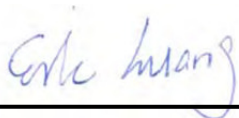


FCC SAR Test Report

APPLICANT : ZTE CORPORATION
EQUIPMENT : CDMA/LTE Multi-mode Digital Mobile Phone
BRAND NAME : ZTE
MODEL NAME : ZTE N9521
FCC ID : SRQ-ZTEN9521
STANDARD : FCC 47 CFR Part 2 (2.1093)
ANSI/IEEE C95.1-1992
IEEE 1528-2003

We, SPORTON INTERNATIONAL (XI'AN) INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in compliance with the applicable technical standards.

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



Reviewed by: Eric Huang / Deputy Manager



Approved by: Jones Tsai / Manager



SPORTON INTERNATIONAL (XI'AN) INC.

1F, Building A3, No. 39 Chuangye Rd., Xi'an Hi-tech Zone, Shanxi Province, P. R. China



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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA551803	Rev. 01	Initial issue of report	Jun. 29, 2015



1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **ZTE CORPORATION, CDMA/LTE Multi-mode Digital Mobile Phone, ZTE N9521**, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary				Highest Simultaneous Transmission 1g SAR (W/kg)
		Head 1g SAR (W/kg)	Wireless Router 1g SAR (W/kg) (Gap 1cm)	Body-worn 1g SAR (W/kg) (Gap 1cm)	Extremity 10g SAR (W/kg) (Gap 0cm)	
PCE	CDMA2000 BC10	0.46	0.84	0.87		1.57
	CDMA2000 BC0	0.50	1.01	1.06		
	CDMA2000 BC1	0.46	1.21	1.18	3.49	
	LTE Band 25	0.34	1.08	1.08		
DTS	WLAN 2.4GHz Band	0.32	0.73	0.73		1.57
Date of Testing:			May 28, 2015 ~ Jun. 11, 2015			

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6W/kg as averaged over any 1 gram of tissue; 4.0W/kg as averaged over any 10 gram of tissue for extremity SAR) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003.

2. Administration Data

Testing Laboratory	
Test Site	SPORTON INTERNATIONAL (XI'AN) INC.
Test Site Location	1F, Building A3, No. 39 Chuangye Rd., Xi'an Hi-tech Zone, Shanxi Province, P. R. China TEL: +86-029-8860-8767 FAX: +86-029-8860-8791

Applicant	
Company Name	ZTE CORPORATION
Address	ZTE Plaza, Keji Road South, Hi-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P. R. China

Manufacturer	
Company Name	ZTE CORPORATION
Address	ZTE Plaza, Keji Road South, Hi-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P. R. China

3. Guidance Standard

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

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2003
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- FCC KDB 865664 D02 SAR Reporting v01r01
- FCC KDB 447498 D01 General RF Exposure Guidance v05r02
- FCC KDB 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r02
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r01
- FCC KDB 941225 D01 3G SAR Procedures v03
- FCC KDB 941225 D05 SAR for LTE Devices v02r03
- FCC KDB 941225 D06 Hotspot Mode SAR v02

4. Equipment Under Test (EUT)

4.1 General Information

Product Feature & Specification	
Equipment Name	CDMA/LTE Multi-mode Digital Mobile Phone
Brand Name	ZTE
Model Name	ZTE N9521
FCC ID	SRQ-ZTEN9521
MEID Code	99000222979538
Wireless Technology and Frequency Range	CDMA2000 BC0: 824.7 MHz ~ 848.31 MHz CDMA 2000 BC10: 817.9 MHz ~ 823.1 MHz CDMA 2000 BC1: 1851.25 MHz ~ 1908.75 MHz LTE Band 25: 1850.7 MHz ~ 1914.3 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	• CDMA2000 : 1xRTT/1xEv-Do(Rcv.0)/1xEv-Do(Rcv.A) • LTE • 802.11b/g/n/ HT20 • Bluetooth v3.0+EDR, Bluetooth v4.0 LE
HW Version	cvjA
SW Version	N9521V1.0.0B02
EUT Stage	Production Unit
Remark:	
1. 802.11n-HT40 is not supported in 2.4GHz WLAN and this device 2.4GHz WLAN supports hotspot operation. 2. This device supported VoIP in CDMA and LTE (e.g. 3rd party VoIP).	

4.2 Maximum Tune-up Limit

Mode	Average power (dBm)		
	CDMA2000 BC10	CDMA2000 BC0	CDMA2000 BC1
1xRTT RC1 SO55	24.5	24.5	24.0
1xRTT RC3 SO55	24.5	24.5	24.0
1xRTT RC3 SO32 (+ F-SCH)	24.5	24.5	24.0
1xRTT RC3 SO32 (+SCH)	24.5	24.5	24.0
1xEV-DO Rev 0 (RTAP 153.6kbps)	24.5	24.5	24.0
1xEV-DO Rev A (RETAP 4096bits)	24.5	24.5	24.0

LTE Band 25				
Average Power (dBm)				
Modulation	BW (MHz)	RB size	MPR	Target Power
QPSK	20	≤ 18	0	23.5
QPSK	20	> 18	1	22.5
16QAM	20	≤ 18	1	22.5
16QAM	20	> 18	2	21.5
QPSK	15	≤ 16	0	23.5
QPSK	15	> 16	1	22.5
16QAM	15	≤ 16	1	22.5
16QAM	15	> 16	2	21.5
QPSK	10	≤ 12	0	23.5
QPSK	10	> 12	1	22.5
16QAM	10	≤ 12	1	22.5
16QAM	10	> 12	2	21.5
QPSK	5	≤ 8	0	23.5
QPSK	5	> 8	1	22.5
16QAM	5	≤ 8	1	22.5
16QAM	5	> 8	2	21.5
QPSK	3	≤ 4	0	23.5
QPSK	3	> 4	1	22.5
16QAM	3	≤ 4	1	22.5
16QAM	3	> 4	2	21.5
QPSK	1.4	≤ 5	0	23.5
QPSK	1.4	> 5	1	22.5
16QAM	1.4	≤ 5	1	22.5
16QAM	1.4	> 5	2	21.5

Mode			Average Power (dBm)
2.4GHz	802.11b	CH 01	19.5
		CH 06	19.5
		CH 11	19.5
	802.11g	CH 01	15.0
		CH 06	19.5
		CH 11	15.0
	802.11n-HT20	CH 01	15.0
		CH 06	19.0
		CH 11	15.0
Bluetooth v3.0 + EDR			3.0
Bluetooth v4.0 LE			-1.0

4.3 General LTE SAR Test and Reporting Considerations

Summarized necessary items addressed in KDB 941225 D05 v02r03												
FCC ID			SRQ-ZTEN9521									
Equipment Name			CDMA/LTE Multi-mode Digital Mobile Phone									
Operating Frequency Range of each LTE transmission band			LTE Band 25: 1850.7 MHz ~ 1914.3 MHz									
Channel Bandwidth			1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz									
uplink modulations used			QPSK, and 16QAM									
LTE Voice / Data requirements			Data only									
LTE MPR permanently built-in by design			Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3									
			Modulation		Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)	
					1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz		
			QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1		
			16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1		
			16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2		
LTE A-MPR			In the base station simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing and the LTE SAR tests was transmitting on all TTI frames (Maximum TTI)									
Spectrum plots for RB configuration			A properly configured base station simulator was used for the SAR and power measurement; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.									
LTE Release Version			R9 Cat 4									
LTE Carrier Aggregation Combinations			Not Supported									
Transmission (H, M, L) channel numbers and frequencies in each LTE band												
LTE Band 25												
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	26047	1850.7	26055	1851.5	26065	1852.5	26090	1855	26115	1857.5	26140	1860
M	26340	1880	26340	1880	26340	1880	26340	1880	26340	1880	26340	1880
H	26683	1914.3	26675	1913.5	26665	1912.5	26640	1910	26615	1907.5	26590	1905

5. RF Exposure Limits

5.1 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.

5.2 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 applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The 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.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

6. Specific Absorption Rate (SAR)

6.1 Introduction

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

6.2 SAR Definition

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

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

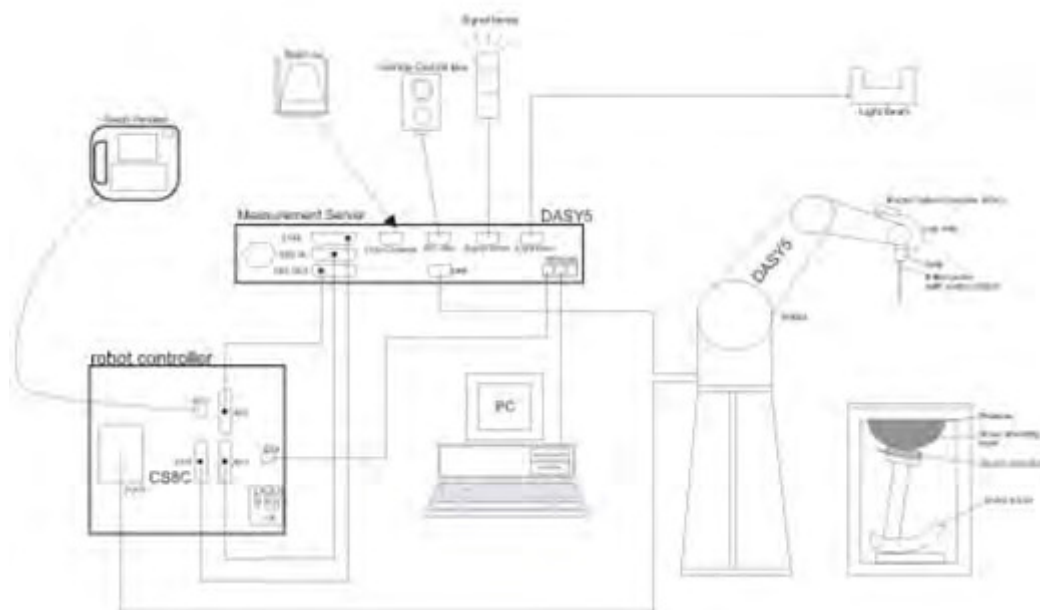
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

7. System Description and Setup

The DASY system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

8. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

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

<SAR measurement>

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

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

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

8.1 Spatial Peak SAR Evaluation

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

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

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

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

8.2 Power Reference Measurement

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

8.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r03 SAR measurement 100 MHz to 6 GHz.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area}	≤ 2 GHz: ≤ 15 mm $2 - 3$ GHz: ≤ 12 mm	$3 - 4$ GHz: ≤ 12 mm $4 - 6$ GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

8.4 Zoom Scan

Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r03 SAR measurement 100 MHz to 6 GHz.

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{\text{Zoom}}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{\text{Zoom}}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{\text{Zoom}}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.				
* When zoom scan is required and the <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

8.5 Volume Scan Procedures

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

8.6 Power Drift Monitoring

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

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz System Validation Kit	D835V2	4d091	Nov. 21, 2014	Nov. 20, 2015
SPEAG	1900MHz System Validation Kit	D1900V2	5d118	Nov. 21, 2014	Nov. 20, 2015
SPEAG	2450MHz System Validation Kit	D2450V2	840	Nov. 19, 2014	Nov. 18, 2015
SPEAG	Data Acquisition Electronics	DAE4	1358	Apr. 28, 2015	Apr. 27, 2016
SPEAG	Dosimetric E-Field Probe	EX3DV4	3911	Oct. 02, 2014	Oct. 01, 2015
SPEAG	SAM Twin Phantom	QD 000 P40 CD	TP-1753	NCR	NCR
SPEAG	SAM Twin Phantom	QD 000 P40 CD	TP-1754	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Agilent	Wireless Communication Test Set	E5515C	MY52102600	Dec. 09, 2014	Dec. 08, 2015
Anritsu	Radio communication analyzer	MT8820C	6201091028	Dec. 09, 2014	Dec. 08, 2015
Agilent	ENA Series Network Analyzer	E5071C	MY46317418	Dec. 09, 2014	Dec. 08, 2015
Agilent	Dielectric Probe Kit	85070E	MY44300751	NCR	NCR
Anritsu	Power Sensor	MA2411B	0917070	Jan. 23, 2015	Jan. 22, 2016
Anritsu	Power Meter	ML2495A	1218010	Jan. 23, 2015	Jan. 22, 2016
ARRA	Power Divider	A3200-2	N/A	NA	NA
R&S	Spectrum Analyzer	FSP7	101045	Dec. 09, 2014	Dec. 08, 2015
Agilent	Dual Directional Coupler	778D	50422	Note1	
Woken	Attenuator 1	WK0602-XX	N/A	Note1	
PE	Attenuator 2	PE7005-10	N/A	Note1	
PE	Attenuator 3	PE7005- 3	N/A	Note1	
AR	Power Amplifier	5S1G4M2	0328767	Note1	
Mini-Circuits	Power Amplifier	ZVE-3W	162601250	Note1	
Mini-Circuits	Power Amplifier	ZHL-42W+	13440021344	Note1	

General Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.

10. System Verification

10.1 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

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

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Conductivity (σ)	Permittivity (ϵ_r)	Conductivity Target (σ)	Permittivity Target (ϵ_r)	Delta (σ) (%)	Delta (ϵ_r) (%)	Limit (%)	Date
835	Head	22.3	0.938	42.700	0.90	41.50	4.22	2.89	±5	Jun. 05, 2015
1900	Head	22.6	1.456	40.840	1.40	40.00	4.00	2.10	±5	Jun. 05, 2015
2450	Head	22.4	1.857	37.703	1.80	39.20	3.17	-3.82	±5	Jun. 11, 2015
835	Body	22.3	1.000	55.514	0.97	55.20	3.09	0.57	±5	Jun. 04, 2015
1900	Body	22.5	1.527	55.253	1.52	53.30	0.46	3.66	±5	May 28, 2015
2450	Body	22.6	1.921	51.188	1.95	52.70	-1.49	-2.87	±5	Jun. 11, 2015

10.2 System Performance Check Results

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

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured SAR (W/kg)	Targeted SAR (W/kg)	Normalized SAR (W/kg)	Deviation (%)
Jun. 05, 2015	835	Head	250	4d091	3911	1358	2.36	9.11	9.44	3.62
Jun. 05, 2015	1900	Head	250	5d118	3911	1358	10.30	40.10	41.2	2.74
Jun. 11, 2015	2450	Head	250	840	3911	1358	13.30	52.30	53.2	1.72
Jun. 04, 2015	835	Body	250	4d091	3911	1358	2.43	9.60	9.72	1.25
May 28, 2015	1900	Body	250	5d118	3911	1358	10.10	40.00	40.4	1.00
Jun. 11, 2015	2450	Body	250	840	3911	1358	12.10	51.00	48.4	-5.10

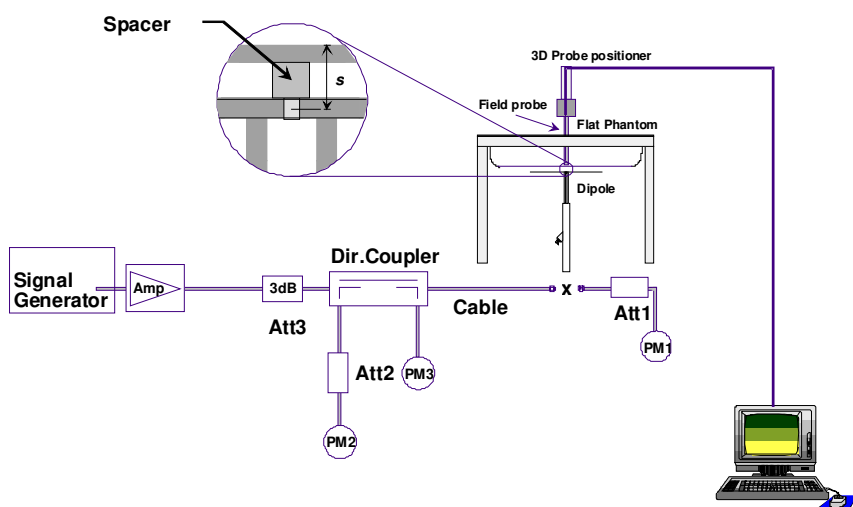


Fig 8.3.1 System Performance Check Setup



Fig 8.3.2 Setup Photo

11. RF Exposure Positions

11.1 Ear and handset reference point

Figure 9.1.1 shows the front, back, and side views of the SAM phantom. The center-of-mouth reference point is labeled "M," the left ear reference point (ERP) is marked "LE," and the right ERP is marked "RE." Each ERP is 15 mm along the B-M (back-mouth) line behind the entrance-to-ear-canal (EEC) point, as shown in Figure 9.1.2 The Reference Plane is defined as passing through the two ear reference points and point M. The line N-F (neck-front), also called the reference pivoting line, is normal to the Reference Plane and perpendicular to both a line passing through RE and LE and the B-M line (see Figure 9.1.3). Both N-F and B-M lines should be marked on the exterior of the phantom shell to facilitate handset positioning. Posterior to the N-F line the ear shape is a flat surface with 6 mm thickness at each ERP, and forward of the N-F line the ear is truncated, as illustrated in Figure 9.1.2. The ear truncation is introduced to preclude the ear lobe from interfering with handset tilt, which could lead to unstable positioning at the cheek.

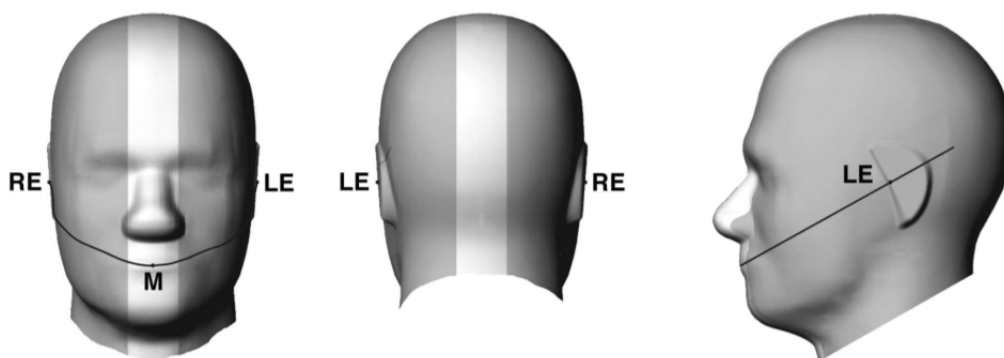


Fig 9.1.1 Front, back, and side views of SAM twin phantom

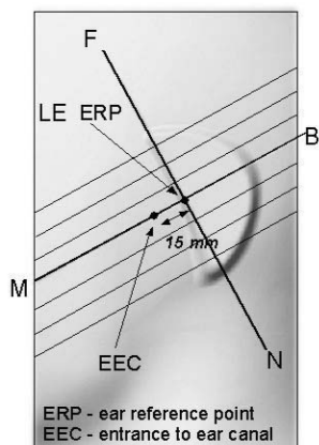


Fig 9.1.2 Close-up side view of phantom showing the ear region.

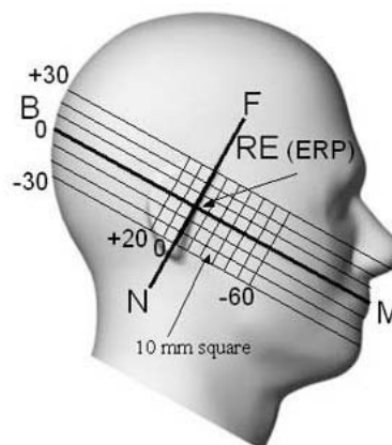


Fig 9.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

11.2 Definition of the cheek position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. Define two imaginary lines on the handset—the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset—the midpoint of the width w_t of the handset at the level of the acoustic output (point A in Figure 9.2.1 and Figure 9.2.2), and the midpoint of the width w_b of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 9.2.1). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 9.2.2), especially for clamshell handsets, handsets with flip covers, and other irregularly-shaped handsets.
3. Position 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 9.2.3), such that the plane defined by the vertical centerline and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.
4. Translate the handset towards the phantom along the line passing through RE and LE until handset point A touches the pinna at the ERP.
5. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to the plane containing B-M and N-F lines, i.e., the Reference Plane.
6. Rotate the handset around the vertical centerline until the handset (horizontal line) is parallel to the N-F line.
7. While maintaining the vertical centerline in the Reference Plane, keeping point A on the line passing through RE and LE, and maintaining the handset contact with the pinna, rotate the handset about the N-F line until any point on the handset is in contact with a phantom point below the pinna on the cheek. See Figure 9.2.3. The actual rotation angles should be documented in the test report.

