

FCC SAR Test Report

APPLICANT : Motorola Mobility LLC
EQUIPMENT : Mobile Cellular Phone
BRAND NAME : Motorola
MODEL NAME : 10711, 10712
FCC ID : IHDT56WD2
STANDARD : FCC 47 CFR Part 2 (2.1093)
ANSI/IEEE C95.1-1992
IEEE 1528-2013

We, SPORTON International (ShenZhen) 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 (ShenZhen) INC., the test report shall not be reproduced except in full.



Prepared by: Mark Qu / Manager

SPORTON LAB.

Approved by: Jones Tsai / Manager



SPORTON International (ShenZhen) INC.

1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan District, Shenzhen City,
Guangdong Province, China



Table of Contents

1. Statement of Compliance	4
2. Administration Data	5
3. Guidance Applied.....	5
4. Equipment Under Test (EUT) Information.....	6
4.1 General Information	6
4.2 Specification of Accessory	7
4.3 General LTE SAR Test and Reporting Considerations.....	8
4.4 Re-use of Measured Data	10
5. RF Exposure Limits.....	12
5.1 Uncontrolled Environment.....	12
5.2 Controlled Environment.....	12
6. Specific Absorption Rate (SAR).....	13
6.1 Introduction	13
6.2 SAR Definition.....	13
7. System Description and Setup	14
7.1 E-Field Probe	15
7.2 Data Acquisition Electronics (DAE)	15
7.3 Phantom.....	15
7.4 Device Holder.....	16
8. Measurement Procedures	17
8.1 Spatial Peak SAR Evaluation.....	17
8.2 Power Reference Measurement.....	18
8.3 Area Scan	18
8.4 Zoom Scan.....	19
8.5 Volume Scan Procedures.....	19
8.6 Power Drift Monitoring.....	19
9. Test Equipment List.....	20
10. System Verification	21
10.1 Tissue Simulating Liquids.....	21
10.2 Tissue Verification	22
10.3 System Performance Check Results.....	23
11. RF Exposure Positions.....	24
11.1 Ear and handset reference point	24
11.2 Definition of the cheek position.....	25
11.3 Definition of the tilt position.....	26
11.4 Body Worn Accessory	27
11.5 Product Specific 10g SAR Exposure	27
11.6 Wireless Router.....	28
12. Conducted RF Output Power (Unit: dBm).....	29
13. Antenna Location	44
14. SAR Test Results	45
14.1 Head SAR	46
14.2 Hotspot SAR	47
14.3 Body Worn Accessory SAR.....	48
14.4 Product specific 10g SAR	49
14.5 Repeated SAR Measurement	50
15. Simultaneous Transmission Analysis	51
15.1 Head Exposure Conditions	52
15.2 Hotspot Exposure Conditions.....	53
15.3 Body-Worn Accessory Exposure Conditions	55
16. Uncertainty Assessment	56
17. References.....	58
Appendix A. Plots of System Performance Check	
Appendix B. Plots of High SAR Measurement	
Appendix C. DASY Calibration Certificate	
Appendix D. Test Setup Photos	
Appendix E. Reference Report	

Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA721309-01	Rev. 01	Initial issue of report	Mar. 31, 2017

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Motorola Mobility LLC, Mobile Cellular Phone, 10711, 10712**, are as follows.

Equipment Class	Frequency Band		Highest SAR Summary			Highest Simultaneous Transmission 1g SAR (W/kg)
			Head (Separation 0mm)	Hotspot (Separation 10mm)	Body-worn (Separation 10mm)	
			1g SAR (W/kg)			
Licensed	GSM	GSM850	0.35	0.59	0.58	1.37
		GSM1900	<0.10	1.14	0.79	
	WCDMA	Band II	0.22	0.63	1.18	
		Band V	0.37	0.68	0.64	
		Band IV	0.30	0.61	0.47	
	LTE	Band 4	0.42	0.74	0.53	
		Band 2	0.17	0.65	1.15	
		Band 5	0.29	0.59	0.58	
		Band 7	0.21	0.69	0.66	
DTS	WLAN	2.4GHz WLAN	0.75	0.19	0.19	1.37
Date of Testing:			2017/3/4 ~ 2017/3/7			

Equipment Class	Frequency Band	Highest SAR Summary
		Extremity 10g SAR (W/kg) (Gap 0mm)
Licensed	WCDMA Band II	3.24
	LTE Band2	2.75

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications

2. Administration Data

Testing Laboratory	
Test Site	SPORTON International (ShenZhen) INC.
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan District, Shenzhen City, Guangdong Province, China TEL: +86-755-8637-9589 FAX: +86-755-8637-9595

Applicant	
Company Name	Motorola Mobility LLC
Address	222 W, Merchandise Mart Plaza, Chicago IL 60654 USA

Manufacturer	
Company Name	Motorola Mobility LLC
Address	222 W, Merchandise Mart Plaza, Chicago IL 60654 USA

3. Guidance Applied

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 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r03
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 941225 D01 3G SAR Procedures v03r01
- FCC KDB 941225 D05 SAR for LTE Devices v02r05
- FCC KDB 941225 D06 Hotspot Mode SAR v02r01

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Mobile Cellular Phone
Brand Name	Motorola
Model Name	10711, 10712
FCC ID	IHDT56WD2
IMEI Code	SIM1: 355635080017571 SIM2: 355635080026226
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band IV: 1712.4 MHz ~ 1752.6 MHz LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 7: 2502.5 MHz ~ 2567.5 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	GSM/GPRS/EGPRS RMC/AMR 12.2Kbps HSDPA HSUPA DC-HSDPA HSPA+ LTE: QPSK, 16QAM 802.11b/g/n HT20 Bluetooth v3.0+EDR/Bluetooth v4.0 LE/Bluetooth v4.1 LE/ Bluetooth v4.2 LE
HW Version	B4-3
SW Version	nicklaus_oem_userdebug_7.0_NMA25.11_122_intcfg-test-keys_oem
GSM / (E)GPRS Transfer mode	Class B – EUT cannot support Packet Switched and Circuit Switched Network simultaneously but can automatically switch between Packet and Circuit Switched Network.
EUT Stage	Identical Prototype
Remark: 1. 802.11n-HT40 is not supported in 2.4GHz WLAN. 2. This device 2.4GHz WLAN supports Hotspot operation. 3. This device supported VoIP in GPRS, EGPRS, WCDMA, LTE (e.g. 3rd party VoIP), LTE supports VoLTE operation. 4. This device supports GRPS/EGPRS mode up to multi-slot class 12. 5. There are two different types of EUT. They are dual SIM card mobile (10711) and single SIM card mobile (10712). It is special to declare. The others are the same including circuit design, PCB board, structure and all components. After pre-scan two types of EUT, we found test result of the sample that dual SIM was the worst, so we chose dual SIM card mobile to perform all tests. 6. The dual SIM card mobile has 2 SIM slots and supports dual SIM dual standby. The WWAN radio transmission will be enabled by either one SIM at a time (single active). After pre-scan two SIM cards power, we found test result of the SIM1 was the worse, so we chose dual SIM1 card to perform all tests. 7. When hotspot mode is enabled, power reduction will be activated to limit the maximum power of WCDMA Band II and LTE Band2.	

4.2 Specification of Accessory

Specification of Accessory				
AC Adapter (EU)	Brand Name	Motorola (AcBel)	Model Name	C-P36 SPN5944A
	Power Rating	I/P: 100 - 240 Vac, 0.3 A, O/P: 5.2 Vdc, 2.0 A		
AC Adapter (UK)	Brand Name	Motorola (AcBel)	Model Name	C-P37 SPN5940A
	Power Rating	I/P: 100 - 240 Vac, 0.3 A, O/P: 5.2 Vdc, 2.0 A		
AC Adapter (US)	Brand Name	Motorola (AcBel)	Model Name	C-P35 SPN5945A
	Power Rating	I/P: 100 - 240 Vac, 0.3 A, O/P: 5.2 Vdc, 2.0 A		
AC Adapter (IN)	Brand Name	Motorola (AcBel)	Model Name	C-P49 SPN5946A
	Power Rating	I/P: 100 - 240 Vac, 0.3 A, O/P: 5.2 Vdc, 2.0 A		
AC Adapter (AR)	Brand Name	Motorola (AcBel)	Model Name	C-P47 SPN5942A
	Power Rating	I/P: 100 - 240 Vac, 0.5 A, O/P: 5.2 Vdc, 2.0 A		
Battery	Brand Name	Motorola (Amperex)	Model Name	HE50
	Power Rating	0.38 Vdc, 5000 mAh	Type	Li-ion
USB Cable	Brand Name	Motorola (Li Qi)	Model Name	LQ-035050
	Signal Line Type	1.0m shielded cable without core		
Earphone 1	Brand Name	Motorola (Tenji)	Model Name	TJ-101814
	Signal Line Type	1.2m unshielded cable without core		
Earphone 2	Brand Name	Motorola(Cosonic)	Model Name	SH38C16617
	Signal Line Type	1.1m unshielded cable without core		

4.3 General LTE SAR Test and Reporting Considerations

Summarized necessary items addressed in KDB 941225 D05 v02r05																																																				
FCC ID	IHDT56WD2																																																			
Equipment Name	Mobile Cellular Phone																																																			
Operating Frequency Range of each LTE transmission band	LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 7: 2502.5 MHz ~ 2567.5 MHz																																																			
Channel Bandwidth	LTE Band 2:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 4:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 5:1.4MHz, 3MHz, 5MHz, 10MHz LTE Band 7: 5MHz, 10MHz, 15MHz, 20MHz																																																			
uplink modulations used	QPSK, and 16QAM																																																			
LTE Voice / Data requirements	Voice and Data																																																			
LTE MPR permanently built-in by design	<table><tr><th colspan="7">Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3</th></tr><tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (RB)</th><th rowspan="2">MPR (dB)</th></tr><tr><th>1.4 MHz</th><th>3.0 MHz</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th></tr><tr><td>QPSK</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 1</td></tr><tr><td>16 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 1</td></tr><tr><td>16 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 2</td></tr></table>							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
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.																																																			
Power reduction applied to satisfy SAR compliance	Yes, when operating in hotspot mode that LTE B2 power reduction applied to satisfy SAR compliance.																																																			
LTE Release Version	R8, Cat 4																																																			
CA Support	Not Supported																																																			

Transmission (H, M, L) channel numbers and frequencies in each LTE band												
LTE Band 2												
	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	18607	1850.7	18615	1851.5	18625	1852.5	18650	1855	18675	1857.5	18700	1860
M	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880
H	19193	1909.3	19185	1908.5	19175	1907.5	19150	1905	19125	1902.5	19100	1900
LTE Band 4												
	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	19957	1710.7	19965	1711.5	19975	1712.5	20000	1715	20025	1717.5	20050	1720
M	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5
H	20393	1754.3	20385	1753.5	20375	1752.5	20350	1750	20325	1747.5	20300	1745
LTE Band 5												
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz					
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	20407	824.7	20415	825.5	20425	826.5	20450	829				
M	20525	836.5	20525	836.5	20525	836.5	20525	836.5				
H	20643	848.3	20635	847.5	20625	846.5	20600	844				
LTE Band 7												
	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	20775	2502.5	20800	2505	20825	2507.5	20850	2510				
M	21100	2535	21100	2535	21100	2535	21100	2535				
H	21425	2567.5	21400	2565	21375	2562.5	21350	2560				

4.4 Re-use of Measured Data

4.4.1 Introduction Section

This application re-uses data collected on a similar device. The subject device of this application (Model: 10711, 10712, FCC ID: IHDT56WD2) is electrically identical to the reference device (Model: 10710, FCC ID: IHDT56WD3) for the portions of the circuitry corresponding to the data being re-used, as treated by KDB Publication 178919 D01.

4.4.2 Difference Section

For details concerning the similarity with respect to component placement, mechanical/electrical design etc., please refer to the Product Equality Declaration "PED" file.

The re-used RF data includes the following bands provided in Appendix E (Sporton SAR Report No. FA721309 for the reference device Model: 10710, FCC ID: IHDT56WD3):

- GSM850/1900,
- WCDMA Band II/ V,
- LTE Band 5/7
- 2.4GHz WLAN
- 2.4GHz Bluetooth

WCDMA Band IV, LTE Band 2/4 full SAR test.

Spot check for WWAN(except for WCDMA Band IV, LTE Band 2/4) and WLAN are performed for ensure that SAR measurement for both device are the same. So, the original SAR value can represent this application.



4.4.3 Spot Check Verification Data Section

Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Original model (FCC ID: IHDT56WD3)				Spot check model (FCC ID: IHDT56WD2))				Deviation
										Average Power (dBm)	Tune-Up Limit (dBm)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Average Power (dBm)	Tune-Up Limit (dBm)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	
WLAN2.4GHz	-	-	-	-	802.11b 1Mbps	Right Cheek	0mm	6	2437	17.22	17.50	0.704	0.751	17.22	17.50	0.709	0.756	0.71%
GSM 850	-	-	-	-	GPRS 4 Tx slots	Left Side	0mm	189	836.4	29.22	29.5	0.550	0.587	29.22	29.5	0.585	0.624	6.36%
GSM1900	-	-	-	-	GPRS 4 Tx slots	Bottom Side	10mm	810	1909.8	25.96	26.5	1.010	1.144	25.96	26.5	1.020	1.155	0.99%
WCDMA V	-	-	-	-	RMC 12.2Kbps	Right Side	10mm	4132	826.4	23.12	23.50	0.621	0.678	23.12	23.50	0.553	0.604	-10.95%
WCDMA II	-	-	-	-	RMC 12.2Kbps	Back	10mm	9538	1907.6	22.58	23	1.070	1.179	22.58	23	0.920	1.013	-14.02%
LTE Band 5	10M	QPSK	1RB	Offset	-	Right Side	10mm	20525	836.5	23.66	24.00	0.548	0.593	23.66	24.00	0.526	0.569	4.01%
LTE Band 7	20M	QPSK	1RB	Offset	-	Bottom Side	10mm	21100	2535	22.63	23	0.630	0.686	22.63	23	0.670	0.730	6.35%
WCDMA II	-	-	-	-	RMC 12.2Kbps	Bottom Side	0mm	9400	1880	22.55	23	2.920	3.239	22.55	23	2.620	2.906	-10.27%

Note: In the table above, all the deviation of SAR test results are compliant with uncertainty budget.

4.4.4 Reference detail Section

Equipment Class	Reference FCC ID	Folder Test/RF Exposure	Report Title/Section
PCE (2G/3G/4G)	IHDT56WD3	RF Exposure(FA721309)	All sections applicable
DTS (BLE)	IHDT56WD3	RF Exposure(FA721309)	All sections applicable
DSS(BER)	IHDT56WD3	RF Exposure(FA721309)	All sections applicable
DTS (WLAN)	IHDT56WD3	RF Exposure(FA721309)	All sections applicable

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

1. 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:

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

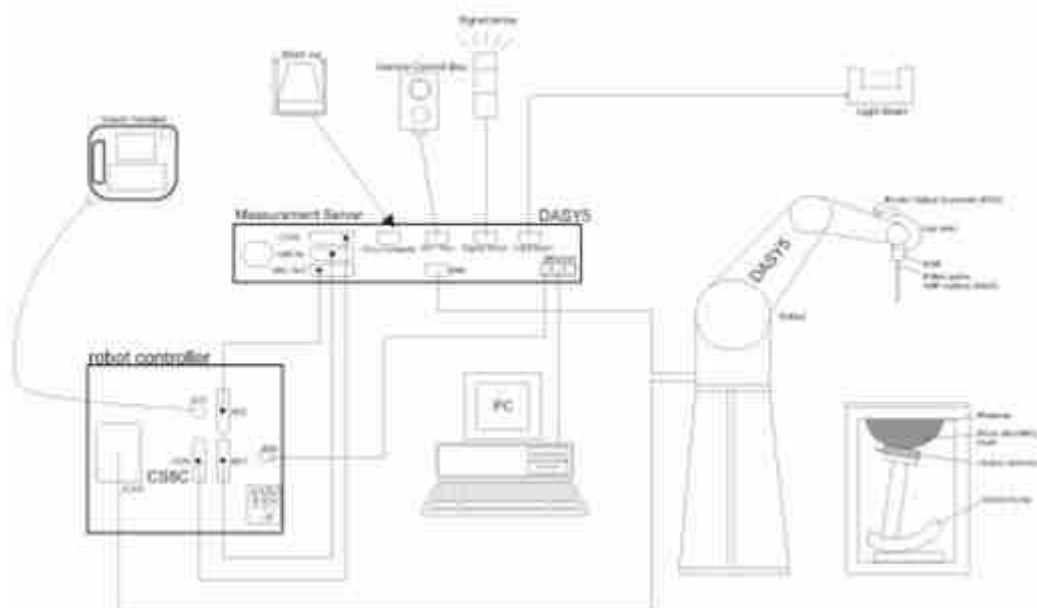
SAR is expressed in units of Watts per kilogram (W/kg)

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

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.

7.1 E-Field Probe

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

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz – >6 GHz Linearity: ± 0.2 dB (30 MHz – 6 GHz)	
Directivity	± 0.3 dB in TSL (rotation around probe axis) ± 0.5 dB in TSL (rotation normal to probe axis)	
Dynamic Range	10 μ W/g – >100 mW/g Linearity: ± 0.2 dB (noise: typically <1 μ W/g)	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

7.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



Fig 5.1 Photo of DAE

7.3 Phantom

<SAM Twin Phantom>

Shell Thickness	2 $\pm$ 0.2 mm; Center ear point: 6 $\pm$ 0.2 mm	
Filling Volume	Approx. 25 liters	
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet	
Measurement Areas	Left Hand, Right Hand, Flat Phantom	

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

7.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.



Mounting Device for Hand-Held Transmitters



Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

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



Mounting Device for Laptops

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 D01v01r04 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 D01v01r04 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	1750MHz System Validation Kit	D1750V2	1137	May 18, 2016	May 17, 2017
SPEAG	1900MHz System Validation Kit	D1900V2	5d118	Nov. 24, 2016	Nov. 23, 2017
SPEAG	Data Acquisition Electronics	DAE4	1303	Nov. 22, 2016	Nov. 21, 2017
SPEAG	Data Acquisition Electronics	DAE4	1279	Apr. 04, 2016	Apr. 03, 2017
SPEAG	Dosimetric E-Field Probe	EX3DV4	3819	Nov. 28, 2016	Nov. 27, 2017
SPEAG	Dosimetric E-Field Probe	EX3DV4	3954	Nov. 28, 2016	Nov. 27, 2017
SPEAG	SAM Twin Phantom	QD 000 P40 CD	TP-1671	NCR	NCR
SPEAG	MFP V5.1C Triple Modular Phantom	QD 000 P51 CA	1139/3, 1153/2, 1153/3	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Anritsu	Radio communication analyzer	MT8820C	6201300653	Jul. 16, 2016	Jul. 15, 2017
Agilent	Wireless Communication Test Set	E5515C	MY50267224	Jul. 16, 2016	Jul. 15, 2017
Agilent	Network Analyzer	E5071C	MY46523671	Oct. 11, 2016	Oct. 10, 2017
Speag	Dielectric Assessment KIT	DAK-3.5	1071	Nov. 23, 2016	Nov. 22, 2017
Agilent	Signal Generator	N5181A	MY50145381	Jan. 03, 2017	Jan. 02, 2018
Anritsu	Power Sensor	MA2411B	1306099	Jan. 03, 2017	Jan. 02, 2018
Anritsu	Power Meter	ML2495A	1349001	Jan. 03, 2017	Jan. 02, 2018
Anritsu	Power Sensor	MA2411B	1207253	Jan. 03, 2017	Jan. 02, 2018
Anritsu	Power Meter	ML2495A	1218010	Jan. 03, 2017	Jan. 02, 2018
R&S	CBT BLUETOOTH TESTER	CBT	100963	Jan. 03, 2017	Jan. 02, 2018
R&S	Spectrum Analyzer	FSP7	101634	Jul. 16, 2016	Jul. 15, 2017
ARRA	Power Divider	A3200-2	N/A	Note 1	
PASTERNAK	Dual Directional Coupler	PE2214-10	N/A	Note 1	
Agilent	Dual Directional Coupler	778D	50422	Note 1	
MCL	Attenuation1	BW-S10W5	N/A	Note 1	
Weinschel	Attenuation2	3M-20	N/A	Note 1	
Zhongjilianhe	Attenuation3	MVE2214-03	N/A	Note 1	
AR	Amplifier	5S1G4	333096	Note 1	
mini-circuits	Amplifier	ZVE-3W-83+	162601250	Note 1	

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 Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.2.



Fig 10.1Photo of Liquid Height for Head SAR



Fig 10.2 Photo of Liquid Height for Body SAR

10.2 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								
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
For Body								
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3

<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
1750	Head	22.9	1.385	39.708	1.37	40.10	1.09	-0.98	±5	2017/3/4
1900	Head	22.7	1.411	38.714	1.40	40.00	0.79	-3.22	±5	2017/3/7
1750	Body	22.6	1.522	52.519	1.49	53.40	2.15	-1.65	±5	2017/3/4
1900	Body	22.7	1.512	51.861	1.52	53.30	-0.53	-2.70	±5	2017/3/7

10.3 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.

<For 1g SAR>:

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2017/3/4	1750	Head	250	1137	3819	1303	9.06	36.50	36.24	-0.71
2017/3/7	1900	Head	250	5d118	3954	1279	9.96	40.4	39.84	-1.39
2017/3/4	1750	Body	250	1137	3819	1303	9.36	37.40	37.44	0.11
2017/3/7	1900	Body	250	5d118	3954	1279	9.68	40.8	38.72	-5.10

<For 10g SAR>:

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2017/3/7	1900	Body	250	5d118	3954	1279	5.05	21.3	20.2	-5.16

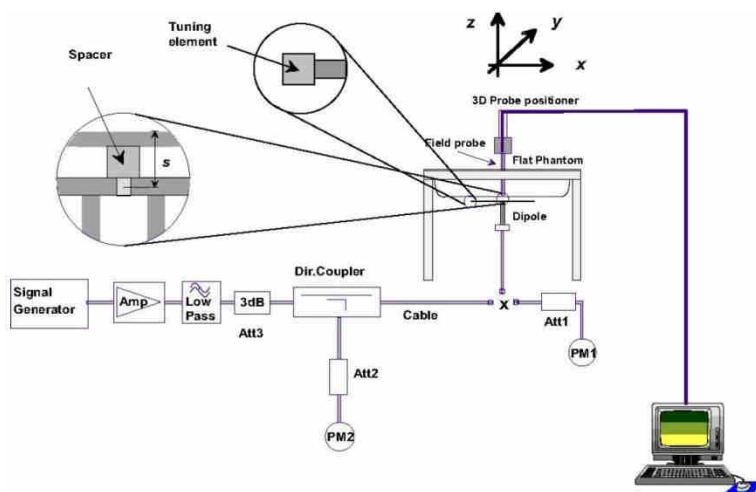


Fig 8.3.1 System Performance Check Setup



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.

