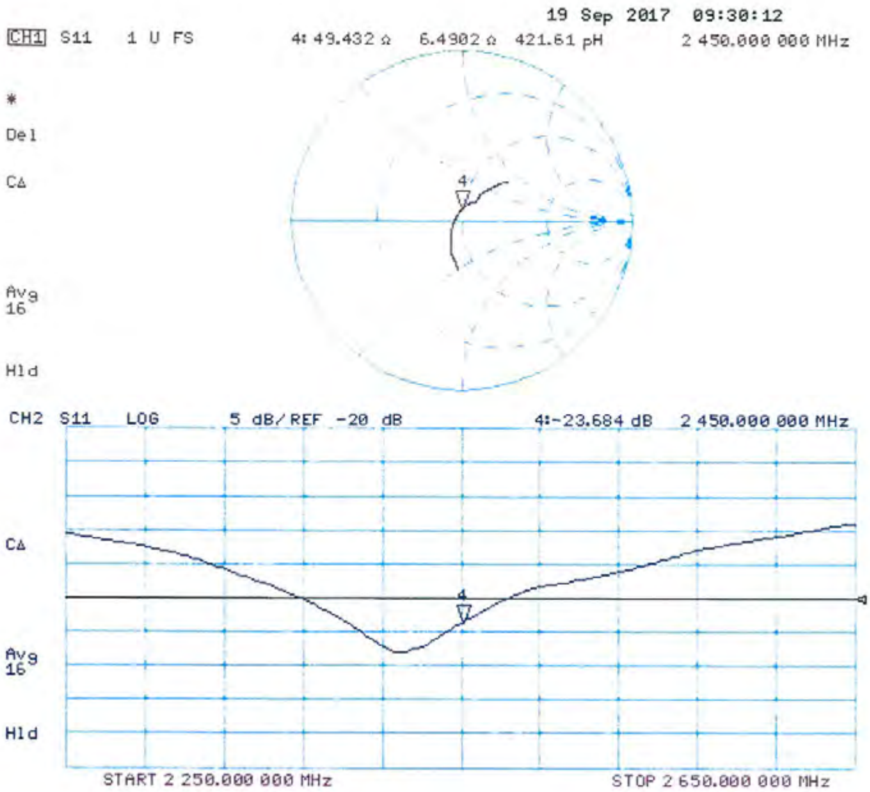
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 104.9 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 25.4 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.05 W/kg
Maximum value of SAR (measured) = 20.3 W/kg



0 dB = 20.3 W/kg = 13.07 dBW/kg

Certificate No: D2450V2-726_Sep17 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-726_Sep17 Page 8 of 8

Attachment 3. – SAR SYSTEM VALIDATION

SAR System Validation

Per FCC KDB 865664 D02v01r02, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01v01r04 and IEEE 1528-2013.Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table Attachment 3.1 SAR System Validation Summary

SAR System	Freq. [MHz]	Date	Probe SN	Probe Type	Probe CAL. Point		PERM.	COND.	CW Validation			MOD. Validation		
							(εr)	(σ)	Sensi-tivity	Probe Linearity	Probe Isortopy	MOD. Type	Duty Factor	PAR
B	1800	2017-10-18	3933	EX3DV4	1800	Head	38.945	1.385	PASS	PASS	PASS	N/A	N/A	N/A
B	1900	2017-10-19	3933	EX3DV4	1900	Head	39.115	1.377	PASS	PASS	PASS	GMSK	PASS	N/A
B	2450	2017-10-20	3933	EX3DV4	2450	Head	38.885	1.778	PASS	PASS	PASS	OFDM	N/A	PASS
B	1800	2017-10-18	3933	EX3DV4	1800	Body	52.546	1.525	PASS	PASS	PASS	N/A	N/A	N/A
B	1900	2017-10-19	3933	EX3DV4	1900	Body	52.456	1.557	PASS	PASS	PASS	GMSK	PASS	N/A
B	2450	2017-10-20	3933	EX3DV4	2450	Body	51.876	2.015	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r04 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.