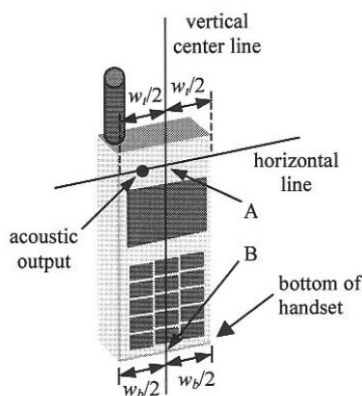


Fig 9.2.1 Handset vertical and horizontal reference lines—"fixed case"

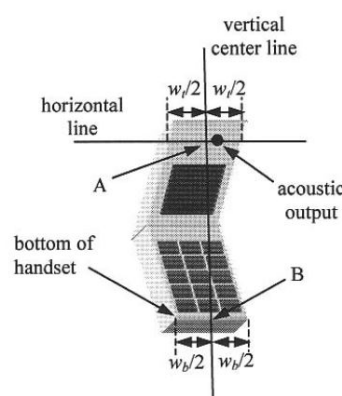


Fig 9.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

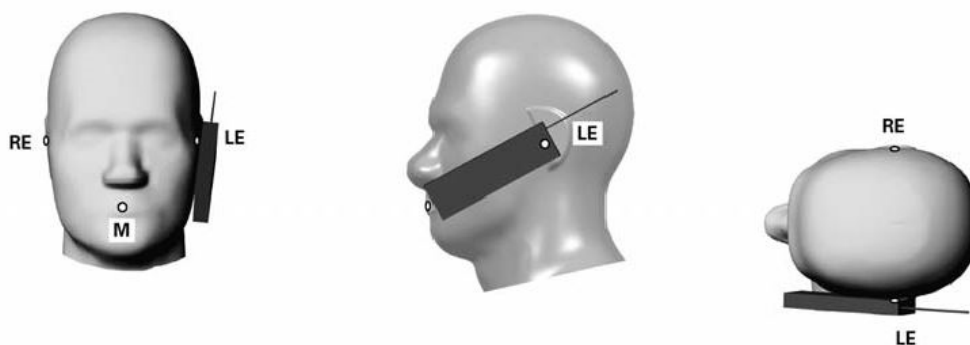


Fig 9.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

11.3 Definition of the tilt position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. While maintaining the orientation of the handset, move the handset away from the pinna along the line passing through RE and LE far enough to allow a rotation of the handset away from the cheek by 15°.
3. Rotate the handset around the horizontal line by 15°.
4. While maintaining the orientation of the handset, move the handset towards the phantom on the line passing through RE and LE until any part of the handset touches the ear. The tilt position is obtained when the contact point is on the pinna. See Figure 9.3.1. If contact occurs at any location other than the pinna, e.g., the antenna at the back of the phantom head, the angle of the handset should be reduced. In this case, the tilt position is obtained if any point on the handset is in contact with the pinna and a second point

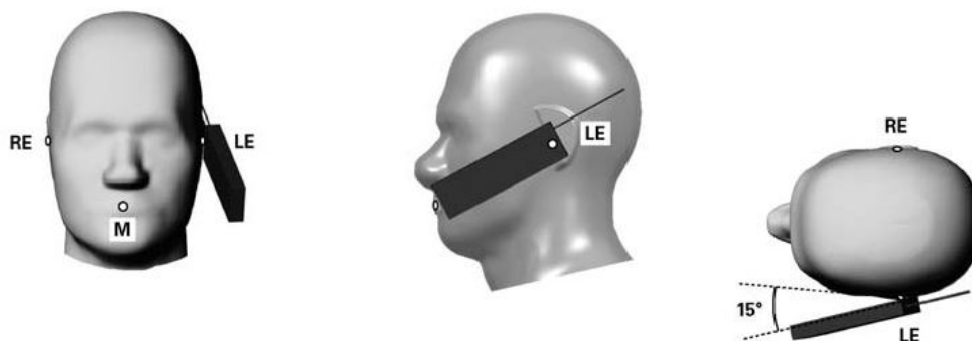


Fig 9.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

11.4 Body Worn Accessory

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 9.4). Per KDB 648474 D04v01r02, body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB 447498 D01v05r02 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for body-worn accessory, measured without a headset connected to the handset is $< 1.2 \text{ W/kg}$, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a handset attached to the handset.

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 test with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-chip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

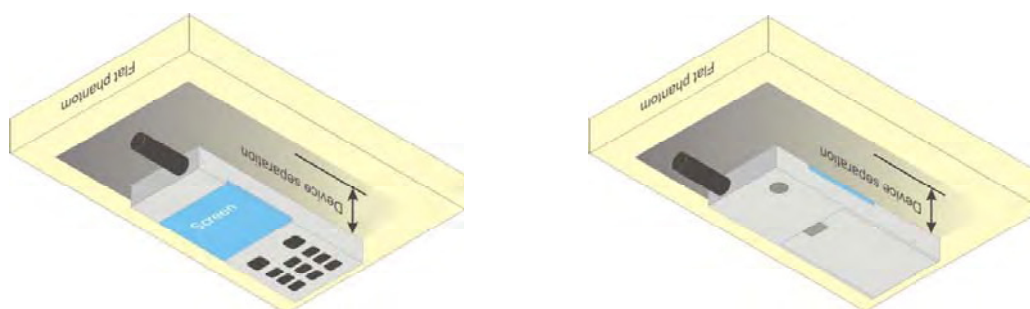


Fig 9.4 Body Worn Position

11.5 Wireless Router

Some battery-operated handsets have the capability to transmit and receive user through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC HDB Publication 941225 D06 v02 where SAR test considerations for handsets ($L \times W \geq 9 \text{ cm} \times 5 \text{ cm}$) are based on a composite test separation distance of 10mm from the front, back and edges of the device containing transmitting antennas within 2.5cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v05r02 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

11.6 Extremity Exposure

For smart phones with a display diagonal dimension $> 15.0 \text{ cm}$ or an overall diagonal dimension $> 16.0 \text{ cm}$ that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that support voice calls next to the ear, According to KDB648474D04v01r02, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless mode and frequency band. Devices marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance

1. The normally required head and body-worn accessory SAR test procedures for handsets, including hotspot mode, must be applied.
2. The UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at $\leq 25 \text{ mm}$ from that surface or edge, in direct contact with a flat phantom, for 10-g extremity SAR according to the body-equivalent tissue dielectric parameters in KDB 865664 to address interactive hand use exposure conditions.⁶ The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR $> 1.2 \text{ W/kg}$.

**12. Conducted RF Output Power (Unit: dBm)****<CDMA2000 Conducted Power>****General Note:**

1. Per KDB 941225 D01v03, SAR for head exposure is measured in RC3 with the handset configured to transmit at full rate in SO55.
2. Per KDB 941225 D01v03, in hotspot mode EUT is treated as data device and SAR is tested with Ev-Do Rev 0 (RTAP 153.6kbps) as the primary mode.
3. Per KDB 941225 D01v03, for body-worn accessory SAR is measured in RC3 with the handset configured in TDSO/SO32 to transmit at full rate on FCH only with all other code channels disabled. The body-worn accessory procedures in KDB Publication 447498 are applied. The 3G SAR test reduction procedure is applied to the multiple code channel configuration (FCH+SCH), with FCH only as the primary mode.

Band	CDMA2000 BC10			CDMA2000 BC0			CDMA2000 BC1		
TX Channel	476	580	684	1013	384	777	25	600	1175
Frequency (MHz)	817.9	820.5	823.1	824.7	836.52	848.31	1851.25	1880	1908.75
1xRTT RC1 SO55	24.21	24.32	24.31	24.37	24.45	24.35	23.95	23.97	23.85
1xRTT RC3 SO55	24.19	24.38	24.27	24.36	24.46	24.34	23.91	23.98	23.82
1xRTT RC3 SO32 (+ F-SCH)	24.29	24.37	24.35	24.45	24.45	24.35	23.92	23.94	23.88
1xRTT RC3 SO32 (+SCH)	24.28	24.34	24.33	24.38	24.41	24.33	23.92	23.95	23.81
1xEV-DO Rev 0 (RTAP 153.6kbps)	24.32	24.34	24.33	24.39	24.43	24.35	23.95	23.95	23.83
1xEV-DO Rev A (RETAP 4096bits)	24.27	24.36	24.35	24.33	24.37	24.32	23.89	23.96	23.79

<LTE Conducted Power>**General Note:**

1. Anritsu MT8820C base station simulator was used to setup the connection with EUT; the frequency band, channel bandwidth, RB allocation configuration, modulation type are set in the base station simulator to configure EUT transmitting at maximum power and at different configurations which are requested to be reported to FCC, for conducted power measurement and SAR testing.
2. Per KDB 941225 D05v02r03, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.
3. Per KDB 941225 D05v02r03, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
4. Per KDB 941225 D05v02r03, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
5. Per KDB 941225 D05v02r03, for QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
6. Per KDB 941225 D05v02r03, 16QAM output power for each RB allocation configuration is $>$ not $\frac{1}{2}$ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, 16QAM SAR testing is not required.
7. Per KDB 941225 D05v02r03, smaller bandwidth output power for each RB allocation configuration is $>$ not $\frac{1}{2}$ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, smaller bandwidth SAR testing is not required.



<LTE Band 25>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune up Limit (dBm)	MPR (dB)
Channel				26140	26340	26590		
Frequency (MHz)				1860	1880	1905		
20	QPSK	1	0	22.72	22.43	22.19	23.5	0
20	QPSK	1	49	23.21	22.54	22.66		
20	QPSK	1	99	22.54	22.29	22.08		
20	QPSK	50	0	22.01	21.50	21.56	22.5	0-1
20	QPSK	50	24	22.07	21.48	21.76		
20	QPSK	50	49	22.06	21.48	21.68		
20	QPSK	100	0	22.07	21.52	21.66		
20	16QAM	1	0	21.74	22.00	21.39	22.5	0-1
20	16QAM	1	49	22.37	21.68	22.34		
20	16QAM	1	99	21.74	21.72	21.41		
20	16QAM	50	0	20.98	20.53	20.68	21.5	0-2
20	16QAM	50	24	21.06	20.57	20.85		
20	16QAM	50	49	21.08	20.54	20.72		
20	16QAM	100	0	21.09	20.58	20.68		
Channel				26115	26340	26615	Tune up Limit (dBm)	MPR (dB)
Frequency (MHz)				1857.5	1880	1907.5		
15	QPSK	1	0	22.98	22.71	22.53	23.5	0
15	QPSK	1	37	23.03	22.49	22.75		
15	QPSK	1	74	23.12	22.60	22.32		
15	QPSK	36	0	22.19	21.60	21.69	22.5	0-1
15	QPSK	36	18	22.15	21.54	21.81		
15	QPSK	36	37	22.16	21.61	21.66		
15	QPSK	75	0	22.11	21.63	21.73		
15	16QAM	1	0	22.23	21.92	22.14	22.5	0-1
15	16QAM	1	37	22.43	21.59	21.86		
15	16QAM	1	74	22.26	21.79	21.71		
15	16QAM	36	0	21.06	20.66	20.66	21.5	0-2
15	16QAM	36	18	21.16	20.60	20.80		
15	16QAM	36	37	21.16	20.59	20.67		
15	16QAM	75	0	21.15	20.56	20.71		
Channel				26090	26340	26640	Tune up Limit (dBm)	MPR (dB)
Frequency (MHz)				1855	1880	1910		
10	QPSK	1	0	23.04	22.69	22.87	23.5	0
10	QPSK	1	24	23.08	22.57	22.72		
10	QPSK	1	49	23.10	22.70	22.32		
10	QPSK	25	0	22.10	21.68	21.88	22.5	0-1
10	QPSK	25	12	22.27	21.49	21.65		
10	QPSK	25	24	22.37	21.60	21.70		
10	QPSK	50	0	22.26	21.61	21.67		
10	16QAM	1	0	22.43	22.08	22.13	22.5	0-1
10	16QAM	1	24	22.14	21.81	21.77		
10	16QAM	1	49	22.49	22.34	21.36		
10	16QAM	25	0	21.10	20.79	20.88	21.5	0-2
10	16QAM	25	12	21.23	20.59	20.69		
10	16QAM	25	24	21.34	20.66	20.80		
10	16QAM	50	0	21.21	20.70	20.69		

Channel				26065	26340	26665	Tune up Limit (dBm)	MPR (dB)
Frequency (MHz)				1852.5	1880	1912.5		
5	QPSK	1	0	23.15	22.81	22.76	23.5	0
5	QPSK	1	12	22.98	22.43	22.50		
5	QPSK	1	24	23.17	22.51	22.41		
5	QPSK	12	0	21.95	21.58	21.67	22.5	0-1
5	QPSK	12	6	22.02	21.63	21.57		
5	QPSK	12	11	22.19	21.59	21.42		
5	QPSK	25	0	22.08	21.63	21.52	22.5	0-1
5	16QAM	1	0	22.31	22.13	22.28		
5	16QAM	1	12	21.98	21.48	21.90		
5	16QAM	1	24	22.36	21.59	21.38	21.5	0-2
5	16QAM	12	0	20.85	20.72	20.76		
5	16QAM	12	6	20.97	20.59	20.63		
5	16QAM	12	11	21.12	20.63	20.45	21.5	0-2
5	16QAM	25	0	21.00	20.57	20.63		
Channel				26055	26340	26675	Tune up Limit (dBm)	MPR (dB)
Frequency (MHz)				1851.5	1880	1913.5		
3	QPSK	1	0	23.01	22.48	22.57	23.5	0
3	QPSK	1	7	22.84	22.52	22.16		
3	QPSK	1	14	23.06	22.47	22.05		
3	QPSK	8	0	21.76	21.55	21.36	22.5	0-1
3	QPSK	8	4	21.86	21.59	21.43		
3	QPSK	8	7	21.89	21.55	21.36		
3	QPSK	15	0	21.85	21.56	21.36	22.5	0-1
3	16QAM	1	0	22.20	21.65	22.04		
3	16QAM	1	7	22.30	21.76	21.50		
3	16QAM	1	14	22.31	22.04	21.29	21.5	0-2
3	16QAM	8	0	20.81	20.51	20.70		
3	16QAM	8	4	20.73	20.64	20.50		
3	16QAM	8	7	20.98	20.63	20.48	21.5	0-2
3	16QAM	15	0	20.76	20.55	20.50		
Channel				26047	26340	26683	Tune up Limit (dBm)	MPR (dB)
Frequency (MHz)				1850.7	1880	1914.3		
1.4	QPSK	1	0	22.87	22.51	22.16	23.5	0
1.4	QPSK	1	2	22.88	22.46	22.02		
1.4	QPSK	1	5	22.79	22.52	21.89		
1.4	QPSK	3	0	22.75	22.45	22.00	22.5	0-1
1.4	QPSK	3	1	22.79	22.52	22.07		
1.4	QPSK	3	2	22.69	22.53	22.08		
1.4	QPSK	6	0	21.71	21.48	21.24	22.5	0-1
1.4	16QAM	1	0	22.21	21.78	21.35		
1.4	16QAM	1	2	22.01	21.47	21.62		
1.4	16QAM	1	5	21.90	21.61	21.10	22.5	0-1
1.4	16QAM	3	0	21.75	21.46	21.18		
1.4	16QAM	3	1	21.66	21.41	21.21		
1.4	16QAM	3	2	21.81	21.45	21.22	21.5	0-2
1.4	16QAM	6	0	20.71	20.52	20.27		

<WLAN Conducted Power>
General Note:

1. Per KDB 248227 D01v02r01, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
2. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
3. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
4. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.18 The initial test position procedure is described in the following:
 - a. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
 - b. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
 - c. For all positions/configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Duty Cycle (%)
2.4GHz WLAN	802.11b	CH 01	2412	1Mbps	19.21	97.64
		CH 06	2437		18.86	
		CH 11	2462		18.47	
	802.11g	CH 01	2412	6Mbps	14.48	87.26
		CH 06	2437		19.30	
		CH 11	2462		14.37	
	802.11n HT20	CH 01	2412	MCS0	14.44	86.64
		CH 06	2437		18.51	
		CH 11	2462		14.35	

13. Bluetooth Exclusions Applied

Mode Band	Average power(dBm)	
	Bluetooth v3.0+EDR	Bluetooth v4.0 LE
2.4GHz Bluetooth	3.0	-1.0

Note:

Per KDB 447498 D01v05r02, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for

1-g SAR and ≤ 7.5 for 10-g extremity SAR

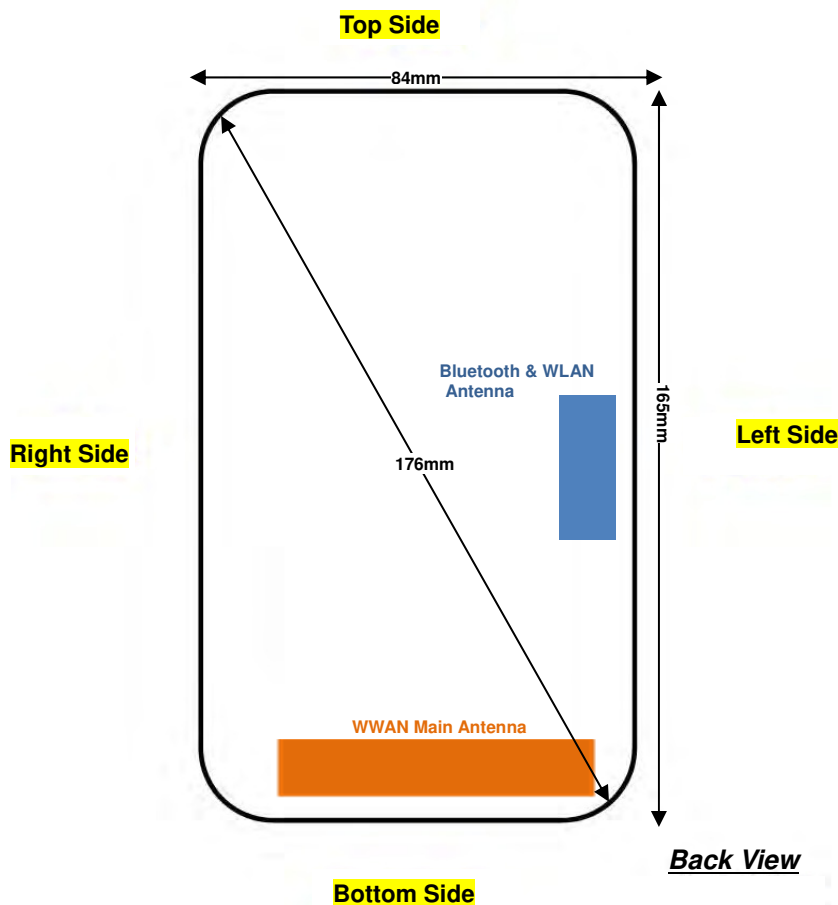
- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

Bluetooth Max Power (dBm)	Separation Distance (mm)	Frequency (GHz)	Exclusion Thresholds
3.0	0	2.48	0.6

Note:

Per KDB 447498 D01v05r02, when the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion. The test exclusion threshold is 0.6 which is ≤ 3, SAR testing is not required.

14. Antenna Location



Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Main	≤ 25mm	≤ 25mm	153mm	≤ 25mm	≤ 25mm	≤ 25mm
BT&WLAN	≤ 25mm	≤ 25mm	79mm	61mm	74mm	≤ 25mm

Positions for SAR tests; Hotspot mode						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Main	Yes	Yes	No	Yes	Yes	Yes
BT&WLAN	Yes	Yes	No	No	No	Yes

General Note: Referring to KDB 941225 D06 v02, when the overall device length and width are $\geq 9\text{cm} \times 5\text{cm}$, the test distance is 10 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.



15. SAR Test Results

General Note:

1. Per KDB 447498 D01v05r02, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
 - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
 - b. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
 - c. For WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01v05r02, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
 - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
 - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
 - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 648474 D04v01r02, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is ≤ 1.2 W/kg, SAR testing with a headset connected to the handset is not required.
4. Per KDB 648474 D04v01r02, for smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm, when hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg, therefore the CDMA2000 BC1 was performed.

CDMA Note:

1. Per KDB 941225 D01v03, SAR for next to the ear head exposure is measured in RC3 with the handset configured to transmit at full rate in SO55.
2. Per KDB 941225 D01v03, in hotspot mode EUT is treated as data device and SAR is tested with Ev-Do Rev 0 (RTAP 153.6kbps) as the primary mode.
3. Per KDB 941225 D01v03, for body-worn accessory SAR is measured in RC3 with the handset configured in TDSO/SO32 to transmit at full rate on FCH only with all other code channels disabled. The body-worn accessory procedures in KDB Publication 447498 are applied. The 3G SAR test reduction procedure is applied to the multiple code channel configuration (FCH+SCH), with FCH only as the primary mode.