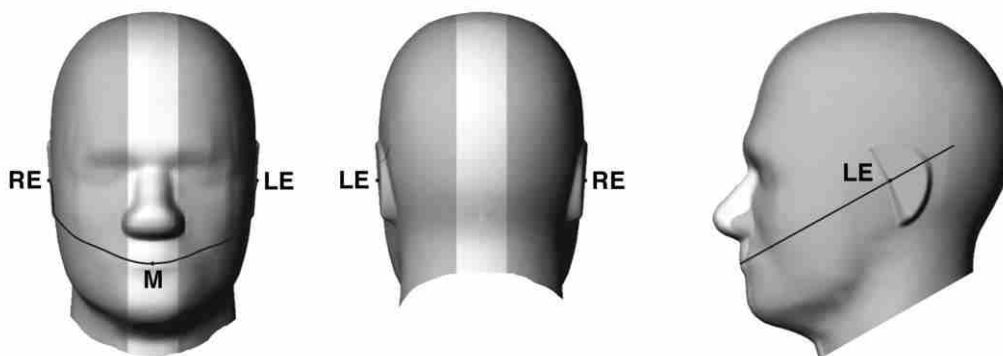


Fig 9.1.1 Front, back, and side views of SAM twin phantom

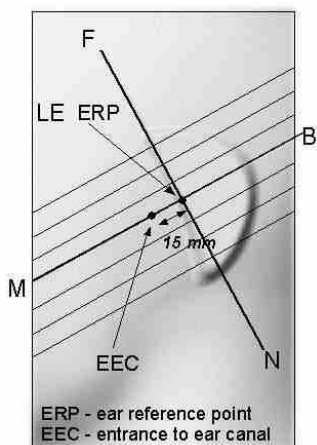


Fig 9.1.2 Close-up side view of phantom showing the ear region.

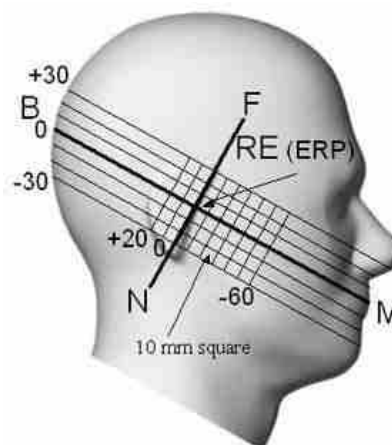


Fig 9.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

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.

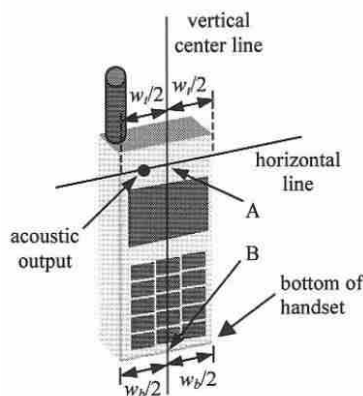


Fig 9.2.1 Handset vertical and horizontal reference lines—“fixed case”

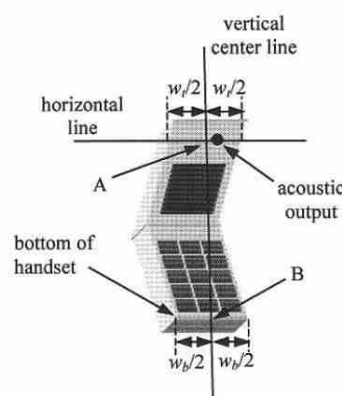


Fig 9.2.2 Handset vertical and horizontal reference lines—“clam-shell case”

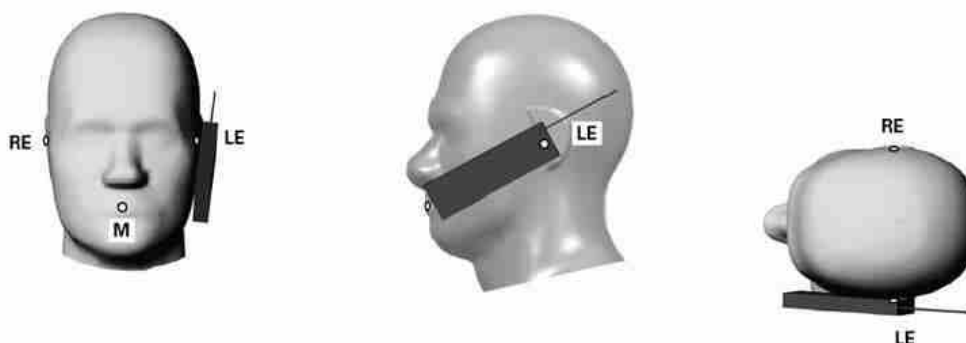


Fig 9.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

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

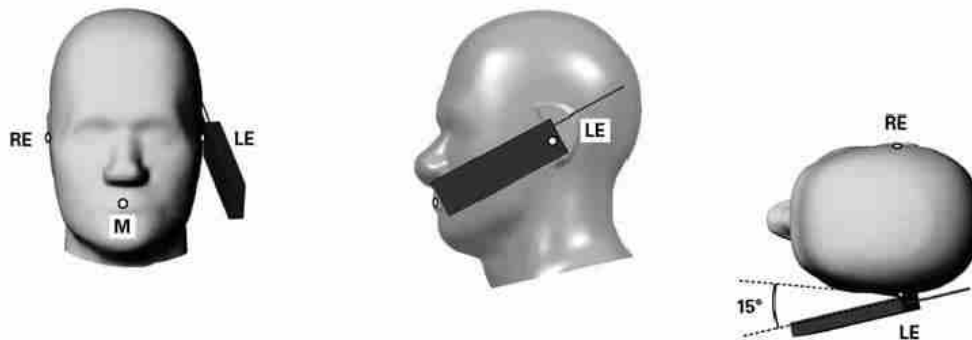


Fig 9.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

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 KDB648474 D04v01r03, body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for body-worn accessory, measured without a headset connected to the handset is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a 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 tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

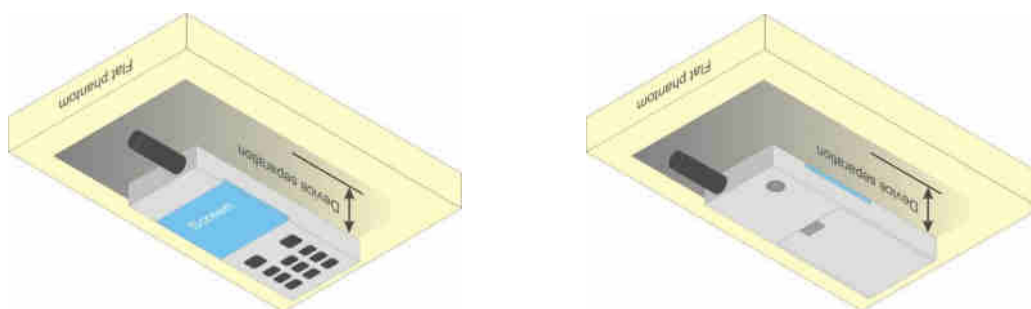


Fig 9.4 Body Worn Position

11.5 Product Specific 10g SAR Exposure

For smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 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 KDB648474 D04v01r03, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless modes 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 ≤ 25 mm from that surface or edge, in direct contact with a flat phantom, for Product specific 10g 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 Product specific 10g SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.



11.6 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 KDB Publication 941225 D06 v02r01 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 D01v06 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

12. Conducted RF Output Power (Unit: dBm)

<WCDMA Conducted Power>

1. The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification.
2. The procedures in KDB 941225 D01v03r01 are applied for 3GPP Rel. 6 HSPA to configure the device in the required sub-test mode(s) to determine SAR test exclusion.
3. For HSPA+ devices supporting 16 QAM in the uplink, power measurements procedure is according to the configurations in Table C.11.1.4 of 3GPP TS 34.121-1.
4. For DC-HSDPA, the device was configured according to the H-Set 12, Fixed Reference Channel (FRC) configuration in Table C.8.1.12 of 3GPP TS 34.121-1, with the primary and the secondary serving HS-DSCH Cell enabled during the power measurement.

A summary of these settings are illustrated below:

HSDPA Setup Configuration:

- a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting:
 - i. Set Gain Factors (β_c and β_d) and parameters were set according to each
 - ii. Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
 - iii. Set RMC 12.2Kbps + HSDPA mode.
 - iv. Set Cell Power = -86 dBm
 - v. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
 - vi. Select HSDPA Uplink Parameters
 - vii. Set Delta ACK, Delta NACK and Delta CQI = 8
 - viii. Set Ack-Nack Repetition Factor to 3
 - ix. Set CQI Feedback Cycle (k) to 4 ms
 - x. Set CQI Repetition Factor to 2
 - xi. Power Ctrl Mode = All Up bits
- d. The transmitted maximum output power was recorded.

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

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note 1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

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

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and $\Delta_{NACK} = 30/15$ with $\beta_{HS} = 30/15 * \beta_c$, and $\Delta_{CQI} = 24/15$ with $\beta_{HS} = 24/15 * \beta_c$.

Note 3: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{HS}/\beta_c = 24/15$. For all other combinations of DPDCCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

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

Setup Configuration

HSUPA Setup Configuration:

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

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

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note 1)	β_{EC}	β_{ED} (Note 5) (Note 6)	β_{ED} (SF)	β_{ED} (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 6)	E-TFCI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/25	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ED1} : 47/15 β_{ED2} : 47/15	4 4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (Note 4)	15/15 (Note 4)	64	15/15 (Note 4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81
Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 30/15$ with $\beta_{HS} = 30/15 * \beta_c$. Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{HS}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference. Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$. Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 14/15$ and $\beta_d = 15/15$. Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g. Note 6: β_{ED} can not be set directly, it is set by Absolute Grant Value.													

Setup Configuration

HSPA+ 3GPP release 7 (uplink category 7) 16QAM, Setup Configuration:

- a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting * :
 - i. Call Configs = 5.2E:HSPA+:UL with 16QAM
 - ii. Set the Gain Factors (β_c and β_d) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.4, quoted from the TS 34.121-1 s5.2E
 - iii. Set Channel Params
 - iv. Set Cell Power = -86 dBm
 - v. Set Channel Type = HSPA
 - vi. Set UE Target Power =21 dBm
 - vii. Power Ctrl Mode= All Up Bits
 - viii. Set Manual Uplink DPCH Bc/Bd = Manual
 - ix. Set Manual Uplink DPCH Bc and Bd=15,15(for 34.121-1 v8.10.0 table C11.1.4 sub-test 1)
 - x. Set HSPA Conn DL Channel Levels
 - xi. Set HS-SCCH Configs
 - xii. Set RB Test Mode Setup
 - xiii. Set Common HSUPA Parameters
 - xiv. Set Serving Grant
 - xv. Confirm that E-TFCI is equal to the target E-TFCI of 105 for sub-test 1, and other subtest's E-TFCI
- d. The transmitted maximum output power was recorded.

Table C.11.1.4: β values for transmitter characteristics tests with HS-DPCCH and E-DCH with 16QAM

Sub-test	β_c (Note 3)	β_d	β_{HS} (Note 1)	β_{ec}	β_{ed} (2xSF2) (Note 4)	β_{ed} (2xSF4) (Note 4)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 4)	E-TFCI (Note 5)	E-TFCI (boost)
1	1	0	30/15	30/15	β_{ed1} : 30/15 β_{ed2} : 30/15	β_{ed3} : 24/15 β_{ed4} : 24/15	3.5	2.5	14	105	105

Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 30/15$ with $\beta_{js} = 30/15 * \beta_c$.
 Note 2: CM = 3.5 and the MPR is based on the relative CM difference, MPR = MAX(CM-1,0).
 Note 3: DPDCH is not configured, therefore the β_c is set to 1 and $\beta_d = 0$ by default.
 Note 4: β_{ed} can not be set directly; it is set by Absolute Grant Value.
 Note 5: All the sub-tests require the UE to transmit 2SF2+2SF4 16QAM EDCH and they apply for UE using E-DPDCH category 7. E-DCH TTI is set to 2ms TTI and E-DCH table index = 2. To support these E-DCH configurations DPDCH is not allocated. The UE is signaled to use the extrapolation algorithm.

Setup Configuration

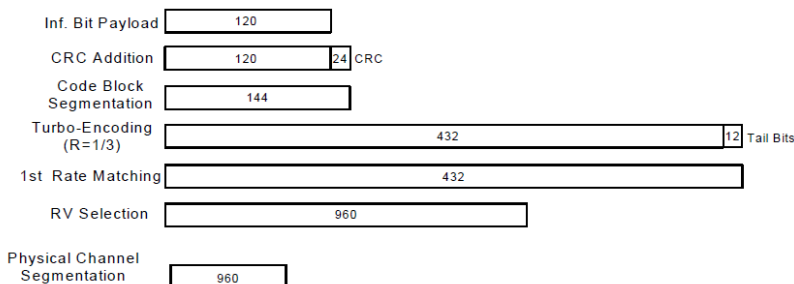
DC-HSDPA 3GPP release 8 Setup Configuration:

- a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration below
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting:
 - i. Set RMC 12.2Kbps + HSDPA mode.
 - ii. Set Cell Power = -25 dBm
 - iii. Set HS-DSCH Configuration Type to FRC (H-set 12, QPSK)
 - iv. Select HSDPA Uplink Parameters
 - v. Set Gain Factors (β_c and β_d) and parameters were set according to each Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
 - a). Subtest 1: $\beta_c/\beta_d=2/15$
 - b). Subtest 2: $\beta_c/\beta_d=12/15$
 - c). Subtest 3: $\beta_c/\beta_d=15/8$
 - d). Subtest 4: $\beta_c/\beta_d=15/4$
 - vi. Set Delta ACK, Delta NACK and Delta CQI = 8
 - vii. Set Ack-Nack Repetition Factor to 3
 - viii. Set CQI Feedback Cycle (k) to 4 ms
 - ix. Set CQI Repetition Factor to 2
 - x. Power Ctrl Mode = All Up bits
- d. The transmitted maximum output power was recorded.

The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification. A summary of these settings are illustrated below:

C.8.1.12 Fixed Reference Channel Definition H-Set 12
Table C.8.1.12: Fixed Reference Channel H-Set 12

Parameter	Unit	Value
Nominal Avg. Inf. Bit Rate	kbps	60
Inter-TTI Distance	TTI's	1
Number of HARQ Processes	Processes	6
Information Bit Payload (N_{INF})	Bits	120
Number Code Blocks	Blocks	1
Binary Channel Bits Per TTI	Bits	960
Total Available SML's in UE	SML's	19200
Number of SML's per HARQ Proc.	SML's	3200
Coding Rate		0.15
Number of Physical Channel Codes	Codes	1
Modulation		QPSK
Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table. Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used.		


Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)
Setup Configuration

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

1. Per KDB 941225 D01v03r01, for SAR testing is measured using a 12.2 kbps RMC with TPC bits configured to all "1's".
2. Per KDB 941225 D01v03r01, RMC 12.2kbps setting is used to evaluate SAR. If the maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA /HSPA+/ DC-HSDPA is $\leq \frac{1}{4}$ dB higher than RMC 12.2Kbps or when the highest reported SAR of the RMC12.2Kbps is scaled by the ratio of specified maximum output power and tune-up tolerance of HSDPA / HSUPA /HSPA+/ DC-HSDPA to RMC12.2Kbps and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for HSDPA / HSUPA/HSPA+/ DC-HSDPA.

Band		WCDMA Band IV			Tune-up Limit (dBm)
TX Channel		1312	1413	1513	
Rx Channel		1537	1638	1738	
Frequency (MHz)		1712.4	1732.6	1752.6	
3GPP Rel 99	AMR 12.2Kbps	22.89	22.85	22.85	23.00
3GPP Rel 99	RMC 12.2Kbps	22.91	22.86	22.88	23.00
3GPP Rel 6	HSDPA Subtest-1	21.79	21.82	21.81	22.50
3GPP Rel 6	HSDPA Subtest-2	21.78	21.88	21.86	22.50
3GPP Rel 6	HSDPA Subtest-3	21.37	21.39	21.38	22.00
3GPP Rel 6	HSDPA Subtest-4	21.34	21.40	21.36	22.00
3GPP Rel 8	DC-HSDPA Subtest-1	21.19	21.23	21.15	21.50
3GPP Rel 8	DC-HSDPA Subtest-2	21.15	21.20	21.16	21.50
3GPP Rel 8	DC-HSDPA Subtest-3	20.86	20.83	20.79	21.00
3GPP Rel 8	DC-HSDPA Subtest-4	20.79	20.83	20.82	21.00
3GPP Rel 6	HSUPA Subtest-1	19.78	19.86	19.78	20.00
3GPP Rel 6	HSUPA Subtest-2	19.79	19.83	19.82	20.00
3GPP Rel 6	HSUPA Subtest-3	20.83	20.88	20.82	21.00
3GPP Rel 6	HSUPA Subtest-4	19.26	19.34	19.27	20.00
3GPP Rel 6	HSUPA Subtest-5	21.80	21.80	21.80	22.00
3GPP Rel 7	HSPA+ Subtest-1	20.01	20.23	19.95	20.50



<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 D05v02r05, 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 D05v02r05, 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 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
5. Per KDB 941225 D05v02r05, 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 D05v02r05, 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 D05v02r05, 16QAM SAR testing is not required.
7. Per KDB 941225 D05v02r05, 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 D05v02r05, smaller bandwidth SAR testing is not required.
8. For LTE B4 / B5 the maximum bandwidth does not support three non-overlapping channels, per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

<Full Power Mode>
<LTE Band 2>

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				18700	18900	19100	22.5	0
Frequency (MHz)				1860	1880	1900		
20	QPSK	1	0	21.97	22.08	22.15	22.5	0
20	QPSK	1	49	21.92	21.99	21.98		
20	QPSK	1	99	21.82	21.81	21.79		
20	QPSK	50	0	20.99	21.13	21.17	21.5	1
20	QPSK	50	24	20.95	21.05	21.02		
20	QPSK	50	50	20.93	20.97	20.95		
20	QPSK	100	0	20.95	21.02	21.03	21.5	1
20	16QAM	1	0	21.21	21.33	21.42		
20	16QAM	1	49	21.19	21.22	21.21		
20	16QAM	1	99	21.07	21.07	20.98	20.5	2
20	16QAM	50	0	19.97	20.10	20.14		
20	16QAM	50	24	19.94	20.02	20.02		
20	16QAM	50	50	19.93	19.96	19.93	20.5	2
20	16QAM	100	0	19.94	20.01	20.00		
Channel				18675	18900	19125	22.5	0
Frequency (MHz)				1857.5	1880	1902.5		
15	QPSK	1	0	21.96	22.04	22.06	22.5	0
15	QPSK	1	37	21.89	21.99	21.95		
15	QPSK	1	74	21.85	21.82	21.78		
15	QPSK	36	0	20.95	21.09	21.07	21.5	1
15	QPSK	36	20	20.94	21.03	20.99		
15	QPSK	36	39	20.95	21.00	20.91		
15	QPSK	75	0	20.96	21.04	21.00	21.5	1
15	16QAM	1	0	21.19	21.30	21.33		
15	16QAM	1	37	21.22	21.22	21.20		
15	16QAM	1	74	21.15	21.11	21.01	20.5	2
15	16QAM	36	0	19.96	20.07	20.07		
15	16QAM	36	20	19.94	20.03	19.98		
15	16QAM	36	39	19.95	20.00	19.89	20.5	2
15	16QAM	75	0	19.95	20.02	19.97		

Channel				18650	18900	19150	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1855	1880	1905		
10	QPSK	1	0	21.92	21.98	22.02	22.5	0
10	QPSK	1	25	21.90	21.98	21.94		
10	QPSK	1	49	21.82	21.86	21.83		
10	QPSK	25	0	20.97	21.03	21.03	21.5	1
10	QPSK	25	12	20.90	21.02	20.99		
10	QPSK	25	25	20.91	20.99	20.97		
10	QPSK	50	0	20.94	21.02	20.99	21.5	1
10	16QAM	1	0	21.17	21.23	21.31		
10	16QAM	1	25	21.18	21.22	21.19		
10	16QAM	1	49	21.12	21.12	21.07	20.5	2
10	16QAM	25	0	19.94	20.02	20.02		
10	16QAM	25	12	19.89	19.98	19.97		
10	16QAM	25	25	19.91	19.96	19.95	20.5	2
10	16QAM	50	0	19.94	19.99	19.97		
Channel				18625	18900	19175	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1852.5	1880	1907.5		
5	QPSK	1	0	21.91	21.96	21.93	22.5	0
5	QPSK	1	12	21.90	21.98	21.91		
5	QPSK	1	24	21.81	21.85	21.80		
5	QPSK	12	0	20.99	21.04	21.01	21.5	1
5	QPSK	12	7	20.97	21.02	20.98		
5	QPSK	12	13	20.95	21.03	20.94		
5	QPSK	25	0	20.92	21.01	20.94	21.5	1
5	16QAM	1	0	21.16	21.19	21.15		
5	16QAM	1	12	21.21	21.22	21.13		
5	16QAM	1	24	21.12	21.09	21.01	20.5	2
5	16QAM	12	0	19.99	20.03	20.00		
5	16QAM	12	7	19.98	20.00	19.97		
5	16QAM	12	13	19.96	20.02	19.93	20.5	2
5	16QAM	25	0	19.91	19.98	19.91		