LTE Note:

1. Per KDB 941225 D05v02r03, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
2. Per KDB 941225 D05v02r03, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
3. Per KDB 941225 D05v02r03, For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
4. Per KDB 941225 D05v02r03, 16QAM output power for each RB allocation configuration is $> \text{not } \frac{1}{2}$ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, 16QAM SAR testing is not required.
5. Per KDB 941225 D05v02r03, Smaller bandwidth output power for each RB allocation configuration is $> \text{not } \frac{1}{2}$ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, smaller bandwidth SAR testing is not required.

WLAN Note:

1. This device 2.4GHz WLAN supports hotspot operation.
2. Per KDB 248227 D01v02r01, for 2.4GHz 802.11g/n SAR testing is not required 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.
3. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closest/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
4. For all positions / configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

15.1 Head SAR

<CDMA SAR>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
#01	CDMA2000 BC10	RC3 SO55	Right Cheek	580	820.5	24.38	24.50	1.028	0.02	0.445	0.457
	CDMA2000 BC10	RC3 SO55	Right Tilted	580	820.5	24.38	24.50	1.028	0.13	0.266	0.273
	CDMA2000 BC10	RC3 SO55	Left Cheek	580	820.5	24.38	24.50	1.028	0.05	0.381	0.392
	CDMA2000 BC10	RC3 SO55	Left Tilted	580	820.5	24.38	24.50	1.028	0.02	0.276	0.284
#02	CDMA2000 BC0	RC3 SO55	Right Cheek	384	836.52	24.46	24.50	1.009	0.03	0.492	0.497
	CDMA2000 BC0	RC3 SO55	Right Tilted	384	836.52	24.46	24.50	1.009	0.06	0.311	0.314
	CDMA2000 BC0	RC3 SO55	Left Cheek	384	836.52	24.46	24.50	1.009	0.06	0.410	0.414
	CDMA2000 BC0	RC3 SO55	Left Tilted	384	836.52	24.46	24.50	1.009	0.03	0.284	0.287
	CDMA2000 BC1	RC3 SO55	Right Cheek	600	1880	23.98	24.00	1.005	0.19	0.237	0.238
	CDMA2000 BC1	RC3 SO55	Right Tilted	600	1880	23.98	24.00	1.005	0.02	0.200	0.201
#03	CDMA2000 BC1	RC3 SO55	Left Cheek	600	1880	23.98	24.00	1.005	0.06	0.457	0.459
	CDMA2000 BC1	RC3 SO55	Left Tilted	600	1880	23.98	24.00	1.005	-0.01	0.190	0.191

<LTE SAR>

Plot No.	Band	BW (MHz)	RB Size	RB Offset	Modulation	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	LTE Band 25	20M	1	49	QPSK	Right Cheek	26140	1860	23.21	23.50	1.069	-0.01	0.170	0.182
	LTE Band 25	20M	25	24	QPSK	Right Cheek	26140	1860	22.07	22.50	1.104	0.03	0.140	0.155
	LTE Band 25	20M	1	49	QPSK	Right Tilted	26140	1860	23.21	23.50	1.069	0.02	0.120	0.128
	LTE Band 25	20M	25	24	QPSK	Right Tilted	26140	1860	22.07	22.50	1.104	0.05	0.101	0.112
#04	LTE Band 25	20M	1	49	QPSK	Left Cheek	26140	1860	23.21	23.50	1.069	0.03	0.316	0.338
	LTE Band 25	20M	25	24	QPSK	Left Cheek	26140	1860	22.07	22.50	1.104	0.15	0.267	0.295
	LTE Band 25	20M	1	49	QPSK	Left Tilted	26140	1860	23.21	23.50	1.069	-0.03	0.132	0.141
	LTE Band 25	20M	25	24	QPSK	Left Tilted	26140	1860	22.07	22.50	1.104	-0.12	0.109	0.120

<DTS WLAN SAR>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN 2.4GHz	802.11b_1Mbps	Right Cheek	1	2412	19.21	19.50	1.069	97.64	1.024	0.04	0.130	0.142
	WLAN 2.4GHz	802.11b_1Mbps	Right Tilted	1	2412	19.21	19.50	1.069	97.64	1.024	-0.06	0.072	0.079
#05	WLAN 2.4GHz	802.11b_1Mbps	Left Cheek	1	2412	19.21	19.50	1.069	97.64	1.024	0.09	0.291	0.319
	WLAN 2.4GHz	802.11b_1Mbps	Left Tilted	1	2412	19.21	19.50	1.069	97.64	1.024	0.07	0.074	0.081

15.2 Hotspot SAR

Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN	≤ 25mm	≤ 25mm	153mm	≤ 25mm	≤ 25mm	≤ 25mm
BT&WLAN	≤ 25mm	≤ 25mm	79mm	61mm	74mm	≤ 25mm

Positions for SAR tests; Hotspot mode						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN	Yes	Yes	No	Yes	Yes	Yes
BT&WLAN	Yes	Yes	No	No	No	Yes

General Note: Referring to KDB 941225 D06 v02, when the overall device length and width are $\geq 9\text{cm} \times 5\text{cm}$, the test distance is 10 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.

<CDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
#06	CDMA2000 BC10	RTAP 153.6kbps	Front	1	580	820.5	24.34	24.50	1.038	-0.06	0.439	0.455
	CDMA2000 BC10	RTAP 153.6kbps	Back	1	580	820.5	24.34	24.50	1.038	-0.03	0.808	0.838
	CDMA2000 BC10	RTAP 153.6kbps	Left side	1	580	820.5	24.34	24.50	1.038	0.06	0.226	0.234
	CDMA2000 BC10	RTAP 153.6kbps	Right side	1	580	820.5	24.34	24.50	1.038	-0.05	0.457	0.474
	CDMA2000 BC10	RTAP 153.6kbps	Bottom side	1	580	820.5	24.34	24.50	1.038	0.09	0.264	0.274
#07	CDMA2000 BC0	RTAP 153.6kbps	Front	1	384	836.52	24.43	24.50	1.016	-0.06	0.585	0.595
	CDMA2000 BC0	RTAP 153.6kbps	Back	1	384	836.52	24.43	24.50	1.016	0.12	0.990	1.006
	CDMA2000 BC0	RTAP 153.6kbps	Left side	1	384	836.52	24.43	24.50	1.016	0.06	0.191	0.194
	CDMA2000 BC0	RTAP 153.6kbps	Right side	1	384	836.52	24.43	24.50	1.016	-0.03	0.451	0.458
	CDMA2000 BC0	RTAP 153.6kbps	Bottom side	1	384	836.52	24.43	24.50	1.016	0.02	0.352	0.358
#08	CDMA2000 BC0	RTAP 153.6kbps	Back	1	1013	824.7	24.39	24.50	1.026	0.03	0.868	0.890
	CDMA2000 BC0	RTAP 153.6kbps	Back	1	777	848.31	24.35	24.50	1.035	0.03	0.866	0.896
	CDMA2000 BC1	RTAP 153.6kbps	Front	1	600	1880	23.95	24.00	1.012	0.01	0.914	0.925
	CDMA2000 BC1	RTAP 153.6kbps	Back	1	600	1880	23.95	24.00	1.012	0.01	1.200	1.214
	CDMA2000 BC1	RTAP 153.6kbps	Left side	1	600	1880	23.95	24.00	1.012	-0.02	0.485	0.491
#08	CDMA2000 BC1	RTAP 153.6kbps	Right side	1	600	1880	23.95	24.00	1.012	0.09	0.197	0.199
	CDMA2000 BC1	RTAP 153.6kbps	Bottom side	1	600	1880	23.95	24.00	1.012	0.1	0.657	0.665
	CDMA2000 BC1	RTAP 153.6kbps	Front	1	25	1851.25	23.95	24.00	1.012	0.07	0.933	0.944
	CDMA2000 BC1	RTAP 153.6kbps	Front	1	1175	1908.75	23.83	24.00	1.040	0.11	0.865	0.900
	CDMA2000 BC1	RTAP 153.6kbps	Back	1	25	1851.25	23.95	24.00	1.012	0.01	1.200	1.214
#08	CDMA2000 BC1	RTAP 153.6kbps	Back	1	1175	1908.75	23.83	24.00	1.040	-0.02	1.140	1.186

<LTE SAR>

Plot No.	Band	BW (MHz)	RB Size	RB Offset	Modulation	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	LTE Band 25	20M	1	49	QPSK	Front	1	26140	1860	23.21	23.50	1.069	0.01	0.573	0.613
	LTE Band 25	20M	50	24	QPSK	Front	1	26140	1860	22.07	22.50	1.104	0.12	0.477	0.527
	LTE Band 25	20M	1	49	QPSK	Back	1	26140	1860	23.21	23.50	1.069	-0.08	0.769	0.822
#09	LTE Band 25	20M	1	49	QPSK	Back	1	26340	1880	22.54	23.50	1.247	-0.02	0.863	1.076
	LTE Band 25	20M	1	49	QPSK	Back	1	26590	1905	22.66	23.50	1.213	0.02	0.847	1.028
	LTE Band 25	20M	50	24	QPSK	Back	1	26140	1860	22.07	22.50	1.104	0.01	0.651	0.719
	LTE Band 25	20M	100	0	QPSK	Back	1	26140	1860	22.07	22.50	1.104	-0.01	0.639	0.706
	LTE Band 25	20M	1	49	QPSK	Left side	1	26140	1860	23.21	23.50	1.069	0.04	0.373	0.399
	LTE Band 25	20M	50	24	QPSK	Left side	1	26140	1860	22.07	22.50	1.104	-0.02	0.314	0.347
	LTE Band 25	20M	1	49	QPSK	Right Side	1	26140	1860	23.21	23.50	1.069	0.07	0.151	0.161
	LTE Band 25	20M	50	24	QPSK	Right Side	1	26140	1860	22.07	22.50	1.104	0.16	0.127	0.140
	LTE Band 25	20M	1	49	QPSK	Bottom side	1	26140	1860	23.21	23.50	1.069	-0.12	0.401	0.429
	LTE Band 25	20M	50	24	QPSK	Bottom side	1	26140	1860	22.07	22.50	1.104	0.11	0.329	0.363

<DTS WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN 2.4GHz	802.11b_1Mbps	Front	1	1	2412	19.21	19.50	1.069	97.64	1.024	-0.19	0.116	0.127
#10	WLAN 2.4GHz	802.11b_1Mbps	Back	1	1	2412	19.21	19.50	1.069	97.64	1.024	0.11	0.670	0.733
	WLAN 2.4GHz	802.11b_1Mbps	Left side	1	1	2412	19.21	19.50	1.069	97.64	1.024	0.03	0.353	0.386

15.3 Extremity SAR
<CDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
	CDMA2000 BC1	RTAP 153.6kbps	Back	0	600	1880	23.95	24.00	1.012	0.07	3.350	3.389
	CDMA2000 BC1	RTAP 153.6kbps	Back	0	25	1851.25	23.95	24.00	1.012	0.07	3.240	3.278
#11	CDMA2000 BC1	RTAP 153.6kbps	Back	0	1175	1908.75	23.83	24.00	1.040	0.04	3.360	3.494



15.4 Body Worn Accessory SAR

<CDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	CDMA2000 BC10	RC3 SO32	Front	1	580	820.5	24.37	24.50	1.030	-0.01	0.435	0.448
#12	CDMA2000 BC10	RC3 SO32	Back	1	580	820.5	24.37	24.50	1.030	0.09	0.848	0.874
	CDMA2000 BC0	RC3 SO32	Front	1	384	836.52	24.45	24.50	1.012	-0.04	0.571	0.578
#13	CDMA2000 BC0	RC3 SO32	Back	1	384	836.52	24.45	24.50	1.012	0.11	1.050	1.062
	CDMA2000 BC0	RC3 SO32	Back	1	1013	824.7	24.45	24.50	1.012	0.06	0.908	0.919
	CDMA2000 BC0	RC3 SO32	Back	1	777	848.31	24.35	24.50	1.035	0.11	0.921	0.953
	CDMA2000 BC1	RC3 SO32	Front	1	600	1880	23.94	24.00	1.014	0.06	0.900	0.913
	CDMA2000 BC1	RC3 SO32	Back	1	600	1880	23.94	24.00	1.014	-0.03	1.160	1.176
	CDMA2000 BC1	RC3 SO32	Front	1	25	1851.25	23.92	24.00	1.019	0.13	0.917	0.934
	CDMA2000 BC1	RC3 SO32	Front	1	1175	1908.75	23.88	24.00	1.028	0.09	0.864	0.888
#14	CDMA2000 BC1	RC3 SO32	Back	1	25	1851.25	23.92	24.00	1.019	0.14	1.160	1.182
#14	CDMA2000 BC1	RC3 SO32	Back	1	1175	1908.75	23.88	24.00	1.028	0.01	1.150	1.182

<LTE SAR>

Plot No.	Band	BW (MHz)	RB Size	RB Offset	Modulation	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	LTE Band 25	20M	1	49	QPSK	Front	1	26140	1860	23.21	23.50	1.069	0.01	0.573	0.613
	LTE Band 25	20M	50	24	QPSK	Front	1	26140	1860	22.07	22.50	1.104	0.12	0.477	0.527
	LTE Band 25	20M	1	49	QPSK	Back	1	26140	1860	23.21	23.50	1.069	-0.08	0.769	0.822
#09	LTE Band 25	20M	1	49	QPSK	Back	1	26340	1880	22.54	23.50	1.247	-0.02	0.863	1.076
	LTE Band 25	20M	1	49	QPSK	Back	1	26590	1905	22.66	23.50	1.213	0.02	0.847	1.028
	LTE Band 25	20M	50	24	QPSK	Back	1	26140	1860	22.07	22.50	1.104	0.01	0.651	0.719
	LTE Band 25	20M	100	0	QPSK	Back	1	26140	1860	22.07	22.50	1.104	-0.01	0.639	0.706

<DTS WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN 2.4GHz	802.11b_1Mbps	Front	1	1	2412	19.21	19.50	1.069	97.64	1.024	-0.19	0.116	0.127
#10	WLAN 2.4GHz	802.11b_1Mbps	Back	1	1	2412	19.21	19.50	1.069	97.64	1.024	0.11	0.670	0.733

15.5 Repeated SAR Measurement

General Note:

1. Per KDB 865664 D01v01r03, for each frequency band, repeated SAR measurement is required only when the measured SAR is $\geq 0.8\text{W/kg}$.
2. Per KDB 865664 D01v01r03, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR $< 1.45\text{W/kg}$, only one repeated measurement is required.
3. Per KDB 865664 D01v01r03, if the extremity repeated SAR is necessary, the same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.
4. The ratio is the difference in percentage between original and repeated *measured SAR*.
5. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

<1g Repeated SAR>

No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	CDMA2000 BC0	RC3 SO32	Back	1	384	836.52	24.45	24.50	1.012	0.11	1.050	1	1.062
2nd	CDMA2000 BC0	RC3 SO32	Back	1	384	836.52	24.45	24.50	1.012	0.03	1.030	1.019	1.042
1st	CDMA2000 BC1	RTAP 153.6kbps	Back	1	600	1880	23.95	24.00	1.012	0.01	1.200	1	1.214
2nd	CDMA2000 BC1	RTAP 153.6kbps	Back	1	600	1880	23.95	24.00	1.012	0.02	1.160	1.034	1.173

<10g Repeated SAR>

No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Ratio	Reported 10g SAR (W/kg)
1st	CDMA2000 BC1	RTAP 153.6kbps	Back	0	1175	1908.75	23.83	24.00	1.040	0.04	3.360	1	3.494
2nd	CDMA2000 BC1	RTAP 153.6kbps	Back	0	1175	1908.75	23.83	24.00	1.040	0.01	3.350	1.003	3.484

16. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Portable Handset			Note
		Head	Body-worn	Hotspot	
1.	CDMA(Voice) + WLAN2.4GHz(data)	Yes	Yes		
2.	CDMA(Voice) + Bluetooth(data)	Yes	Yes		
3.	CDMA(Data) + WLAN2.4GHz(data)	Yes	Yes	Yes	2.4GHz Hotspot
4.	LTE(Data) + WLAN2.4GHz(data)	Yes	Yes	Yes	2.4GHz Hotspot
5.	CDMA(Data) + Bluetooth(data)	Yes	Yes	Yes	Bluetooth Tethering
6.	LTE(Data) + Bluetooth(data)	Yes	Yes	Yes	Bluetooth Tethering

General Note:

- This device supported VoIP in CDMA and LTE (e.g. 3rd party VoIP).
- This device 2.4GHz WLAN supports hotspot operation.
- WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
- CDMA 2000 and LTE share the same antenna, EUT will choose either CDMA2000 or LTE according to the network signal condition; therefore, they will not transmit simultaneously.
- The reported SAR summation is calculated based on the same configuration and test position.
- Per KDB 447498 D01v05r02, simultaneous transmission SAR is compliant if,
 - Scalar SAR summation $< 1.6\text{W/kg}$.
 - $\text{SPLSR} = (\text{SAR}_1 + \text{SAR}_2)^{1.5} / (\text{min. separation distance, mm})$, and the peak separation distance is determined from the square root of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$, where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
 - If $\text{SPLSR} \leq 0.04$, simultaneously transmission SAR measurement is not necessary.
 - Simultaneously transmission SAR measurement, and the reported multi-band SAR $< 1.6\text{W/kg}$.
- For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05r02 based on the formula below.
 - $(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})} / x] \text{ W/kg}$ for test separation distances $\leq 50 \text{ mm}$; where $x = 7.5$ for 1-g SAR, and $x = 18.75$ for 10-g SAR.
 - When the minimum separation distance is $< 5\text{mm}$, the distance is used 5mm to determine SAR test exclusion.
 - 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is $> 50 \text{ mm}$.

Bluetooth Max Power	Exposure Position	Head	Hotspot	Body worn
	Test separation	0 mm	10 mm	10 mm
3.0 dBm	Estimated 1g SAR (W/kg)	0.084 W/kg	0.042 W/kg	0.042 W/kg

16.1 Head Exposure Conditions
<WWAN PCE + WLAN DTS>

WWAN Band		Exposure Position	WWAN PCE Max. WWAN 1g SAR (W/kg)	WLAN DTS Max. WLAN 1g SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
CDMA2000	BC10	Right Cheek	0.457	0.142	0.60		
		Right Tilted	0.273	0.079	0.35		
		Left Cheek	0.392	0.319	0.71		
		Left Tilted	0.284	0.081	0.37		
	BC0	Right Cheek	0.497	0.142	0.64		
		Right Tilted	0.314	0.079	0.39		
		Left Cheek	0.414	0.319	0.73		
		Left Tilted	0.287	0.081	0.37		
	BC1	Right Cheek	0.238	0.142	0.38		
		Right Tilted	0.201	0.079	0.28		
		Left Cheek	0.459	0.319	0.78		
		Left Tilted	0.191	0.081	0.27		
LTE	Band 25	Right Cheek	0.182	0.142	0.32		
		Right Tilted	0.128	0.079	0.21		
		Left Cheek	0.338	0.319	0.66		
		Left Tilted	0.141	0.081	0.22		

<WWAN PCE + Bluetooth DSS>

WWAN Band		Exposure Position	WWAN PCE Max. WWAN 1g SAR (W/kg)	Bluetooth DSS Estimated Bluetooth 1g SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
CDMA2000	BC10	Right Cheek	0.457	0.084	0.54		
		Right Tilted	0.273	0.084	0.36		
		Left Cheek	0.392	0.084	0.48		
		Left Tilted	0.284	0.084	0.37		
	BC0	Right Cheek	0.497	0.084	0.58		
		Right Tilted	0.314	0.084	0.40		
		Left Cheek	0.414	0.084	0.50		
		Left Tilted	0.287	0.084	0.37		
	BC1	Right Cheek	0.238	0.084	0.32		
		Right Tilted	0.201	0.084	0.29		
		Left Cheek	0.459	0.084	0.54		
		Left Tilted	0.191	0.084	0.28		
LTE	Band 25	Right Cheek	0.182	0.084	0.27		
		Right Tilted	0.128	0.084	0.21		
		Left Cheek	0.338	0.084	0.42		
		Left Tilted	0.141	0.084	0.23		

16.2 Hotspot Exposure Conditions
<WWAN PCE + WLAN DTS>

WWAN Band		Exposure Position	WWAN PCE Max. WWAN 1g SAR (W/kg)	WLAN DTS Max. WLAN 1g SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
CDMA2000	BC10	Front	0.455	0.127	0.58		
		Back	0.838	0.733	1.57		
		Left Side	0.234	0.386	0.62		
		Right Side	0.474		0.47		
		Bottom Side	0.274		0.27		
	BC0	Front	0.595	0.127	0.72		
		Back	1.006	0.733	1.74	0.03	#1
		Left Side	0.194	0.386	0.58		
		Right Side	0.458		0.46		
		Bottom Side	0.358		0.36		
	BC1	Front	0.944	0.127	1.07		
		Back	1.214	0.733	1.95	0.04	#2
		Left Side	0.491	0.386	0.88		
		Right Side	0.199		0.20		
		Bottom Side	0.665		0.67		
LTE	Band 25	Front	0.613	0.127	0.74		
		Back	1.076	0.733	1.81	0.04	#3
		Left Side	0.399	0.386	0.79		
		Right Side	0.161		0.16		
		Bottom Side	0.429		0.43		

<WWAN PCE + Bluetooth DSS>

WWAN Band		Exposure Position	WWAN PCE	Bluetooth DSS	Summed SAR (W/kg)	SPLSR	Case No
			Max. WWAN 1g SAR (W/kg)	Estimated Bluetooth 1g SAR (W/kg)			
CDMA2000	BC10	Front	0.455	0.042	0.50		
		Back	0.838	0.042	0.88		
		Left Side	0.234	0.042	0.28		
		Right Side	0.474		0.47		
		Bottom Side	0.274		0.27		
	BC0	Front	0.595	0.042	0.64		
		Back	1.006	0.042	1.05		
		Left Side	0.194	0.042	0.24		
		Right Side	0.458		0.46		
		Bottom Side	0.358		0.36		
	BC1	Front	0.944	0.042	0.99		
		Back	1.214	0.042	1.26		
		Left Side	0.491	0.042	0.53		
		Right Side	0.199		0.20		
		Bottom Side	0.665		0.67		
LTE	Band 25	Front	0.613	0.042	0.66		
		Back	1.076	0.042	1.12		
		Left Side	0.399	0.042	0.44		
		Right Side	0.161		0.16		
		Bottom Side	0.429		0.43		

16.3 Body-Worn Accessory Exposure Conditions
<WWAN PCE + WLAN DTS>

WWAN Band		Exposure Position	WWAN PCE Max. WWAN 1g SAR (W/kg)	WLAN DTS Max. WLAN 1g SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
CDMA2000	BC10	Front	0.448	0.127	0.58		
		Back	0.874	0.733	1.61	0.03	#4
	BC0	Front	0.578	0.127	0.71		
		Back	1.062	0.733	1.80	0.03	#5
	BC1	Front	0.934	0.127	1.06		
		Back	1.182	0.733	1.92	0.04	#6
LTE	Band 25	Front	0.613	0.127	0.74		
		Back	1.076	0.733	1.81	0.04	#3

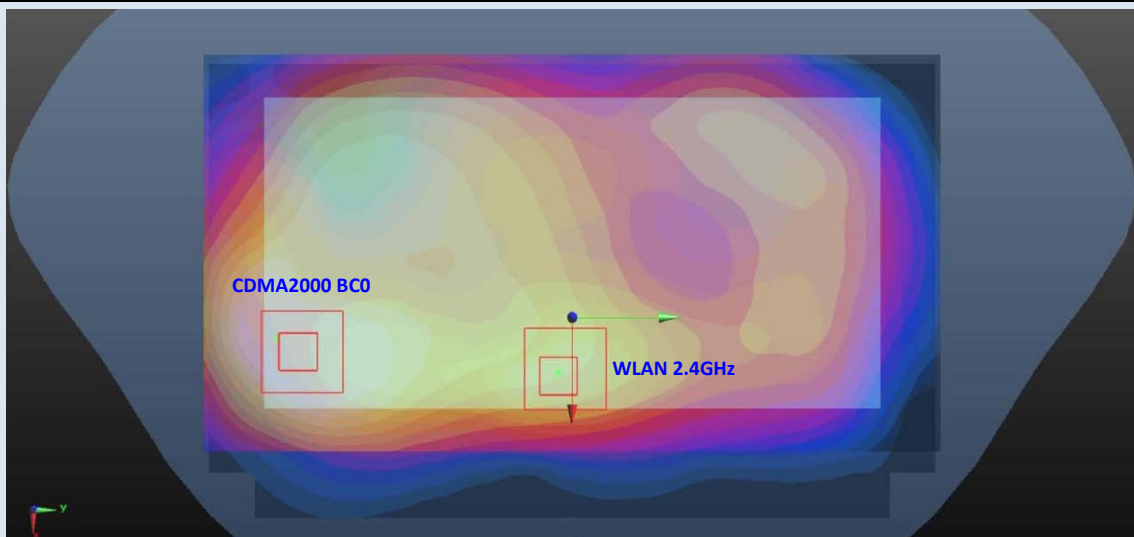
<WWAN PCE + Bluetooth DSS>

WWAN Band		Exposure Position	WWAN PCE Max. WWAN 1g SAR (W/kg)	Bluetooth DSS Estimated Bluetooth 1g SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
CDMA2000	BC10	Front	0.448	0.042	0.49		
		Back	0.874	0.042	0.92		
	BC0	Front	0.578	0.042	0.62		
		Back	1.062	0.042	1.10		
	BC1	Front	0.934	0.042	0.98		
		Back	1.182	0.042	1.22		
LTE	Band 25	Front	0.613	0.042	0.66		
		Back	1.076	0.042	1.12		

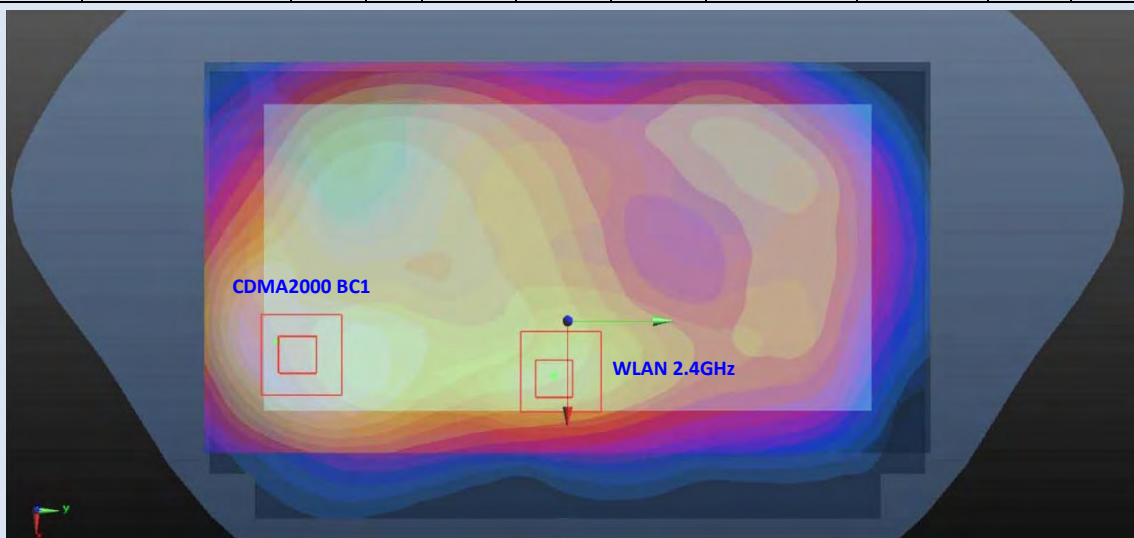
16.4 SPLSR Evaluation and Analysis

General Note: $SPLSR = (SAR_1 + SAR_2)^{1.5} / (\text{min. separation distance, mm})$. If $SPLSR \leq 0.04$, simultaneously transmission SAR measurement is not necessary.

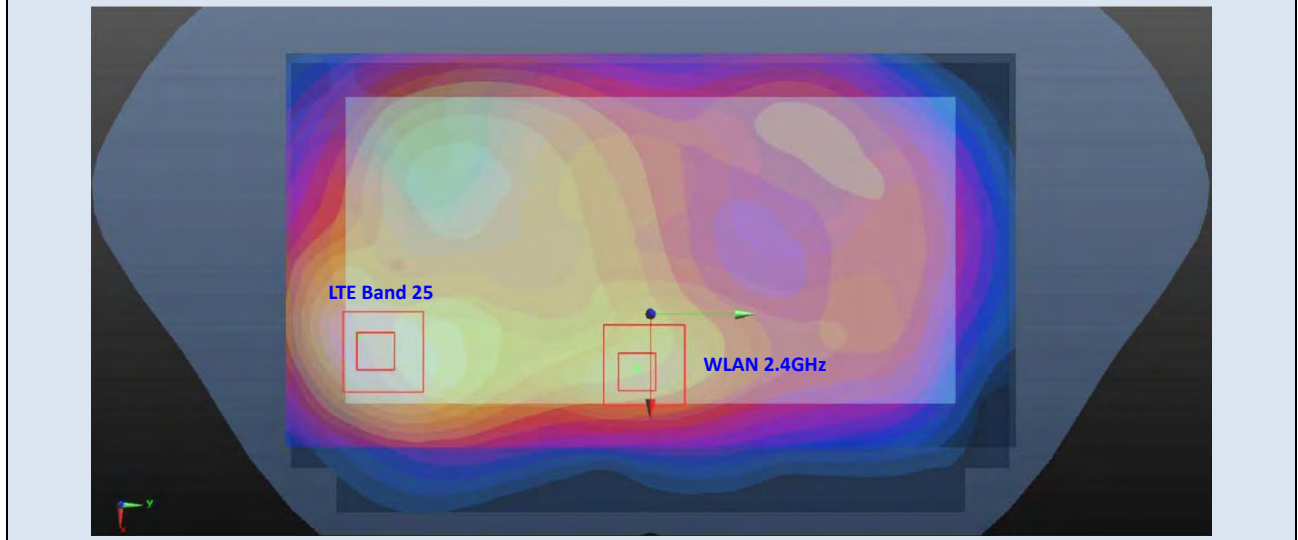
Case No #1	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
				X	Y	Z				
Back	CDMA2000 BC0	1.006	1	-0.001	-0.0785	-0.205	76.5	1.74	0.03	Not required
	WLAN 2.4GHz	0.733	1	0.0146	-0.0036	-0.205				



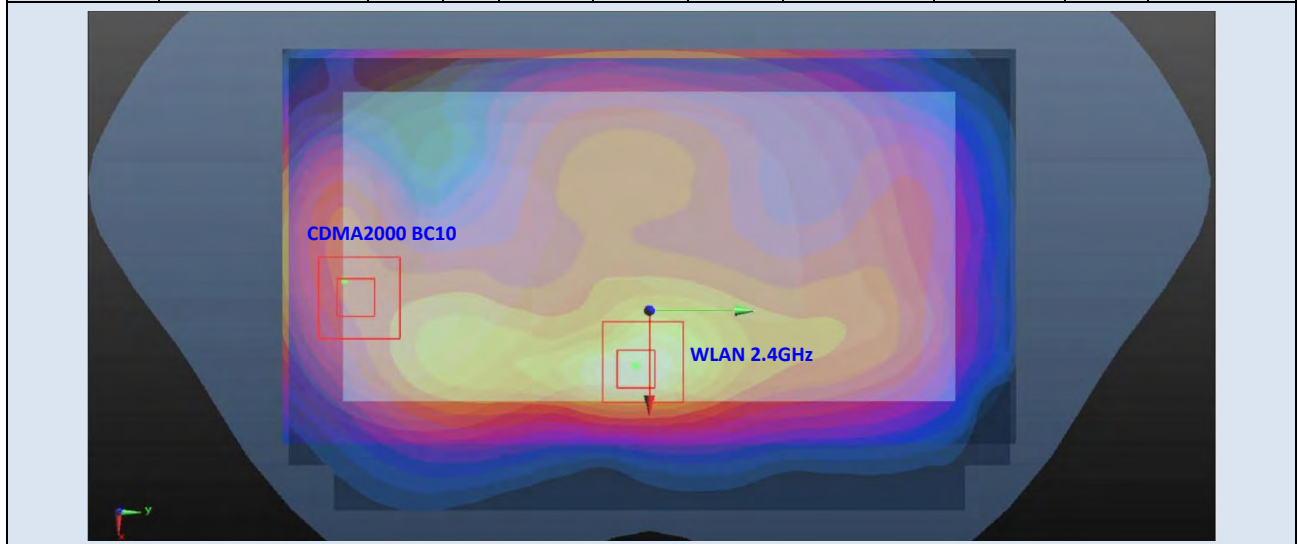
Case No #2	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
				X	Y	Z				
Back	CDMA2000 BC1	1.214	1	0.0125	-0.069	-0.205	65.4	1.95	0.04	Not required
	WLAN 2.4GHz	0.733	1	0.0146	-0.0036	-0.205				



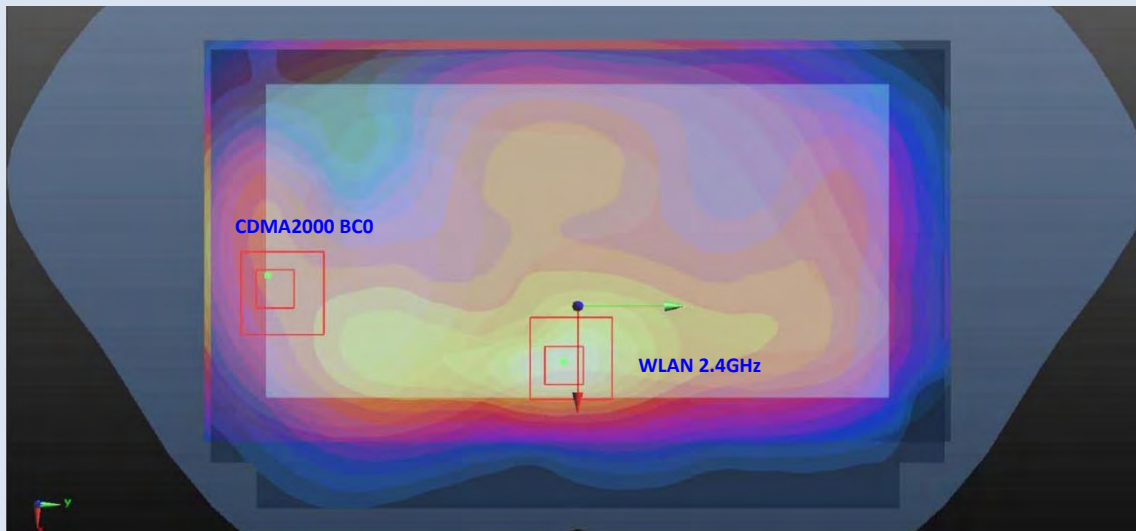
Case No #3	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
Position				X	Y	Z				
Back	LTE Band 25	1.076	1	0.0125	-0.069	-0.205	65.4	1.81	0.04	Not required
	WLAN 2.4GHz	0.733	1	0.0146	-0.0036	-0.205				



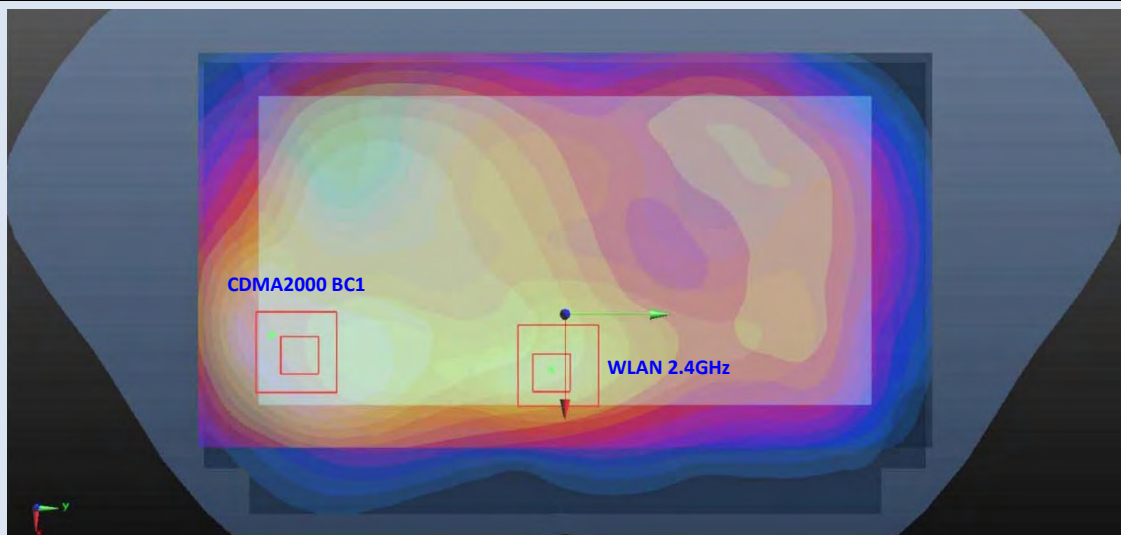
Case No #4	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
Position				X	Y	Z				
Back	CDMA2000 BC10	0.874	1	-0.009	-0.08	-0.205	80.0	1.61	0.03	Not required
	WLAN 2.4GHz	0.733	1	0.0146	-0.0036	-0.205				



Case No #5	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
				X	Y	Z				
Back	CDMA2000 BC0	1.062	1	-0.009	-0.08	-0.205	80.0	1.80	0.03	Not required
	WLAN 2.4GHz	0.733	1	0.0146	-0.0036	-0.205				



Case No #6	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
				X	Y	Z				
Back	CDMA2000 BC1	1.182	1	0.0125	-0.069	-0.205	65.4	1.92	0.04	Not required
	WLAN 2.4GHz	0.733	1	0.0146	-0.0036	-0.205				



Test Engineer : Kat Yin

17. Uncertainty Assessment

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

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

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

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor ^(a)	1/ κ ^(b)	1/ $\sqrt{3}$	1/ $\sqrt{6}$	1/ $\sqrt{2}$

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

(b) κ is the coverage factor

Table 17.1. Standard Uncertainty for Assumed Distribution

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

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

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

Table 17.2. Uncertainty Budget for frequency range 300 MHz to 3 GHz

18. References

- [1] FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations".
- [2] ANSI/IEEE Std. C95.1-1992, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", September 1992.
- [3] ANSI/IEEE C95.3-2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, New York: IEEE, December 2002.
- [4] IEEE Std. 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003.
- [5] SPEAG DASY System Handbook.
- [6] FCC KDB 865664 D01 v01r03 "SAR Measurement Requirements for 100 MHz to 6 GHz", February 2014.
- [7] FCC KDB 865664 D02 v01r01, "RF Exposure Compliance Reporting and Documentation Considerations", May 2013.
- [8] FCC KDB 447498 D01 v05r02 General RF Exposure Guidance "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", February 2014.
- [9] FCC KDB 648474 D04 v01r02, "SAR Evaluation Considerations for Wireless Handsets", December 2003.
- [10] FCC KDB 248227 D01 v02r01, "SAR Guidance for IEEE 802.11 (WiFi) Transmitters", June 2015.
- [11] FCC KDB 941225 D01 3G SAR Procedures v03, "3G SAR measurement procedures", October 2014.
- [12] FCC KDB 941225 D05 v02r03, "SAR Evaluation Considerations for LTE Devices", December 2003.
- [13] FCC KDB 941225 D06 v02, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", October 2014.



Appendix A. Plots of System Performance Check

The plots are shown as follows.