Channel				18615	18900	19185	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1851.5	1880	1908.5		
3	QPSK	1	0	21.85	21.92	21.82	22.5	0
3	QPSK	1	8	21.90	21.95	21.84		
3	QPSK	1	14	21.79	21.84	21.77		
3	QPSK	8	0	20.98	21.01	20.95	21.5	1
3	QPSK	8	4	20.97	21.00	20.94		
3	QPSK	8	7	20.94	20.99	20.91		
3	QPSK	15	0	20.95	21.00	20.94	21.5	1
3	16QAM	1	0	21.04	21.06	21.02		
3	16QAM	1	8	21.11	21.14	21.04		
3	16QAM	1	14	21.05	21.03	20.97	20.5	2
3	16QAM	8	0	20.03	20.05	19.97		
3	16QAM	8	4	20.02	20.02	19.95		
3	16QAM	8	7	20.00	20.02	19.94	20.5	2
3	16QAM	15	0	19.96	19.98	19.91		
Channel				18607	18900	19193	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1850.7	1880	1909.3		
1.4	QPSK	1	0	21.90	21.94	21.82	22.5	0
1.4	QPSK	1	3	21.95	22.03	21.89		
1.4	QPSK	1	5	21.88	21.90	21.79		
1.4	QPSK	3	0	21.98	22.05	21.93		
1.4	QPSK	3	1	21.93	21.96	21.87		
1.4	QPSK	3	3	21.93	21.96	21.85	21.5	1
1.4	QPSK	6	0	20.95	21.00	20.91		
1.4	16QAM	1	0	21.15	21.16	21.05	21.5	1
1.4	16QAM	1	3	21.20	21.25	21.10		
1.4	16QAM	1	5	21.13	21.10	21.02		
1.4	16QAM	3	0	20.98	21.01	20.88		
1.4	16QAM	3	1	20.93	20.95	20.83		
1.4	16QAM	3	3	20.90	20.93	20.83	20.5	2
1.4	16QAM	6	0	20.01	20.05	19.97		



<LTE Band 4>

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				20050	20175	20300	23.5	0
Frequency (MHz)				1720	1732.5	1745		
20	QPSK	1	0	23.22	23.09	22.76		
20	QPSK	1	49	22.96	22.74	23.01	22.5	1
20	QPSK	1	99	22.77	22.86	23.00		
20	QPSK	50	0	22.27	21.99	21.96		
20	QPSK	50	24	22.06	21.86	22.06	22.5	1
20	QPSK	50	50	22.00	21.82	22.17		
20	QPSK	100	0	22.05	21.86	22.08		
20	16QAM	1	0	22.46	22.41	22.35	22.5	1
20	16QAM	1	49	22.49	21.73	22.37		
20	16QAM	1	99	21.89	22.18	22.31		
20	16QAM	50	0	21.20	20.98	21.01	21.5	2
20	16QAM	50	24	21.07	20.84	21.08		
20	16QAM	50	50	20.96	20.86	21.12		
20	16QAM	100	0	21.06	20.87	20.99	21.5	2
Channel				20025	20175	20325		
Frequency (MHz)				1717.5	1732.5	1747.5		
15	QPSK	1	0	23.10	22.97	22.93	23.5	0
15	QPSK	1	37	23.04	22.77	23.07		
15	QPSK	1	74	22.83	22.74	23.05		
15	QPSK	36	0	22.23	21.95	21.98	22.5	1
15	QPSK	36	20	22.14	21.85	22.13		
15	QPSK	36	39	22.07	21.85	22.25		
15	QPSK	75	0	22.12	21.88	22.07	22.5	1
15	16QAM	1	0	22.49	21.90	22.00		
15	16QAM	1	37	22.45	21.85	21.93		
15	16QAM	1	74	22.46	21.93	22.48	21.5	2
15	16QAM	36	0	21.22	20.99	20.99		
15	16QAM	36	20	21.16	20.93	21.08		
15	16QAM	36	39	21.04	20.81	21.18	21.5	2
15	16QAM	75	0	21.10	20.91	21.10		

Channel				20000	20175	20350	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1715	1732.5	1750		
10	QPSK	1	0	23.08	23.00	22.91	23.5	0
10	QPSK	1	25	23.01	22.77	23.05		
10	QPSK	1	49	22.81	22.74	23.05		
10	QPSK	25	0	22.23	21.95	21.95	22.5	1
10	QPSK	25	12	22.14	21.86	22.13		
10	QPSK	25	25	22.07	21.87	22.25		
10	QPSK	50	0	22.15	21.90	22.05	22.5	1
10	16QAM	1	0	22.38	21.90	21.99		
10	16QAM	1	25	22.47	21.85	21.97		
10	16QAM	1	49	22.46	21.94	22.48	21.5	2
10	16QAM	25	0	21.25	20.99	21.00		
10	16QAM	25	12	21.17	20.91	21.08		
10	16QAM	25	25	21.04	20.79	21.18	21.5	2
10	16QAM	50	0	21.05	20.94	21.08		
Channel				19975	20175	20375	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1712.5	1732.5	1752.5		
5	QPSK	1	0	23.02	22.75	23.14	23.5	0
5	QPSK	1	12	23.15	22.89	23.15		
5	QPSK	1	24	23.03	22.75	23.08		
5	QPSK	12	0	22.15	21.88	22.23	22.5	1
5	QPSK	12	7	22.18	21.84	22.28		
5	QPSK	12	13	22.09	21.85	22.31		
5	QPSK	25	0	22.10	21.82	22.25	22.5	1
5	16QAM	1	0	22.28	22.31	22.47		
5	16QAM	1	12	22.39	21.95	22.10		
5	16QAM	1	24	22.41	21.64	22.19	21.5	2
5	16QAM	12	0	21.20	20.94	21.26		
5	16QAM	12	7	21.18	20.90	21.29		
5	16QAM	12	13	21.12	20.83	21.31	21.5	2
5	16QAM	25	0	21.15	20.83	21.21		

Channel				19965	20175	20385	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1711.5	1732.5	1753.5		
3	QPSK	1	0	22.92	22.83	23.03	23.5	0
3	QPSK	1	8	22.99	22.71	23.16		
3	QPSK	1	14	22.99	22.64	23.20		
3	QPSK	8	0	22.13	21.84	22.28	22.5	1
3	QPSK	8	4	22.10	21.82	22.29		
3	QPSK	8	7	22.10	21.80	22.29		
3	QPSK	15	0	22.15	21.80	22.29	22.5	1
3	16QAM	1	0	22.08	21.77	22.20		
3	16QAM	1	8	22.03	22.01	22.41		
3	16QAM	1	14	22.30	21.95	22.39	21.5	2
3	16QAM	8	0	21.15	20.94	21.37		
3	16QAM	8	4	21.02	20.96	21.44		
3	16QAM	8	7	21.11	20.83	21.37	21.5	2
3	16QAM	15	0	21.14	20.76	21.33		
Channel				19957	20175	20393	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1710.7	1732.5	1754.3		
1.4	QPSK	1	0	22.97	22.73	23.18	23.5	0
1.4	QPSK	1	3	23.04	22.76	23.20		
1.4	QPSK	1	5	23.05	22.73	23.18		
1.4	QPSK	3	0	23.13	22.85	23.05		
1.4	QPSK	3	1	23.15	22.80	23.18		
1.4	QPSK	3	3	23.11	22.85	23.00		
1.4	QPSK	6	0	22.16	21.83	22.30	22.5	1
1.4	16QAM	1	0	21.92	21.93	22.33	22.5	1
1.4	16QAM	1	3	22.12	22.03	22.18		
1.4	16QAM	1	5	22.36	22.25	22.22		
1.4	16QAM	3	0	22.02	21.86	22.20		
1.4	16QAM	3	1	22.05	21.85	22.28		
1.4	16QAM	3	3	22.09	21.87	22.27		
1.4	16QAM	6	0	21.26	20.97	21.44	21.5	2

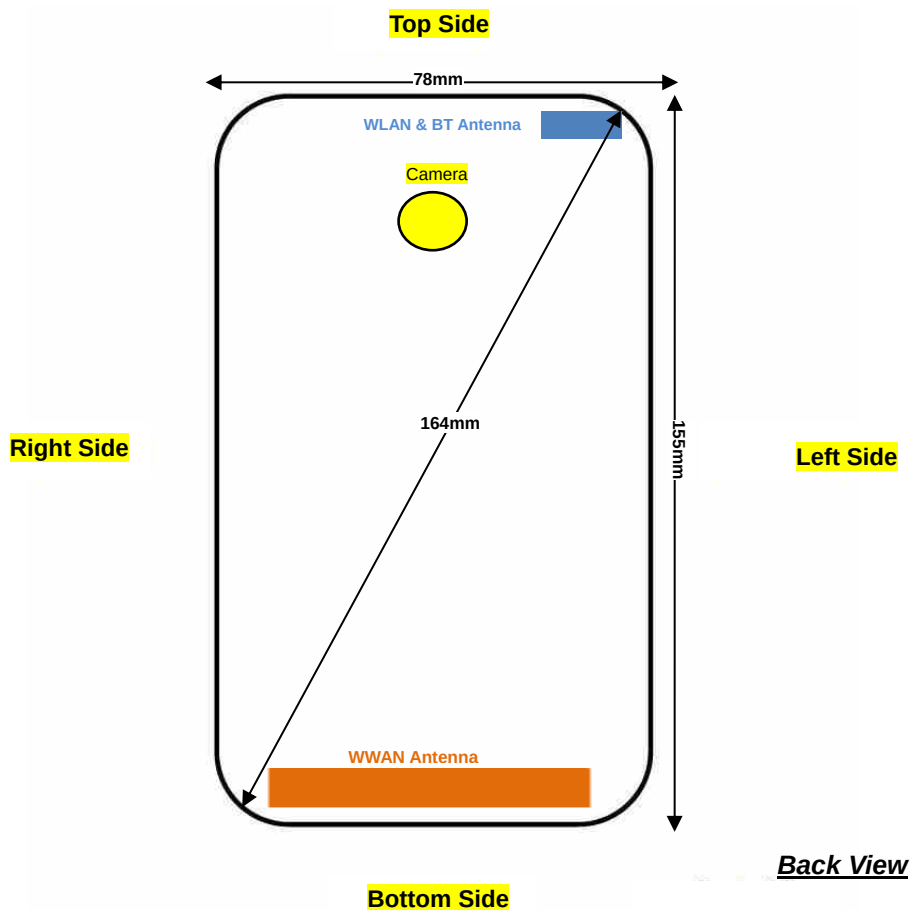
<Hotspot Reduced Power Mode>
<LTE Band 2>

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				18700	18900	19100	19.5	0
Frequency (MHz)				1860	1880	1900		
20	QPSK	1	0	19.10	19.20	19.25		
20	QPSK	1	49	18.99	19.02	19.00	19.5	0
20	QPSK	1	99	18.92	18.89	18.90		
20	QPSK	50	0	19.10	19.17	19.19		
20	QPSK	50	24	19.04	19.07	19.06	19.5	0
20	QPSK	50	50	19.02	19.01	19.01		
20	QPSK	100	0	19.02	19.05	19.08		
20	16QAM	1	0	19.39	19.46	19.48	19.5	0
20	16QAM	1	49	19.27	19.31	19.24		
20	16QAM	1	99	19.23	19.15	19.14		
20	16QAM	50	0	19.09	19.16	19.17	19.5	0
20	16QAM	50	24	19.02	19.05	19.04		
20	16QAM	50	50	19.01	18.99	18.99		
20	16QAM	100	0	19.00	19.03	19.06	19.5	0
Channel				18675	18900	19125		
Frequency (MHz)				1857.5	1880	1902.5		
15	QPSK	1	0	19.06	19.12	19.11	19.5	0
15	QPSK	1	37	18.97	19.05	18.99		
15	QPSK	1	74	18.95	18.90	18.89		
15	QPSK	36	0	19.06	19.14	19.10	19.5	0
15	QPSK	36	20	19.01	19.08	19.03		
15	QPSK	36	39	19.03	19.01	18.97		
15	QPSK	75	0	19.03	19.07	19.04	19.5	0
15	16QAM	1	0	19.33	19.41	19.34		
15	16QAM	1	37	19.25	19.32	19.25		
15	16QAM	1	74	19.23	19.17	19.14	19.5	0
15	16QAM	36	0	19.05	19.13	19.07		
15	16QAM	36	20	19.00	19.07	19.01		
15	16QAM	36	39	19.02	19.00	18.95	19.5	0
15	16QAM	75	0	19.02	19.06	19.01		

Channel				18650	18900	19150	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1855	1880	1905		
10	QPSK	1	0	19.07	19.02	19.06	19.5	0
10	QPSK	1	25	18.98	19.03	19.01		
10	QPSK	1	49	18.94	18.93	18.96		
10	QPSK	25	0	19.07	19.06	19.04	19.5	0
10	QPSK	25	12	18.99	19.03	19.02		
10	QPSK	25	25	19.00	19.01	19.00		
10	QPSK	50	0	19.03	19.04	19.04	19.5	0
10	16QAM	1	0	19.34	19.31	19.32		
10	16QAM	1	25	19.29	19.31	19.25		
10	16QAM	1	49	19.25	19.19	19.19	19.5	0
10	16QAM	25	0	19.06	19.06	19.02		
10	16QAM	25	12	18.99	19.02	19.00		
10	16QAM	25	25	19.00	19.00	18.98	19.5	0
10	16QAM	50	0	19.03	19.02	19.02		
Channel				18625	18900	19175	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1852.5	1880	1907.5		
5	QPSK	1	0	19.03	18.99	18.97	19.5	0
5	QPSK	1	12	19.00	19.00	18.98		
5	QPSK	1	24	18.96	18.94	18.92		
5	QPSK	12	0	19.10	19.08	19.03	19.5	0
5	QPSK	12	7	19.05	19.05	19.01		
5	QPSK	12	13	19.05	19.03	19.00		
5	QPSK	25	0	19.02	19.02	18.99	19.5	0
5	16QAM	1	0	19.32	19.28	19.21		
5	16QAM	1	12	19.27	19.27	19.22		
5	16QAM	1	24	19.23	19.20	19.16	19.5	0
5	16QAM	12	0	19.09	19.07	19.01		
5	16QAM	12	7	19.05	19.04	18.99		
5	16QAM	12	13	19.04	19.02	18.98	19.5	0
5	16QAM	25	0	19.01	19.01	18.96		

Channel				18615	18900	19185	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1851.5	1880	1908.5		
3	QPSK	1	0	18.95	18.95	18.88	19.5	0
3	QPSK	1	8	19.01	18.98	18.94		
3	QPSK	1	14	18.90	18.90	18.83		
3	QPSK	8	0	19.07	19.06	19.00	19.5	0
3	QPSK	8	4	19.06	19.03	18.99		
3	QPSK	8	7	19.05	19.02	18.97		
3	QPSK	15	0	19.05	19.01	18.99	19.5	0
3	16QAM	1	0	19.23	19.23	19.14		
3	16QAM	1	8	19.30	19.25	19.19		
3	16QAM	1	14	19.19	19.17	19.06	19.5	0
3	16QAM	8	0	19.12	19.10	19.02		
3	16QAM	8	4	19.10	19.06	19.02		
3	16QAM	8	7	19.09	19.06	18.99	19.5	0
3	16QAM	15	0	19.06	19.02	18.99		
Channel				18607	18900	19193	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1850.7	1880	1909.3		
1.4	QPSK	1	0	18.99	18.99	18.90	19.5	0
1.4	QPSK	1	3	19.07	19.06	18.96		
1.4	QPSK	1	5	18.96	18.95	18.88		
1.4	QPSK	3	0	19.07	19.07	18.99	19.5	0
1.4	QPSK	3	1	19.05	18.99	18.95		
1.4	QPSK	3	3	19.05	18.99	18.94		
1.4	QPSK	6	0	19.06	19.03	18.97	19.5	0
1.4	16QAM	1	0	19.27	19.30	19.15	19.5	0
1.4	16QAM	1	3	19.37	19.34	19.21		
1.4	16QAM	1	5	19.24	19.27	19.13		
1.4	16QAM	3	0	19.06	19.08	18.98	19.5	0
1.4	16QAM	3	1	19.04	19.01	18.93		
1.4	16QAM	3	3	19.04	19.00	18.92		
1.4	16QAM	6	0	19.12	19.10	19.01	19.5	0

13. 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	135mm	≤ 25mm	≤ 25mm	≤ 25mm
BT&WLAN	≤ 25mm	≤ 25mm	≤ 25mm	134mm	56mm	≤ 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	Yes	No	No	Yes

General Note:

- Referring to KDB 941225 D06 v02r01, 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

14. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, 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. WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
2. Per KDB 447498 D01v06, 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 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥ 0.8 W/kg.
4. When hotspot mode is enabled, power reduction will be activated to limit the maximum power of WCDMA Band II and LTE Band2.
5. Per KDB 648474 D04v01r03, 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.
6. Per KDB648474 D04v01r03, 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, however, when power reduction applies to hotspot mode the measured SAR must be scaled to the maximum output power, including tolerance, allowed for phablet modes to compare with the 1.2 W/kg SAR test reduction threshold.

UMTS Note:

1. Per KDB 941225 D01v03r01, for SAR testing is measured using a 12.2 kbps RMC with TPC bits configured to all "1's".
2. Per KDB 941225 D01v03r01, RMC 12.2kbps setting is used to evaluate SAR. If the maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA /HSPA+/ DC-HSDPA is $\leq \frac{1}{4}$ dB higher than RMC 12.2Kbps or when the highest reported SAR of the RMC12.2Kbps is scaled by the ratio of specified maximum output power and tune-up tolerance of HSDPA / HSUPA /HSPA+/ DC-HSDPA to RMC12.2Kbps and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for HSDPA / HSUPA /HSPA+/ DC-HSDPA.

LTE Note:

1. Per KDB 941225 D05v02r05, 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 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
3. Per KDB 941225 D05v02r05, 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 D05v02r05, 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 D05v02r05, 16QAM SAR testing is not required.
5. Per KDB 941225 D05v02r05, 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 D05v02r05, smaller bandwidth SAR testing is not required.
6. For LTE B4 / B5 the maximum bandwidth does not support three non-overlapping channels, per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.



14.1 Head SAR

<WCDMA 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	WCDMA IV	RMC 12.2Kbps	Right Cheek	1312	1712.4	22.91	23.00	1.021	-0.02	0.295	0.301
	WCDMA IV	RMC 12.2Kbps	Right Tilted	1312	1712.4	22.91	23.00	1.021	0.07	0.141	0.144
	WCDMA IV	RMC 12.2Kbps	Left Cheek	1312	1712.4	22.91	23.00	1.021	0.04	0.173	0.177
	WCDMA IV	RMC 12.2Kbps	Left Tilted	1312	1712.4	22.91	23.00	1.021	-0.01	0.140	0.143

< FDD LTE SAR>

Plot No.	Band	BW (MHz)	Mode	RB Size	RB Offset	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)
02	LTE Band 4	20M	QPSK	1RB	0Offset	Right Cheek	20175	1732.5	23.09	23.50	1.099	-0.06	0.386	0.424
	LTE Band 4	20M	QPSK	1RB	0Offset	Right Tilted	20175	1732.5	23.09	23.50	1.099	0.07	0.154	0.169
	LTE Band 4	20M	QPSK	1RB	0Offset	Left Cheek	20175	1732.5	23.09	23.50	1.099	0.04	0.166	0.182
	LTE Band 4	20M	QPSK	1RB	0Offset	Left Tilted	20175	1732.5	23.09	23.50	1.099	0.04	0.150	0.165
	LTE Band 4	20M	QPSK	50RB	0Offset	Right Cheek	20175	1732.5	21.99	22.50	1.125	-0.04	0.270	0.304
	LTE Band 4	20M	QPSK	50RB	0Offset	Right Tilted	20175	1732.5	21.99	22.50	1.125	-0.09	0.123	0.138
	LTE Band 4	20M	QPSK	50RB	0Offset	Left Cheek	20175	1732.5	21.99	22.50	1.125	0.15	0.135	0.152
	LTE Band 4	20M	QPSK	50RB	0Offset	Left Tilted	20175	1732.5	21.99	22.50	1.125	0.01	0.120	0.135
	LTE Band 2	20M	QPSK	1RB	0Offset	Right Cheek	19100	1900	22.15	22.5	1.084	-0.18	0.102	0.111
	LTE Band 2	20M	QPSK	1RB	0Offset	Right Tilted	19100	1900	22.15	22.5	1.084	0.03	0.099	0.107
03	LTE Band 2	20M	QPSK	1RB	0Offset	Left Cheek	19100	1900	22.15	22.5	1.084	0.11	0.159	0.172
	LTE Band 2	20M	QPSK	1RB	0Offset	Left Tilted	19100	1900	22.15	22.5	1.084	0.13	0.086	0.093
	LTE Band 2	20M	QPSK	50RB	0Offset	Right Cheek	19100	1900	21.17	21.5	1.079	-0.05	0.086	0.093
	LTE Band 2	20M	QPSK	50RB	0Offset	Right Tilted	19100	1900	21.17	21.5	1.079	0.03	0.082	0.088
	LTE Band 2	20M	QPSK	50RB	0Offset	Left Cheek	19100	1900	21.17	21.5	1.079	0.01	0.128	0.138
	LTE Band 2	20M	QPSK	50RB	0Offset	Left Tilted	19100	1900	21.17	21.5	1.079	0.14	0.069	0.074

14.2 Hotspot SAR

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	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)
	WCDMA IV	RMC 12.2Kbps	Front	10	1312	1712.4	22.91	23	1.021	-0.08	0.457	0.467
	WCDMA IV	RMC 12.2Kbps	Back	10	1312	1712.4	22.91	23	1.021	-0.05	0.401	0.409
	WCDMA IV	RMC 12.2Kbps	Left Side	10	1312	1712.4	22.91	23	1.021	0.06	0.093	0.095
	WCDMA IV	RMC 12.2Kbps	Right Side	10	1312	1712.4	22.91	23	1.021	-0.06	0.291	0.297
04	WCDMA IV	RMC 12.2Kbps	Bottom Side	10	1312	1712.4	22.91	23	1.021	-0.07	0.597	0.610