System Check_Head_835MHz_150605

DUT: D835V2 - SN: 4d091

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL_835_150605 Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.938 \text{ S/m}$; $\epsilon_r = 42.7$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.8°C ; Liquid Temperature : 22.3°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(9.62, 9.62, 9.62); Calibrated: 2014/10/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/4/28
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 3.02 W/kg

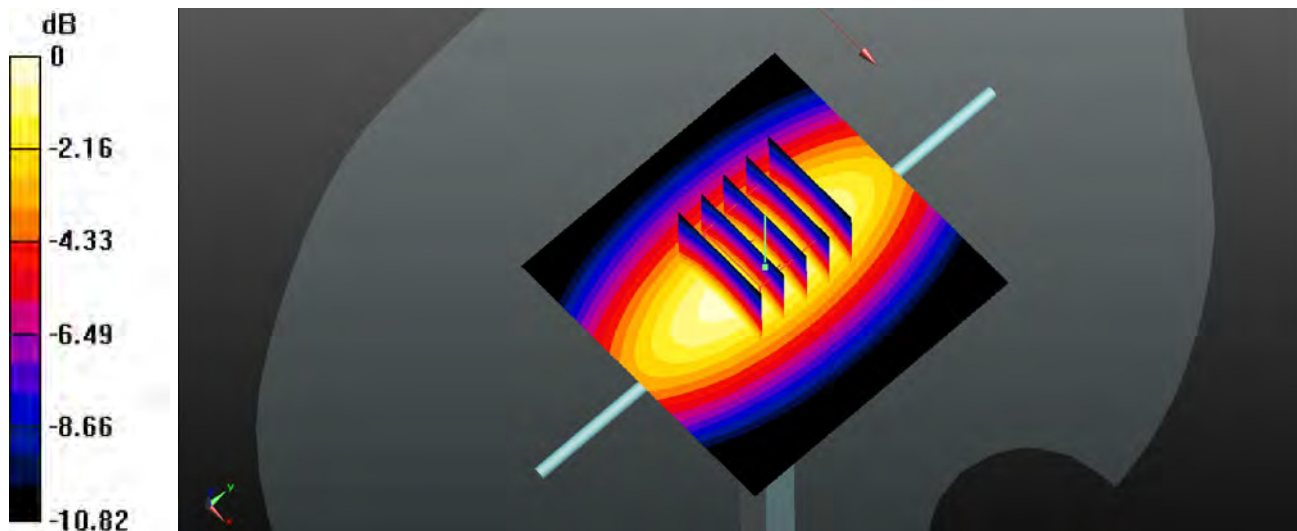
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 54.34 V/m ; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.57 W/kg

SAR(1 g) = 2.36 W/kg ; SAR(10 g) = 1.53 W/kg

Maximum value of SAR (measured) = 3.01 W/kg



0 dB = 3.01 W/kg

System Check_Head_1900MHz_150605

DUT: D1900V2 - SN: 5d118

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL_1900_150605 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.456$ S/m; $\epsilon_r = 40.84$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.95, 7.95, 7.95); Calibrated: 2014/10/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/4/28
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 14.8 W/kg

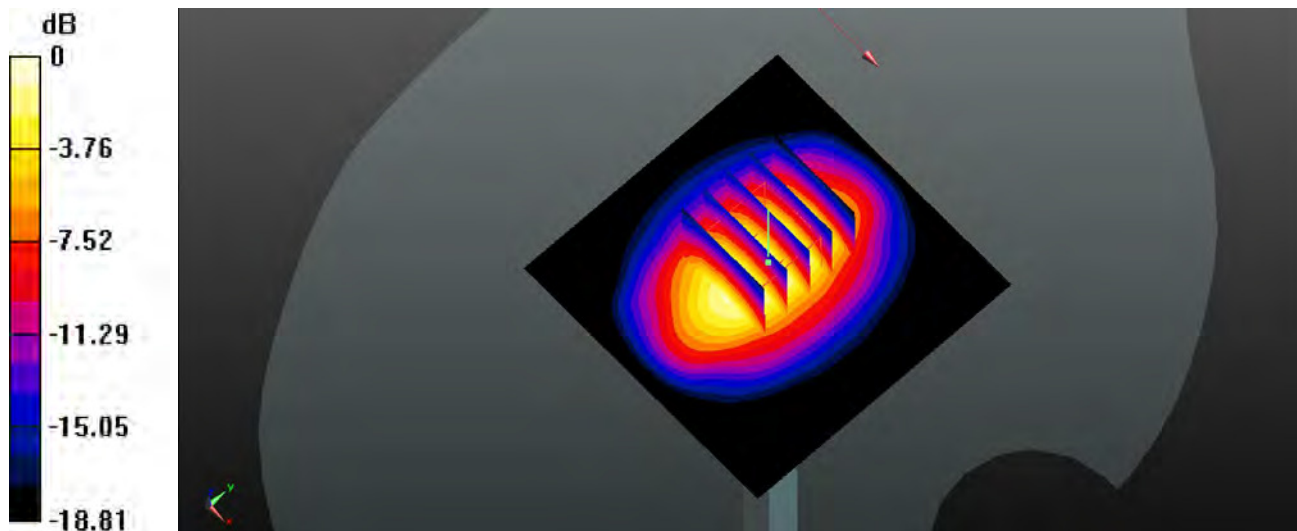
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 99.33 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 18.9 W/kg

SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.32 W/kg

Maximum value of SAR (measured) = 14.6 W/kg



0 dB = 14.6 W/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/6/11

System Check_Head_2450MHz_150611

DUT:

System Check_Body_835MHz_150604

DUT: D835V2 - SN: 4d091

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL_835_150604 Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.000 \text{ S/m}$; $\epsilon_r = 55.514$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.7°C ; Liquid Temperature : 22.3°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(9.66, 9.66, 9.66); Calibrated: 2014/10/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/4/28
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 3.10 W/kg

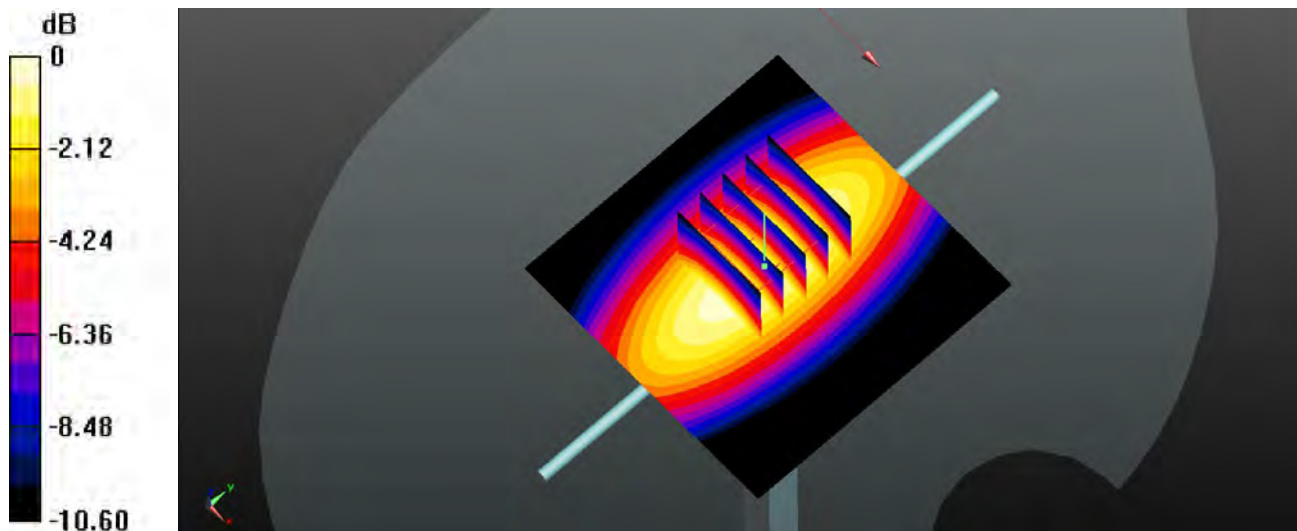
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 50.44 V/m ; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.65 W/kg

SAR(1 g) = 2.43 W/kg ; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 3.08 W/kg



0 dB = 3.08 W/kg

System Check_Body_1900MHz_150528

DUT: D1900V2 - SN: 5d118

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL_1900_150528 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.527$ S/m; $\epsilon_r = 55.253$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.57, 7.57, 7.57); Calibrated: 2014/10/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/4/28
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 14.2 W/kg

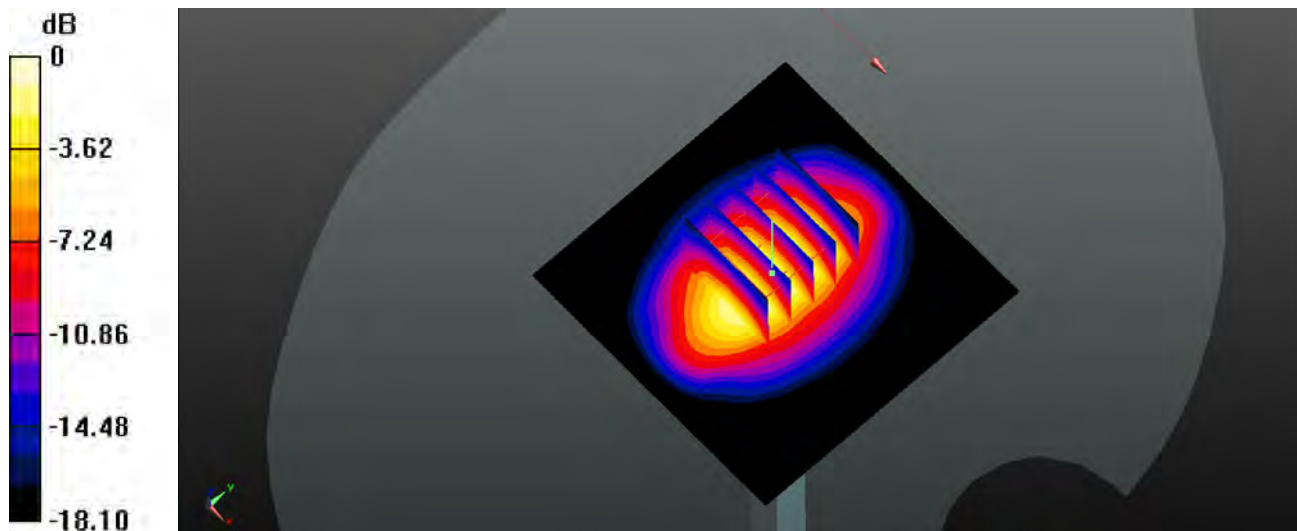
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 84.98 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 18.1 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.24 W/kg

Maximum value of SAR (measured) = 14.2 W/kg



0 dB = 14.2 W/kg

System Check_Body_2450MHz_150611

DUT: D2450V2 - SN: 840

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL_2450_150611 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.921$ S/m; $\epsilon_r = 51.188$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.18, 7.18, 7.18); Calibrated: 2014/10/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/4/28
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 18.1 W/kg

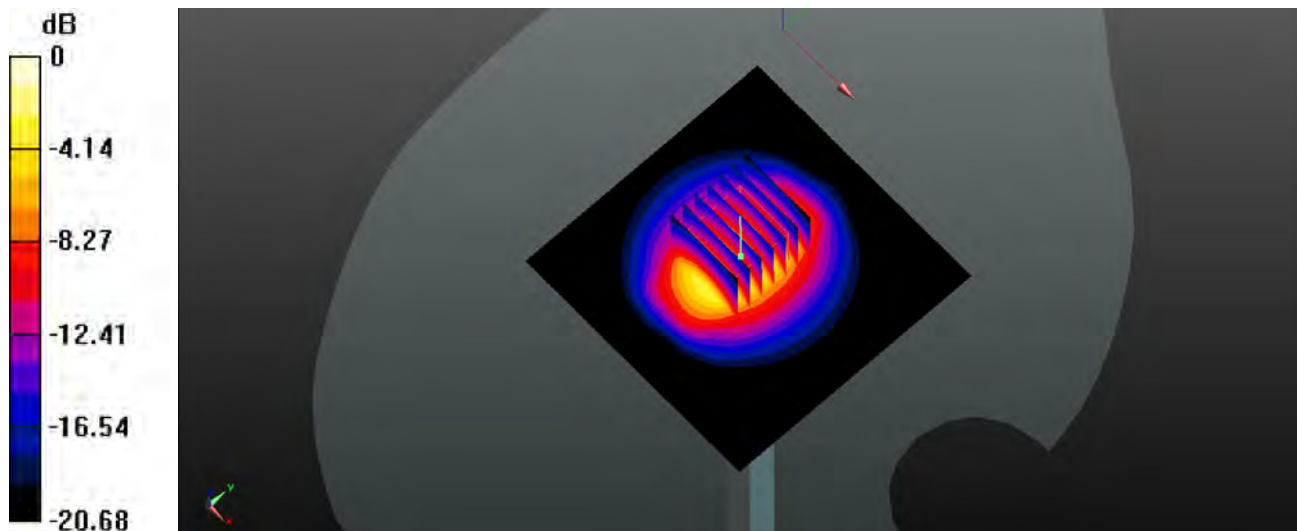
Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 78.19 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 24.4 W/kg

SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.66 W/kg

Maximum value of SAR (measured) = 18.2 W/kg



0 dB = 18.2 W/kg



Appendix B. Plots of High SAR Measurement

The plots are shown as follows.

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/6/5

#02 CDMA2000 BC0_RC3 SO55_Right Cheek_Ch384

Communication System: UID 0, CDMA2000 (0); Frequency: 836.52 MHz; Duty Cycle: 1:1
Medium: HSL_835_150605 Medium parameters used: $f = 836.52$ MHz; $\sigma = 0.939$ S/m; $\epsilon_r = 42.687$; $\rho = 1000$ kg/m³
Ambient Temperature : 23.8 °C; Liquid Temperature : 22.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(9.62, 9.62, 9.62); Calibrated: 2014/10/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/4/28
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch384/Area Scan (71x131x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.579 W/kg

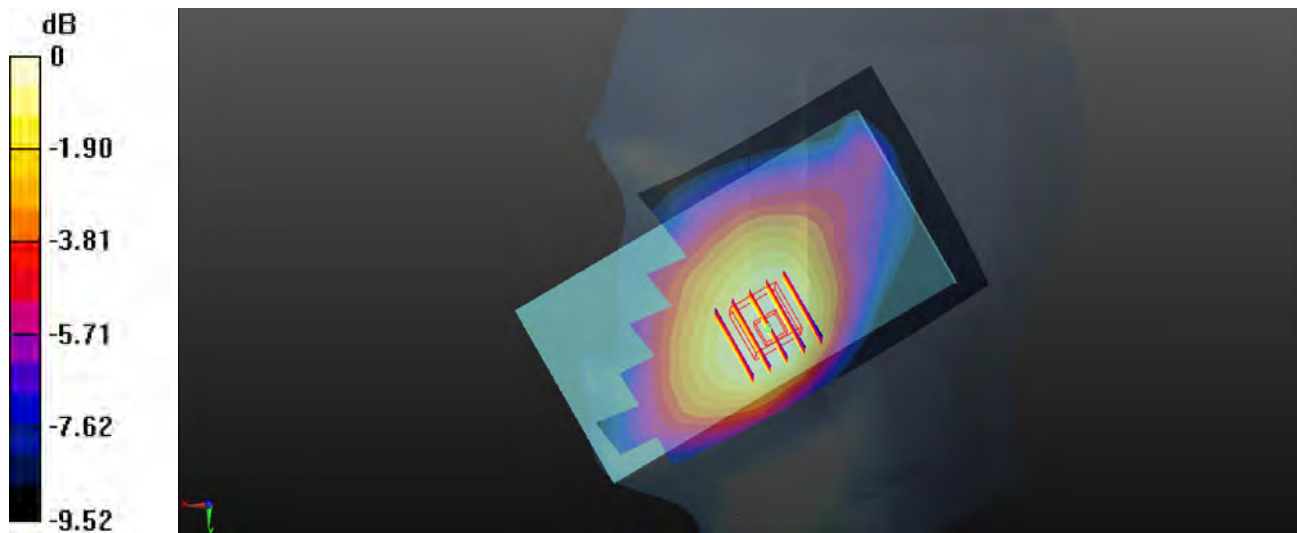
Ch384/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 10.43 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.617 W/kg

SAR(1 g) = 0.492 W/kg; SAR(10 g) = 0.377 W/kg

Maximum value of SAR (measured) = 0.561 W/kg



0 dB = 0.561 W/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/6/5

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/6/5

#05 WLAN 2.4GHz_802.11b_1Mbps_Left Cheek_Ch1

Communication System: UID 0, 802.11b (0); Frequency: 2412 MHz; Duty Cycle: 1:1.024

Medium: HSL_2450_150611 Medium parameters used: $f = 2412$ MHz; $\sigma = 1.815$ S/m; $\epsilon_r = 37.875$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.8 °C; Liquid Temperature : 22.4 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.05, 7.05, 7.05); Calibrated: 2014/10/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/4/28
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1/Area Scan (91x161x1): Interpolated grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 0.410 W/kg

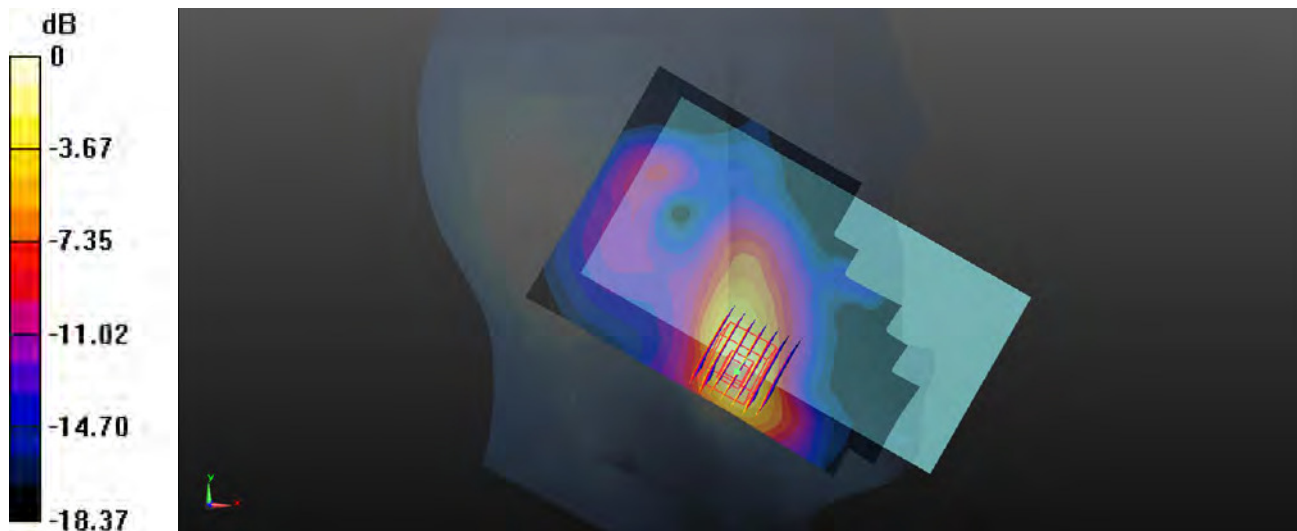
Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 4.489 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 0.575 W/kg

SAR(1 g) = 0.291 W/kg; SAR(10 g) = 0.143 W/kg

Maximum value of SAR (measured) = 0.430 W/kg



0 dB = 0.430 W/kg

#06 CDMA2000 BC10_RTAP 153.6kbps_Back_1.0cm_Ch580

Communication System: UID 0, CDMA2000 (0); Frequency: 820.5 MHz; Duty Cycle: 1:1

Medium: MSL_835_150604 Medium parameters used: $f = 820.5$ MHz; $\sigma = 0.986$ S/m; $\epsilon_r = 55.604$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.7 °C; Liquid Temperature : 22.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(9.66, 9.66, 9.66); Calibrated: 2014/10/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/4/28
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch580/Area Scan (71x131x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.06 W/kg

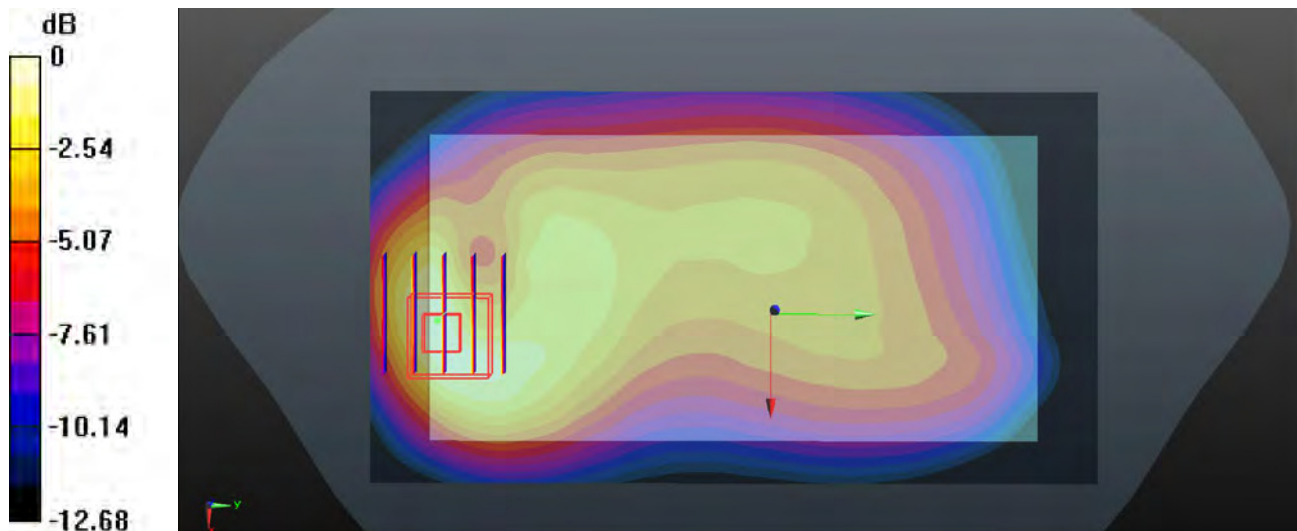
Ch580/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 20.56 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 1.37 W/kg

SAR(1 g) = 0.808 W/kg; SAR(10 g) = 0.478 W/kg

Maximum value of SAR (measured) = 1.08 W/kg



0 dB = 1.08 W/kg

#07 CDMA2000 BC0_RTAP 153.6kbps_Back_1.0cm_Ch384

Communication System: UID 0, CDMA2000 (0); Frequency: 836.52 MHz; Duty Cycle: 1:1
 Medium: MSL_835_150604 Medium parameters used: $f = 836.52 \text{ MHz}$; $\sigma = 1.002 \text{ S/m}$; $\epsilon_r = 55.503$; $\rho = 1000 \text{ kg/m}^3$
 Ambient Temperature : 23.7°C ; Liquid Temperature : 22.3°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(9.66, 9.66, 9.66); Calibrated: 2014/10/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/4/28
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch384/Area Scan (71x131x1): Interpolated grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 1.29 W/kg

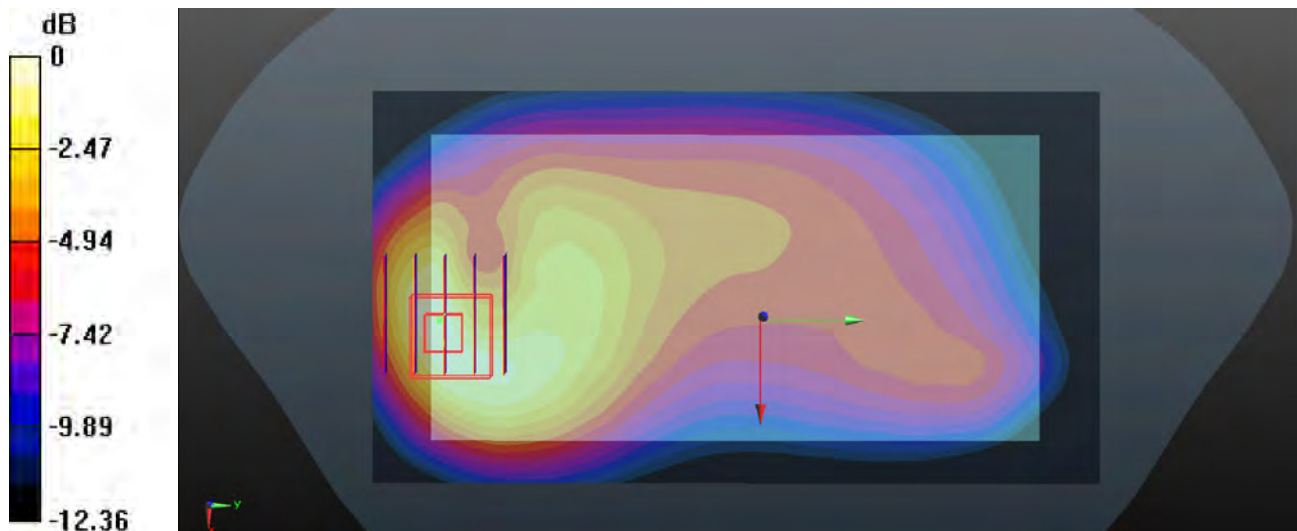
Ch384/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 18.76 V/m ; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 1.65 W/kg

SAR(1 g) = 0.990 W/kg ; SAR(10 g) = 0.590 W/kg

Maximum value of SAR (measured) = 1.31 W/kg



0 dB = 1.31 W/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/5/28

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/5/28

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/5/28

#10 WLAN 2.4GHz_802.11b_1Mbps_Back_1.0cm_Ch1

Communication System: UID 0, 802.11b (0); Frequency: 2412 MHz; Duty Cycle: 1:1.024

Medium: MSL_2450_150611 Medium parameters used: $f = 2412$ MHz; $\sigma = 1.873$ S/m; $\epsilon_r = 51.322$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.18, 7.18, 7.18); Calibrated: 2014/10/2;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/4/28
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1/Area Scan (101x161x1): Interpolated grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 1.01 W/kg

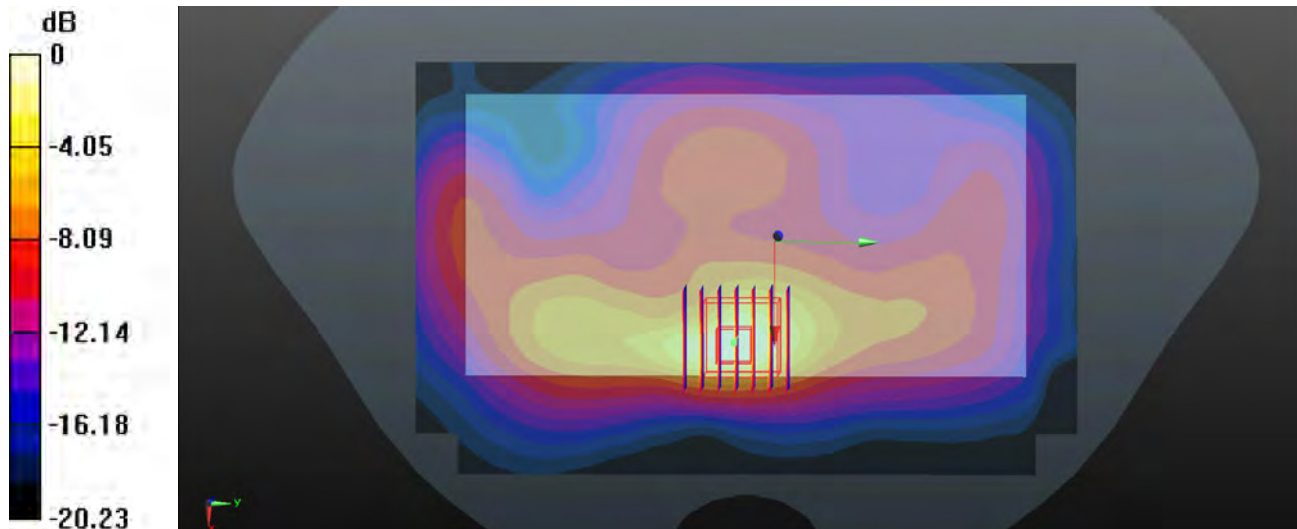
Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.016 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 1.38 W/kg

SAR(1 g) = 0.670 W/kg; SAR(10 g) = 0.312 W/kg

Maximum value of SAR (measured) = 1.03 W/kg



0 dB = 1.03 W/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/5/28

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/6/4

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/6/4

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/5/28

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2015/5/28



Appendix C. DASYS Calibration Certificate

The DASYS calibration certificates are shown as follows.



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

Accreditation No.: **SCS 108**

Client **Sporton-CN (Auden)**

Certificate No: **D835V2-4d091_Nov14**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d091**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **November 21, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Name** Michael Weber **Function** Laboratory Technician

Signature

Approved by: **Name** Katja Pokovic **Function** Technical Manager

Issued: November 21, 2014

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

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:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.2 $\pm$ 6 %	0.91 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.11 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.50 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.95 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.5 $\pm$ 6 %	1.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.48 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.60 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.31 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω - 1.8 j Ω
Return Loss	- 32.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.7 Ω - 4.2 j Ω
Return Loss	- 25.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.394 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	September 15, 2009

DASY5 Validation Report for Head TSL

Date: 19.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d091

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.91 \text{ S/m}$; $\epsilon_r = 41.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.22, 6.22, 6.22); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

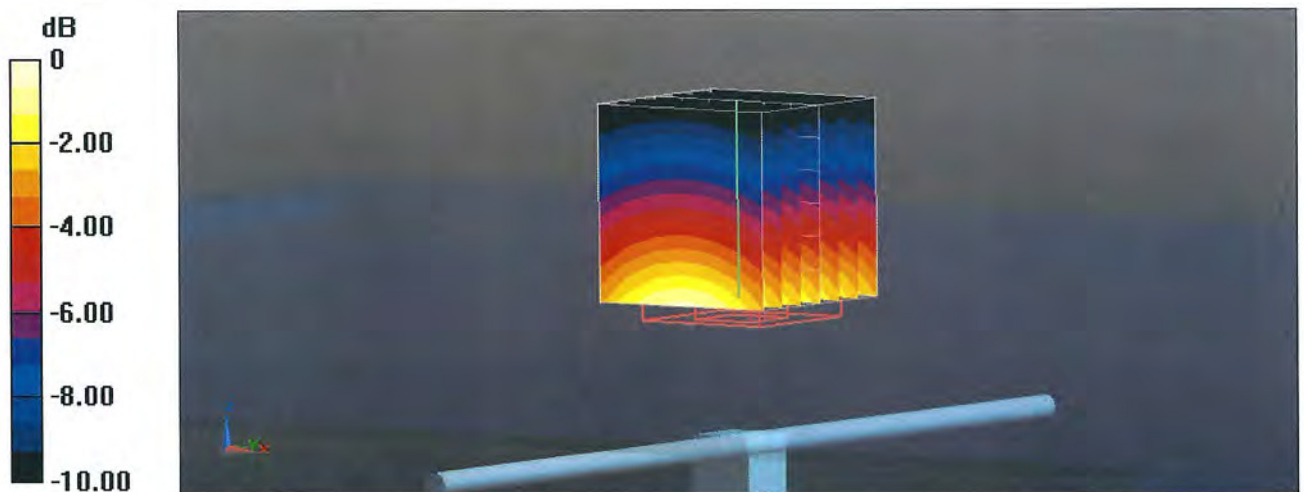
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 56.46 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.43 W/kg

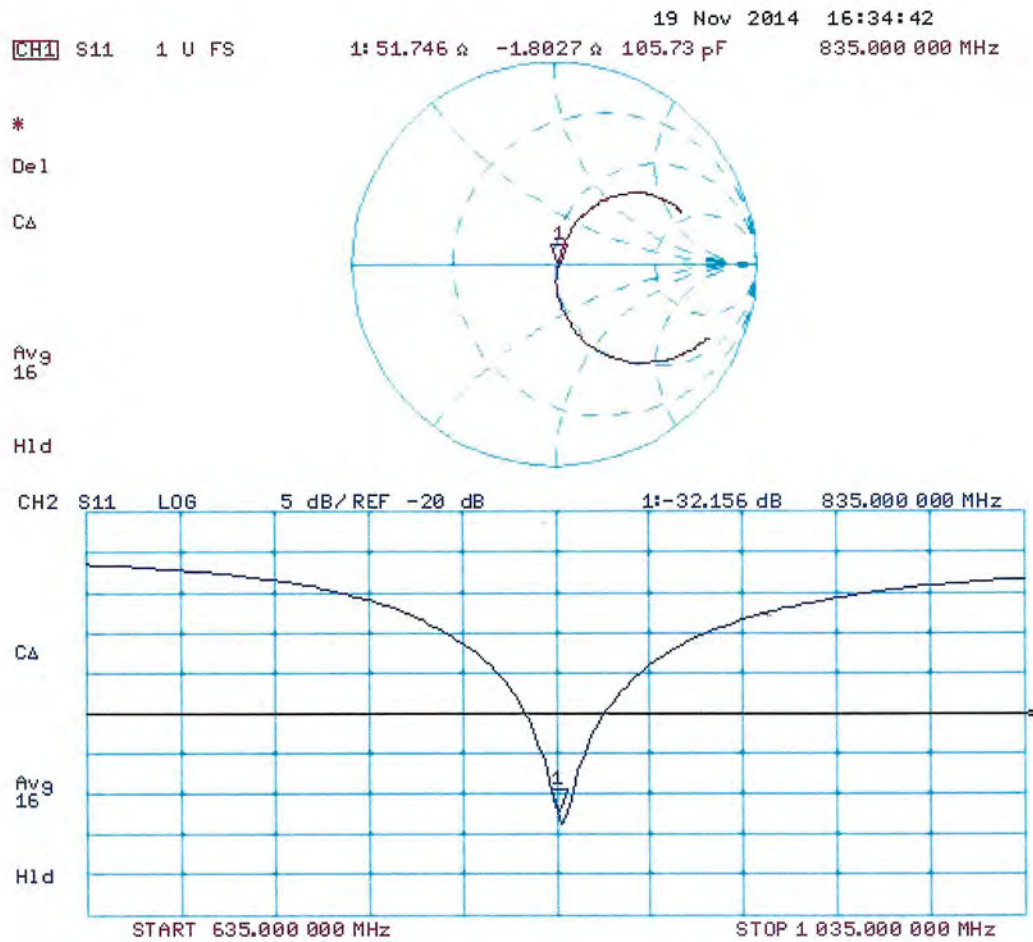
SAR(1 g) = 2.3 W/kg; SAR(10 g) = 1.5 W/kg

Maximum value of SAR (measured) = 2.69 W/kg



0 dB = 2.69 W/kg = 4.30 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 21.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d091

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.01 \text{ S/m}$; $\epsilon_r = 54.5$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

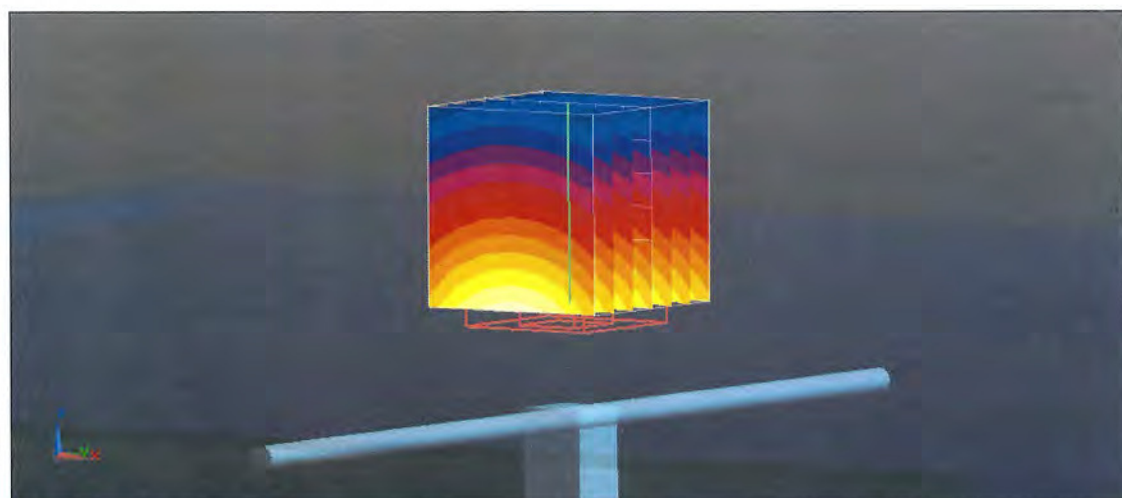
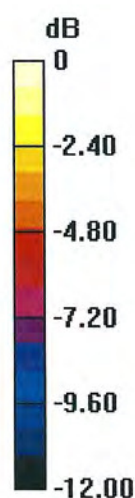
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 55.36 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.64 W/kg

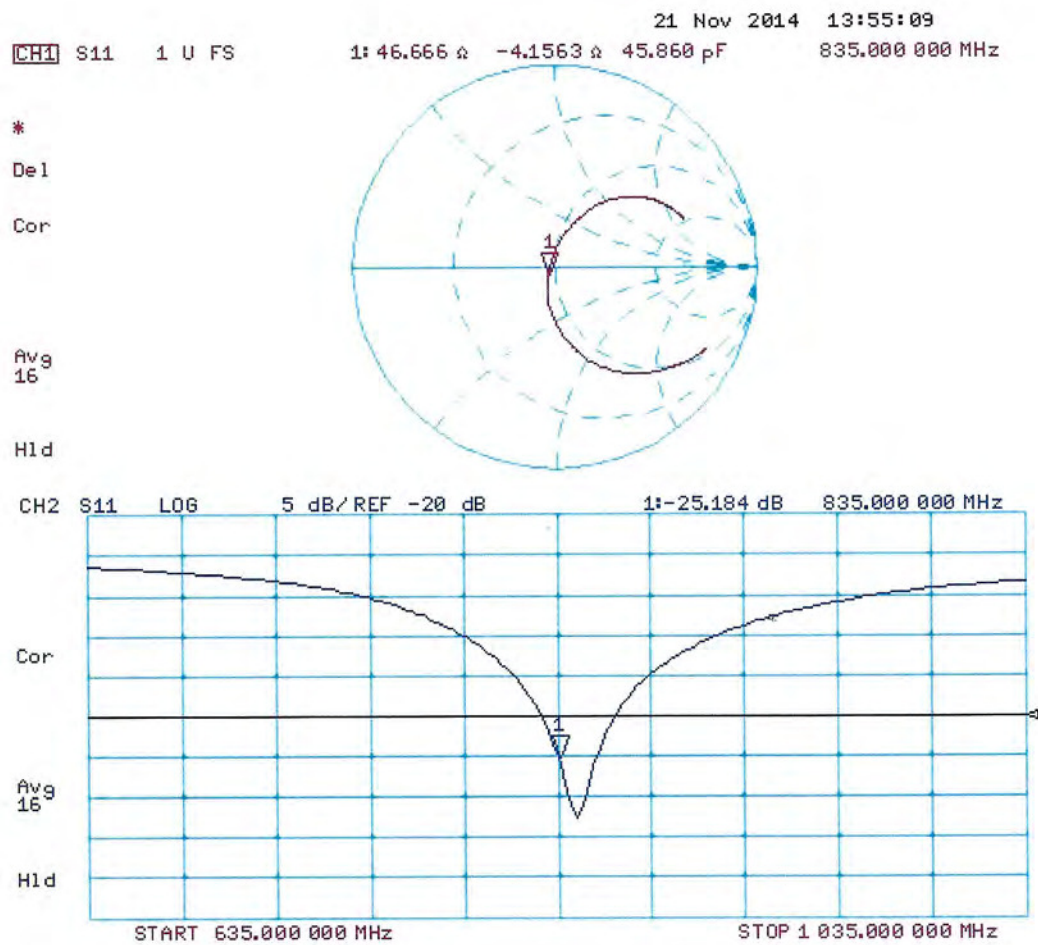
SAR(1 g) = 2.48 W/kg; SAR(10 g) = 1.62 W/kg

Maximum value of SAR (measured) = 2.89 W/kg



0 dB = 2.89 W/kg = 4.61 dBW/kg

Impedance Measurement Plot for Body TSL





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

Accreditation No.: **SCS 108**

Client **Sporton-CN (Auden)**

Certificate No: **D1900V2-5d118_Nov14**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d118**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **November 21, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Name** Michael Weber **Function** Laboratory Technician

Signature

Approved by: **Name** Katja Pokovic **Function** Technical Manager

Issued: November 21, 2014

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
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 $\pm$ 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 $\pm$ 0.2) °C	40.1 $\pm$ 6 %	1.39 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.97 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.0 W/kg $\pm$ 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 $\pm$ 0.2) °C	53.3 $\pm$ 6 %	1.52 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.0 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.34 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.4 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.3 \Omega + 6.8 j\Omega$
Return Loss	- 23.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$47.5 \Omega + 7.1 j\Omega$
Return Loss	- 22.3 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	August 21, 2009

DASY5 Validation Report for Head TSL

Date: 21.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d118

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.39$ S/m; $\epsilon_r = 40.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

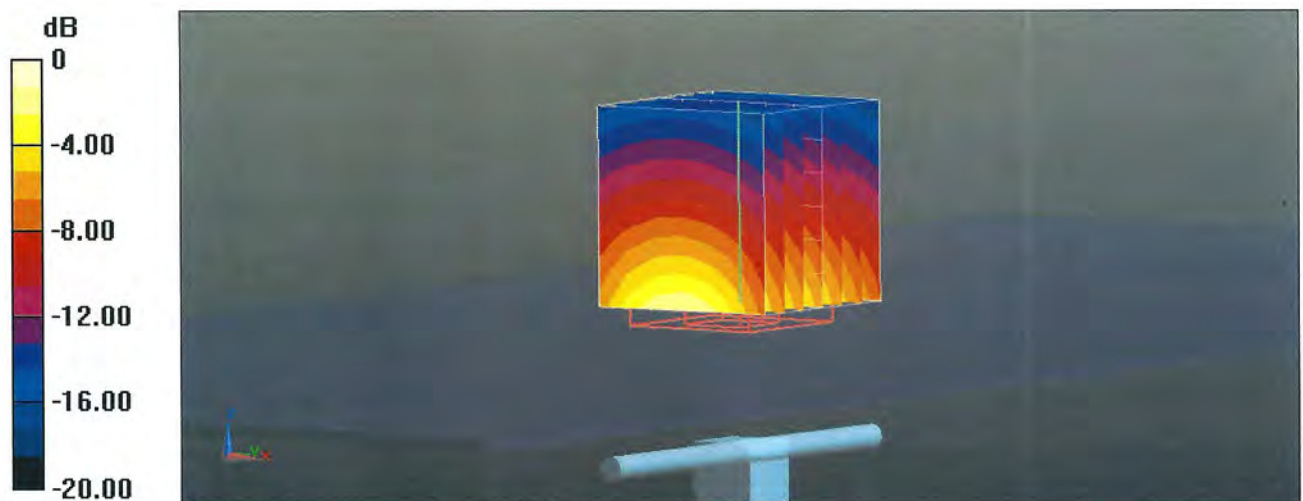
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.04 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 18.2 W/kg