< FDD LTE SAR>

Plot No.	Band	BW (MHz)	Mode	RB Size	RB Offset	Test Position	Gap (mm)	Power Reduction	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 4	20M	QPSK	1RB	0Offset	Front	10	Off	20175	1732.5	23.09	23.5	1.099	-0.13	0.485	0.533
	LTE Band 4	20M	QPSK	1RB	0Offset	Back	10	Off	20175	1732.5	23.09	23.5	1.099	0.09	0.442	0.486
	LTE Band 4	20M	QPSK	1RB	0Offset	Left Side	10	Off	20175	1732.5	23.09	23.5	1.099	-0.04	0.095	0.104
	LTE Band 4	20M	QPSK	1RB	0Offset	Right Side	10	Off	20175	1732.5	23.09	23.5	1.099	-0.05	0.265	0.291
05	LTE Band 4	20M	QPSK	1RB	0Offset	Bottom Side	10	Off	20175	1732.5	23.09	23.5	1.099	-0.02	0.669	0.735
	LTE Band 4	20M	QPSK	50RB	0Offset	Front	10	Off	20175	1732.5	21.99	22.5	1.125	-0.06	0.386	0.434
	LTE Band 4	20M	QPSK	50RB	0Offset	Back	10	Off	20175	1732.5	21.99	22.5	1.125	-0.12	0.382	0.430
	LTE Band 4	20M	QPSK	50RB	0Offset	Left Side	10	Off	20175	1732.5	21.99	22.5	1.125	-0.06	0.080	0.090
	LTE Band 4	20M	QPSK	50RB	0Offset	Right Side	10	Off	20175	1732.5	21.99	22.5	1.125	-0.01	0.213	0.240
	LTE Band 4	20M	QPSK	50RB	0Offset	Bottom Side	10	Off	20175	1732.5	21.99	22.5	1.125	-0.09	0.546	0.614
	LTE Band 2	20M	QPSK	1RB	0Offset	Front	10	On	19100	1900	19.25	19.5	1.059	0.02	0.343	0.363
	LTE Band 2	20M	QPSK	1RB	0Offset	Back	10	On	19100	1900	19.25	19.5	1.059	0.02	0.392	0.415
	LTE Band 2	20M	QPSK	1RB	0Offset	Left Side	10	On	19100	1900	19.25	19.5	1.059	0.03	0.073	0.077
	LTE Band 2	20M	QPSK	1RB	0Offset	Right Side	10	On	19100	1900	19.25	19.5	1.059	-0.05	0.043	0.046
06	LTE Band 2	20M	QPSK	1RB	0Offset	Bottom Side	10	On	19100	1900	19.25	19.5	1.059	0.06	0.616	0.653
	LTE Band 2	20M	QPSK	50RB	0Offset	Front	10	On	19100	1900	19.19	19.5	1.074	0.08	0.342	0.367
	LTE Band 2	20M	QPSK	50RB	0Offset	Back	10	On	19100	1900	19.19	19.5	1.074	0.09	0.390	0.419
	LTE Band 2	20M	QPSK	50RB	0Offset	Left Side	10	On	19100	1900	19.19	19.5	1.074	0.04	0.054	0.058
	LTE Band 2	20M	QPSK	50RB	0Offset	Right Side	10	On	19100	1900	19.19	19.5	1.074	0.09	0.048	0.052
	LTE Band 2	20M	QPSK	50RB	0Offset	Bottom Side	10	On	19100	1900	19.19	19.5	1.074	0.07	0.591	0.635



14.3 Body Worn Accessory SAR

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	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)
07	WCDMA IV	RMC 12.2Kbps	Front	10	1312	1712.4	22.91	23	1.021	-0.08	0.457	0.467
	WCDMA IV	RMC 12.2Kbps	Back	10	1312	1712.4	22.91	23	1.021	-0.05	0.401	0.409

< FDD LTE SAR>

Plot No.	Band	BW (MHz)	Mode	RB Size	RB Offset	Test Position	Gap (mm)	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)
08	LTE Band 4	20M	QPSK	1RB	0Offset	Front	10	20175	1732.5	23.09	23.5	1.099	-0.13	0.485	0.533
	LTE Band 4	20M	QPSK	1RB	0Offset	Back	10	20175	1732.5	23.09	23.5	1.099	0.09	0.442	0.486
	LTE Band 4	20M	QPSK	50RB	0Offset	Front	10	20175	1732.5	21.99	22.5	1.125	-0.06	0.386	0.434
	LTE Band 4	20M	QPSK	50RB	0Offset	Back	10	20175	1732.5	21.99	22.5	1.125	-0.12	0.382	0.430
	LTE Band 2	20M	QPSK	1RB	0Offset	Front	10	19100	1900	22.15	22.5	1.084	-0.17	0.877	0.951
	LTE Band 2	20M	QPSK	1RB	0Offset	Front	10	18700	1860	21.97	22.5	1.130	-0.12	0.790	0.893
	LTE Band 2	20M	QPSK	1RB	0Offset	Front	10	18900	1880	22.08	22.5	1.102	0.12	0.879	0.968
	LTE Band 2	20M	QPSK	1RB	0Offset	Back	10	19100	1900	22.15	22.5	1.084	-0.17	0.999	1.083
	LTE Band 2	20M	QPSK	1RB	0Offset	Back	10	18700	1860	21.97	22.5	1.130	-0.19	0.950	1.073
09	LTE Band 2	20M	QPSK	1RB	0Offset	Back	10	18900	1880	22.08	22.5	1.102	-0.08	1.040	1.146
	LTE Band 2	20M	QPSK	50RB	0Offset	Front	10	19100	1900	21.17	21.5	1.079	0.01	0.664	0.716
	LTE Band 2	20M	QPSK	50RB	0Offset	Back	10	19100	1900	21.17	21.5	1.079	0.1	0.731	0.789
	LTE Band 2	20M	QPSK	50RB	0Offset	Back	10	18700	1860	20.99	21.5	1.125	0.19	0.675	0.759
	LTE Band 2	20M	QPSK	50RB	0Offset	Back	10	18900	1880	21.13	21.5	1.089	0.08	0.757	0.824
	LTE Band 2	20M	QPSK	100RB	0Offset	Front	10	19100	1900	21.03	21.5	1.114	0.07	0.653	0.728
	LTE Band 2	20M	QPSK	100RB	0Offset	Back	10	19100	1900	21.03	21.5	1.114	0.09	0.717	0.799

**14.4 Product specific 10g SAR****< FDD LTE SAR >**

Plot No.	Band	BW (MHz)	Mode	RB Size	RB Offset	Test Position	Gap (mm)	Power Reduction	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)
	LTE Band 2	20M	QPSK	1RB	0Offset	Bottom Side	0	Off	19100	1900	22.15	22.5	1.084	0.06	2.280	2.471
	LTE Band 2	20M	QPSK	1RB	0Offset	Bottom Side	0	Off	18700	1860	21.97	22.5	1.130	0.01	2.370	2.678
10	LTE Band 2	20M	QPSK	1RB	0Offset	Bottom Side	0	Off	18900	1880	22.08	22.5	1.102	0.03	2.500	2.754

**14.5 Repeated SAR Measurement****<1g SAR>**

No.	Band	BW (MHz)	Mode	RB Size	RB Offset	Test Position	Gap (mm)	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	LTE Band 2	20M	QPSK	1RB	0Offset	Back	10	18900	1880	22.08	22.5	1.102	-0.08	1.040	1	1.146
2nd	LTE Band 2	20M	QPSK	1RB	0Offset	Back	10	18900	1880	22.08	22.5	1.102	-0.03	1.010	1.029	1.113

<10g SAR>

No.	Band	BW (MHz)	Mode	RB Size	RB Offset	Test Position	Gap (mm)	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	LTE Band 2	20M	QPSK	1RB	0Offset	Bottom Side	0	18900	1880	22.08	22.5	1.102	0.03	2.500	1	2.754
2nd	LTE Band 2	20M	QPSK	1RB	0Offset	Bottom Side	0	18900	1880	22.08	22.5	1.102	0.04	2.460	1.016	2.710

General Note:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥ 0.8 W/kg.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR < 1.45 W/kg, only one repeated measurement is required.
3. Per KDB 865664 D01v01r04, 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.

15. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Mobile Cellular Phone			Note
		Head	Body-worn	Hotspot	
1.	GSM Voice + WLAN2.4GHz	Yes	Yes		
2.	GPRS/EDGE + WLAN2.4GHz	Yes	Yes	Yes	Hotspot
3.	WCDMA + WLAN2.4GHz	Yes	Yes	Yes	Hotspot
4.	LTE + WLAN2.4GHz	Yes	Yes	Yes	Hotspot
5.	GSM Voice + Bluetooth		Yes		
6.	GPRS/EDGE + Bluetooth		Yes		WWAN VoIP
7.	WCDMA+ Bluetooth		Yes		WWAN VoIP
8.	LTE + Bluetooth		Yes		WWAN VoIP

General Note:

- This device supported VoIP in GPRS, EGPRS, WCDMA, LTE (e.g. 3rd party VoIP) , LTE supports VoLTE operation.
- This device 2.4GHz WLAN supports Hotspot operation.
- EUT will choose each GSM, WCDMA and LTE according to the network signal condition; therefore, they will not operate simultaneously at any moment.
- WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
- The Scaled SAR summation is calculated based on the same configuration and test position.
- Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
 - Scalar SAR summation < 1.6W/kg.
 - $SPLSR = (SAR1 + SAR2)^{1.5} / (\text{min. separation distance, mm})$, and the peak separation distance is determined from the square root of $[(x1-x2)^2 + (y1-y2)^2 + (z1-z2)^2]$, where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
 - If $SPLSR \leq 0.04$, simultaneously transmission SAR measurement is not necessary.
 - Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.
- For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v06 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 < 5mm, 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 mm.

Bluetooth Max Power	Exposure Position	Body Worn
	Test Separation	10 mm
7.5 dBm	Estimated SAR (W/kg)	0.126 W/kg

15.1 Head Exposure Conditions

WWAN Band		Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)
			WWAN	2.4GHz WLAN	
			1g SAR (W/kg)	1g SAR (W/kg)	
GSM	GSM850	Right Cheek	0.346	0.751	1.10
		Right Tilted	0.202	0.751	0.95
		Left Cheek	0.323	0.751	1.07
		Left Tilted	0.174	0.751	0.93
	GSM1900	Right Cheek	0.048	0.751	0.80
		Right Tilted	0.037	0.751	0.79
		Left Cheek	0.077	0.751	0.83
		Left Tilted	0.020	0.751	0.77
WCDMA	Band II	Right Cheek	0.135	0.751	0.89
		Right Tilted	0.128	0.751	0.88
		Left Cheek	0.218	0.751	0.97
		Left Tilted	0.090	0.751	0.84
	Band V	Right Cheek	0.363	0.751	1.11
		Right Tilted	0.235	0.751	0.99
		Left Cheek	0.372	0.751	1.12
		Left Tilted	0.210	0.751	0.96
	Band IV	Right Cheek	0.301	0.751	1.05
		Right Tilted	0.144	0.751	0.90
		Left Cheek	0.177	0.751	0.93
		Left Tilted	0.143	0.751	0.89
LTE	Band 5	Right Cheek	0.269	0.751	1.02
		Right Tilted	0.173	0.751	0.92
		Left Cheek	0.288	0.751	1.04
		Left Tilted	0.152	0.751	0.90
	Band 7	Right Cheek	0.120	0.751	0.87
		Right Tilted	0.095	0.751	0.85
		Left Cheek	0.210	0.751	0.96
		Left Tilted	0.070	0.751	0.82
	Band 2	Right Cheek	0.111	0.751	0.86
		Right Tilted	0.107	0.751	0.86
		Left Cheek	0.172	0.751	0.92
		Left Tilted	0.093	0.751	0.84
	Band 4	Right Cheek	0.424	0.751	1.18
		Right Tilted	0.169	0.751	0.92
		Left Cheek	0.182	0.751	0.93
		Left Tilted	0.165	0.751	0.92

15.2 Hotspot Exposure Conditions

WWAN Band		Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)
			WWAN	2.4GHz WLAN	
			1g SAR (W/kg)	1g SAR (W/kg)	
GSM	GSM850	Front	0.407	0.189	0.60
		Back	0.575	0.189	0.76
		Left side	0.587	0.189	0.78
		Right side	0.548		0.55
		Top side		0.189	0.19
		Bottom side	0.057		0.06
	GSM1900	Front	0.715	0.189	0.90
		Back	0.791	0.189	0.98
		Left side	0.056	0.189	0.25
		Right side	0.041		0.04
		Top side		0.189	0.19
		Bottom side	1.144		1.14
WCDMA	Band II	Front	0.359	0.189	0.55
		Back	0.377	0.189	0.57
		Left side	0.075	0.189	0.26
		Right side	0.090		0.09
		Top side		0.189	0.19
		Bottom side	0.633		0.63
	Band V	Front	0.450	0.189	0.64
		Back	0.636	0.189	0.83
		Left side	0.672	0.189	0.86
		Right side	0.678		0.68
		Top side		0.189	0.19
		Bottom side	0.059		0.06
	Band IV	Front	0.467	0.189	0.66
		Back	0.409	0.189	0.60
		Left side	0.095	0.189	0.28
		Right side	0.297		0.30
		Top side		0.189	0.19
		Bottom side	0.610		0.61

WWAN Band		Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)
			WWAN	2.4GHz WLAN	
			1g SAR (W/kg)	1g SAR (W/kg)	
LTE	Band 5	Front	0.397	0.189	0.59
		Back	0.579	0.189	0.77
		Left side	0.554	0.189	0.74
		Right side	0.593		0.59
		Top side		0.189	0.19
		Bottom side	0.056		0.06
	Band 7	Front	0.623	0.189	0.81
		Back	0.662	0.189	0.85
		Left side	0.204	0.189	0.39
		Right side	0.186		0.19
		Top side		0.189	0.19
		Bottom side	0.686		0.69
	Band 2	Front	0.367	0.189	0.56
		Back	0.419	0.189	0.61
		Left side	0.077	0.189	0.27
		Right side	0.052		0.05
		Top side		0.189	0.19
		Bottom side	0.653		0.65
	Band 4	Front	0.533	0.189	0.72
		Back	0.486	0.189	0.68
		Left side	0.104	0.189	0.29
		Right side	0.291		0.29
		Top side		0.189	0.19
		Bottom side	0.735		0.74



15.3 Body-Worn Accessory Exposure Conditions

WWAN Band		Exposure Position	1	2	3	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)
			WWAN	2.4GHz WLAN	Bluetooth		
			1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)		
GSM	GSM850	Front	0.407	0.189	0.126	0.60	0.53
		Back	0.575	0.189	0.126	0.76	0.70
	GSM1900	Front	0.715	0.189	0.126	0.90	0.84
		Back	0.791	0.189	0.126	0.98	0.92
WCDMA	Band II	Front	0.991	0.189	0.126	1.18	1.12
		Back	1.179	0.189	0.126	1.37	1.31
	Band V	Front	0.450	0.189	0.126	0.64	0.58
		Back	0.636	0.189	0.126	0.83	0.76
	Band IV	Front	0.467	0.189	0.126	0.66	0.59
		Back	0.409	0.189	0.126	0.60	0.54
LTE	Band 5	Front	0.397	0.189	0.126	0.59	0.52
		Back	0.579	0.189	0.126	0.77	0.71
	Band 7	Front	0.623	0.189	0.126	0.81	0.75
		Back	0.662	0.189	0.126	0.85	0.79
	Band 2	Front	0.968	0.189	0.126	1.16	1.09
		Back	1.146	0.189	0.126	1.34	1.27
	Band 4	Front	0.533	0.189	0.126	0.72	0.66
		Back	0.486	0.189	0.126	0.68	0.61

Test Engineer : Luke Lu and Nick Hu

16. 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)	$1/k^{(b)}$	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

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

(b) k is the coverage factor

Table 16.1. 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	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	6.00	N	1	1	1	6.0	6.0
Axial Isotropy	4.70	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.60	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	1.00	R	1.732	1	1	0.6	0.6
Linearity	4.70	R	1.732	1	1	2.7	2.7
System Detection Limits	1.00	R	1.732	1	1	0.6	0.6
Modulation Response	4.68	R	1.732	1	1	2.7	2.7
Readout Electronics	0.30	N	1	1	1	0.3	0.3
Response Time	0.00	R	1.732	1	1	0.0	0.0
Integration Time	2.60	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.00	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.00	R	1.732	1	1	1.7	1.7
Probe Positioner	0.40	R	1.732	1	1	0.2	0.2
Probe Positioning	2.90	R	1.732	1	1	1.7	1.7
Max. SAR Eval.	2.00	R	1.732	1	1	1.2	1.2
Test Sample Related							
Device Positioning	3.03	N	1	1	1	3.0	3.0
Device Holder	3.60	N	1	1	1	3.6	3.6
Power Drift	5.00	R	1.732	1	1	2.9	2.9
Power Scaling	0.00	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.10	R	1.732	1	1	3.5	3.5
SAR correction	0.00	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.03	N	1	0.78	0.71	0.0	0.0
Liquid Conductivity (target)	5.00	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.50	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.68	R	1.732	0.78	0.71	1.7	1.5
Liquid Permittivity Repeatability	0.02	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.00	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.50	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.84	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						11.6%	11.6%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						23.2%	23.1%

Table 16.2. Uncertainty Budget for frequency range 300 MHz to 3 GHz

17. 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] IEEE Std. 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", Sep 2013
- [4] SPEAG DASY System Handbook
- [5] FCC KDB 248227 D01 v02r02, "SAR Guidance for IEEE 802.11 (WiFi) Transmitters", Oct 2015.
- [6] FCC KDB 447498 D01 v06, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", Oct 2015
- [7] FCC KDB 648474 D04 v01r03, "SAR Evaluation Considerations for Wireless Handsets", Oct 2015.
- [8] FCC KDB 941225 D01 v03r01, "3G SAR MEAUREMENT PROCEDURES", Oct 2015
- [9] FCC KDB 941225 D05 v02r05, "SAR Evaluation Considerations for LTE Devices", Dec 2015
- [10] FCC KDB 941225 D06 v02r01, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", Oct 2015.
- [11] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.
- [12] FCC KDB 865664 D02 v01r02, "RF Exposure Compliance Reporting and Documentation Considerations" Oct 2015.



Appendix A. Plots of System Performance Check

The plots are shown as follows.

System Check_Head_1750MHz

DUT: Dipole 1750 MHz

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: HSL_1800 Medium parameters used: $f = 1750$ MHz; $\sigma = 1.385$ S/m; $\epsilon_r = 39.708$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.9 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3819; ConvF(8.56, 8.56, 8.56); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2016.11.22
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1671
- 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) = 13.2 W/kg

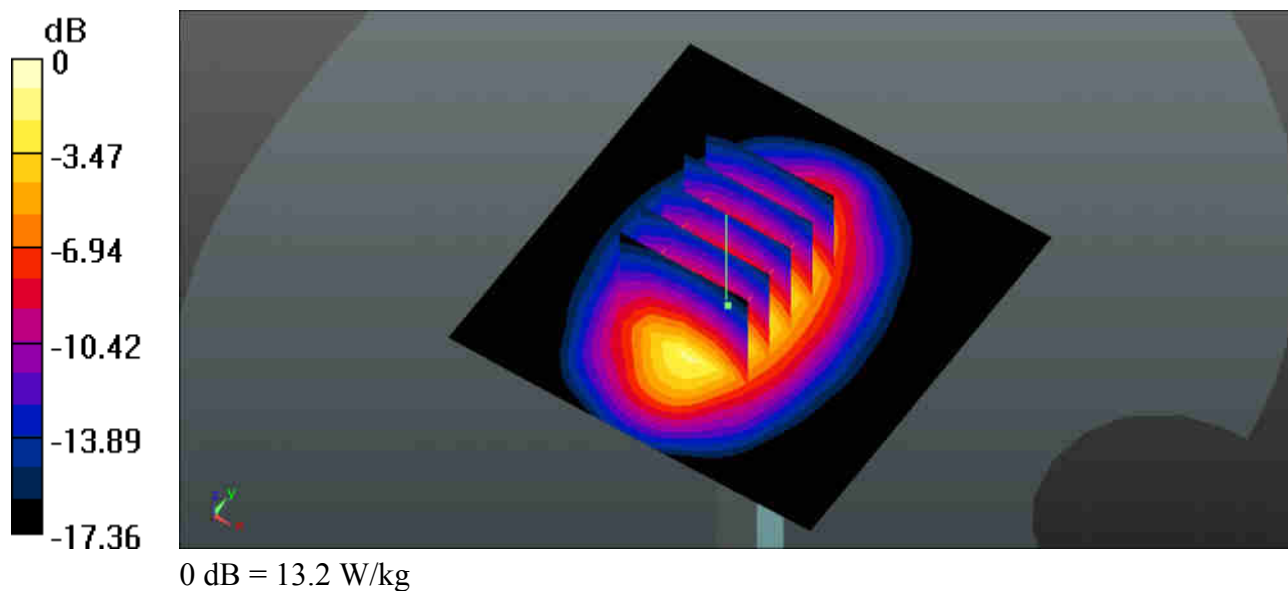
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 96.30 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 16.4 W/kg

SAR(1 g) = 9.06 W/kg; SAR(10 g) = 4.8 W/kg

Maximum value of SAR (measured) = 12.9 W/kg



System Check_Head_1900MHz**DUT: D1900V2 - SN:5d118**

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

Medium: HSL_1900 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.411$ S/m; $\epsilon_r = 38.714$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(8.32, 8.32, 8.32); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2016.4.4
- Phantom: SAM1; Type: SAM; Serial: TP-1644
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 14.5 W/kg

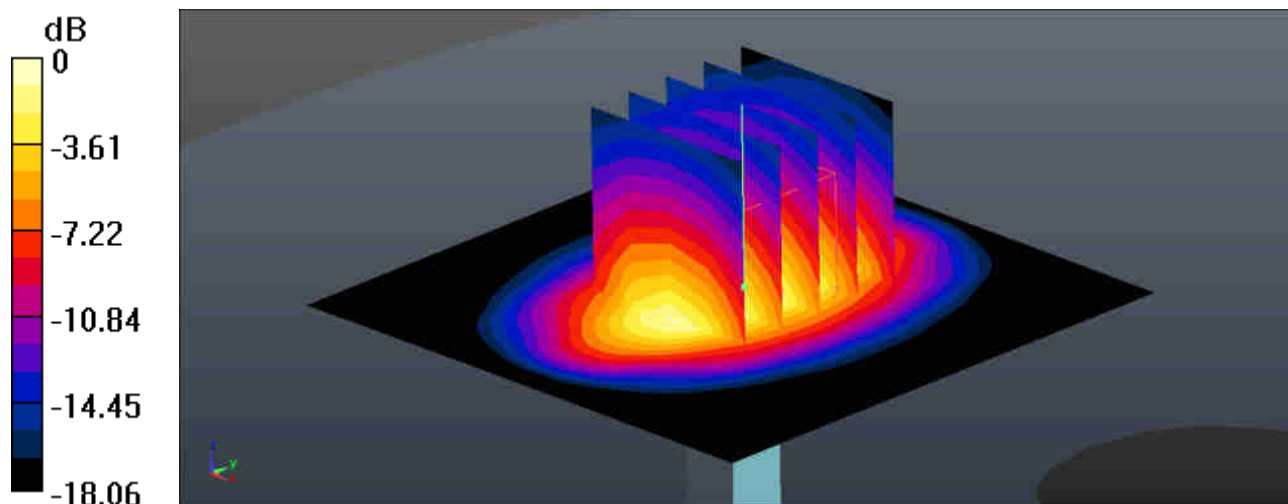
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 88.67 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 18.1 W/kg

SAR(1 g) = 9.96 W/kg; SAR(10 g) = 5.19 W/kg

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



0 dB = 14.2 W/kg = 11.52 dBW/kg

System Check_Body_1750MHz_170304**DUT: Dipole 1750 MHz**

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: MSL_1800 Medium parameters used: $f = 1750$ MHz; $\sigma = 1.522$ S/m; $\epsilon_r = 52.519$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3819; ConvF(8.08, 8.08, 8.08); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2016.11.22
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1671
- 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) = 13.1 W/kg

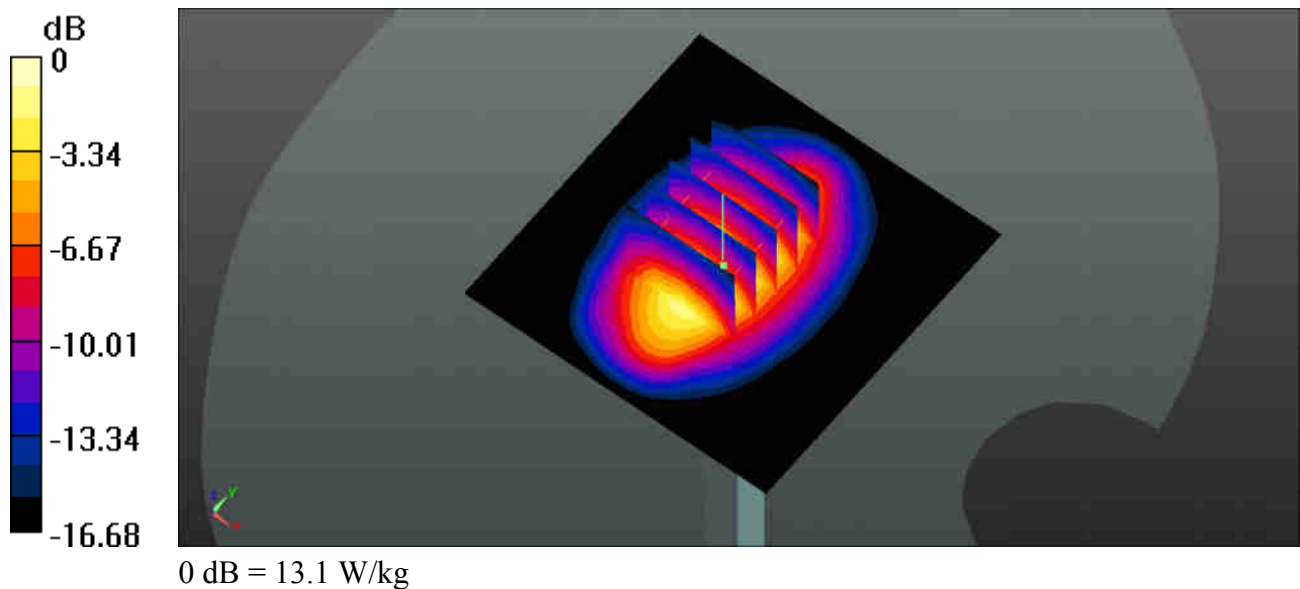
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 93.46 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 16.2 W/kg

SAR(1 g) = 9.36 W/kg; SAR(10 g) = 5.01 W/kg

Maximum value of SAR (measured) = 13.1 W/kg



System Check_Body_1900MHz**DUT: D1900V2 - SN:5d118**

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

Medium: MSL_1900 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.512$ S/m; $\epsilon_r = 51.861$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(8.01, 8.01, 8.01); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2016.4.4
- Phantom: SAM2; Type: SAM; Serial: TP-1542
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 13.9 W/kg

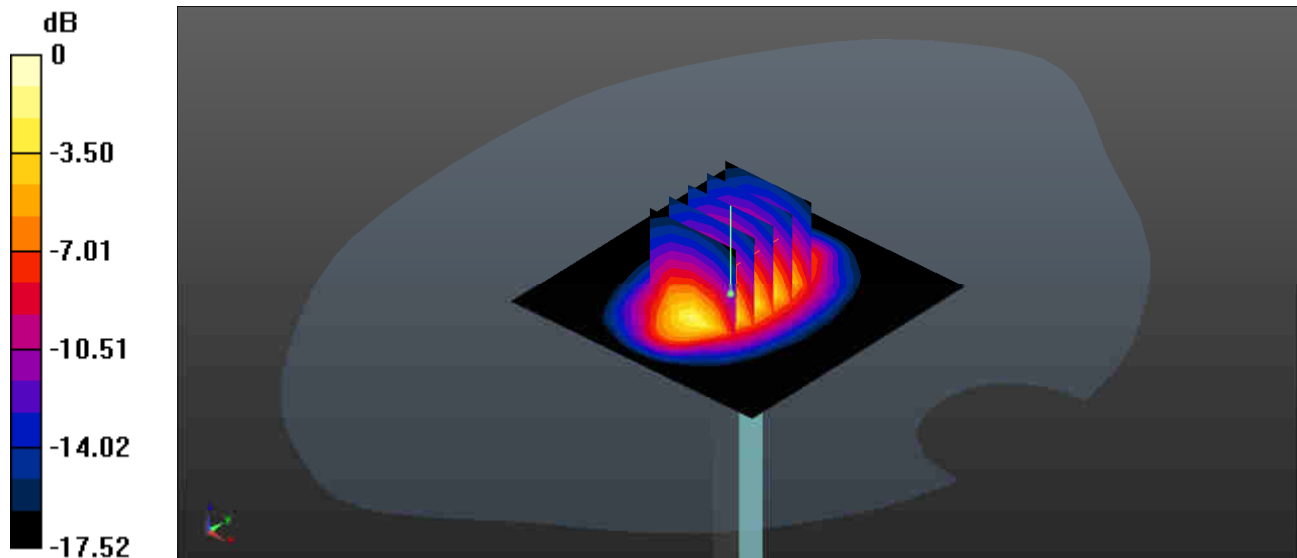
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 84.86 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 17.4 W/kg

SAR(1 g) = 9.68 W/kg; SAR(10 g) = 5.05 W/kg

Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg



Appendix B. Plots of SAR Measurement

The plots are shown as follows.

01_WCDMA IV_RMC 12.2Kbps_Right Cheek_Ch1312

Communication System: UID 0, UMTS (0); Frequency: 1712.4 MHz; Duty Cycle: 1:1

Medium: HSL_1800_170304 Medium parameters used: $f = 1712.4$ MHz; $\sigma = 1.35$ S/m; $\epsilon_r = 39.724$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C; Liquid Temperature : 22.9 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3819; ConvF(8.56, 8.56, 8.56); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2016.11.22
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1671
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1312/Area Scan (71x121x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.349 W/kg

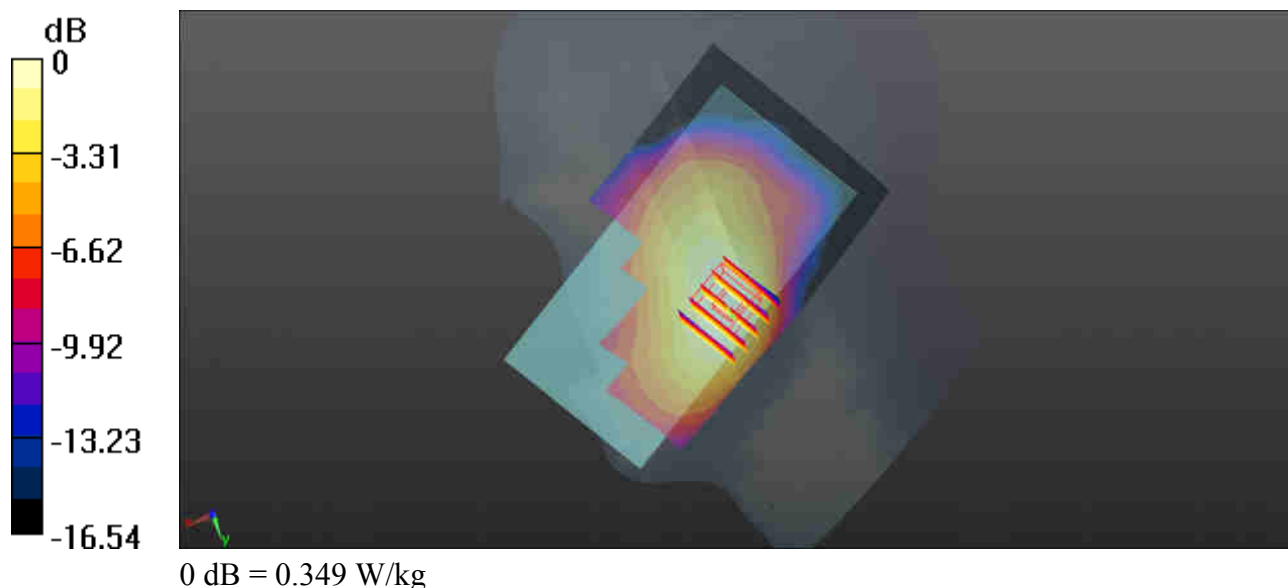
Ch1312/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.477 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.425 W/kg

SAR(1 g) = 0.295 W/kg; SAR(10 g) = 0.195 W/kg

Maximum value of SAR (measured) = 0.362 W/kg



02_LTE Band 4_20M_QPSK_1RB_0Offset_Right Cheek_Ch20175

Communication System: UID 0, LTE (0); Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium: HSL_1800_170304 Medium parameters used: $f = 1732.5$ MHz; $\sigma = 1.371$ S/m; $\epsilon_r = 39.759$;

$\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C; Liquid Temperature : 22.9 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3819; ConvF(8.56, 8.56, 8.56); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2016.11.22
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1671
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch20175/Area Scan (71x121x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.461 W/kg

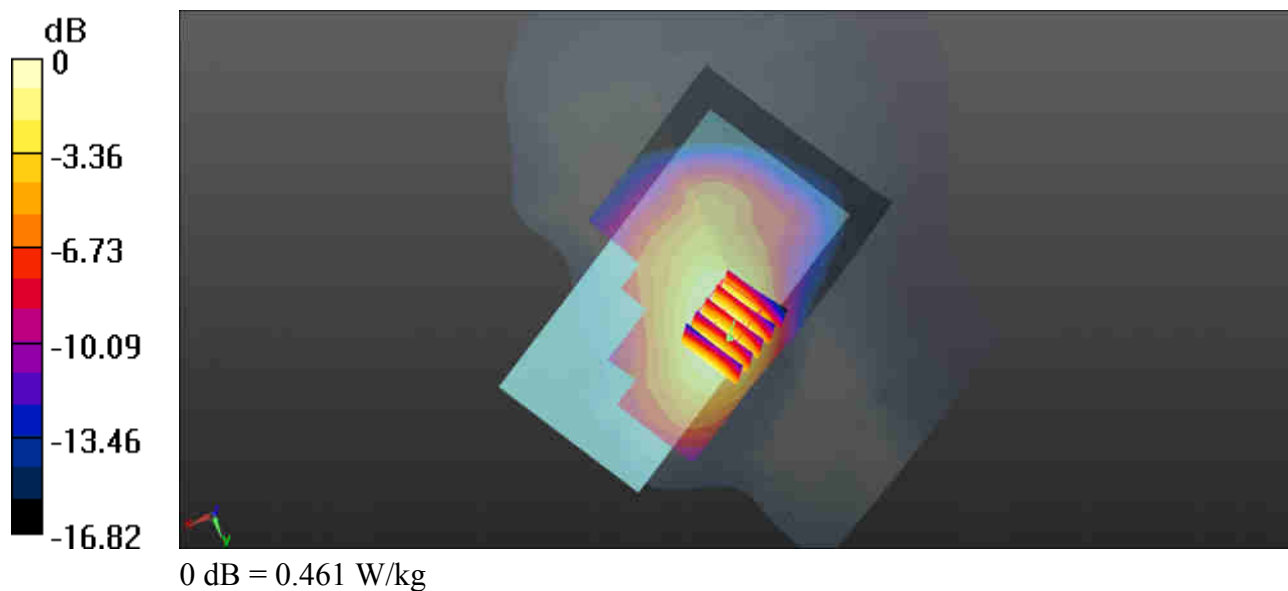
Ch20175/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.425 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.558 W/kg

SAR(1 g) = 0.386 W/kg; SAR(10 g) = 0.253 W/kg

Maximum value of SAR (measured) = 0.470 W/kg



03_LTE Band 2_20M_QPSK_1RB_0Offset_Left Cheek_0mm_Ch19100

Communication System: UID 0, FDD_LTE (0); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL_1900 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.411$ S/m; $\epsilon_r = 38.714$; $\rho = 1000$

kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(8.32, 8.32, 8.32); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2016.4.4
- Phantom: SAM1; Type: SAM; Serial: TP-1644
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch19100/Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.206 W/kg

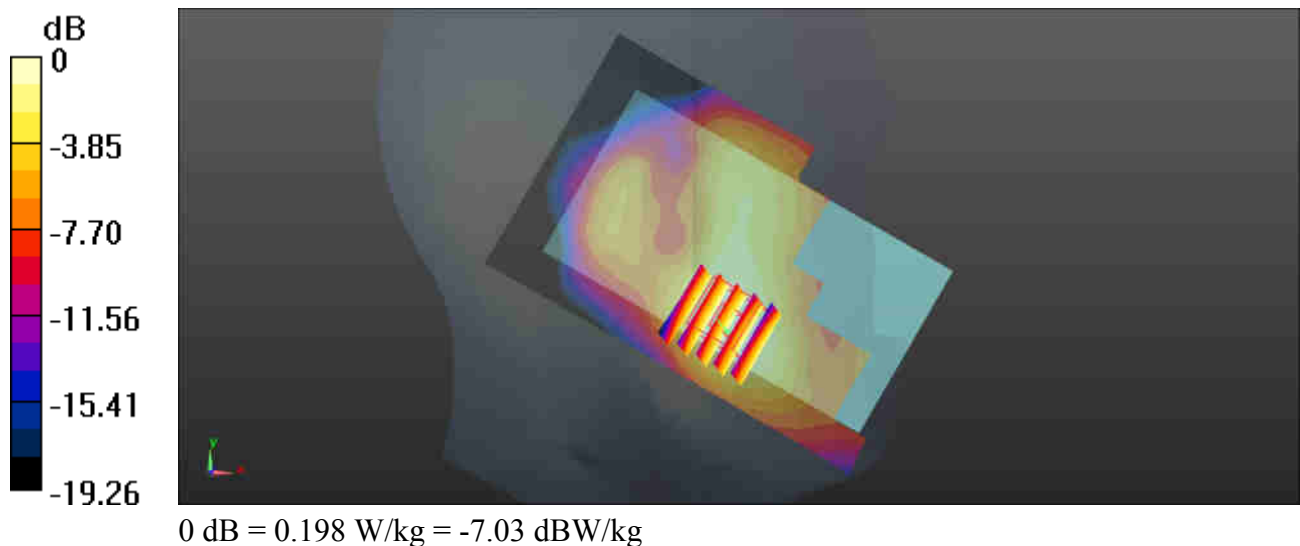
Ch19100/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.012 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.233 W/kg

SAR(1 g) = 0.159 W/kg; SAR(10 g) = 0.103 W/kg

Maximum value of SAR (measured) = 0.198 W/kg



04_WCDMA IV_RMC 12.2Kbps_Bottom Side_10mm_Ch1312

Communication System: UID 0, UMTS (0); Frequency: 1712.4 MHz; Duty Cycle: 1:1

Medium: MSL_1800_170304 Medium parameters used: $f = 1712.4$ MHz; $\sigma = 1.479$ S/m; $\epsilon_r = 52.596$;

$\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3819; ConvF(8.08, 8.08, 8.08); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2016.11.22
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1671
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1312/Area Scan (41x71x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.842 W/kg

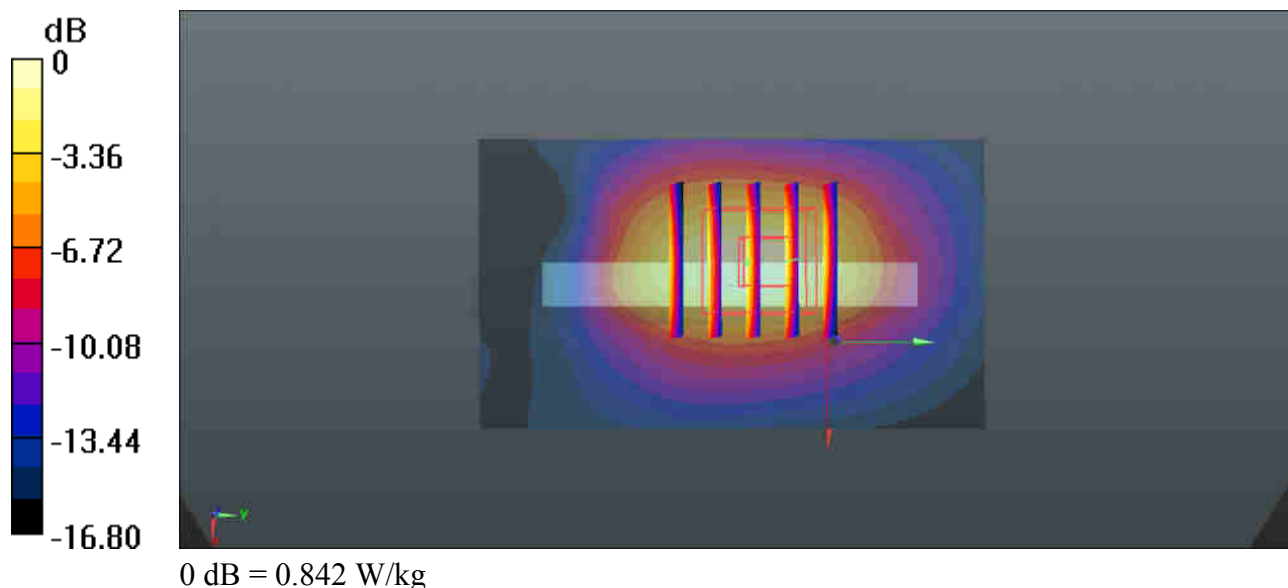
Ch1312/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.963 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 0.990 W/kg

SAR(1 g) = 0.597 W/kg; SAR(10 g) = 0.329 W/kg

Maximum value of SAR (measured) = 0.795 W/kg



05_LTE Band 4_20M_QPSK_1RB_0Offset_Bottom Side_10mm_Ch20175

Communication System: UID 0, LTE (0); Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium: MSL_1800_170304 Medium parameters used: $f = 1732.5$ MHz; $\sigma = 1.502$ S/m; $\epsilon_r = 52.553$;

$\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3819; ConvF(8.08, 8.08, 8.08); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2016.11.22
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1671
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch20175/Area Scan (41x71x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.968 W/kg

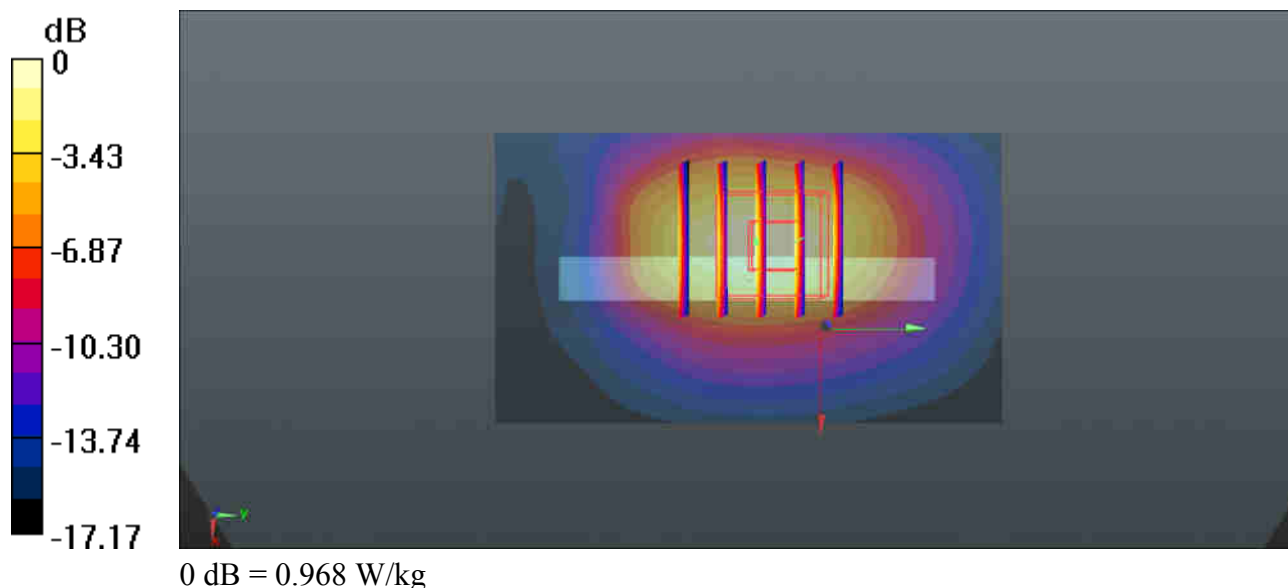
Ch20175/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.073 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 1.10 W/kg