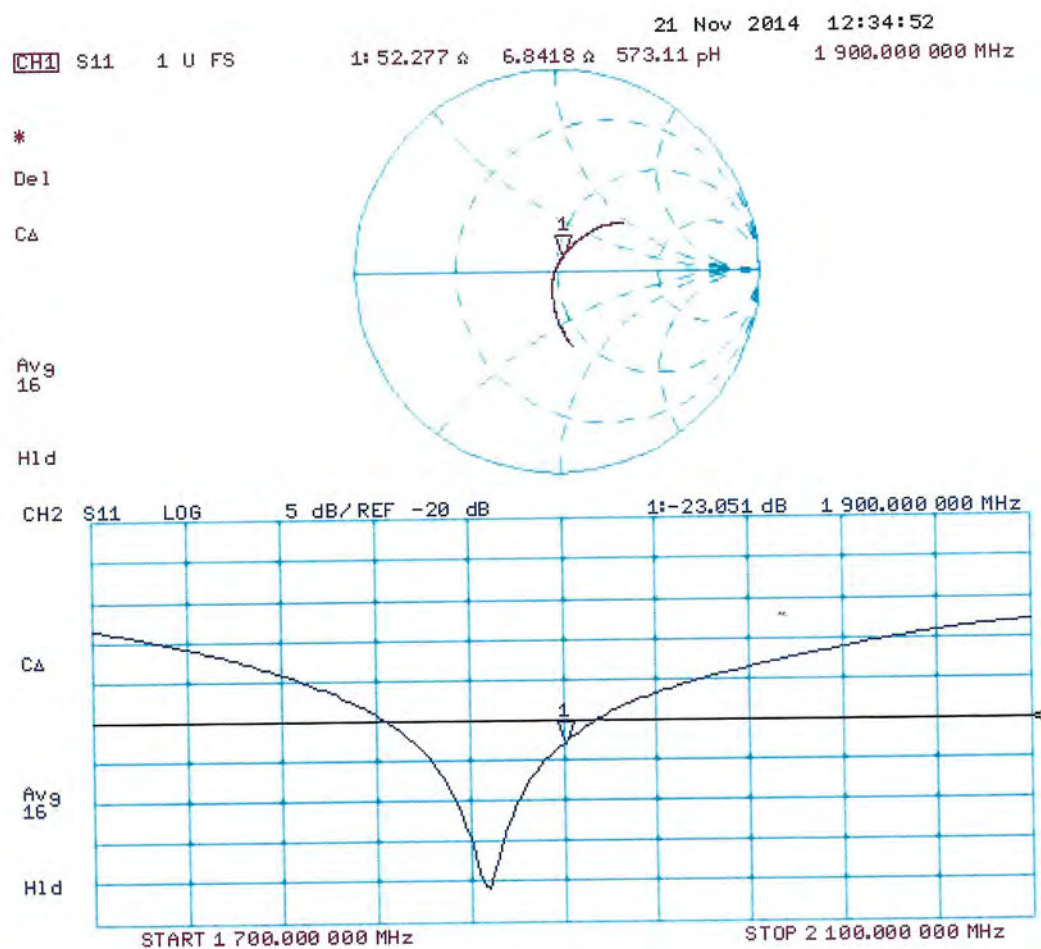
SAR(1 g) = 9.97 W/kg; SAR(10 g) = 5.24 W/kg

Maximum value of SAR (measured) = 12.6 W/kg



0 dB = 12.6 W/kg = 11.00 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 21.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d118

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.52$ S/m; $\epsilon_r = 53.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

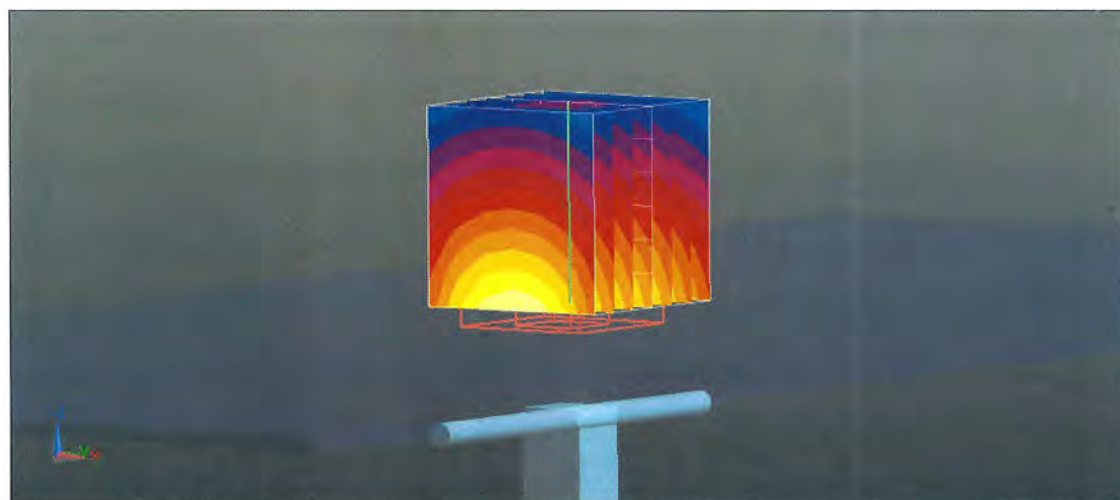
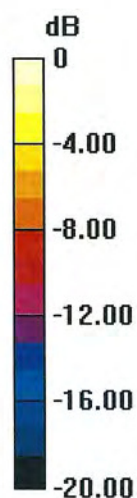
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.09 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.5 W/kg

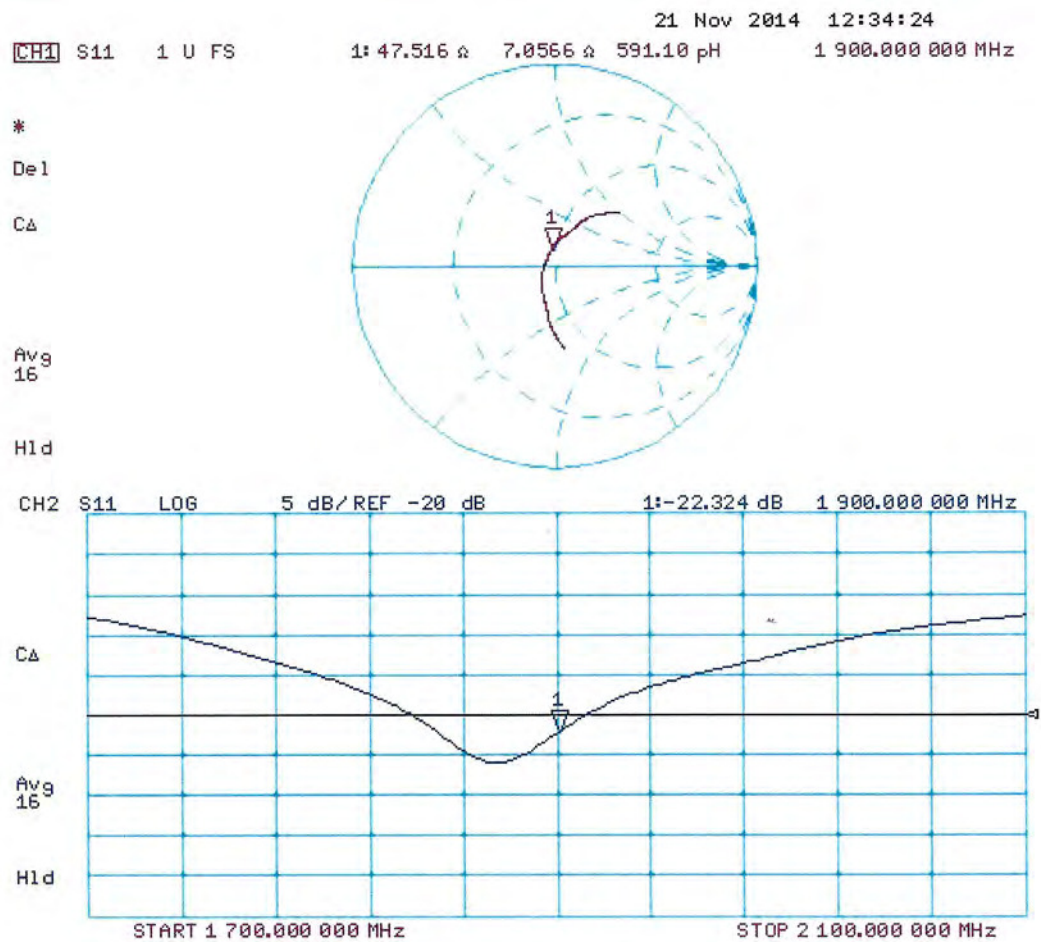
SAR(1 g) = 10 W/kg; SAR(10 g) = 5.34 W/kg

Maximum value of SAR (measured) = 12.7 W/kg



0 dB = 12.7 W/kg = 11.04 dBW/kg

Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 108**

Client **Sporton-CN (Auden)**

Certificate No: **D2450V2-840_Nov14**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 840**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **November 19, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: November 20, 2014

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
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 $\pm$ 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 $\pm$ 0.2) °C	39.0 $\pm$ 6 %	1.86 mho/m $\pm$ 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	52.3 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.6 W/kg $\pm$ 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 $\pm$ 0.2) °C	50.9 $\pm$ 6 %	2.03 mho/m $\pm$ 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	13.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.0 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.00 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.6 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$54.7 \Omega + 2.8 j\Omega$
Return Loss	- 25.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.9 \Omega + 4.4 j\Omega$
Return Loss	- 27.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.162 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	July 20, 2009

DASY5 Validation Report for Head TSL

Date: 19.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 840

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.86$ S/m; $\epsilon_r = 39$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

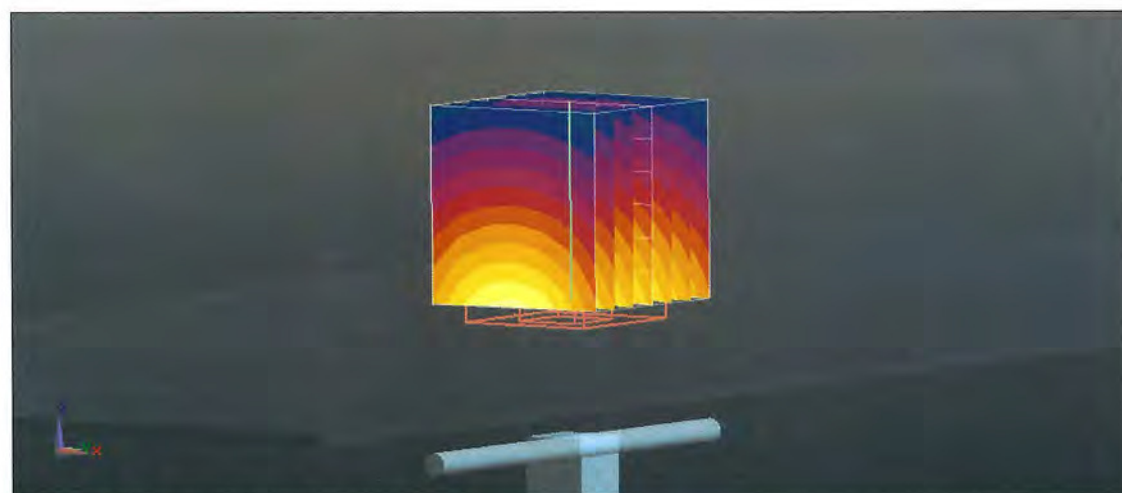
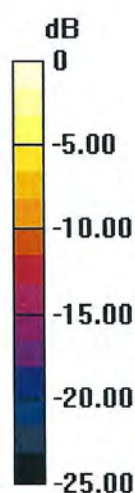
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.9 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 27.3 W/kg

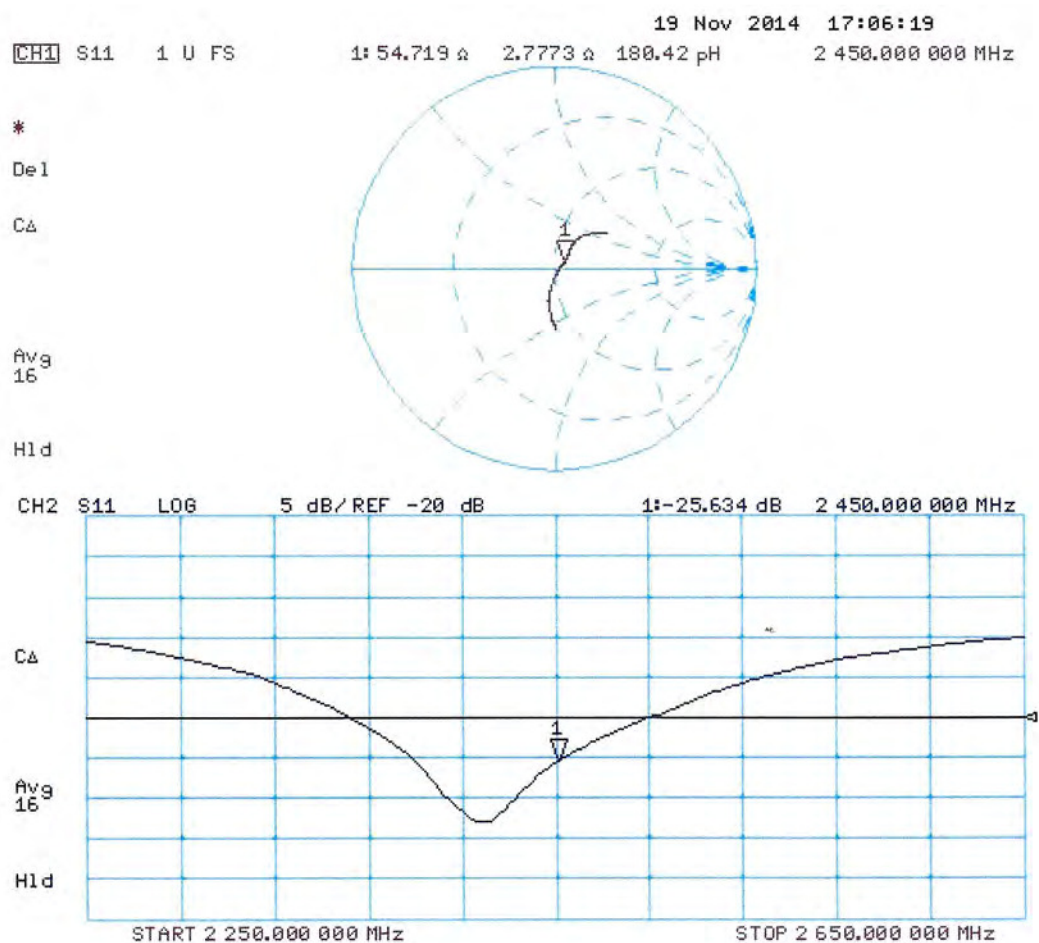
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.21 W/kg

Maximum value of SAR (measured) = 17.5 W/kg



0 dB = 17.5 W/kg = 12.43 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 840

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 50.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

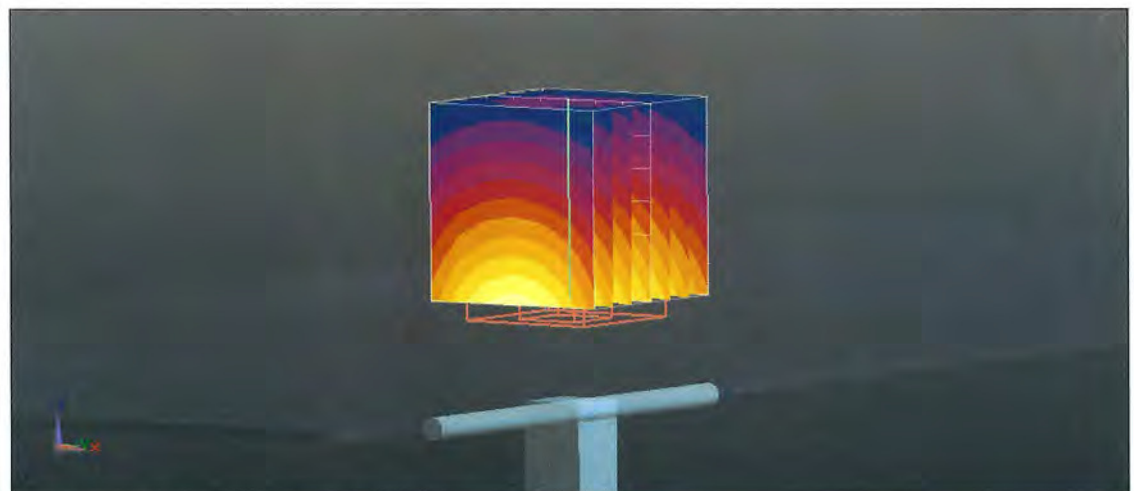
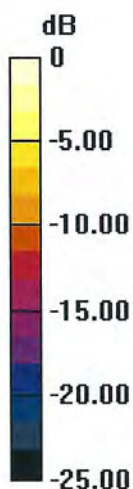
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.80 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 27.6 W/kg

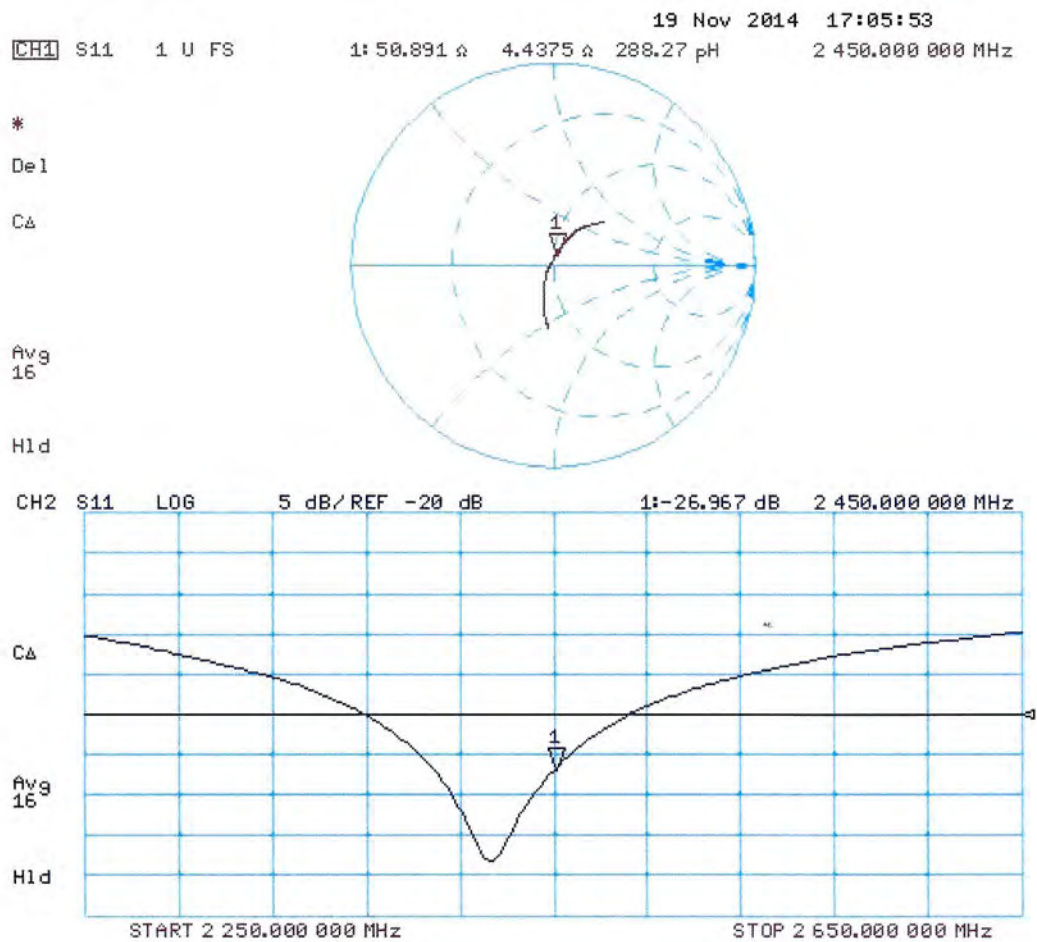
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6 W/kg

Maximum value of SAR (measured) = 17.3 W/kg



0 dB = 17.3 W/kg = 12.38 dBW/kg

Impedance Measurement Plot for Body TSL



IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:

Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:

Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:

To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.