SAR(1 g) = 0.669 W/kg; SAR(10 g) = 0.373 W/kg

Maximum value of SAR (measured) = 0.895 W/kg



06_LTE Band 2_20M_QPSK_1RB_0Offset_Bottom Side_10mm_Ch19100

Communication System: UID 0, FDD_LTE (0); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: MSL_1900 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.512$ S/m; $\epsilon_r = 51.861$; $\rho = 1000$ kg/m³
Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(8.01, 8.01, 8.01); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2016.4.4
- Phantom: SAM2; Type: SAM; Serial: TP-1542
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch19100/Area Scan (41x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.883 W/kg

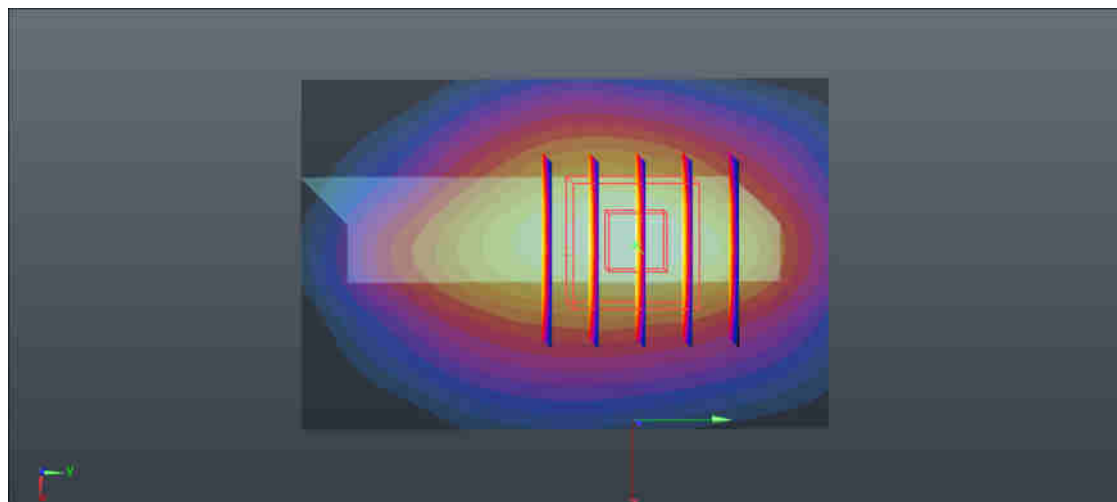
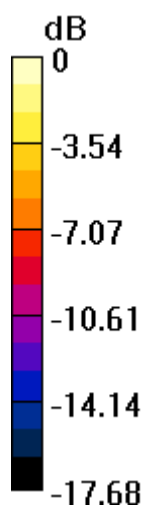
Ch19100/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 20.58 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 1.05 W/kg

SAR(1 g) = 0.616 W/kg; SAR(10 g) = 0.327 W/kg

Maximum value of SAR (measured) = 0.855 W/kg



0 dB = 0.855 W/kg = -0.68 dBW/kg

07_WCDMA IV_RMC 12.2Kbps_Front_10mm_Ch1312

Communication System: UID 0, UMTS (0); Frequency: 1712.4 MHz; Duty Cycle: 1:1

Medium: MSL_1800_170304 Medium parameters used: $f = 1712.4$ MHz; $\sigma = 1.479$ S/m; $\epsilon_r = 52.596$;

$\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3819; ConvF(8.08, 8.08, 8.08); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2016.11.22
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1671
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1312/Area Scan (71x121x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.612 W/kg

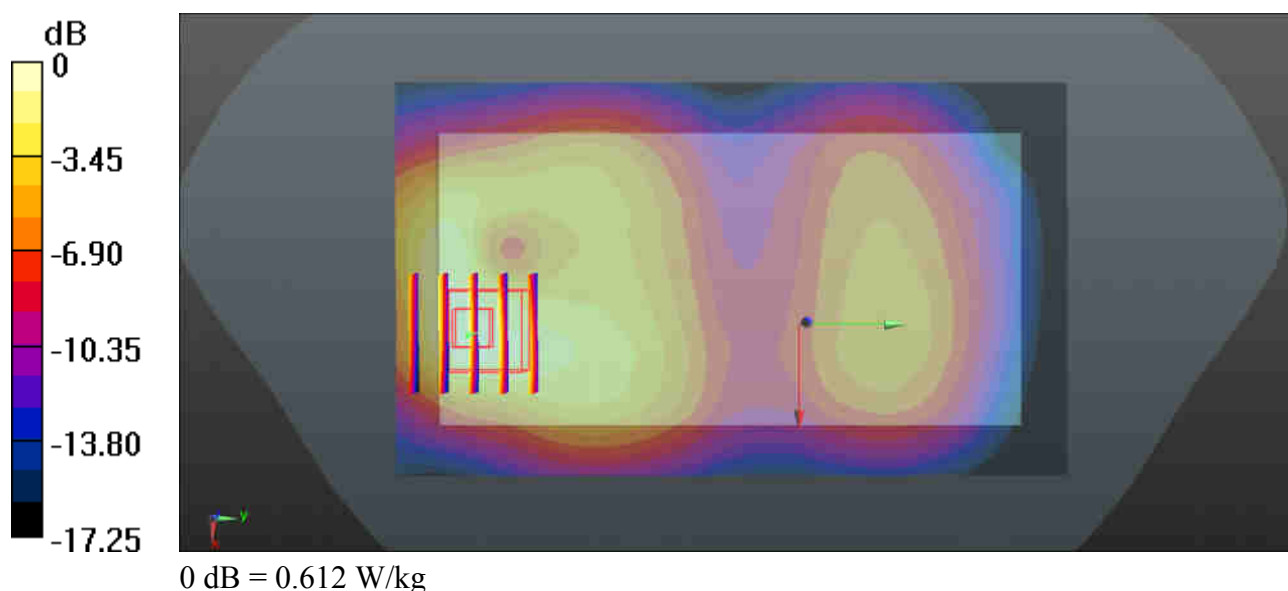
Ch1312/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.168 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.751 W/kg

SAR(1 g) = 0.457 W/kg; SAR(10 g) = 0.266 W/kg

Maximum value of SAR (measured) = 0.611 W/kg



08_LTE Band 4_20M_QPSK_1RB_0Offset_Front_10mm_Ch20175

Communication System: UID 0, LTE (0); Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium: MSL_1800_170304 Medium parameters used: $f = 1732.5$ MHz; $\sigma = 1.502$ S/m; $\epsilon_r = 52.553$;

$\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3819; ConvF(8.08, 8.08, 8.08); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2016.11.22
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1671
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch20175/Area Scan (71x121x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.656 W/kg

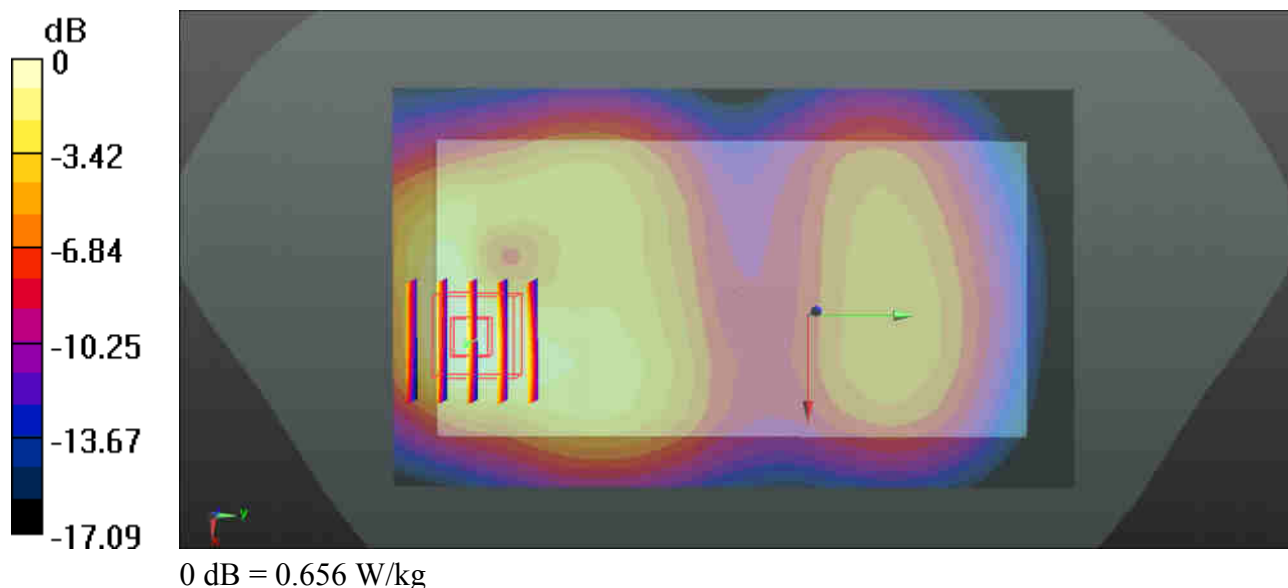
Ch20175/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.209 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 0.805 W/kg

SAR(1 g) = 0.485 W/kg; SAR(10 g) = 0.280 W/kg

Maximum value of SAR (measured) = 0.650 W/kg



09_LTE Band 2_20M_QPSK_1RB_0Offset_Back_10mm_Ch18900

Communication System: UID 0, FDD_LTE (0); Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: MSL_1900 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.489$ S/m; $\epsilon_r = 51.943$; $\rho = 1000$

kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(8.01, 8.01, 8.01); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2016.4.4
- Phantom: SAM2; Type: SAM; Serial: TP-1542
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch18900/Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.39 W/kg

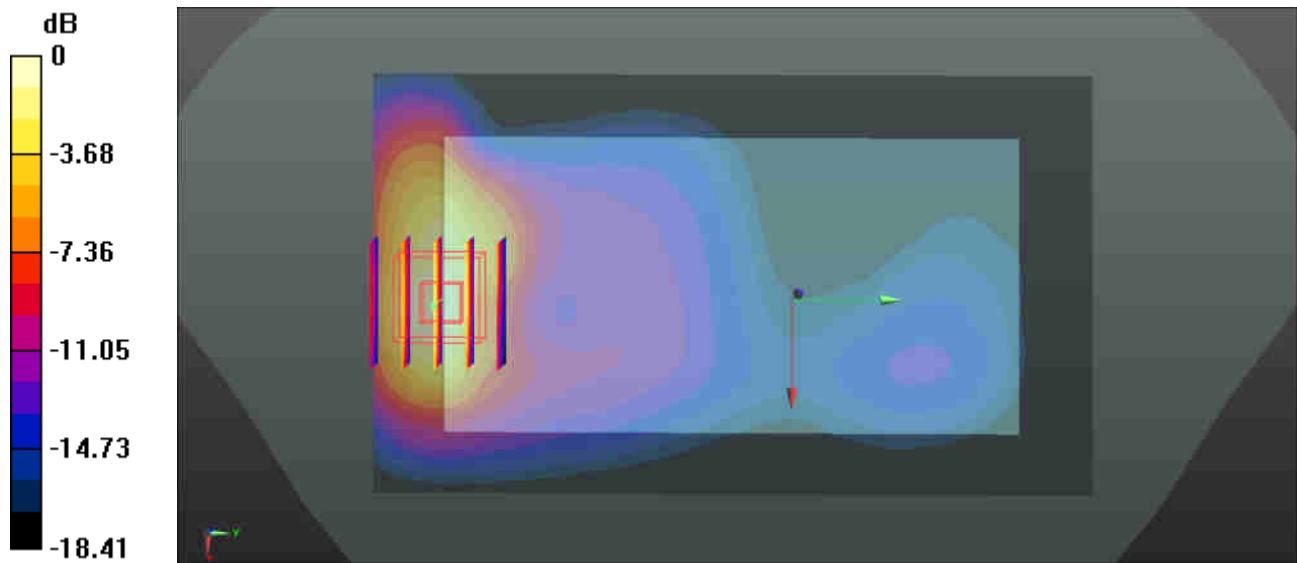
Ch18900/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.814 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 1.81 W/kg

SAR(1 g) = 1.04 W/kg; SAR(10 g) = 0.540 W/kg

Maximum value of SAR (measured) = 1.37 W/kg



0 dB = 1.37 W/kg = 1.37 dBW/kg

10_LTE Band 2_20M_QPSK_1RB_0Offset_Bottom Side_0mm_Ch18900

Communication System: UID 0, FDD_LTE (0); Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: MSL_1900 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.489$ S/m; $\epsilon_r = 51.943$; $\rho = 1000$

kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(8.01, 8.01, 8.01); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2016.4.4
- Phantom: SAM2; Type: SAM; Serial: TP-1542
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch18900/Area Scan (41x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 9.13 W/kg

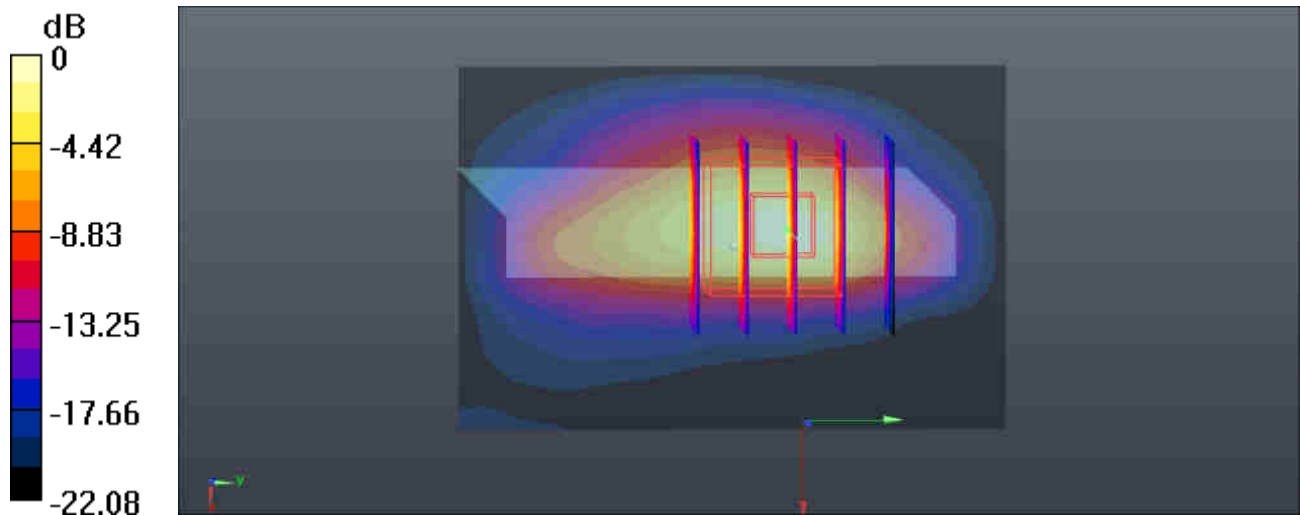
Ch18900/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 61.43 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 12.6 W/kg

SAR(1 g) = 5.8 W/kg; SAR(10 g) = 2.5 W/kg

Maximum value of SAR (measured) = 9.84 W/kg



0 dB = 9.84 W/kg = 9.93 dBW/kg



Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.



In Collaboration with
s p e a g
CALIBRATION LABORATORY



中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

Client

Sporton_CN

Certificate No: Z16-97070

CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1137**

Calibration Procedure(s) **FD-Z11-2-003-01**
Calibration Procedures for dipole validation kits

Calibration date: **May 18, 2016**

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(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	01-Jul-15 (CTTL, No.J15X04256)	Jun-16
Power sensor NRP-Z91	101547	01-Jul-15 (CTTL, No.J15X04256)	Jun-16
Reference Probe EX3DV4	SN 7307	19-Feb-16(SPEAG,No.EX3-7307_Feb16)	Feb-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG,No.Z16-97011)	Feb-17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: May 20, 2016

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



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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 300MHz to 3GHz)", February 2005
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, 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%.



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
 E-mail: cttl@chinattl.com Http://www.chinattl.cn

Measurement Conditions

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

DASY Version	DASY52	52.8.8.1258
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.3 $\pm$ 6 %	1.39 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.18 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	36.5 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.04 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.1 mW / g $\pm$ 20.4 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.3 $\pm$ 6 %	1.48 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.27 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	37.4 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	4.96 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.0 mW / g $\pm$ 20.4 % (k=2)



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$50.3\Omega + 0.73j\Omega$
Return Loss	- 42.0dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$44.9\Omega + 1.29j\Omega$
Return Loss	- 25.2dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.321 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
-----------------	-------



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY5 Validation Report for Head TSL

Date: 05.18.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1137

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.388$ S/m; $\epsilon_r = 40.26$; $\rho = 1000$ kg/m³

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(8.37, 8.37, 8.37); Calibrated: 2/19/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:

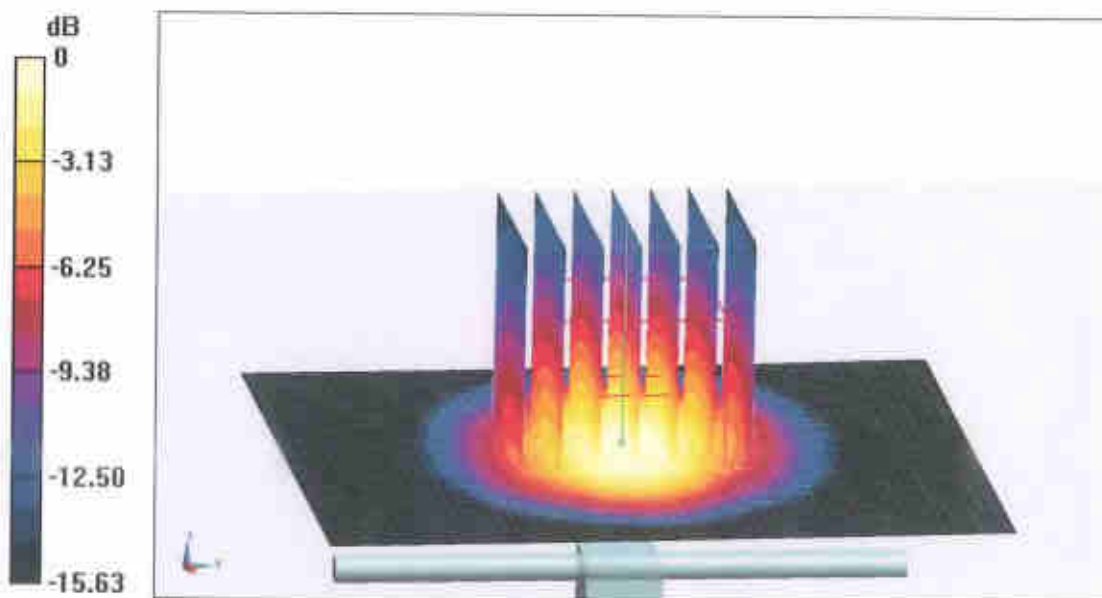
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 97.87V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 15.9W/kg

SAR(1 g) = 9.18 W/kg; SAR(10 g) = 5.04 W/kg

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



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



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

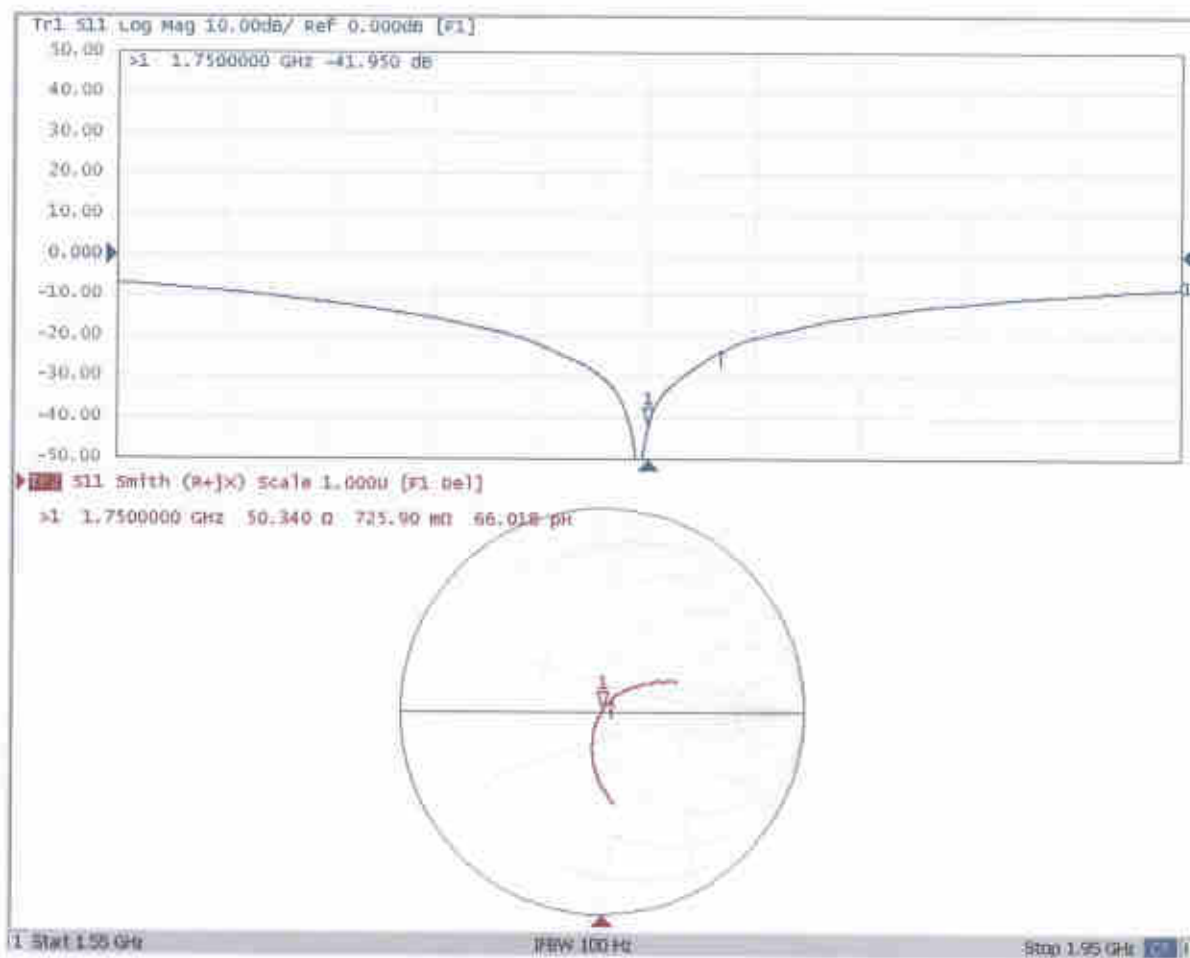
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

Http://www.chinattl.cn

Impedance Measurement Plot for Head TSL





In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

Http://www.chinattl.cn

DASY5 Validation Report for Body TSL

Date: 05.18.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1137

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.476$ S/m; $\epsilon_r = 54.25$; $\rho = 1000$ kg/m³

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(8.18, 8.18, 8.18); Calibrated: 2/19/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:

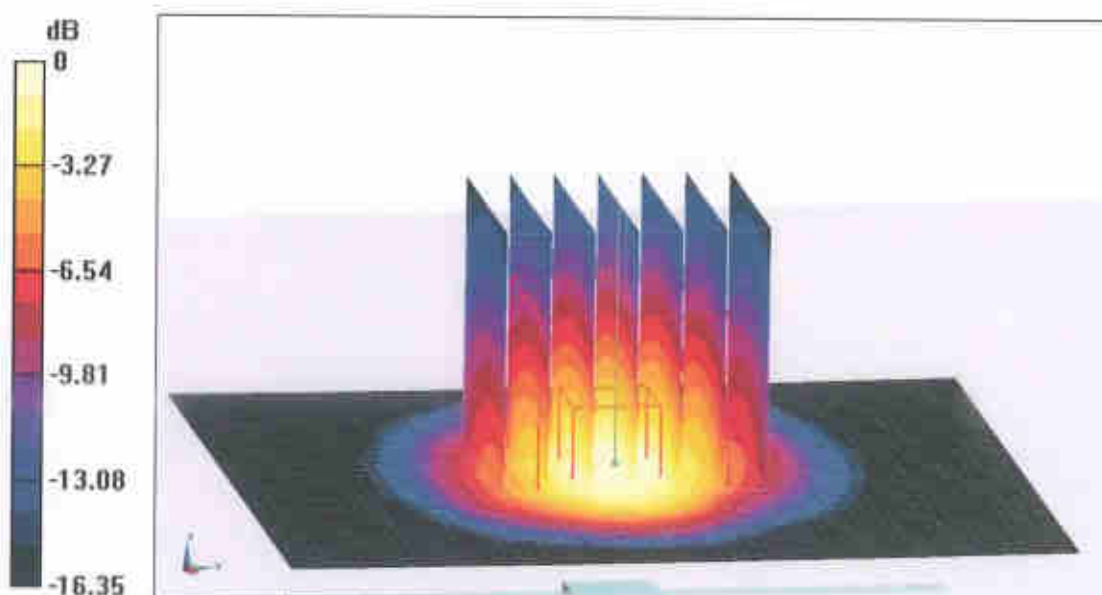
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 96.05 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 16.3 W/kg

SAR(1 g) = 9.27 W/kg; SAR(10 g) = 4.96 W/kg

Maximum value of SAR (measured) = 13.0 W/kg



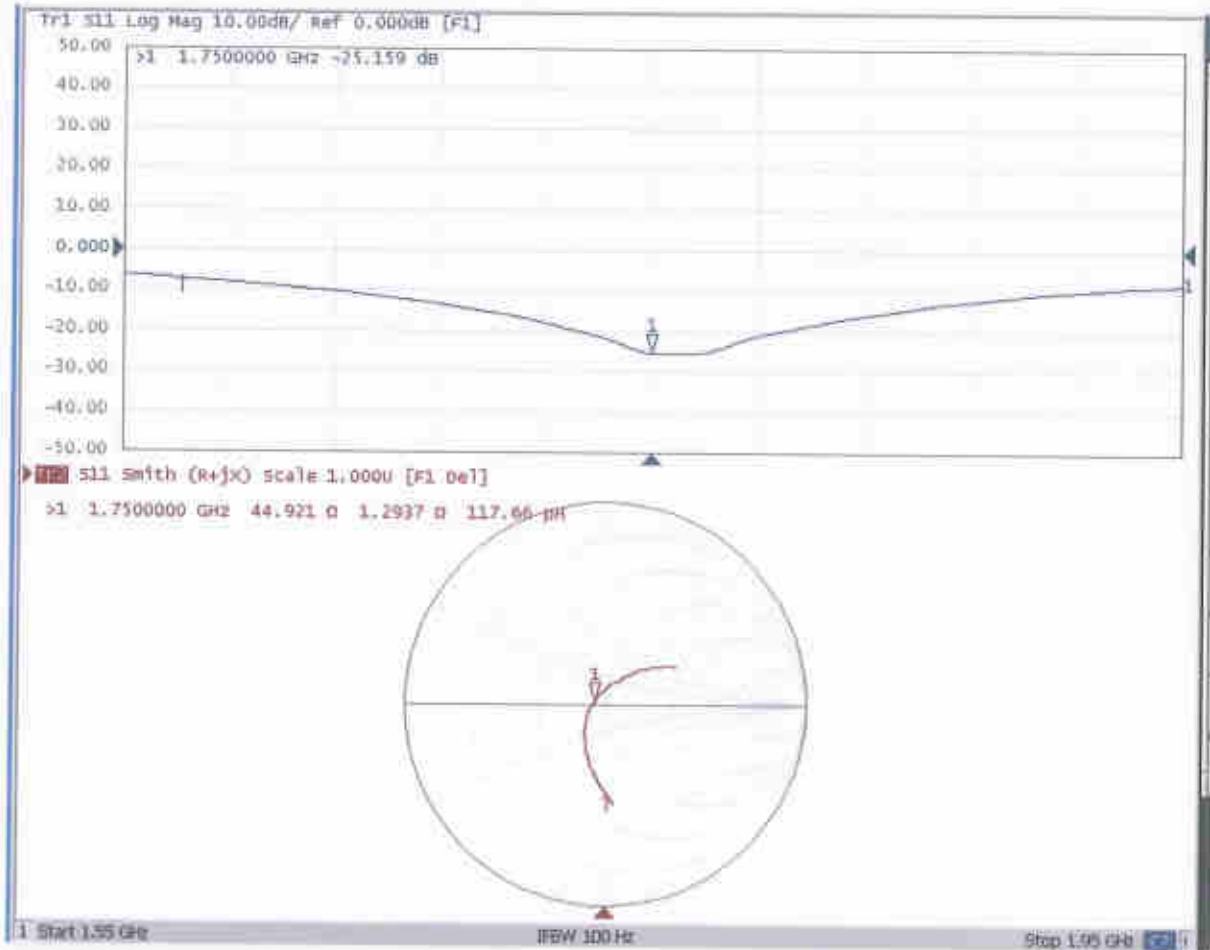
0 dB = 13.0 W/kg = 11.14 dBW/kg



In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Impedance Measurement Plot for Body TSL





In Collaboration with
s p e a g
CALIBRATION LABORATORY



中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

Client

Sporton-CN

Certificate No: **Z16-97229**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d118**

Calibration Procedure(s) **FD-Z11-003-01**
Calibration Procedures for dipole validation kits

Calibration date: **November 24, 2016**

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG,No.Z16-97011)	Feb-17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: November 27, 2016

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



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

Http://www.chinattl.cn

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 300MHz to 3GHz)", February 2005
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, 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%.



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

Http://www.chinattl.cn

Measurement Conditions

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

DASY Version	DASY52	52.8.8.1258
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
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	40.4 $\pm$ 6 %	1.43 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.4 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.29 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.0 mW / g $\pm$ 20.4 % (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	54.6 $\pm$ 6 %	1.53 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.8 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.32 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.3 mW / g $\pm$ 20.4 % (k=2)



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

Http://www.chinattl.cn

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$50.4\Omega + 6.22j\Omega$
Return Loss	- 24.2dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$47.5\Omega + 7.79j\Omega$
Return Loss	- 21.6dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.086 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
-----------------	-------



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

Http://www.chinattl.cn

DASY5 Validation Report for Head TSL

Date: 11.24.2016

Test Laboratory: CTTL, Beijing, China

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

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.426$ S/m; $\epsilon_r = 40.35$; $\rho = 1000$ kg/m³

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.98, 7.98, 7.98); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:

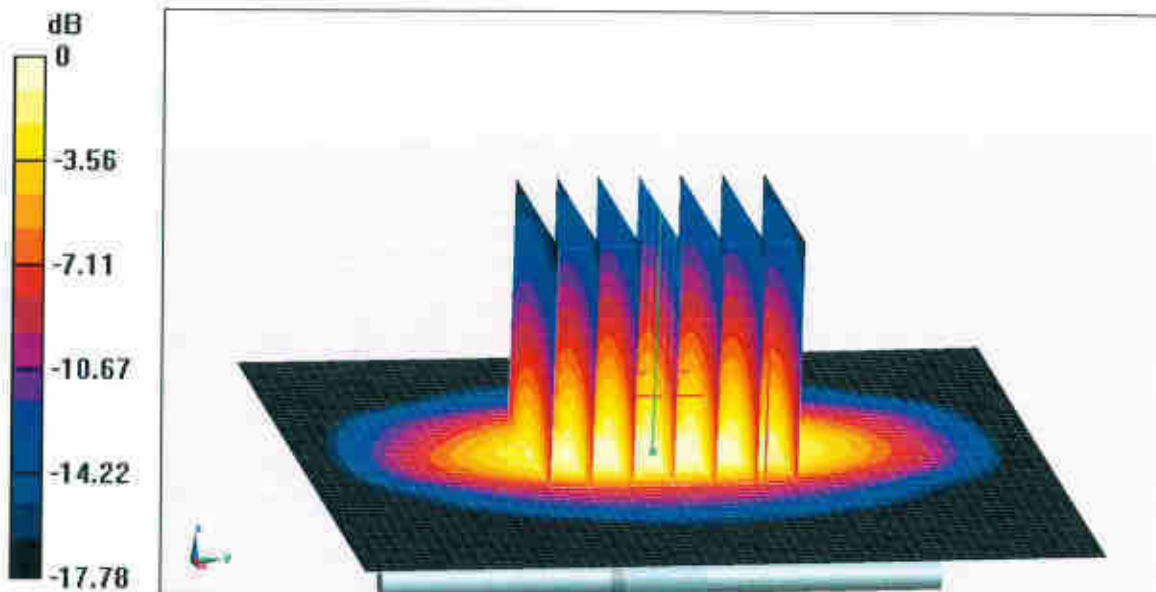
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 103.5 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 18.9 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.29 W/kg

Maximum value of SAR (measured) = 14.7 W/kg



0 dB = 14.7 W/kg = 11.67 dBW/kg



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

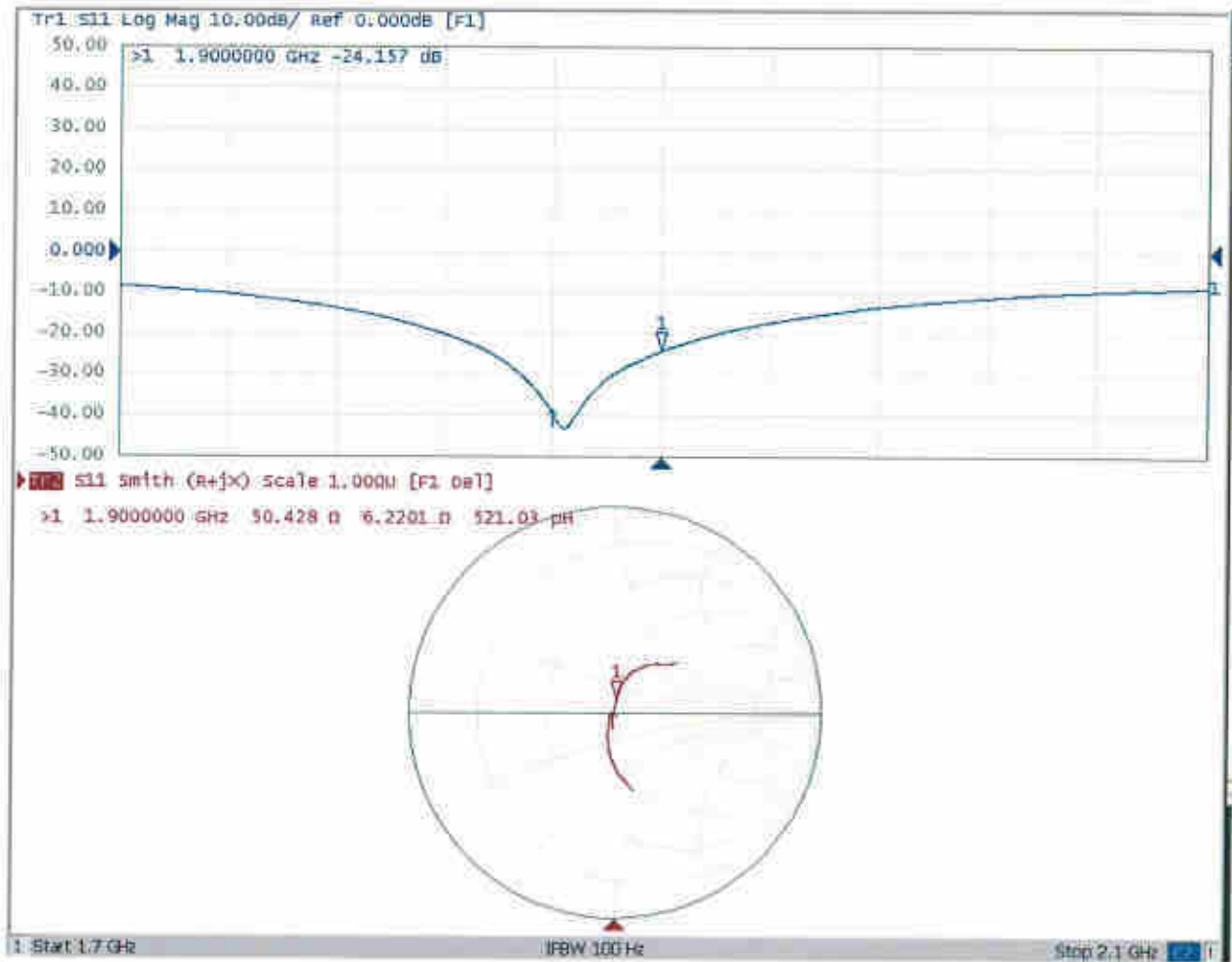
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

Http://www.chinattl.cn

Impedance Measurement Plot for Head TSL





In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY5 Validation Report for Body TSL

Date: 11.23.2016

Test Laboratory: CTTL, Beijing, China

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

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.531$ S/m; $\epsilon_r = 54.57$; $\rho = 1000$ kg/m³

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.7, 7.7, 7.7); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:

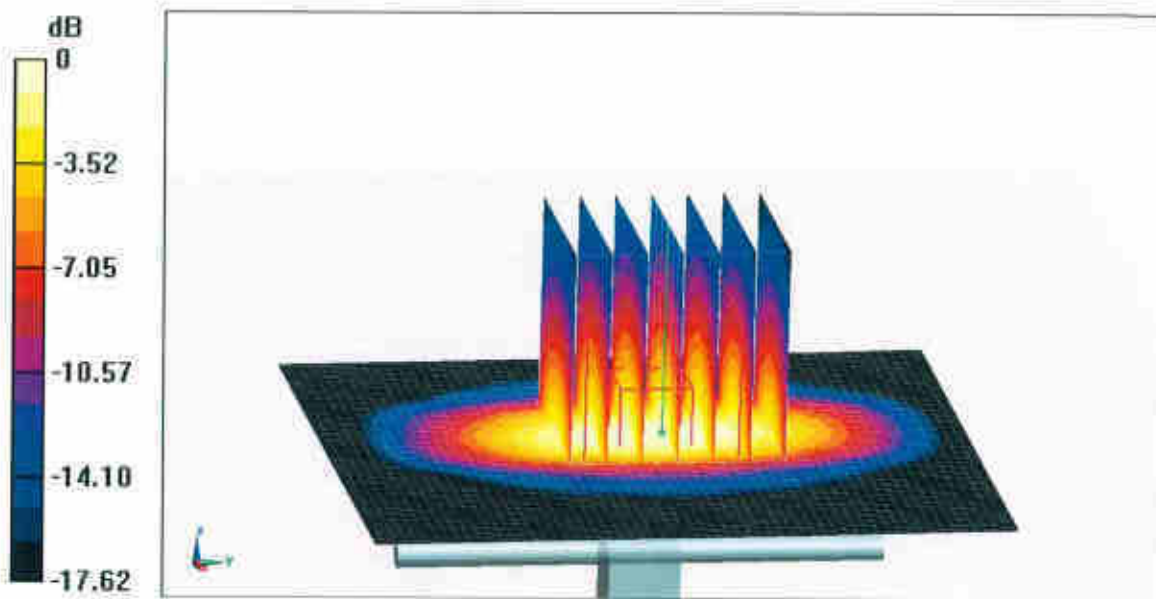
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 98.23 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 18.5 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.32 W/kg

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



0 dB = 14.6 W/kg = 11.64 dBW/kg



In Collaboration with

s p e a g

CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

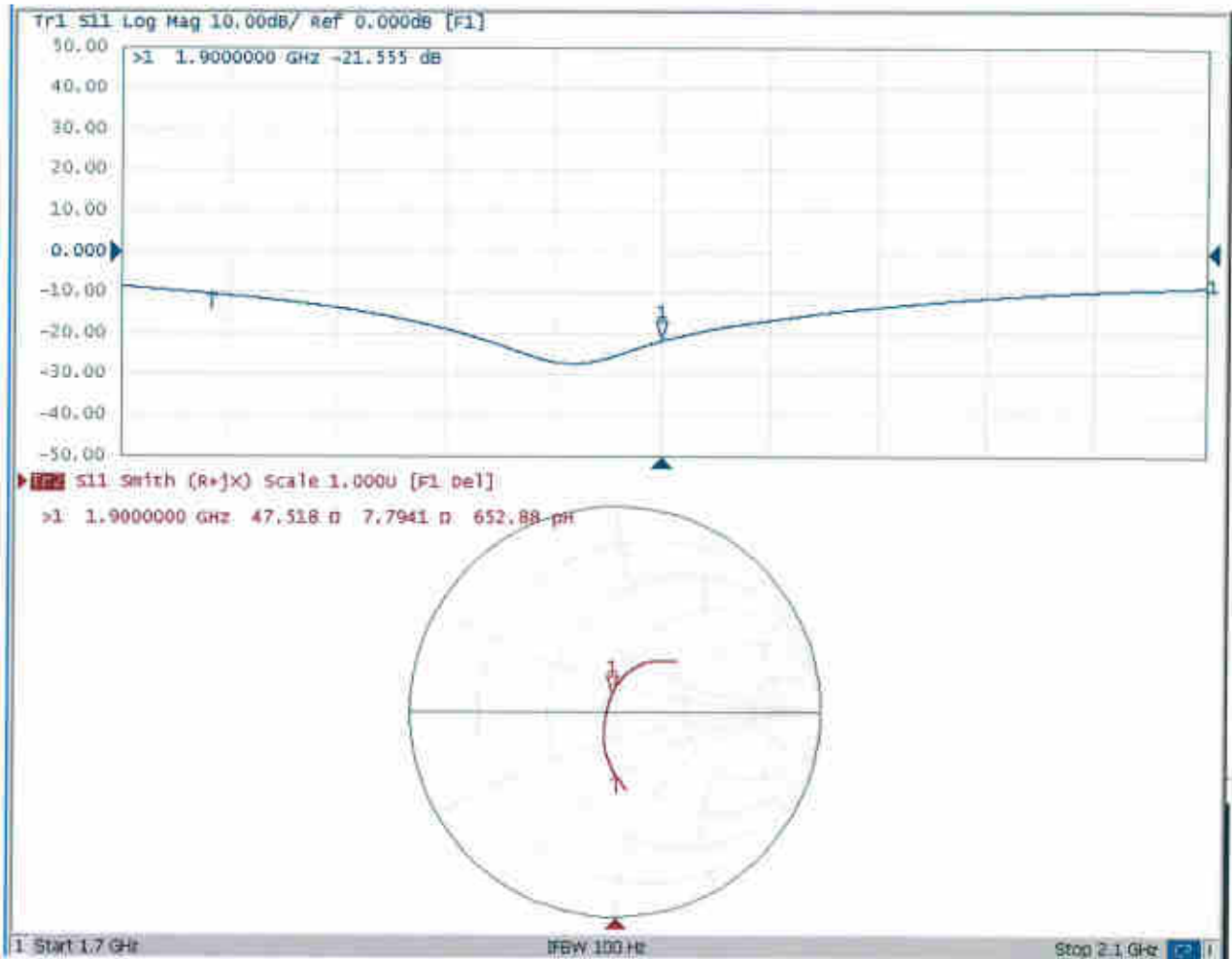
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

Http://www.chinattl.cn

Impedance Measurement Plot for Body TSL



1303

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.



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

Accreditation No.: **SCS 0108**

Client **Sporton - SZ (Auden)**

Certificate No: **DAE4-1303_Nov16**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BM - SN: 1303**

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

Calibration date: **November 22, 2016**

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 $(22 \pm 3)^{\circ}\text{C}$ 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	09-Sep-16 (No:19065)	Sep-17
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-16 (in house check)	In house check: Jan-17
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-16 (in house check)	In house check: Jan-17

	Name	Function	Signature
Calibrated by:	Adrian Gehring	Technician	
Approved by:	Fin Bornholt	Deputy Technical Manager	

Issued: November 22, 2016

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



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 0108**

Glossary

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	405.606 $\pm$ 0.02% (k=2)	403.476 $\pm$ 0.02% (k=2)	404.919 $\pm$ 0.02% (k=2)
Low Range	3.96607 $\pm$ 1.50% (k=2)	3.99309 $\pm$ 1.50% (k=2)	4.01584 $\pm$ 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	35.5 ° $\pm$ 1 °
---	------------------

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	200033.27	-3.37	-0.00
Channel X + Input	20005.30	-0.07	-0.00
Channel X - Input	-20004.41	0.82	-0.00
Channel Y + Input	200032.45	-3.99	-0.00
Channel Y + Input	20004.24	-0.94	-0.00
Channel Y - Input	-20006.06	-0.71	0.00
Channel Z + Input	200036.33	-0.22	-0.00
Channel Z + Input	20003.18	-2.03	-0.01
Channel Z - Input	-20006.39	-1.04	0.01

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2001.51	-0.05	-0.00
Channel X + Input	201.95	0.53	0.26
Channel X - Input	-197.81	0.55	-0.28
Channel Y + Input	2000.90	-0.50	-0.03
Channel Y + Input	200.67	-0.72	-0.36
Channel Y - Input	-199.08	-0.50	0.25
Channel Z + Input	2002.13	0.75	0.04
Channel Z + Input	201.06	-0.23	-0.11
Channel Z - Input	-200.21	-1.59	0.80

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	17.00	15.49
	- 200	-3.45	-5.04
Channel Y	200	6.40	5.76
	- 200	-7.38	-7.65
Channel Z	200	-2.14	-1.80
	- 200	-2.12	-1.86

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	-	1.16	-4.78
Channel Y	200	7.83	-	1.39
Channel Z	200	9.43	5.25	-

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	15919	16679
Channel Y	15630	16907
Channel Z	16103	14029

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	0.32	-0.90	1.62	0.50
Channel Y	-0.88	-2.56	0.01	0.41
Channel Z	-1.07	-2.44	0.01	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

1279

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.



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

Accreditation No.: **SCS 0108**

Client **Sporton-TW (Auden)**

Certificate No: **DAE4-1279_Apr16**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BM - SN: 1279**

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

Calibration date: **April 04, 2016**

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 $(22 \pm 3)^{\circ}\text{C}$ 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	09-Sep-15 (No:17153)	Sep-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-16 (in house check)	In house check: Jan-17
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-16 (in house check)	In house check: Jan-17

Calibrated by:	Name Dominique Steffen	Function Technician	Signature
Approved by:	Fin Bornholt	Deputy Technical Manager	

Issued: April 4, 2016

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



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 0108**

Glossary

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 = 61 nV , full range = -1.....+3mV

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

Calibration Factors	X	Y	Z
High Range	403.905 $\pm$ 0.02% (k=2)	403.857 $\pm$ 0.02% (k=2)	404.596 $\pm$ 0.02% (k=2)
Low Range	3.94769 $\pm$ 1.50% (k=2)	3.98798 $\pm$ 1.50% (k=2)	3.98844 $\pm$ 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	353.0 $^{\circ}$ $\pm$ 1 $^{\circ}$
---	-------------------------------------

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	200034.21	0.64	0.00
Channel X + Input	20007.04	2.71	0.01
Channel X - Input	-20003.94	1.81	-0.01
Channel Y + Input	200033.55	0.14	0.00
Channel Y + Input	20003.53	-0.81	-0.00
Channel Y - Input	-20006.93	-1.15	0.01
Channel Z + Input	200035.84	2.29	0.00
Channel Z + Input	20004.20	-0.11	-0.00
Channel Z - Input	-20007.71	-1.89	0.01

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2000.35	-0.21	-0.01
Channel X + Input	201.21	0.64	0.32
Channel X - Input	-198.81	0.54	-0.27
Channel Y + Input	2000.44	-0.15	-0.01
Channel Y + Input	200.00	-0.41	-0.21
Channel Y - Input	-199.44	-0.00	0.00
Channel Z + Input	1999.73	-0.78	-0.04
Channel Z + Input	199.17	-1.28	-0.64
Channel Z - Input	-200.05	-0.52	0.26

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	-18.84	-20.08
	- 200	22.54	20.58
Channel Y	200	4.56	4.07
	- 200	-5.40	-5.53
Channel Z	200	5.77	5.39
	- 200	-7.62	-7.90

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	-	3.57	-3.56
Channel Y	200	8.26	-	4.72
Channel Z	200	10.27	5.83	-

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	15947	15498
Channel Y	15956	16142
Channel Z	15706	15616

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	-0.29	-1.03	1.13	0.38
Channel Y	0.16	-0.88	1.41	0.42
Channel Z	-1.95	-3.80	-0.11	0.58

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



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

Accreditation No.: **SCS 0108**

Client **Sporton-SZ (Auden)**

Certificate No: **EX3-3819_Nov16**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3819**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

Calibration date: **November 28, 2016**

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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: November 28, 2016			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ 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:3819

Manufactured:	September 2, 2011
Calibrated:	November 28, 2016

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3819

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.46	0.40	0.45	$\pm 10.1 \%$
DCP (mV) ^B	96.6	98.3	104.7	

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	130.8	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		142.8	
		Z	0.0	0.0	1.0		133.4	

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

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

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3819

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	10.11	10.11	10.11	0.30	1.13	± 12.0 %
835	41.5	0.90	9.76	9.76	9.76	0.41	0.90	± 12.0 %
900	41.5	0.97	9.65	9.65	9.65	0.38	0.92	± 12.0 %
1450	40.5	1.20	8.71	8.71	8.71	0.32	0.80	± 12.0 %
1750	40.1	1.37	8.56	8.56	8.56	0.36	0.84	± 12.0 %
1900	40.0	1.40	8.17	8.17	8.17	0.37	0.80	± 12.0 %
2000	40.0	1.40	8.10	8.10	8.10	0.18	1.15	± 12.0 %
2300	39.5	1.67	7.57	7.57	7.57	0.29	0.90	± 12.0 %
2450	39.2	1.80	7.24	7.24	7.24	0.31	0.90	± 12.0 %
2600	39.0	1.96	7.03	7.03	7.03	0.44	0.80	± 12.0 %
3500	37.9	2.91	6.98	6.98	6.98	0.27	1.25	± 13.1 %
5250	35.9	4.71	5.17	5.17	5.17	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.55	4.55	4.55	0.45	1.80	± 13.1 %
5750	35.4	5.22	4.70	4.70	4.70	0.45	1.80	± 13.1 %

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

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

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3819

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	55.5	0.96	9.86	9.86	9.86	0.36	0.92	± 12.0 %
835	55.2	0.97	9.53	9.53	9.53	0.36	1.00	± 12.0 %
1750	53.4	1.49	8.08	8.08	8.08	0.41	0.80	± 12.0 %
1900	53.3	1.52	7.77	7.77	7.77	0.28	0.99	± 12.0 %
2300	52.9	1.81	7.54	7.54	7.54	0.43	0.80	± 12.0 %
2450	52.7	1.95	7.34	7.34	7.34	0.36	0.80	± 12.0 %
2600	52.5	2.16	7.11	7.11	7.11	0.38	0.80	± 12.0 %
3500	51.3	3.31	6.69	6.69	6.69	0.30	1.25	± 13.1 %
5250	48.9	5.36	4.50	4.50	4.50	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.95	3.95	3.95	0.50	1.90	± 13.1 %
5750	48.3	5.94	4.13	4.13	4.13	0.50	1.90	± 13.1 %

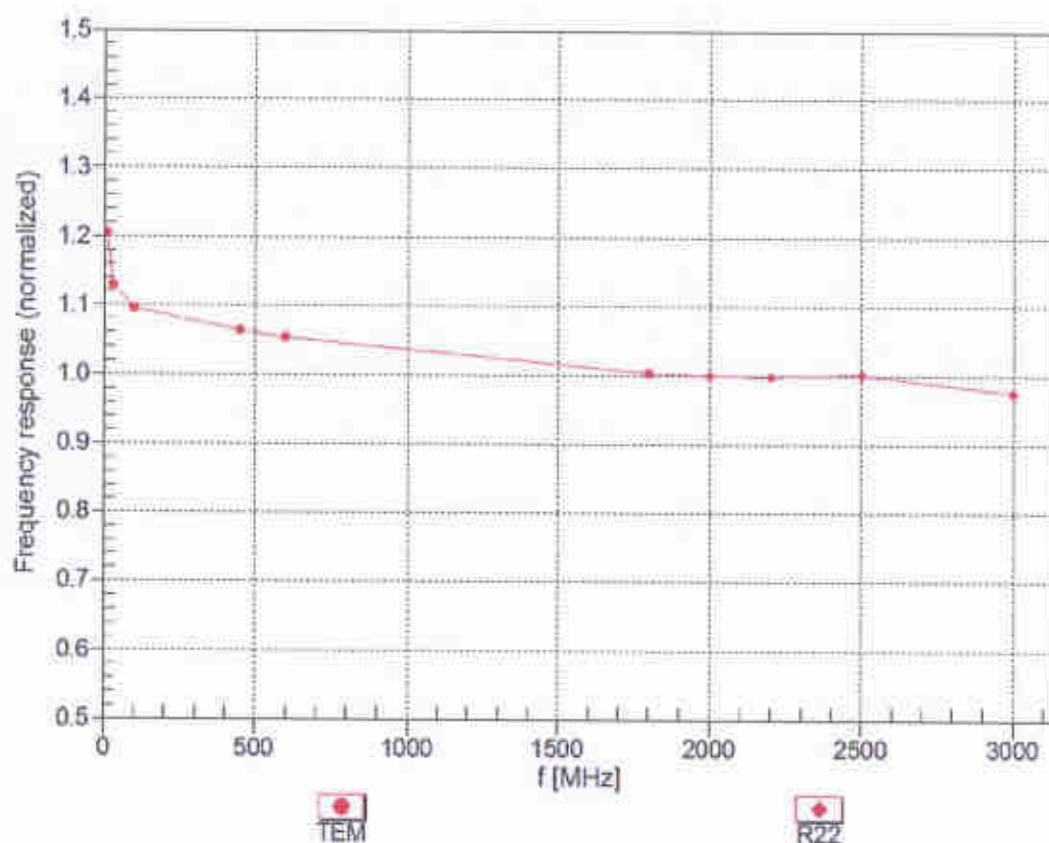
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is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

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

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

Frequency Response of E-Field

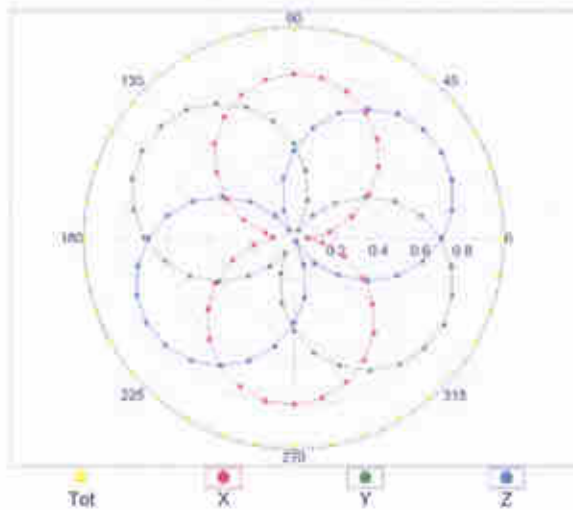
(TEM-Cell: ifi110 EXX, Waveguide: R22)



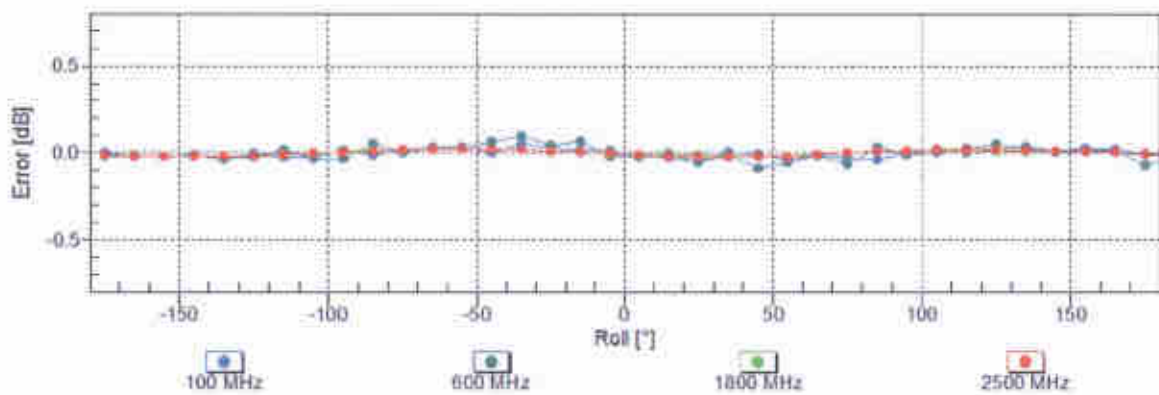
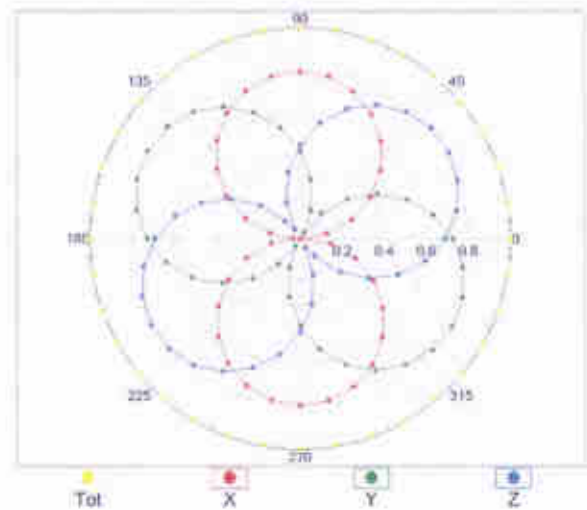
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz, TEM

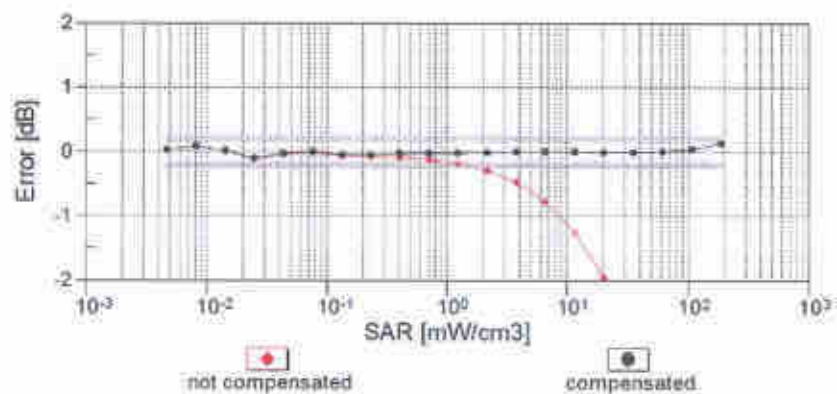
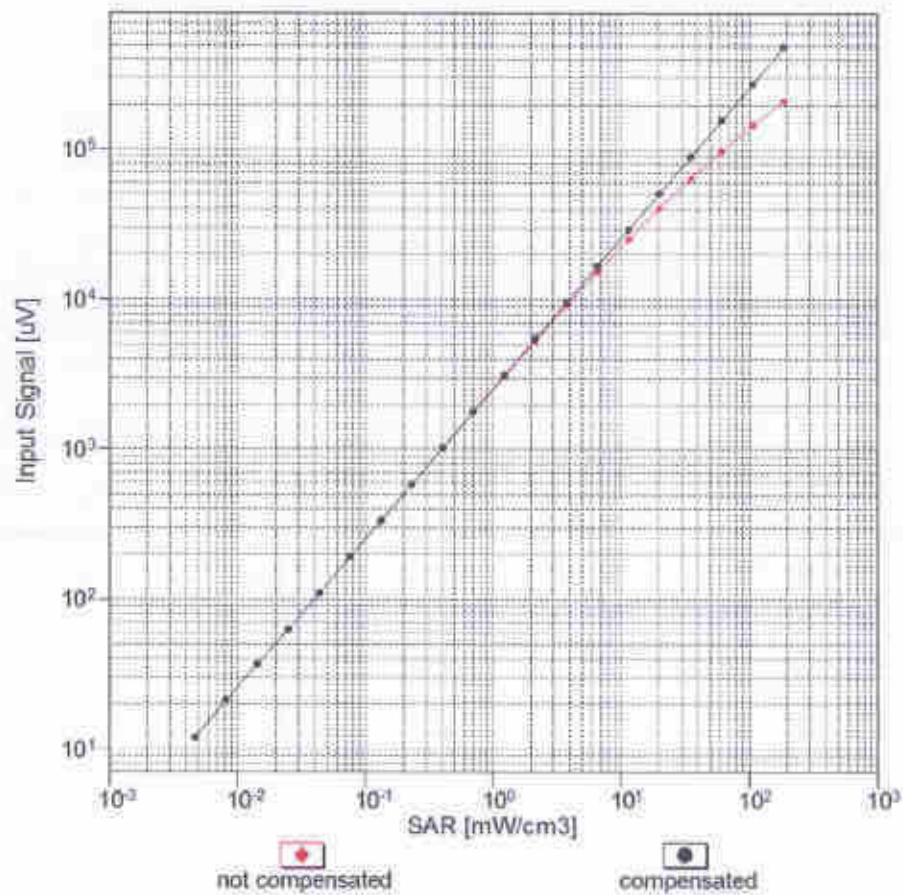


f=1800 MHz, R22



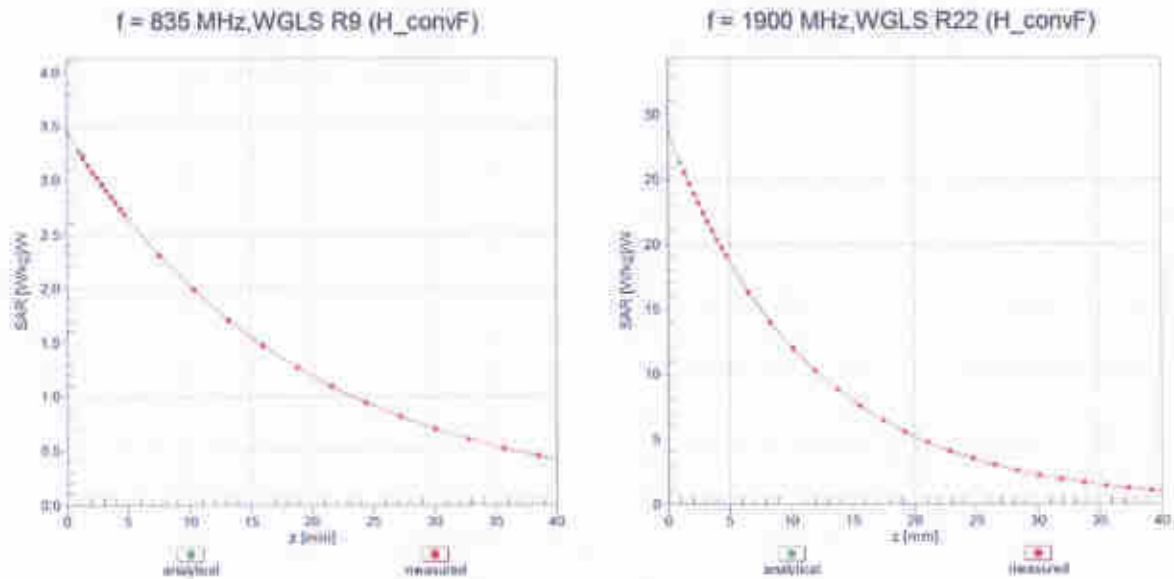
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



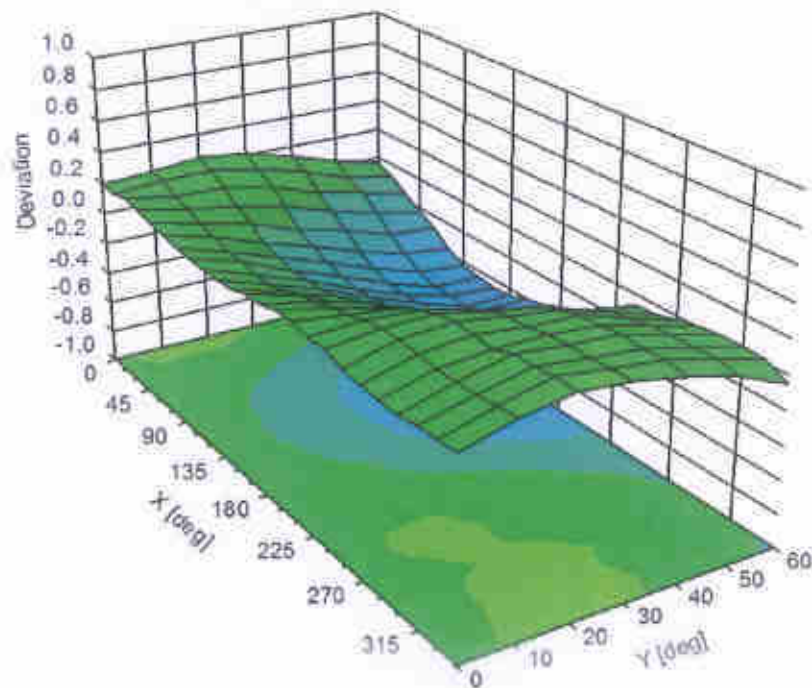
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3819

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	115.1
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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Client **Sporton-KS (Auden)**

Certificate No: **EX3-3954_Nov16**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3954**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

Calibration date: **November 28, 2016**

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642J01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: November 28, 2016			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			