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Accreditation No.: SCS 0108

Client Sporton CN (Auden)

Certificate No: DAE4-1358_Apr15

CALIBRATION CERTIFICATE

Object DAE4 - SD 000 D04 BM - SN: 1358

Calibration procedure(s) QA CAL-06.v29
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: April 28, 2015

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
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-14 (No:15573)	Oct-15
Secondary Standards	ID #	Check Date (In house)	Scheduled Check
Auto DAE Calibration Unit Calibrator Box V2.1	SE UWS 053 AA 1001	06-Jan-15 (In house check)	In house check: Jan-16
	SE UMS 006 AA 1002	06-Jan-15 (In house check)	In house check: Jan-16

Calibrated by: Name R. Mayoraz Function Technician

Signature

Approved by: Fin Bornholt Deputy Technical Manager

Issued: April 28, 2015

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Accreditation No.: **SCS 0108**

Glossary

DAE data acquisition electronics
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- **DC Voltage Measurement:** Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- **Connector angle:** The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
 - **DC Voltage Measurement Linearity:** Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
 - **Common mode sensitivity:** Influence of a positive or negative common mode voltage on the differential measurement.
 - **Channel separation:** Influence of a voltage on the neighbor channels not subject to an input voltage.
 - **AD Converter Values with inputs shorted:** Values on the internal AD converter corresponding to zero input voltage
 - **Input Offset Measurement:** Output voltage and statistical results over a large number of zero voltage measurements.
 - **Input Offset Current:** Typical value for information; Maximum channel input offset current, not considering the input resistance.
 - **Input resistance:** Typical value for information; DAE input resistance at the connector, during internal auto-zeroing and during measurement.
 - **Low Battery Alarm Voltage:** Typical value for information. Below this voltage, a battery alarm signal is generated.
 - **Power consumption:** Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V, full range = -100...+300 mV
Low Range: 1LSB = 61nV, full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.483 $\pm$ 0.02% (k=2)	403.518 $\pm$ 0.02% (k=2)	403.518 $\pm$ 0.02% (k=2)
Low Range	3.96161 $\pm$ 1.50% (k=2)	3.98846 $\pm$ 1.50% (k=2)	3.99209 $\pm$ 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	136.0 $^{\circ}$ $\pm$ 1 $^{\circ}$
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Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	199994.26	0.19	0.00
Channel X + Input	20001.61	1.85	0.01
Channel X - Input	-19999.78	2.01	-0.01
Channel Y + Input	199995.03	0.73	0.00
Channel Y + Input	19996.49	-3.43	-0.02
Channel Y - Input	-20003.21	-1.32	0.01
Channel Z + Input	199996.71	2.48	0.00
Channel Z + Input	20001.26	1.31	0.01
Channel Z - Input	-20002.05	-0.22	0.00

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	1999.91	0.13	0.01
Channel X + Input	201.31	1.19	0.59
Channel X - Input	-199.69	0.03	-0.02
Channel Y + Input	1999.53	-0.30	-0.01
Channel Y + Input	199.29	-0.81	-0.40
Channel Y - Input	-200.90	-1.13	0.57
Channel Z + Input	1999.62	-0.16	-0.01
Channel Z + Input	199.39	-0.68	-0.34
Channel Z - Input	-200.48	-0.73	0.37

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	23.04	21.59
	- 200	-20.28	-21.73
Channel Y	200	-27.94	-27.90
	- 200	26.04	25.76
Channel Z	200	-11.37	-11.39
	- 200	10.05	10.04

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	2.06	-3.29
Channel Y	200	9.41	-	3.82
Channel Z	200	10.45	5.44	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15573	16145
Channel Y	16047	15196
Channel Z	16064	15449

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	0.95	0.01	1.94	0.34
Channel Y	0.52	-0.73	2.21	0.53
Channel Z	0.85	-0.34	2.15	0.50

6. Input Offset Current

Nominal input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton-CN (Auden)**

Certificate No: **EX3-3911_Oct14**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3911**

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

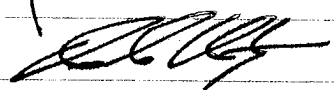
Calibration date: **October 2, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: October 2, 2014

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe EX3DV4

SN:3911

Manufactured:	September 4, 2012
Repaired:	September 26, 2014
Calibrated:	October 2, 2014

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3911

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.32	0.42	0.49	$\pm 10.1 \%$
DCP (mV) ^B	102.9	96.3	97.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	145.4	$\pm 2.5 \%$
		Y	0.0	0.0	1.0		141.8	
		Z	0.0	0.0	1.0		136.8	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3911

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	9.89	9.89	9.89	0.48	0.76	± 12.0 %
835	41.5	0.90	9.62	9.62	9.62	0.55	0.70	± 12.0 %
900	41.5	0.97	9.38	9.38	9.38	0.23	1.18	± 12.0 %
1750	40.1	1.37	8.18	8.18	8.18	0.26	1.01	± 12.0 %
1900	40.0	1.40	7.95	7.95	7.95	0.27	1.01	± 12.0 %
2000	40.0	1.40	7.92	7.92	7.92	0.34	0.88	± 12.0 %
2300	39.5	1.67	7.53	7.53	7.53	0.44	0.73	± 12.0 %
2450	39.2	1.80	7.05	7.05	7.05	0.31	0.92	± 12.0 %
2600	39.0	1.96	6.92	6.92	6.92	0.36	0.92	± 12.0 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

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

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3911

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	9.61	9.61	9.61	0.20	1.44	± 12.0 %
835	55.2	0.97	9.66	9.66	9.66	0.61	0.65	± 12.0 %
900	55.0	1.05	9.36	9.36	9.36	0.32	1.07	± 12.0 %
1750	53.4	1.49	7.93	7.93	7.93	0.70	0.66	± 12.0 %
1900	53.3	1.52	7.57	7.57	7.57	0.31	0.98	± 12.0 %
2000	53.3	1.52	7.76	7.76	7.76	0.35	0.92	± 12.0 %
2300	52.9	1.81	7.39	7.39	7.39	0.41	0.88	± 12.0 %
2450	52.7	1.95	7.18	7.18	7.18	0.72	0.61	± 12.0 %
2600	52.5	2.16	7.03	7.03	7.03	0.80	0.50	± 12.0 %

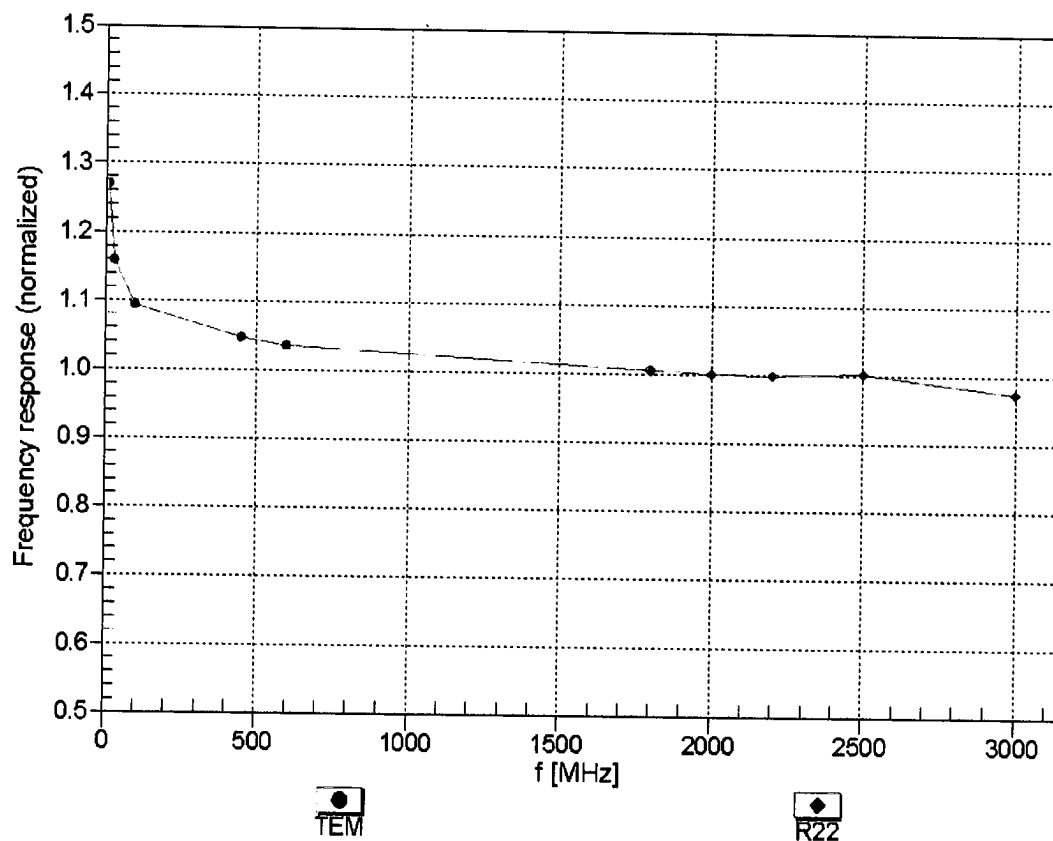
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

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^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.

Frequency Response of E-Field

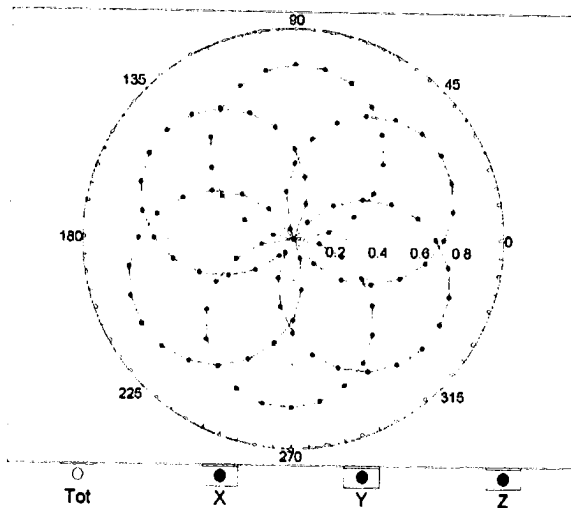
(TEM-Cell:ifi110 EXX, Waveguide: R22)



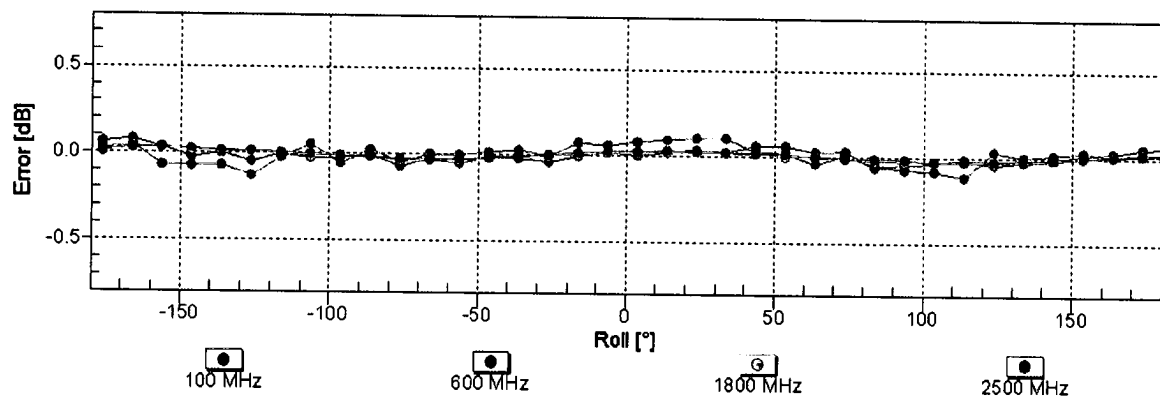
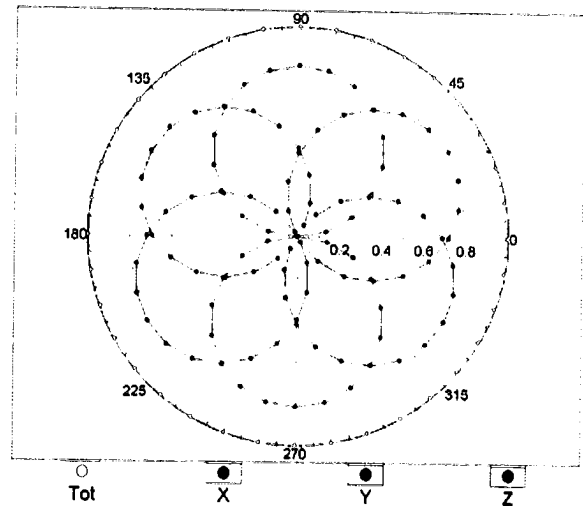
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz, TEM

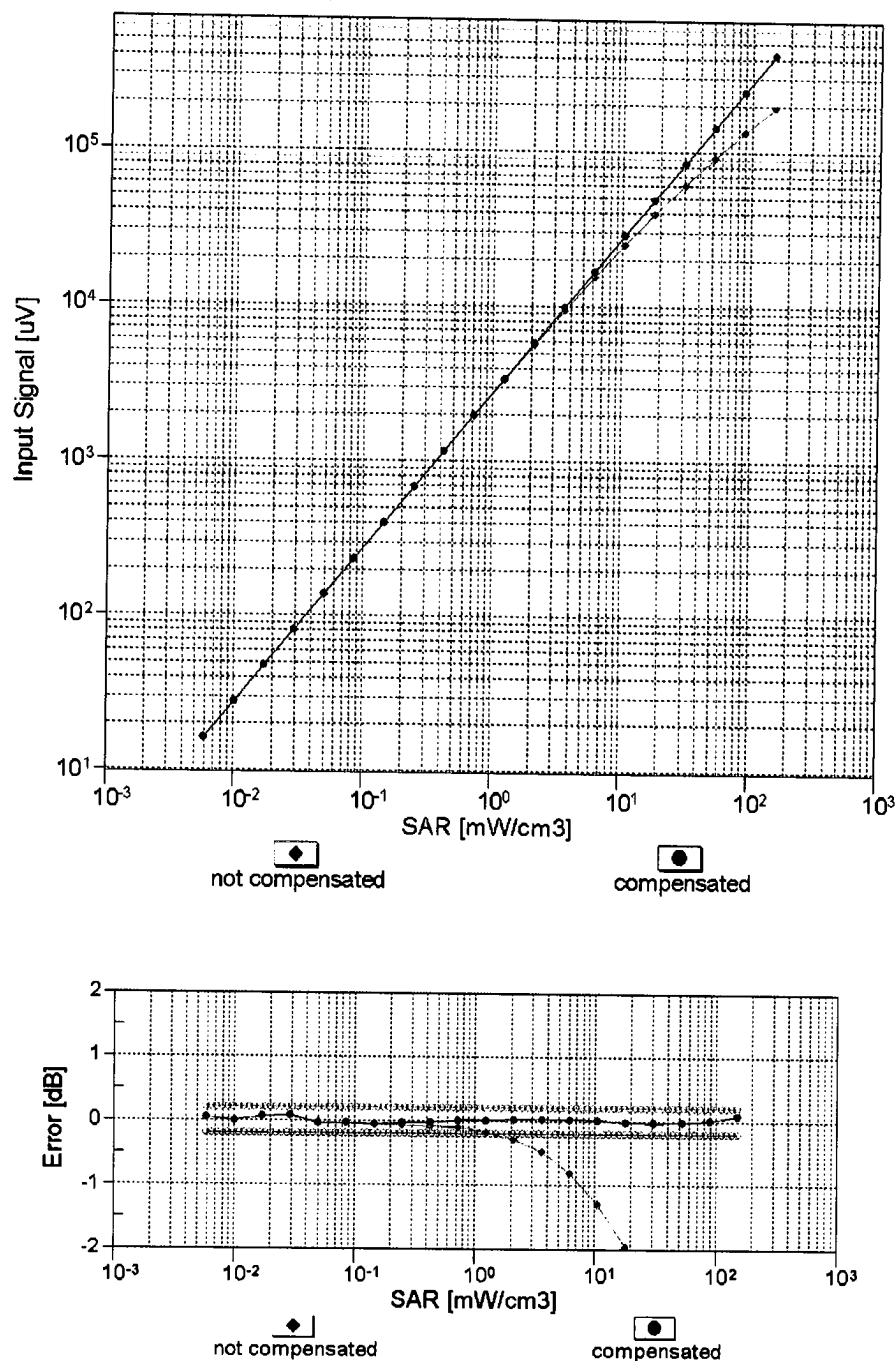


f=1800 MHz, R22



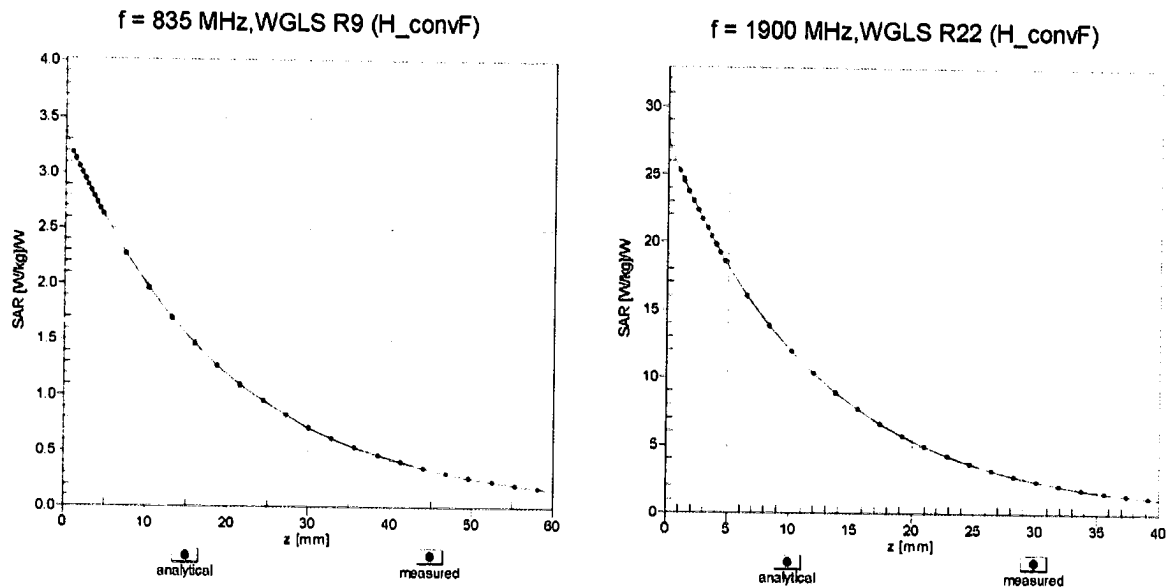
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



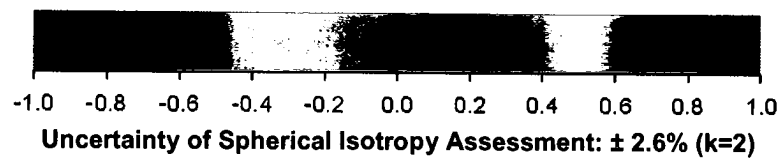
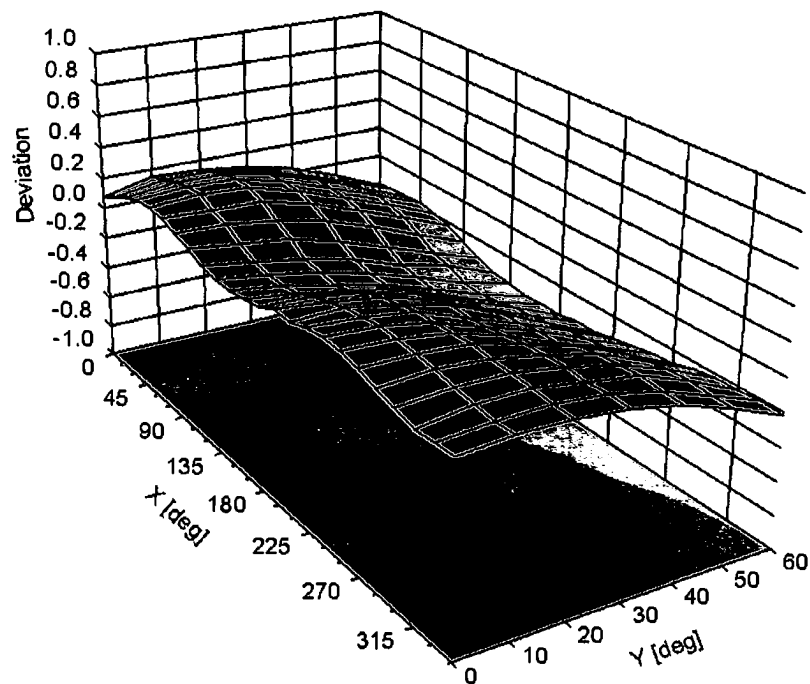
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3911

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-76.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm