Tejet

中国认可
国际互认
检测
TESTING
CNAS L4963

SAR TEST REPORT

Report No. 2017SAR082

FCC ID:	2AH25P1
Applicant:	Shanghai Sunmi Technology Co.,Ltd.
Product:	Smart POS system
Model:	W6900
HW Version:	V1.1
SW Version:	B900_A1BOM_P1_V1.1.4_20170103
Issue Date:	2017-04-12

Prepared by: Chen Qiang **Reviewed by:** Yin Xiaoming **Approved by:** Sun Guangxu (Technical Manager)

Remark: This report details the results of the testing carried out on the samples specified in this report, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. The report shall not be reproduced except in full, without written approval of the Company.

Standards

Applicable Limit Regulations	**ANSI/IEEE C95.1-2005** Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields. 3 kHz to 300 GHz
	ANSI/IEEE C95.3-2002 Recommended Practice For Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to such Fields. 100 kHz-300 GHz
Applicable Standards	**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
	KDB865664 D01v01r04: SAR Measurement 100 MHz to 6 GHz
	KDB865664 D02v01r02: Exposure Reporting
	KDB447498 D01v06: General RF Exposure Guidance
	KDB648474 D03v01r04: Handset Wireless Chargers Battery Covers
	KDB648474 D04v01r03: Handset SAR
	KDB248227 D01v02r02: 802 11 Wi-Fi SAR
	KDB941225 D01v03r01: 3G SAR Procedures
	KDB941225 D05v02r05: SAR for LTE Devices
	KDB941225 D06v02: Hotspot Mode

Conclusion

Localized Specific Absorption Rate (SAR) of this equipment has been measured in all cases requested by the relevant standards above. Maximum localized SAR is below exposure limits as well.

Change History

Version	Change Contents	Author	Date
V1.0	First edition	Chen Qiang	2017-02-22
V2.0	Update Hardware Version Number	Chen Qiang	2017-04-05
V3.0	Update evaluation of BT	Chen Qiang	2017-04-12

Note: The last version will be invalid automatically while the new version is issued.

CONTENTS:

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Shanghai Sunmi Technology Co.,Ltd. Smart POS system W6900** are as follows.

Highest standalone SAR Summary:

Exposure Position	Frequency Band	Maximum reported 1g SAR (W/kg)	Highest reported 1g SAR (W/kg)
Body-worn (10mm)	GSM850	1.145	1.290
	GSM1900	1.160	
	WCDMA BAND II	1.290	
	WCDMA BAND V	0.799	
	Wi-Fi（2.45G）	0.055	0.055

Evaluation for Simultaneous SAR			
Summation BAND	**Exposure Position**	**Maximum reported 1g SAR (W/kg)**	**Summation SAR(1g) (W/kg)**
WWAN +WiFi	Body-worn(0mm)	1.290+0.055=1.345	＜1.6
WWAN +BT	Body-worn(0mm)	1.290+0.041=1.331	＜1.6

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits(1.6W/kg) specified in FCC 47 CFR part 2(2.1093) and ANSI/IEEE C95.1-2005,and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

2. Administrative Information

2.1 Project Information

Date of start test	2017-01-25
Date of end test:	2017-02-10

2.2 Test Laboratory Information

Company:	Shanghai Tejet Communications Technology Co., Ltd Testing Center
Address:	Room 6205-6208, Building 6, No.399 Cailun Rd. Zhangjiang Hi-Tech Park, Shanghai, China
Post Code:	210203
Tel:	+86-21-61650880
Fax:	+86-21-61650881
Website:	www.tejet.cn

2.3 Test Environment

Temperature:	20℃～25 ℃
Relative Humidity:	20%～70%

3. Client Information

3.1 Applicant information

Company Name:	Shanghai Sunmi Technology Co.,Ltd.
Address:	Room 505, KIC Plaza, No.388 Song Hu Road, Yang Pu District, Shanghai, China
City:	Shanghai
Postal Code:	/
Country:	China
Telephone:	18721763396
Fax:	021-61079307

3.2 Manufacturer Information

Company Name:	Shanghai Sunmi Technology Co.,Ltd.
Address:	Room 505, KIC Plaza, No.388 Song Hu Road, Yang Pu District, Shanghai, China
City:	Shanghai
Postal Code:	/
Country:	China
Telephone:	18721763396
Fax:	/

4. Equipment Under Test (EUT) and Accessory Equipment (AE)

4.1 Information of EUT

<table>
<tr><td>Device Type</td><td colspan="2">Portable device</td></tr>
<tr><td>Product</td><td colspan="2">Smart POS system</td></tr>
<tr><td>Model</td><td colspan="2">W6900</td></tr>
<tr><td>Type</td><td colspan="2">Identical Prototype</td></tr>
<tr><td>Exposure Category</td><td colspan="2">Uncontrolled environment / general population</td></tr>
<tr><td colspan="3">Device operation configuration:</td></tr>
<tr><td rowspan="4">Operating Mode(s):</td><td colspan="2">GSM850</td></tr>
<tr><td colspan="2">PCS1900</td></tr>
<tr><td colspan="2">WCDMA BAND II/V</td></tr>
<tr><td colspan="2">802.11b/g/n（20M）</td></tr>
<tr><td>Test Modulation</td><td colspan="2">(GSM/GPRS)GMSK，(EDGE)QPSK/8PSK
（WCDMA）QPSK,</td></tr>
<tr><td>GPRS Operation Class</td><td colspan="2">B</td></tr>
<tr><td>GPRS Multislot Class</td><td colspan="2">12</td></tr>
<tr><td>EDGE Class</td><td colspan="2">12(downlink only)</td></tr>
<tr><td>DTM Support</td><td colspan="2">N/A</td></tr>
<tr><td>AP Support</td><td colspan="2">N/A</td></tr>
<tr><td rowspan="6">Rated Output Power</td><td colspan="2">GSM 850:33.0dBm</td></tr>
<tr><td colspan="2">PCS1900: 30.0dBm</td></tr>
<tr><td colspan="2">WCDMA BAND II: 23.0dBm</td></tr>
<tr><td colspan="2">WCDMA BAND V: 22.5dBm</td></tr>
<tr><td colspan="2">802.11b：17dBm
802.11g：15dBm
802.11n(20M)：15dBm</td></tr>
<tr><td colspan="2">BT：-2 dBm</td></tr>
<tr><td>WCDMA category</td><td colspan="2">6（uplink），14（downlink）</td></tr>
<tr><td>GPRS Release version</td><td colspan="2">R99</td></tr>
<tr><td>WCDMA Release version</td><td colspan="2">R99</td></tr>
<tr><td>Antenna Type:</td><td colspan="2">Internal antenna</td></tr>
<tr><td rowspan="4">Operating Frequency Range(s):</td><td>Band</td><td>Tx(MHz)</td></tr>
<tr><td>GSM850</td><td>824.2～848.8</td></tr>
<tr><td>PCS1900</td><td>1850.2～1909.8</td></tr>
<tr><td>WCDMA BAND II</td><td>1852.4～1907.6</td></tr>
</table>

	WCDMA BAND V	826.4～846.6
Power Class	GSM850: 4,test with power level 5	
	PCS1900: 1,test with power level 0	
	WCDMA BAND II/V：3，test with maximum output power	
EUT size	length, width：21.2cm*8.3cm diagonal length：22.1cm	
Size of display	length, width: 12.2cm *6.8cm diagonal length：14.2cm	

4.2 Identification of EUT

EUT ID	SN or IMEI	HW Version	SW Version	Received Date
TN04	323584789138008	V1.1	B900_A1BOM_P1_V1.1.4_20170103	2017-01-24

*EUT ID: identify the test sample in the lab internally.

4.3 Identification of AE

AE ID*	**Description**
AE1	Battery
AE2	Travel Adaptor

AE1

Model	B900
Manufacturer	SHENZHEN DONGJIE NEW ENERGY CO.,LTD
Capacitance	5200mAh
Nominal Voltage	3.7V

AE2

Model	TPA-46050200UU
Manufacturer	SHENZHEN TIANYIN ELECTRONICS CO.,LTD.
Length of DC line	0cm with USB connector

*AE ID: identify the test sample in the lab internally.

5. Operational Conditions during Test

5.1 General description of test procedures

A communication link is set up with a system simulator by air link， and a call is established. The absolute radio frequency channel is allocated to low, middle and high respectively in the case of each band. The EUT is commanded to operate at maximum transmitting power.

Connection to the EUT is established via air interface with CMU200, and the EUT is set to maximum output power by CMU200. The antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the EUT. The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the EUT by at least 30dB.

The device size is 21.2 cm x 8.3 cm, test separation distance was 0mm.

5.2 GSM Test Configuration

SAR test for GSM 850/1900, a communication link is set up with a system simulator by air link. Using CMU200 the power level is set to “5” in SAR of GSM850，set to “0” in SAR of GSM 1900，The tests in the band of GSM850/1900 are performed in the mode of data transfer function.

For Class A devices, the SAR evaluation must take into account the maximum CS and PS time slots defined by the DTM multislot class for the device, with respect to head body-worn accessory and other near body operating configurations and exposure conditions. SAR may be evaluated for DTM with the device operating in DTM using one CS plus the number of PS time-slots that result in the highest source-based time-averaged maximum output or by summing the single time-slot CS and highest maximum output multislot PS SAR.38 A communication test set with DTM support is necessary to configure the test device for SAR measurement in DTM mode. Alternatively, the single slot CS GSM/GMSK voice mode SAR for each applicable exposure condition can be added respectively to the PS (E)GPRS multislot data-mode SAR to demonstrate SAR compliance for DTM.

5.3 WCDMA Test Configuration

SAR test for WCDMA BANDII/V, a communication link is set up with a system simulator by air link. Using CMU200 the power level is set to “3” in SAR of WCDMA BAND II/V. The tests in the band of WCDMA BAND II/V are performed in the mode of RMC 12.2kbps transfer function.

SAR for body exposure configurations in voice and data modes is measured using 12.2kbps RMC with TPC bits configured to all “1’s”. SAR for other spreading codes and multiple DPDCHn , when supported by the DYT, are not required when the maximum average output of each RF channel, for each spreading code and DPDCHn configuration, are lessthan 1/4 dB higher than those measured in 12.2 kbps RMC. Otherwise , SAR is measured on the maximum output channel with an applicable RMC configuration for the corresponding spreading code or DPDCHn using the exposure configuration that results in the highest SAR with 12.2 kbps RMC. When more than 2 DPDCHn are supported by the DUT, it may be necessary to configure additional DPDCHn for a DUT using FTM(Factory Test Mode) or other chipset based test approaches with parameters similar to those used in 384kbps and 968 kbps RMC.

HSDPA Test Configuration

Body SAR is also measured for HSDPA when the maximum average output of each RF channel with HSDPA active is at least 1/4 dB higher than that measured without HSDPA using 12.2 kbps RMC or the maximum SAR 12.2 kbps RMC is above75% of the SAR limit. Body SAR is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1 , using the highest body SAR configuration in 12.2 kbps RMC without HSDPA.
HSDPA should be configured according to the UE category of a test device. The number of HS-DSCH/HS-PDSCHs, HARQ processes , minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set f. To maintain a consistent test configuration and stable transmission condition, QPSK is user in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4 ms with a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. DPCCH and DODCH gain factors(β c,β d), and HS_DPCCH power offset parameters(△ACK, △NACK, △CQI) should be set according to values indicated in the Table below. The CQI value is determined by the UE category, transport block size, number of HS_PDSCHs and modulation used in the H-set.

Table 1:Subtest for UMTS Release 5 HSDPA

Sub-set	β c	β d	B d（SF）	B c/β d	β hs	CM(dB)
1	2/15	15/15	64	2/15	4/15	0.0
2	12/15	15/15	64	12/15	24/15	1.0
3	15/15	8/15	64	15/8	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5
Note 1: △ACK, △NACK, △CQI=8⇔Ahs=β hs/β c=30/15⇔β hs=30/15c Note 2: CM=1 forβ c/β d=12/15, β hs/β c=24/15 Note 3: For subset 2 theβ cβ d ratio of 12/15 for the TFC during the measurement period(TF1,TF0) is achieved by setting the signaled gain factor for the reference TFC (TFC1,TF1) toβ c=11/15 andβ d=15/15.						

Table 2:Settings of required H-set 1 QPSK in HSDPA mode

Parameter	Unit	Value
Nominal Avg.Inf.Bit Rate	Kbps	534
Inter-TTI Distance	TTI’s	3

Number of HARQ Processes	Processes	2
Information Bit Payload	Bitw	3202
Number Code Blocks	Blocks	1
Binary Channel Bits Per TTI	Bots	4800
Total Avaliable SML's in UE	SML's	19200
Number of SML's per HARQ Proc.	SML's	9600
Coding Rate	/	0.67
Number of Physical Channel Codes	Codes	5
Modulation	/	QPSK

Table 3：HSDPA UE category

HS-DSCH Category	Maximum HS_DSCH Codes Received	Minimum Inter-TTI Interval	Maximum Transport Bits/HS-DSCH	Total Channel
1	5	3	7298	19200
2	5	3	7298	28800
3	5	2	7298	28800
4	5	2	7298	38400
5	5	1	7298	57600
6	5	1	7298	67200
7	10	1	14411	115200
8	10	1	14411	134400
9	15	1	25251	172800
1 2	15	1	27952	172800
1 1	5	2	3630	14400
1 2	5	1	3630	28800
1 3	15	1	34800	259200
1 4	15	1	42196	259200
1 5	15	1	23370	345600
1 6	15	1	27952	345600

HSUPA Test Configuration

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

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

Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. 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 signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.

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

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

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

applicable only if Maximum Power Reduction (MPR) is implemented according to Cubic Metric (CM) requirements.[37]

SAR is required for Rel. 8 DC-HSDPA when SAR is required for Rel. 5 HSDPA; otherwise, the 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode. Power is measured for DC-HSDPA according to the H-Set 12, FRC configuration in Table C.8.1.12 of 3GPP TS 34.121-1 to determine SAR test reduction. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to be acceptable.

5.5 Bluetooth Test Configuration

The Bluetooth transmitter of the device under test can be excluded from stand-alone and simultaneous SAR evaluation, per the requirements from FCC KDB 648474, as follows:

1. The separation between the Bluetooth antenna and the main antenna is 11.4cm
2. The maximum conducted output power of Bluetooth is -2dBm=0.63mW<P（max）=10mW

   According to FCC KDB648474, stand along SAR and Simultaneous Transmission SAR are not required.

   According to FCC KDB447498v06, Apppendix A

Appendix A

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table.

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

For 2450MHz，5mm test distance, P（max）=10mW

For Simultaneous Transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05 based on the formula below.

(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance,

mm)] · [√ f(GHz)/x] W/kg for test separation distances ≤ 50 mm;
where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.

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	Turn-up Maximum Power(dBm)	Head 0mm gap	Body-worn 0mm gap
Estimated SAR(W/kg)	-2	/	0.041

According to FCC KDB447498v06, Apppendix D
For 2450MHz，0mm test distance ,SAR1g（BT）=0.052

5.6 Wi-Fi Test Configuration

The Wi-Fi is set to different data rate and channels by the software.
According to KDB648474:

1. The separation between the Wi-Fi antenna and the main antenna is 11.4cm
2.The maximum conducted output power of Wi-Fi is17dBm=50.12mW＞P（max）=10mW
So stand along SAR is needed。

According to KDB248227 D01 802.11 Wi-Fi SAR v02r02

SAR is measured using the highest measured maximum output power channel for the initial test configuration (see 5.3.2 and 5.3.3). SAR measurement and test reduction for the remaining 802.11 modes and test channels are determined according to measured or specified maximum output power and reported SAR of the initial measurements. The general test reduction and SAR measurement approaches are summarized in the following:

a) The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures (see Clause 4).

b) For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, an “initial test configuration” (see 5.3.2) is first determined for each standalone and aggregated frequency band according to the maximum output power and tune-up tolerance specified for production units.

1) When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band.

2) SAR is measured for OFDM configurations using the initial test configuration procedures (see 5.3.3). Additional frequency band specific SAR test reduction may be considered for

individual frequency bands (see 5.2.2 and 5.3.1).

3) Depending on the reported SAR of the highest maximum output power channel tested in the initial test configuration, SAR test reduction may apply to subsequent highest output channels in the initial test configuration to reduce the number of SAR measurements.

c) The Initial test configuration does not apply to DSSS. The 2.4 GHz band SAR test requirements (see 3.1) and 802.11b DSSS procedures (see 5.2.1) are used to establish the transmission configurations required for SAR measurement.

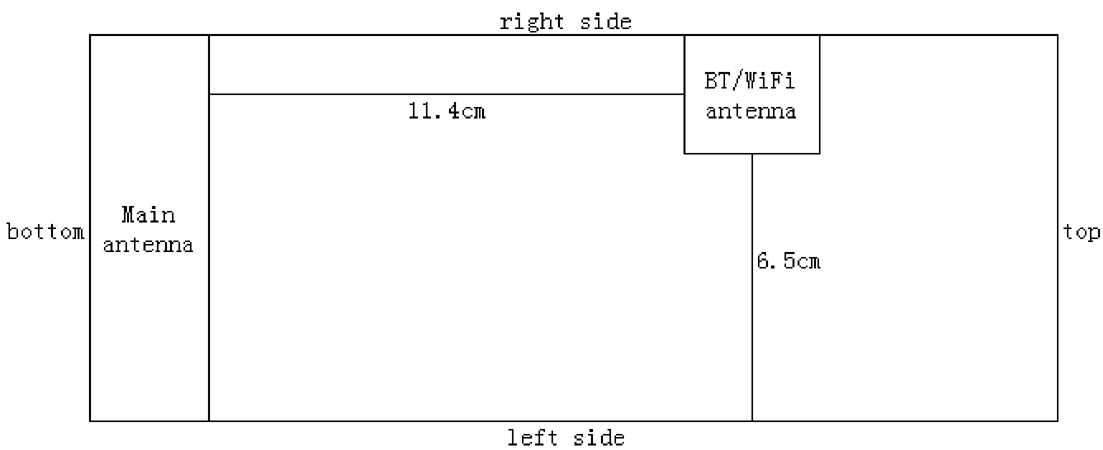
d) An “initial test position” (see 5.1) is applied to further reduce the number of SAR tests for devices operating in next to the ear, UMPC mini-tablet or hotspot mode exposure configurations that require multiple test positions.

1) SAR is measured for 802.11b according to the 2.4 GHz DSSS procedure (see 5.2.1) using the exposure condition established by the initial test position.

2) SAR is measured for 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration.

e) The Initial test position does not apply to devices that require a fixed exposure test position. SAR is measured in a fixed exposure test position for these devices in 802.11b according to the 2.4 GHz DSSS procedure (see 5.2.1) or in 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration procedures (see 5.3.3).

f) The “subsequent test configuration” (see 5.3.4) procedures are applied to determine if additional SAR measurements are required for the remaining OFDM transmission modes that have not been tested in the initial test configuration. SAR test exclusion is determined according to reported SAR in the initial test configuration and maximum output power specified or measured for these other OFDM configurations.



Picture of antennas

6. SAR Measurements system configuration

6.1 SAR Measurement set-up

The DASY5 system for performing compliance tests consists of the following items:

·A standard high precision 6-axis robot (Staubli TX=RX family) 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 and the DASY5 software.
·Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
·The generic twin phantom enabling the testing of left-hand and right-hand usage.
·The device holder for handheld mobile phones.
·Tissue simulating liquid mixed according to the given recipes.
·System validation dipoles allowing to validate the proper functioning of the system.

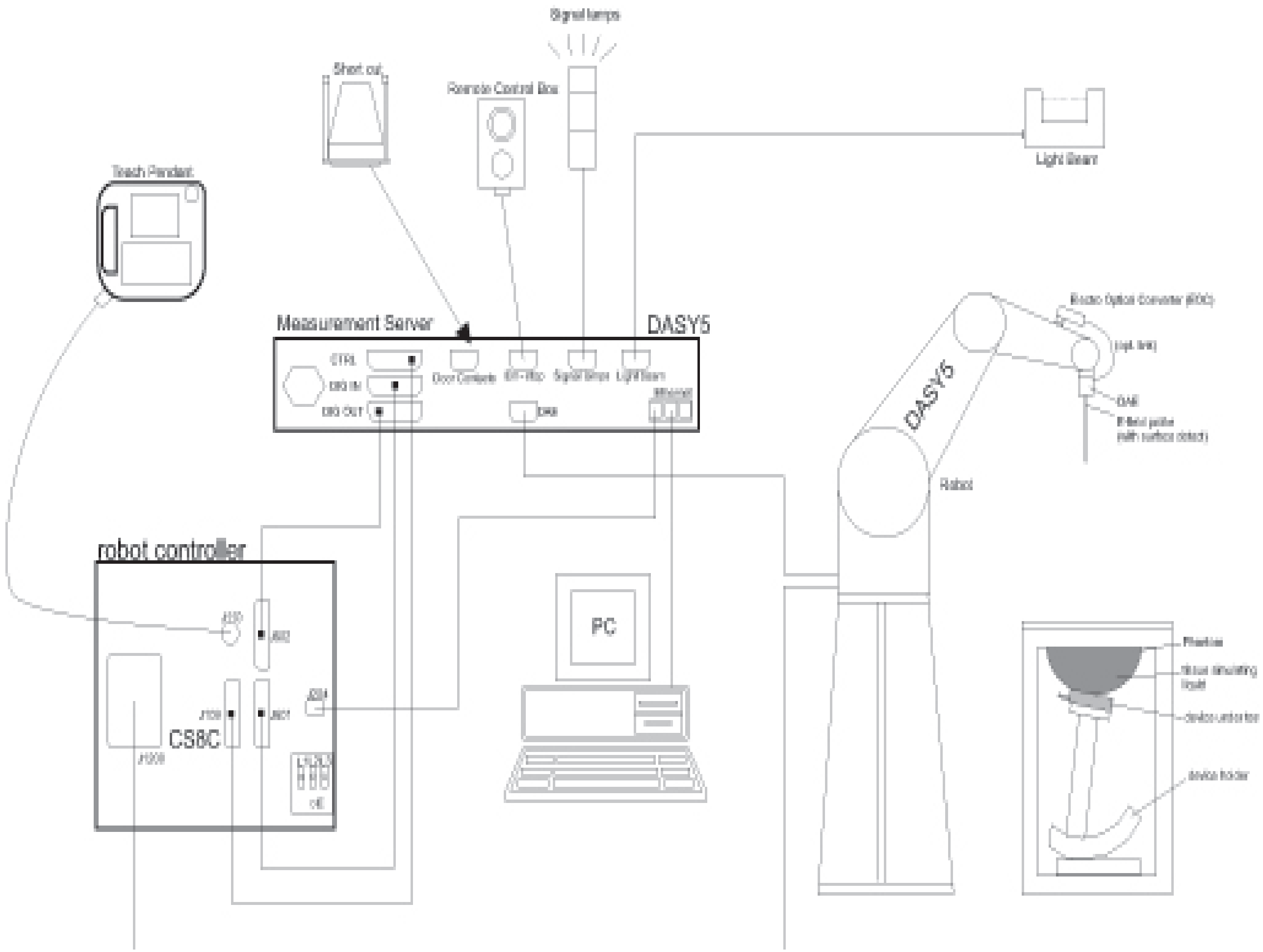


Figure 5-1 SAR Lab Test Measurement Set-up

6.2 DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe ES3DV3 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

6.2.1 Ex3DV4 Probe Specification

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 850 and HSL 1750 Additional CF for other liquids and frequencies upon request
Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 μW/g to > 100 mW/g Linearity: ± 0.2dB (noise: typically < 1 μW/g)

Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

Figure 5-2.Ex3DV4 E-field Probe

Figure 5-3. Ex3DV4 E-field probe

6.2.2 E-field Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than ±10%. The spherical isotropy was evaluated and found to be better than ± 0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

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

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

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

Where: Δt = Exposure time (30 seconds),

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

ΔT = Temperature increase due to RF exposure.

Or

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

Where:
σ = Simulated tissue conductivity,
ρ = Tissue density (kg/m3).

6.3 Other Test Equipment

6.3.1 Device Holder for Transmitters

The DASY5 device holder is designed to cope with the die rent positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales are the ear reference point (ERP). Thus the device needs no repositioning when changing the angles. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the inference of the clamp on the test results could thus be lowered.

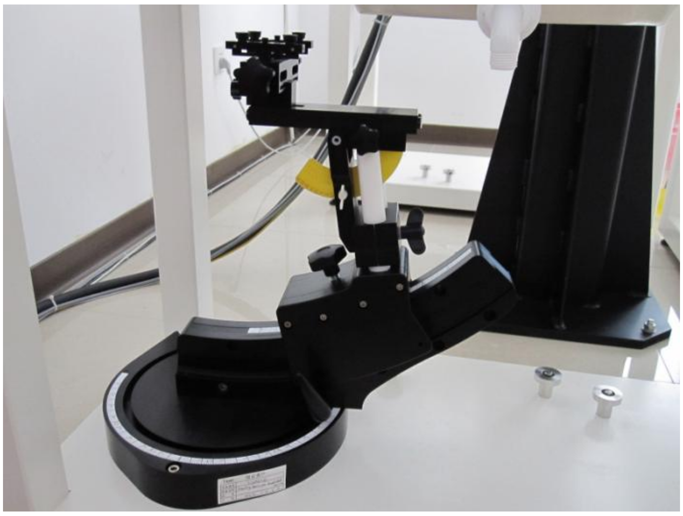


Figure 5-4.Device Holder

6.3.2 Phantom

The Generic Twin Phantom is constructed of a fiberglass shell integrated in a wooden Figure. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness	2±0.1 mm
Filling Volume	Approx. 20 liters
Dimensions	810 x l000 x 500 mm (H x L x W)

Aailable Special

Figure 5-5.Generic Twin Phantom

6.4 Scanning procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

• The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. ±5%.

• The “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)

• Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot. Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged.

After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

• Zoom Scan

Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

• Spatial Peak Detection

The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses. The DASY5 system allows evaluations that combine measured data and robot positions, such as:

• maximum search
• extrapolation
• boundary correction
• peak search for averaged SAR

During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard 's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space.

They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

• A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

6.5 Data Storage and Evaluation

6.5.1 Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated. The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

6.5.2 Data Evaluation by SEMCAD

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	Dcp_i
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	
	- Density	

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.
The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot cf / dcp_i$$

With V_i = compensated signal of channel i (i = x, y, z)

U_i = input signal of channel i (i = x, y, z)

cf = crest factor of exciting field (DASY parameter)

dcp_i = diode compression point (DASY parameter)

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

E-field probes: $E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$

H-field probes: $H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1} f + a_{i2} f^2) / f$

With V_i = compensated signal of channel i (i = x, y, z)

$Norm_i$ = sensor sensitivity of channel i (i = x, y, z)

[mV/(V/m)[2]] for E-field Probes

ConvF = sensitivity enhancement in solution

a_{ij} = sensor sensitivity factors for H-field probes

f = carrier frequency [GHz]

E_i = electric field strength of channel i in V/m

H_i = magnetic field strength of channel i in A/m

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

$$E_{tot} = (E_X^2 + E_Y^2 + E_Z^2)^{1/2}$$

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

$$SAR = (E_{tot}^2 \cdot \quad) \square \;/ (\quad \cdot 1000)$$

with ***SAR*** = local specific absorption rate in mW/g

E_{tot} = total field strength in V/m

□ = conductivity in [mho/m] or [Siemens/m]

□ = equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

$P_{pwe} = E_{tot}^2 / 3770$ or $P_{pwe} = H_{tot}^2 \cdot 37.7$

with P_{pwe} = equivalent power density of a plane wave in mW/cm²

E_{tot} = total electric field strength in V/m

H_{tot} = total magnetic field strength in A/m

6.6 System check

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulates were measured every day using the dielectric probe kit and the network analyzer. A system check measurement was made following the determination of the dielectric parameters of the simulates, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system check results (dielectric parameters and SAR values) are given in the 6.2.1 and6.2.2

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10 %).
System check is performed regularly on all frequency bands where tests are performed with the DASY 5 system.

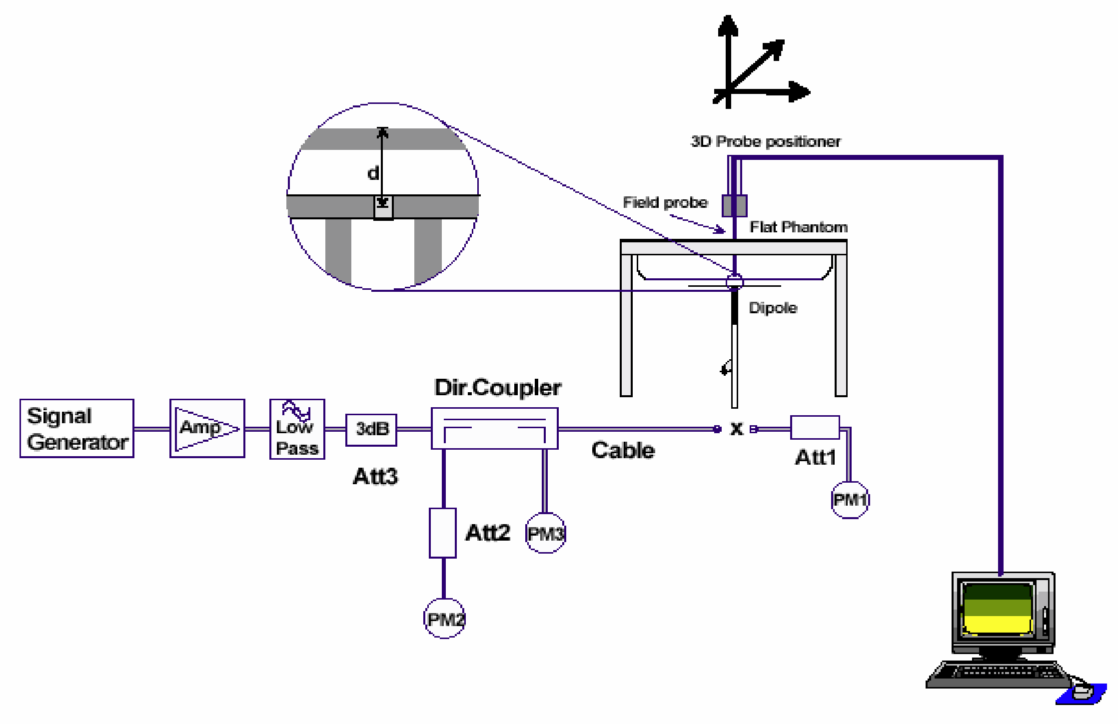


Figure 5-6. System Check Set-up

6.7 Equivalent Tissues

The liquid is consisted of water, salt, Glycol, Sugar, Preventol and Cellulose. The liquid has previously been proven to be suited for worst-case. The Table show the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the OET 65.

MIXTURE%	FREQUENCY(body) 835MHz
Water	52.5
Sugar	45
Salt	1.4
Preventol	0.1
Cellulose	1
Dielectric Parameters Target Value	f=835MHz ε=55.2 σ=0.97
MIXTURE%	FREQUENCY(body)1900MHz
Water	69.91
Glycol monobutyl	29.96
Salt	0.13
Dielectric Parameters Target Value	f=1900MHz ε=53.3 σ=1.52
MIXTURE%	FREQUENCY(body)2450MHz
Water	70
Glycol monobutyl	30
Salt	0
Dielectric Parameters Target Value	f=2450MHz ε=52.7 σ=1.95

7. Summary of Test Results

7.1 Conducted Output Power Measurement

7.1.1 Summary

The DUT is tested using CMU200/MT8820C communications tester as controller unit to set test channels and maximum output power to the DUT, as well as for measuring the conducted power.
Conducted output power was measured using an integrated RF connector and attached RF cable.
This result contains conducted output power for the EUT.

7.1.2 Conducted Power Results

GSM850		Conducted output power(dBm)						
		low	middle	high				
		CH128	CH189	CH251				
		824.2MHz	836.6MHz	848.8MHz				
GSM		/	/	/	(dB)	CH128	CH189	CH251
GPRS	1 TX-slot result	32.2	32.3	32.4	-9.03	23.17	23.27	23.37
	2 TX-slot result	31.9	31.8	31.9	-6.02	25.88	25.78	25.88
	3 TX-slot result	30.4	30.4	30.5	-4.26	26.14	26.14	26.24
	4 TX-slot result	29.4	29.5	29.5	-3.01	**26.39**	**26.49**	**26.49**

GSM1900		Conducted output power(dBm)						
		low	middle	high				
		CH512	CH661	CH810				
		1850.2MHz	1880MHz	1909.8MHz				
GSM		/	/	/	(dB)	CH512	CH661	CH810
GPRS	1 TX-slot result	29.1	28.9	28.9	-9.03	20.07	19.87	19.87
	2 TX-slot result	26.3	26.1	26.1	-6.02	20.28	20.08	20.08
	3 TX-slot result	24.3	24.1	24.1	-4.26	20.04	19.84	19.84
	4 TX-slot result	23.4	23.1	23.1	-3.01	**20.39**	**20.09**	**20.09**

Note: To average the power, the division factor is as follows:

1 TX-slot =1 transmit time slot of 8 time slots
=>conducted power divided by (8/1) =>-9.03dB

2 TX-slot =2 transmit time slot of 8 time slots
=>conducted power divided by (8/2) =>-6.02dB

3 TX-slot =3 transmit time slot of 8 time slots
=>conducted power divided by (8/3) =>-4.26dB
4 TX-slot =4 transmit time slot of 8 time slots
=>conducted power divided by (8/4) =>-3.01dB

Body-worn of GSM850/1900 are tested with GMSK GPRS 4 timeslots

WCDMA BAND II		Conducted Output power (dBm)		
		low	middle	high
		CH9262	CH9400	CH9538
		1852.4MHz	1800MHz	1907.6MHz
12.2kbps RMC		22.70	22.92	22.77
HSDPA	SUB-TEST 1	22.61	22.82	22.67
	SUB-TEST 2	22.56	22.77	22.62
	SUB-TEST 3	22.09	22.37	22.17
	SUB-TEST 4	22.08	22.25	22.15
HSUPA	SUB-TEST 1	22.49	22.73	22.58
	SUB-TEST 2	20.92	20.72	20.73
	SUB-TEST 3	21.34	21.87	21.65
	SUB-TEST 4	20.95	20.99	20.98
	SUB-TEST 5	22.46	22.70	22.55

WCDMA BAND V		Conducted Output power (dBm)		
		low	middle	high
		CH4132	CH4183	CH4233
		826.4 MHz	836.6MHz	846.6MHz
12.2kbps RMC		22.33	22.23	22.11
HSDPA	SUB-TEST 1	22.23	22.13	22.01
	SUB-TEST 2	22.21	22.11	21.99
	SUB-TEST 3	21.71	21.61	21.49
	SUB-TEST 4	21.65	21.55	21.43
HSUPA	SUB-TEST 1	22.15	22.01	21.95
	SUB-TEST 2	20.77	20.62	20.73
	SUB-TEST 3	21.15	21.11	21.15
	SUB-TEST 4	20.84	20.62	20.74
	SUB-TEST 5	22.11	22.01	21.85

Body-worn of WCDMA BAND II/V are tested with 12.2kbps RMC.

Testing for HSDPA/HSUPA are not required.

For Bluetooth maximum conducted power is -1 dBm

Wi-Fi
Average Conducted Power

Channel\dFreq.(MHz)			Maximum Conducted Out Power(dBm)		
			802.11b	802.11g	802.11n(HT20)
low	2412MHz	1	16.81	13.15	13.08
middle	2437MHz	6	16.37	14.92	14.91
high	2462MHz	11	15.66	14.52	14.21

The maximum conducted output power of Wi-Fi is 17dBm=50.12mW>P(max)=10mW..
So stand alone SAR is required.
1.Per KDB 248227D01v02.，choose the highest output power channel to test SAR and determine further SAR exclution.
2. Per KDB 248227D01v02.，In the 2.4GHz band,separate SAR procedure are applied to DSSS and OFDM conditions:
1) When KDB Pubication 447498 SAR test exclution applied to the OFDM configuration.
2) When the highest reported SAR for DSSS is adjusted by the radio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤1.2W/kg.

SAR of WLAN should be tested on 802.11b 1Mbps.

band	Fre'	Duty cycle	Duty cycle factor
802.11b 1Mbps.	2412 MHz	99.6%	1.004
	2437 MHz	99.6%	1.004
	2462 MHz	99.6%	1.004

7.2 Test Results

7.2.1. Dielectric Performance

Dielectric Performance of Tissue Simulating Liquid

Frequency	Description	Dielectric Parameters εr	σ(s/m)	temp ℃
835MHz (body)	Target value 5% window	55.2 52.44-57.96	0.97 0.92-1.02	/
	Measurement value 2017-01-25	54.72	0.95	21.7
1900MHz (body)	Target value 5% window	53.3 50.63-55.96	1.52 1.44 -1.60	/
	Measurement value 2017-02-09	52.49	1.49	21.7
2450MHz (body)	Target value 5% window	52.7 50.06-55.33	1.95 1.85 -2.05	/
	Measurement value 2017-02-10	52.17	1.93	21.8

7.2.2. System Check Results

System Check for tissue simulation liquid

Frequency	Description	SAR(W/kg)		Targeted SAR1g（W/kg）	Normalized SAR1g（W/kg）	Deviation（%）
		10g	1g			
835MHz (body)	Recommended result ±10% window	1.59 1.43-1.75	2.39 2.15-2.63	/	/	/
	Measurement value 2017-01-25（250mW）	1.56	2.37	9.61	9.48	-1.35
1900MHz (body)	Recommended result ±10% window	5.21 4.69-5.73	9.87 8.08-10.86	/	/	/
	Measurement value 2017-02-09（250mW）	5.09	9.81	39.9	39.24	-1.65
2450MHz (body)	Recommended result ±10% window	5.99 5.39-6.59	12.7 11.43-13.97	/	/	/
	Measurement value 2017-02-10（250mW）	5.88	12.5	51.2	50	-2.34

Note: 1. the graph results see ANNEX B.1.
2 .Recommended Values used derive from the calibration certificate and 250 mW is used as feeding power to the calibrated dipole.

7.2.3 Scaling Factor Calculation

Operation Mode	Channel	Output Power(dBm)	Turn-up Limt (dBm)	Duty Cycle Factor	Scaling Factor
GPRS 850(4Tx)	128	29.4	30	/	1.148
	189	29.5	30	/	1.122
	251	**29.5**	30	/	1.122
GPRS 1900(4Tx)	512	23.4	24	/	1.148
	661	23.1	24	/	1.230
	810	**23.1**	24	/	1.230
WCDMA 850	4132	22.7	23	/	1.072
	4183	22.92	23	/	1.019
	4233	22.77	23	/	1.054
WCDMA 1900	9262	22.33	22.5	/	1.040
	9400	22.23	22.5	/	1.064
	9538	22.11	22.5	/	1.094
WiFi802.11b	2412	16.81	17	1.004	1.049
	2437	16.37	17	1.004	1.161
	2462	15.66	17	1.004	1.367

7.2.4 Test Results

7.2.4.1 Summary of Measurement Results (GSM850)

SAR Values (GSM850)

Test Case		Measurement Result(W/kg)	Scaled Factor	Scaled 1g SAR(W/Kg)	Note
Different Test Position	Channel	1g SAR Average			
Test position of Body GPRS(4up) (Distance 0 mm)					
back	low	**0.997**	1.148	**1.145**	max
	mid	0.786	1.122	0.882	
	high	0.613	1.122	0.688	
back	low	0.952	1.148	1.093	repeat

Note: 1.The value with blue color is the maximum SAR Value of test case of head and body in each test band.

2.When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy thefollowing conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v06)

- ≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg, when the transmission band is ≥ 200 MHz

7.2.4.2 Summary of Measurement Results (PCS1900)

SAR Values (PCS1900)

Test Case		Measurement Result(W/kg)	Scaled Factor	Scaled 1g SAR(W/Kg)	Note
Different Test Position	Channel	1g SAR Average			
Test position of Body GPRS(4up) (Distance 0 mm)					
back	low	1.0	1.148	1.148	
	mid	0.746	1.230	0.918	
	high	0.596	1.230	0.733	
back	low	**1.01**	1.148	**1.160**	Repeat max

Note: 1.The value with blue color is the maximum SAR Value of test case of head and body in each test band.

2.When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy thefollowing conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v06)

- ≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg, when the transmission band is ≥ 200 MHz

7.2.4.3 Summary of Measurement Results (WCDMA BAND II)

SAR Values (WCDMA BAND II)

Test Case		Measurement Result(W/kg)	Scaled Factor	Scaled 1g SAR(W/Kg)	Note
Different Test Position	Channel	1g SAR Average			
Test position of Body (Distance 0 mm)					
back	low	1.24	1.040	1.290	
	mid	0.956	1.064	1.017	
	high	0.836	1.094	0.915	
back	low	**1.24**	1.040	**1.290**	Repeat1 max
back	low	1.22	1.040	1.269	Repeat2

Note: 1.The value with blue color is the maximum SAR Value of test case of head and body in each test band.

2.Per KDB Publication 941225 D01v03r01. RMC 12.2kbps was as primary mode SAR, when the primary modeSAR less than 1.2W/kg, secondary SAR (HSPA) was not requires.

3.When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy thefollowing conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v06)

- ≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg, when the transmission band is ≥ 200 MHz

7.2.4.4 Summary of Measurement Results (WCDMA BAND V)

SAR Values (WCDMA BAND V)

Test Case		Measurement Result(W/kg)	Scaled Factor	Scaled 1g SAR(W/Kg)	Note
Different Test Position	Channel	1g SAR Average			
Test position of Body (Distance 0 mm)					
back	low	**0.746**	1.072	0.799	max
	mid	0.688	1.019	0.701	
	high	0.547	1.054	0.577	

Note: 1.The value with blue color is the maximum SAR Value of test case of head and body in each test band.

2.Per KDB Publication 941225 D01v03r01. RMC 12.2kbps was as primary mode SAR, when the primary modeSAR less than 1.2W/kg, secondary SAR (HSPA) was not requires.

3.When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy thefollowing conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v06)

- ≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg, when the transmission band is ≥ 200 MHz

7.2.4.10 Summary of Measurement Results (802.11b)

SAR Values (802.11b)

Test Case		Measurement Result(W/kg)	Duty Cycle Factor	Scaled Factor	Scaled 1g SAR(W/Kg)	Note
Different Test Position	Channel	1g SAR Average				
Test position of Body (Distance 0 mm)						
back	low	0.035	1.004	1.049	0.037	
	mid	0.038	1.004	1.161	0.044	
	high	**0.041**	1.004	1.367	0.055	max

Note: 1.The value with blue color is the maximum SAR Value of test case of head and body in each test band.

2.When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy thefollowing conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v06)

- ≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg, when the transmission band is ≥ 200 MHz

7.2.5 Maximum SAR

Band	Worst Position		Channel	Reported 1g SAR (W/kg)
GSM850	Body	Back With GPRS(4up)	Low	1.145
GSM1900	Body	Back With GPRS(4up)	Low	1.160
WCDMA Band II	Body	back	Low	1.290
WCDMA Band V	Body	back	Low	0.799
WiFi	Body	back	High	0.055

Evaluation for Simultaneous SAR					
Summation BAND	**Exposure Position**	**Maximum reported 1g SAR (W/kg)**	**Summation SAR(1g) (W/kg)**	**SAR –to-peak-location Separation Ratio**	**Simultaneous Measurement Required?**
WWAN +WiFi	Body-worn(0mm)	1.290+0.055=1.345	＜1.6	/	No
WWAN+BT	Body-worn(0mm)	1.290+0.041=1.321	＜1.6	/	No

General Judgment： PASS

8. Test Equipments Utilized

No.	Name	Type	S/N	Calibration Date	Valid Period
01	Network analyzer	Agilent E5071E	MY46109425	Oct 28th, 2016	One year
02	Dielectric Probe Kit	Agilent 85070E	MY44300524	N/A	
03	Power meter	Agilent E4418B	MY50000852	Oct 28th, 2016	One year
04	Power sensor	Agilent E9200B	MY50300011	Oct 28th, 2016	One year
05	Signal Generator	Agilent N5182A	MY49071248	Oct 28th, 2016	One year
06	Amplifier	ZHL-42W	QA1020005	N/A	
07	BTS	CMU200	121464	Oct 28th, 2016	One year
08	BTS	MT8820C	6201107310	May 31th, 2016	One year
09	E-field Probe	EX3DV4	3717	Oct 19th, 2016	One year
10	DAE	DAE4	1327	Apr 15th, 2016	One year
11	Validation Kit 835MHz	D835V2	4d100	Oct 10th, 2016	One year
12	Validation Kit 1900MHz	D1900V2	5d155	Apr 14th, 2016	One year
13	Validation Kit 2450MHz	D2450V2	845	Oct 12th, 2016	One year

9. Measurement Uncertainty

No	Source of Uncertainty	Type	Uncertainty value ± %	Probability Distribution	Div.	c_i (1 g)	c_i (10 g)	Standard Unc ± %, (1 g)	Standard Unc ± %, (10 g)	v_i or v_{eff}
1	System repetivity	A	2.7	N	1	1	1	2.7	2.7	9
Measurement System										
2	Probe Calibration	B	5.9	N	1	1	1	5.9	5.9	∞
3	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
4	Boundary Effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
5	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
6	Detection Limits	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
7	Readout Electronics	B	0.3	N	1	1	1	0.3	0.3	∞
8	Response Time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
9	Integration Time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
10	RF ambient conditions – noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	RF ambient conditions – reflections	B	0	R	$\sqrt{3}$	1	1	0	0	∞
12	Probe Positioner Mech. Restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
13	Probe Positioning with respect to Phantom Shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
14	Post-Processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test Sample Related										

15	Test Sample Positioning	A	3.3	N	1	1	1	3.3	3.3	*71*
16	Device Holder Uncertainty	A	4.1	N	1	1	1	4.1	4.1	*5*
17	Drift of Output Power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and Set-up										
18	Phantom Uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
19	Liquid Conductivity (target.)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
20	Liquid Conductivity (meas.)	A	2.06	N	1	0,64	0,43	1.7	1.4	*43*
21	Liquid Permittivity (target.)	B	5.0	R	$\sqrt{3}$	0,6	0,49	1.7	1.4	∞
22	Liquid Permittivity (meas.)	A	1.6	N	1	0,6	0,49	1.0	0.8	521
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						10.54	10.34	
Expanded uncertainty (95 % confidence interval)		k=2						21.08	20.68	

ANNEX A: Detailed Test Results

Annex A.1 System Check Results

System check 835body

Date/Time: 25/01/2017 08:38:00

Communication System: UID 10000, CW; Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 835 MHz; $\sigma = 0.945$ S/m; $\varepsilon_r = 54.722$; $\rho = 1000$ kg/m^3

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528-2013)

DASY5 Configuration:

- Probe: EX3DV4 - SN3717; ConvF(8.99, 8.99, 8.99); Calibrated: 19/10/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1327; Calibrated: 15/04/2016
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835body/d=15mm, Pin=250 mW/Area Scan (61x121x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 2.39 W/kg

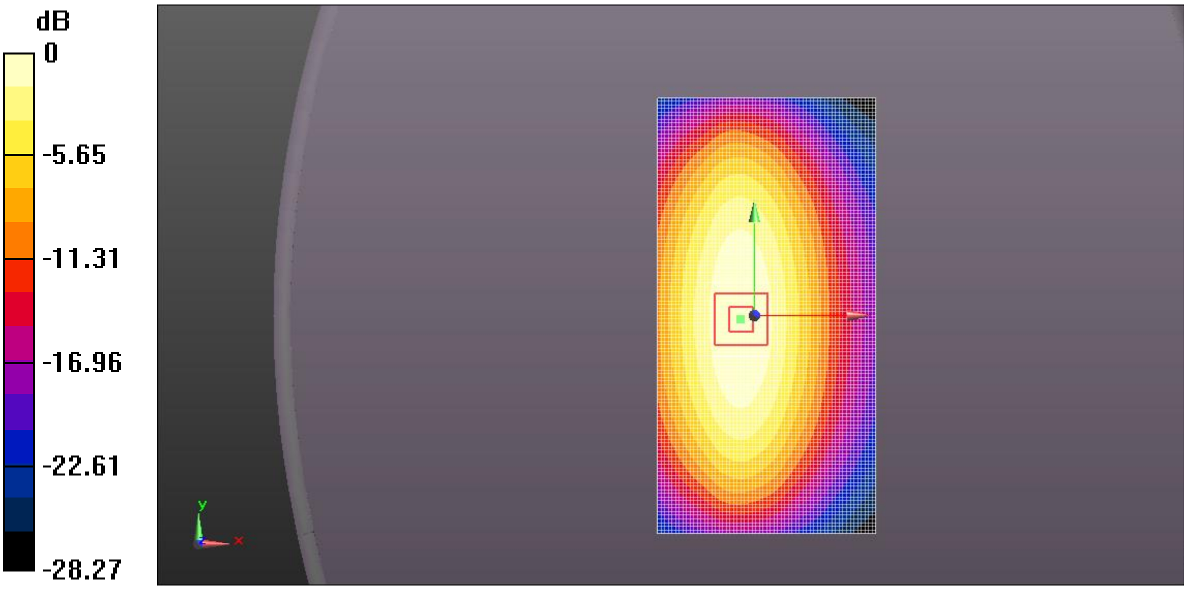
835body/d=15mm, Pin=250 mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 51.344 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.19 W/kg

SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.56 W/kg

Maximum value of SAR (measured) = 2.38 W/kg



0 dB = 2.39 W/kg = 3.78 dBW/kg

System check 1900body

Date/Time: 09/02/2017 08:52:43

Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 1900 MHz; σ = 1.494 S/m; ε_r = 52.491; ρ = 1000 kg/m^3

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528-2013)

DASY5 Configuration:

- Probe: EX3DV4 - SN3717; ConvF(7.44, 7.44, 7.44); Calibrated: 19/10/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1327; Calibrated: 15/04/2016
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1900body/d=10mm, Pin=250 mW/Area Scan (61x71x1): Measurement grid: dx=10mm, dy=10mm

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

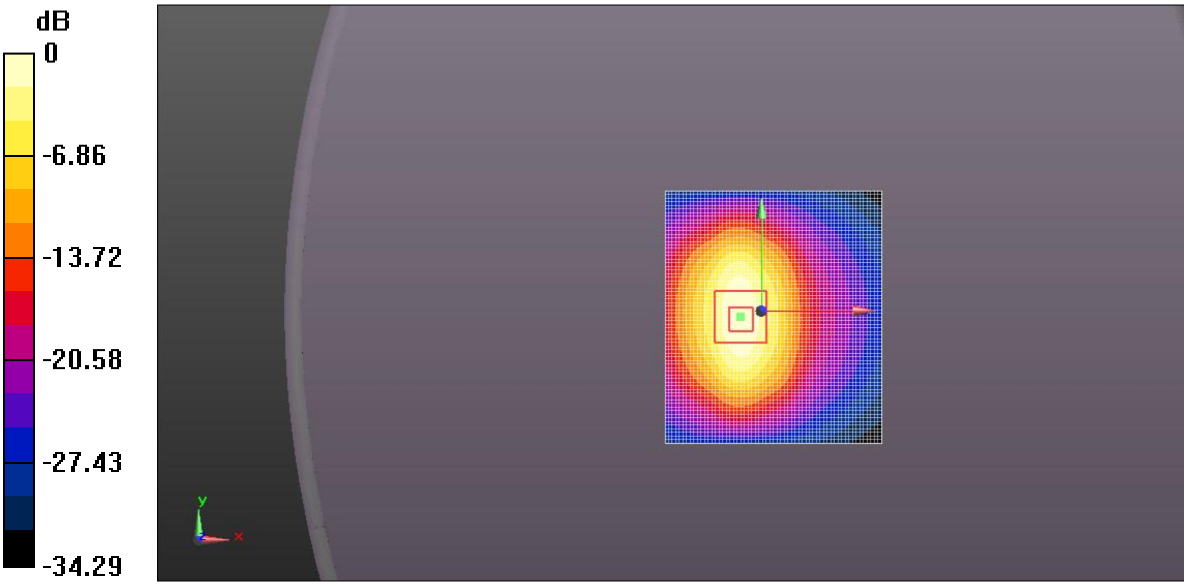
1900body/d=10mm, Pin=250 mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 70.500 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 16.0 W/kg

SAR(1 g) = 9.81 W/kg; SAR(10 g) = 5.09 W/kg

Maximum value of SAR (measured) = 11.7 W/kg



0 dB = 12.6 W/kg = 11.01 dBW/kg

System check 2450body

Date/Time: 10/02/2017 08:56:12

Communication System: UID 10000, CW; Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 2450 MHz; σ = 1.931 S/m; ε_r = 52.172; ρ = 1000 kg/m^3

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528-2013)

DASY5 Configuration:

- Probe: EX3DV4 - SN3717; ConvF(7.04, 7.04, 7.04); Calibrated: 19/10/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1327; Calibrated: 15/04/2016
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

2450body/d=10mm, Pin=250 mW/Area Scan (41x61x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 17.6 W/kg

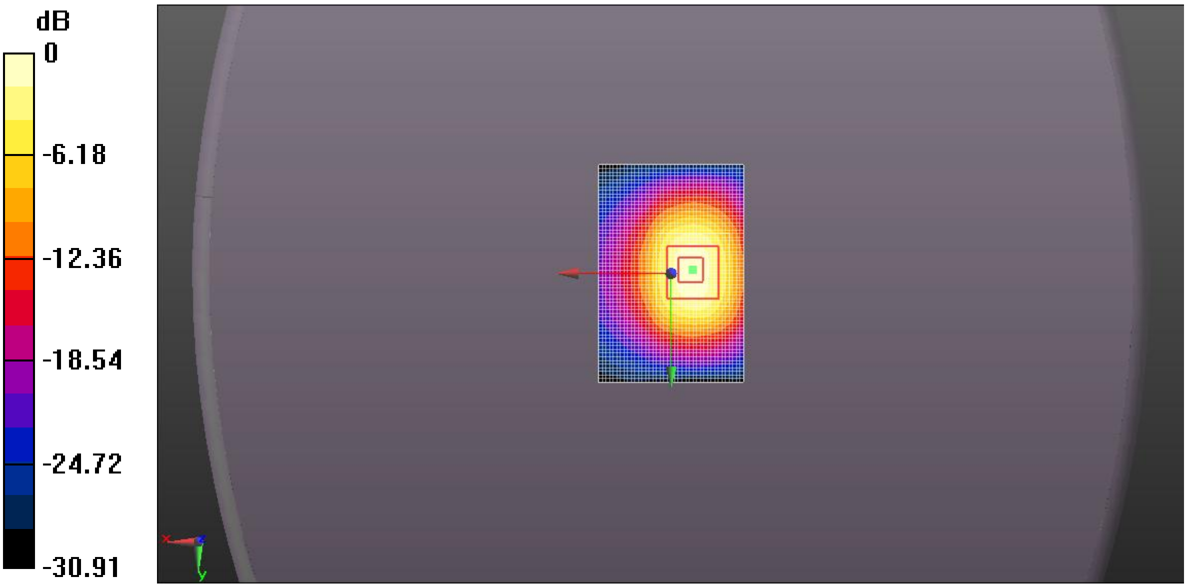
2450body/d=10mm, Pin=250 mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 71.463 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 26.2 W/kg

SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.88 W/kg

Maximum value of SAR (measured) = 16.8 W/kg



0 dB = 17.6 W/kg = 12.46 dBW/kg

Annex A.2 Graph Result

GSM850 GPRS(4UP) back low

Date/Time: 25/01/2017 13:12:34

Communication System: UID 0, GPRS/EGPRS(4UP) (0); Communication System Band: GSM850; Frequency: 824.2 MHz;Communication System PAR: 3.18 dB

Medium parameters used (interpolated): f = 824.2 MHz; σ = 0.933 S/m; ε_r = 54.311; ρ = 1000 kg/m^3

Phantom section: Flat Section

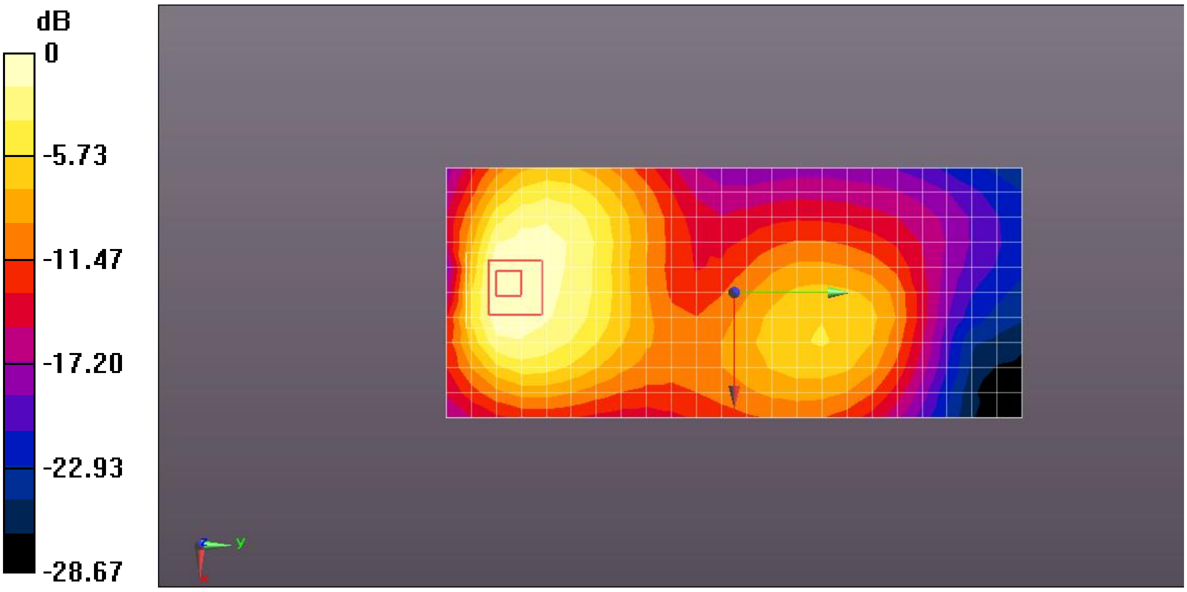
Measurement Standard: DASY5 (IEEE1528-2013)

DASY5 Configuration:

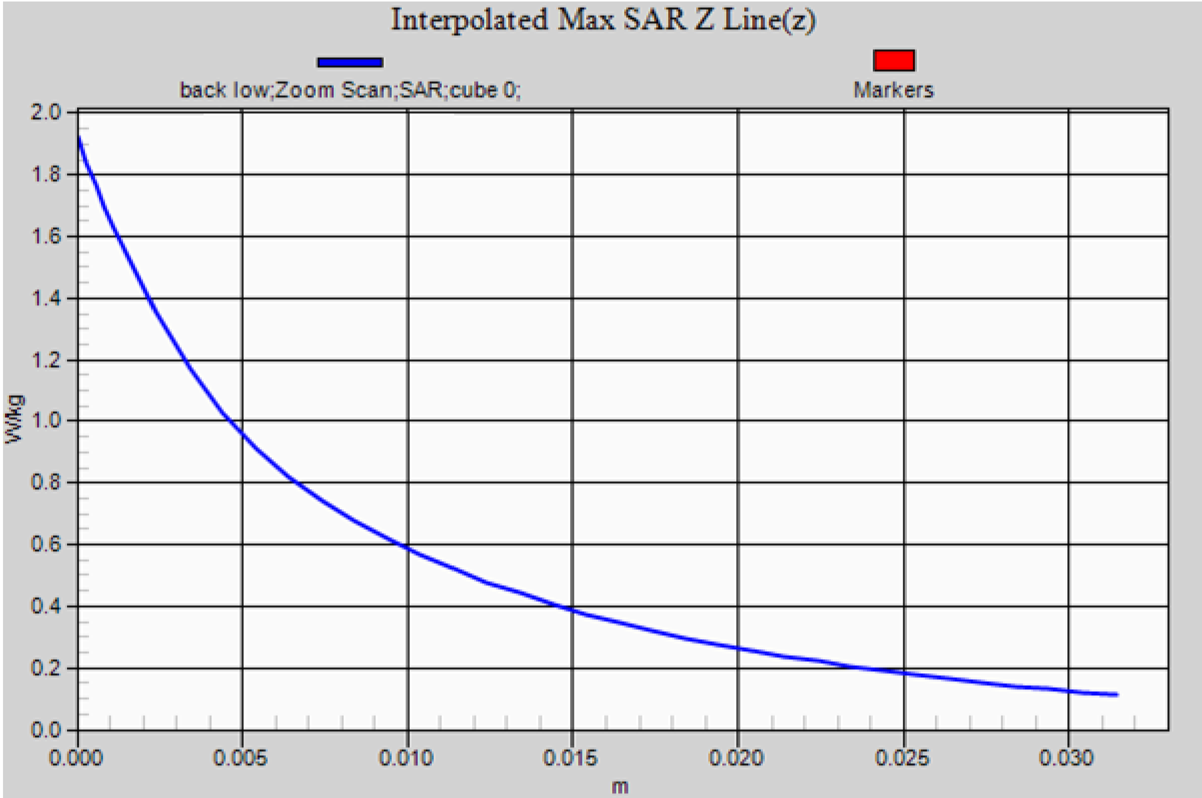
- Probe: EX3DV4 - SN3717; ConvF(8.99, 8.99, 8.99); Calibrated: 19/10/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1327; Calibrated: 15/04/2016
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

body/back low/Area Scan (11x24x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.31 W/kg

body/back low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.21 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 1.92 W/kg
SAR(1 g) = 0.997 W/kg; SAR(10 g) = 0.616 W/kg
Maximum value of SAR (measured) = 1.56 W/kg



0 dB = 1.31 W/kg = 1.18 dBW/kg


Interpolated Max SAR Z Line(z)
back low;Zoom Scan;SAR;cube 0;
Markers
W/kg
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

GSM1900 GPRS(4UP) back low repeat1

Date/Time: 09/02/2017 13:01:00

Communication System: UID 0, GPRS/EGPRS(4UP) (0); Communication System Band: PCS1900; Frequency: 1850.2 MHz;Communication System PAR: 3.18 dB

Medium parameters used (interpolated): f = 1850.2 MHz; σ = 1.448 S/m; ε_r = 52.486; ρ = 1000 kg/m^3

Phantom section: Flat Section

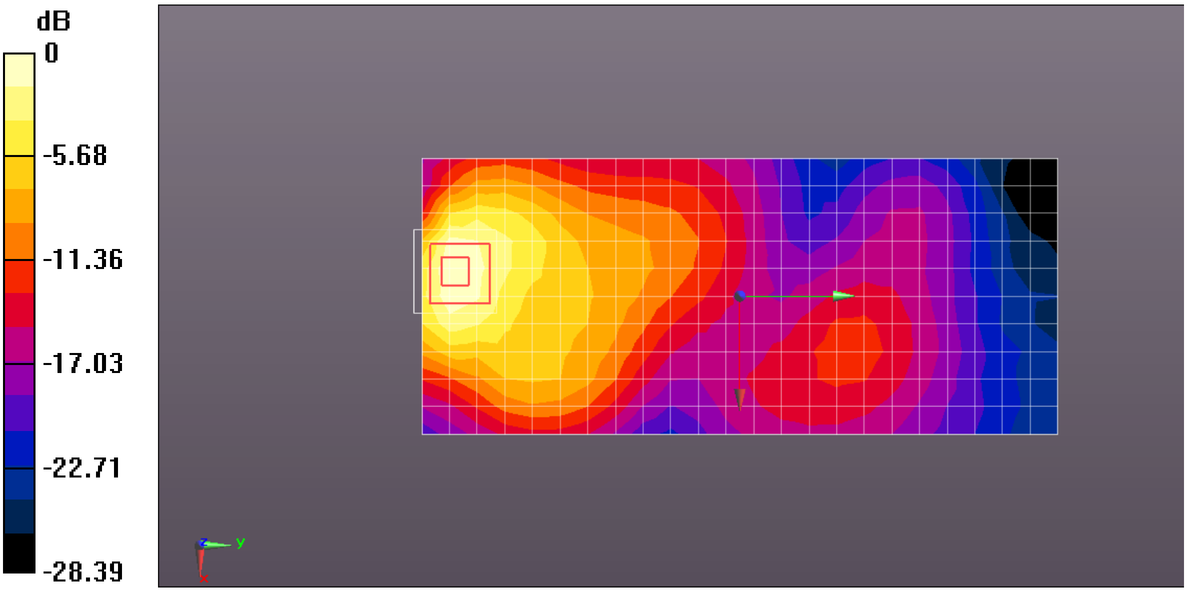
Measurement Standard: DASY5 (IEEE1528-2013))

DASY5 Configuration:

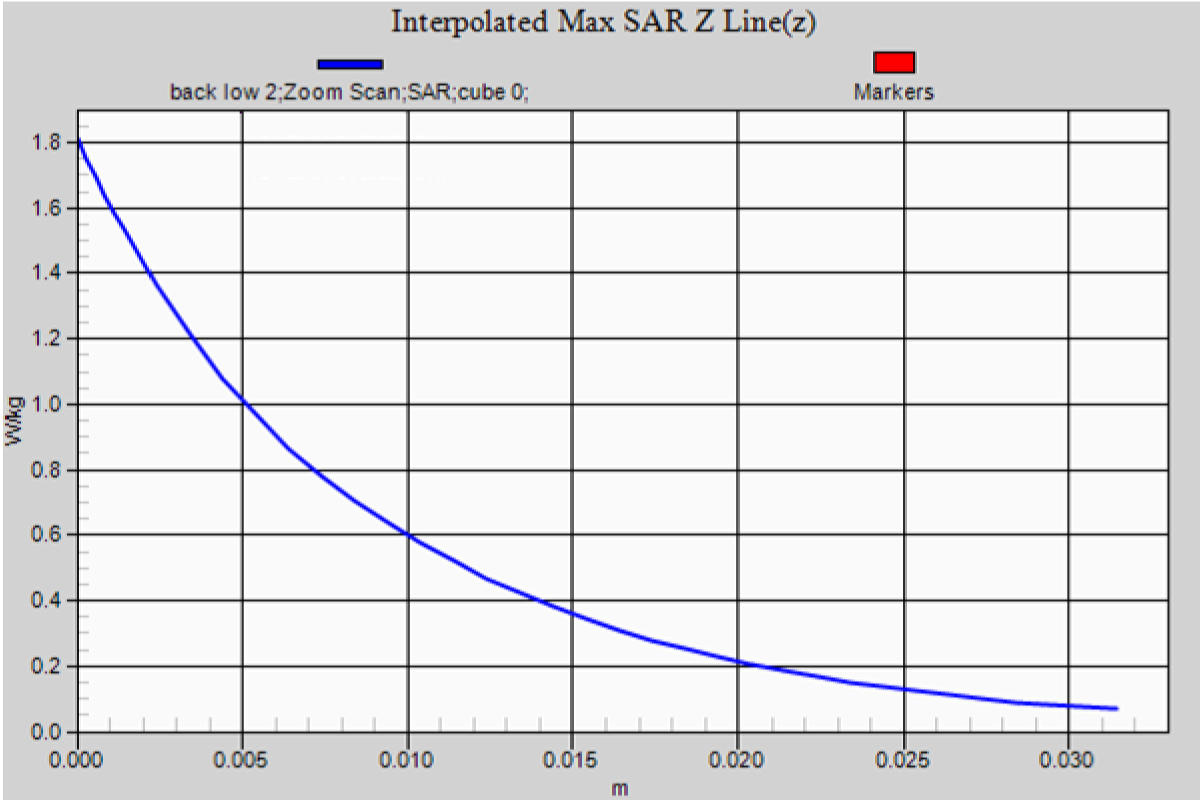
- Probe: EX3DV4 - SN3717; ConvF(7.44, 7.44, 7.44); Calibrated: 19/10/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1327; Calibrated: 15/04/2016
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

body/back low 2/Area Scan (11x24x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.47 W/kg

body/back low 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.990 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 1.81 W/kg
SAR(1 g) = 1.01 W/kg; SAR(10 g) = 0.546 W/kg
Maximum value of SAR (measured) = 1.54 W/kg



0 dB = 1.47 W/kg = 1.67 dBW/kg


Interpolated Max SAR Z Line(z)
back low 2;Zoom Scan;SAR;cube 0;
Markers
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
W/kg
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

WCDMA BAND II back low repeat

Date/Time: 09/02/2017 15:14:41

Communication System: UID 0, WCDMA (0); Communication System Band: BAND 2; Frequency: 1852.4 MHz;Communication System PAR: 0 dB

Medium parameters used (interpolated): f = 1852.4 MHz; σ = 1.451 S/m; ε_r = 52.481; ρ = 1000 kg/m^3

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528-2013))

DASY5 Configuration:

- Probe: EX3DV4 - SN3717; ConvF(7.44, 7.44, 7.44); Calibrated: 19/10/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1327; Calibrated: 15/04/2016
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

body/back low 2/Area Scan (11x24x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.71 W/kg

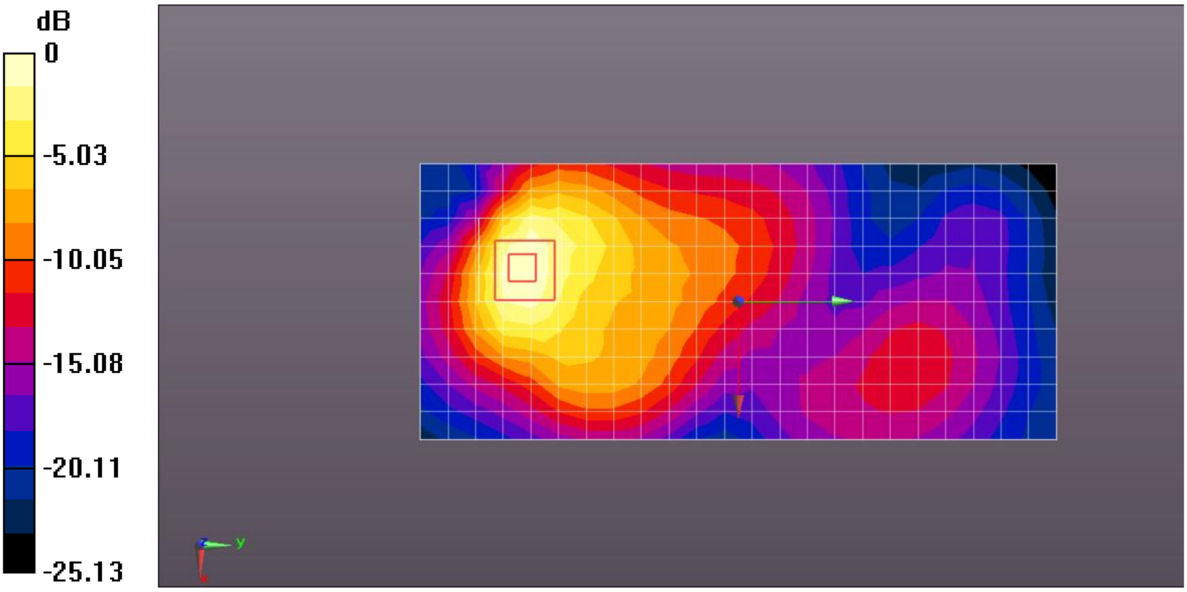
body/back low 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 8.836 V/m; Power Drift = 0.09 dB

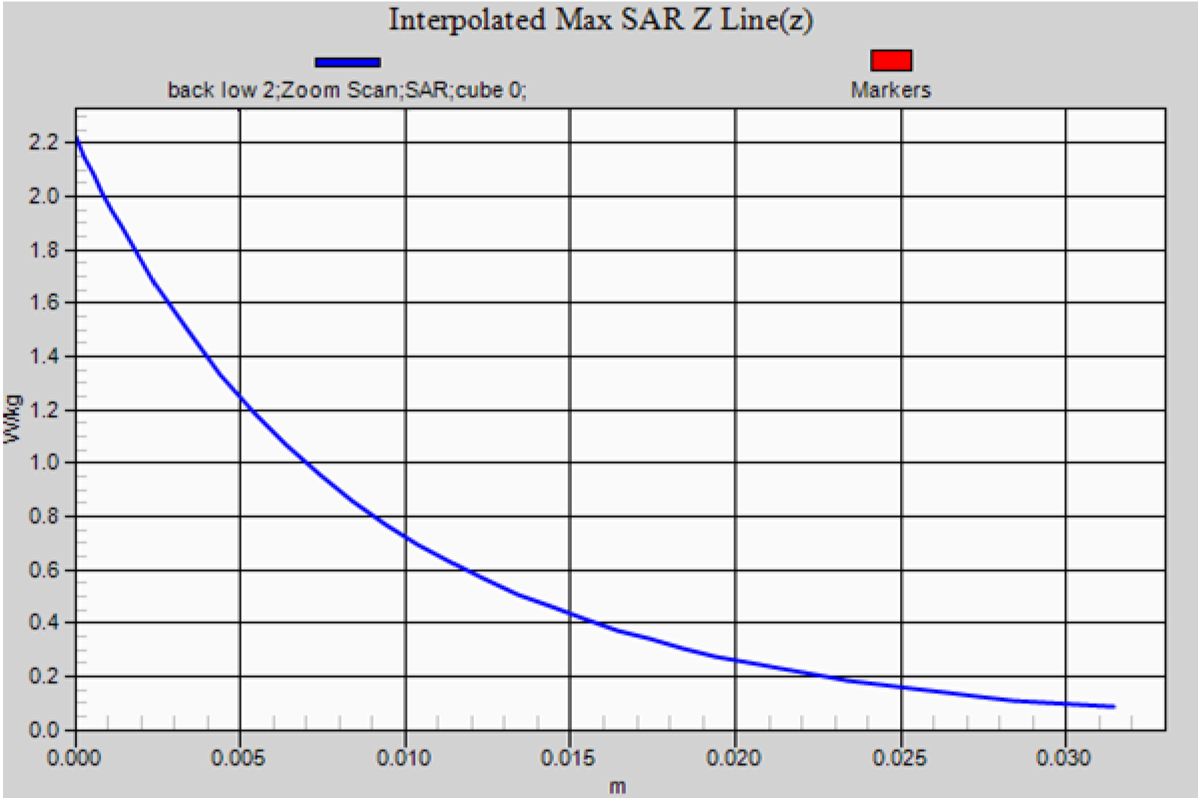
Peak SAR (extrapolated) = 2.22 W/kg

SAR(1 g) = 1.24 W/kg; SAR(10 g) = 0.669 W/kg

Maximum value of SAR (measured) = 1.87 W/kg



0 dB = 1.71 W/kg = 2.33 dBW/kg


Interpolated Max SAR Z Line(z)
back low 2;Zoom Scan;SAR;cube 0;
Markers
W/kg
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

WCDMA BAND V back low

Date/Time: 25/01/2017 10:56:54

Communication System: UID 0, WCDMA (0); Communication System Band: BAND 5; Frequency: 826.4 MHz;Communication System PAR: 0 dB

Medium parameters used (interpolated): f = 826.4 MHz; σ = 0.936 S/m; ε_r = 54.3; ρ = 1000 kg/m^3

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528-2013))

DASY5 Configuration:

- Probe: EX3DV4 - SN3717; ConvF(8.99, 8.99, 8.99); Calibrated: 19/10/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1327; Calibrated: 15/04/2016
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

body/back low/Area Scan (11x24x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.976 W/kg

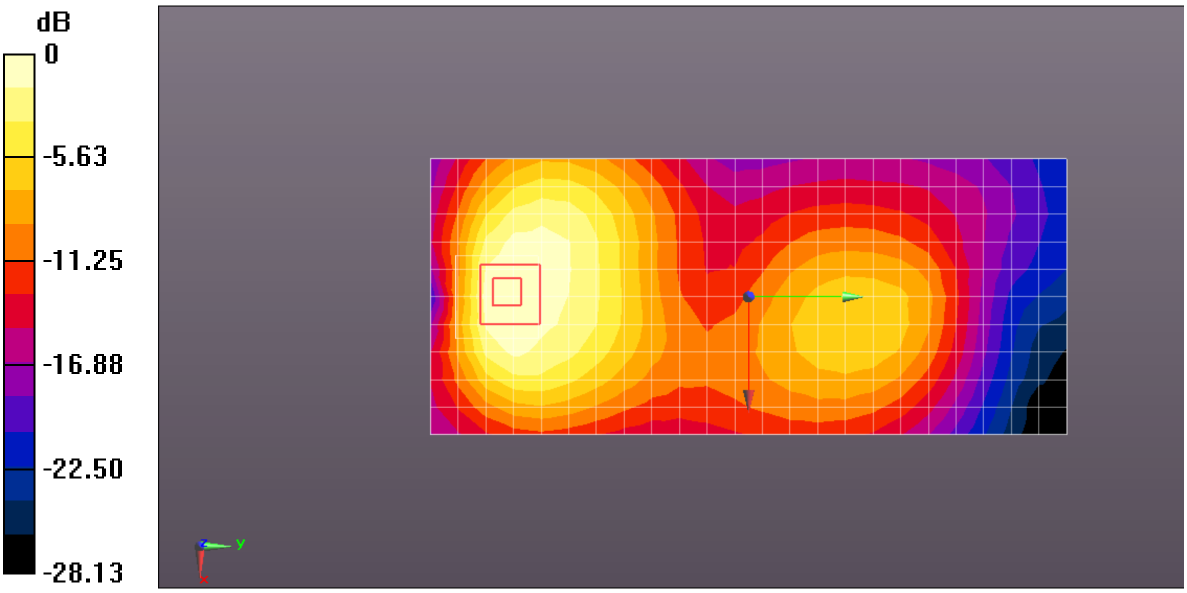
body/back low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 8.550 V/m; Power Drift = 0.00 dB

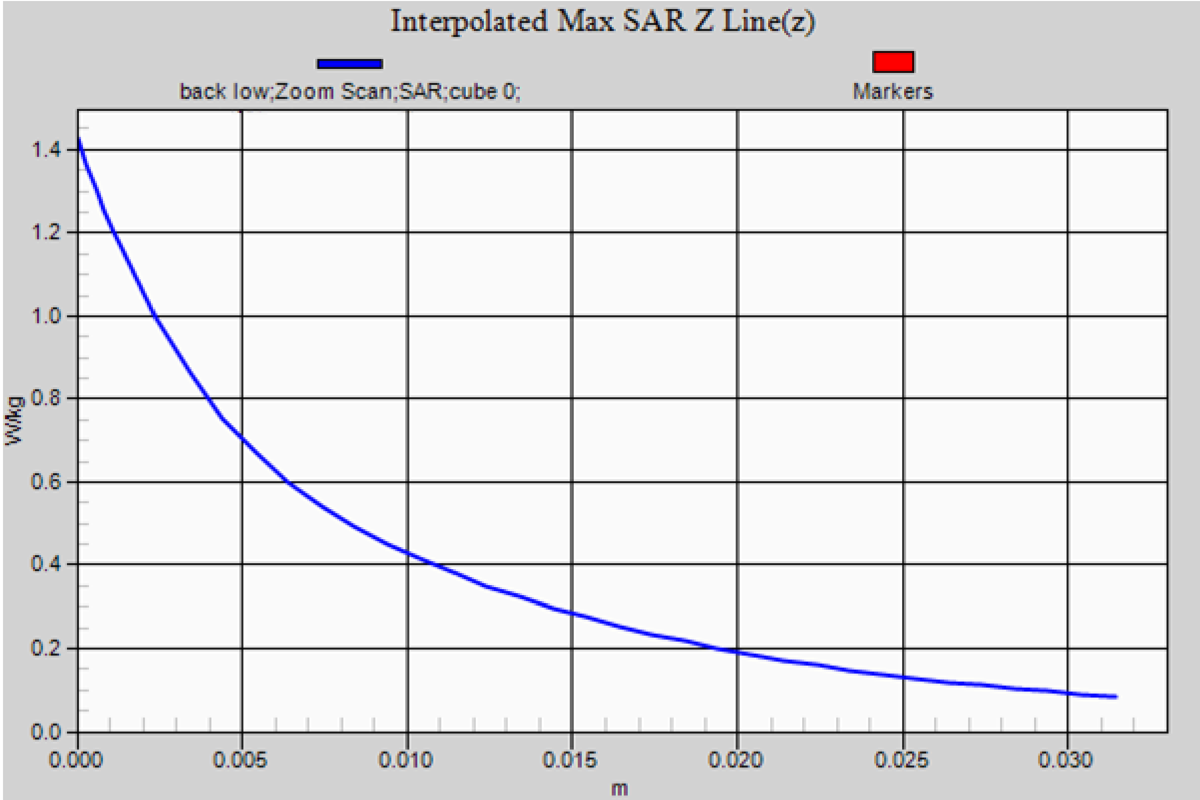
Peak SAR (extrapolated) = 1.43 W/kg

SAR(1 g) = 0.746 W/kg; SAR(10 g) = 0.452 W/kg

Maximum value of SAR (measured) = 1.11 W/kg



0 dB = 0.976 W/kg = -0.11 dBW/kg


Interpolated Max SAR Z Line(z)
back low;Zoom Scan;SAR;cube 0;
Markers
W/kg
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

802.11b Date Rate: 1 Mbps back high

Date/Time: 10/02/2017 14:14:37

Communication System: UID 0, 802.11b/g/n 2.45GHz (0); Communication System Band: 2.4G; Frequency: 2462 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 2462 MHz; σ = 1.934 S/m; ε_r = 51.886; ρ = 1000 kg/m^3

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528-2013))

DASY5 Configuration:

- Probe: EX3DV4 - SN3717; ConvF(7.04, 7.04, 7.04); Calibrated: 19/10/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1327; Calibrated: 15/04/2016
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/back high/Area Scan (12x25x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.0604 W/kg

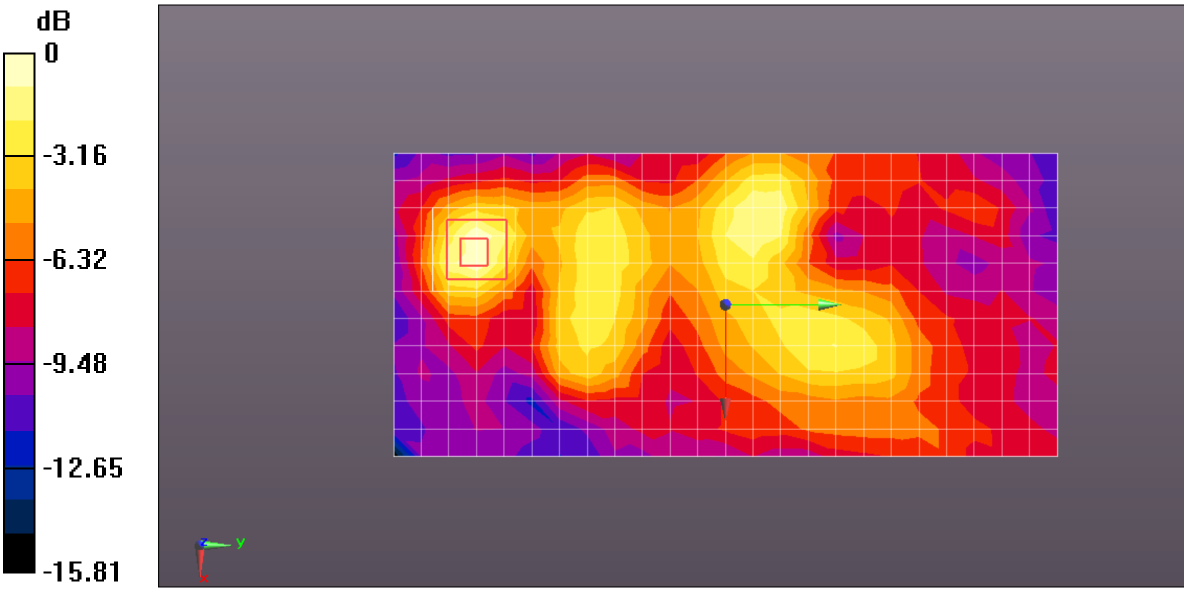
Configuration/back high/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 3.337 V/m; Power Drift = -0.12 dB

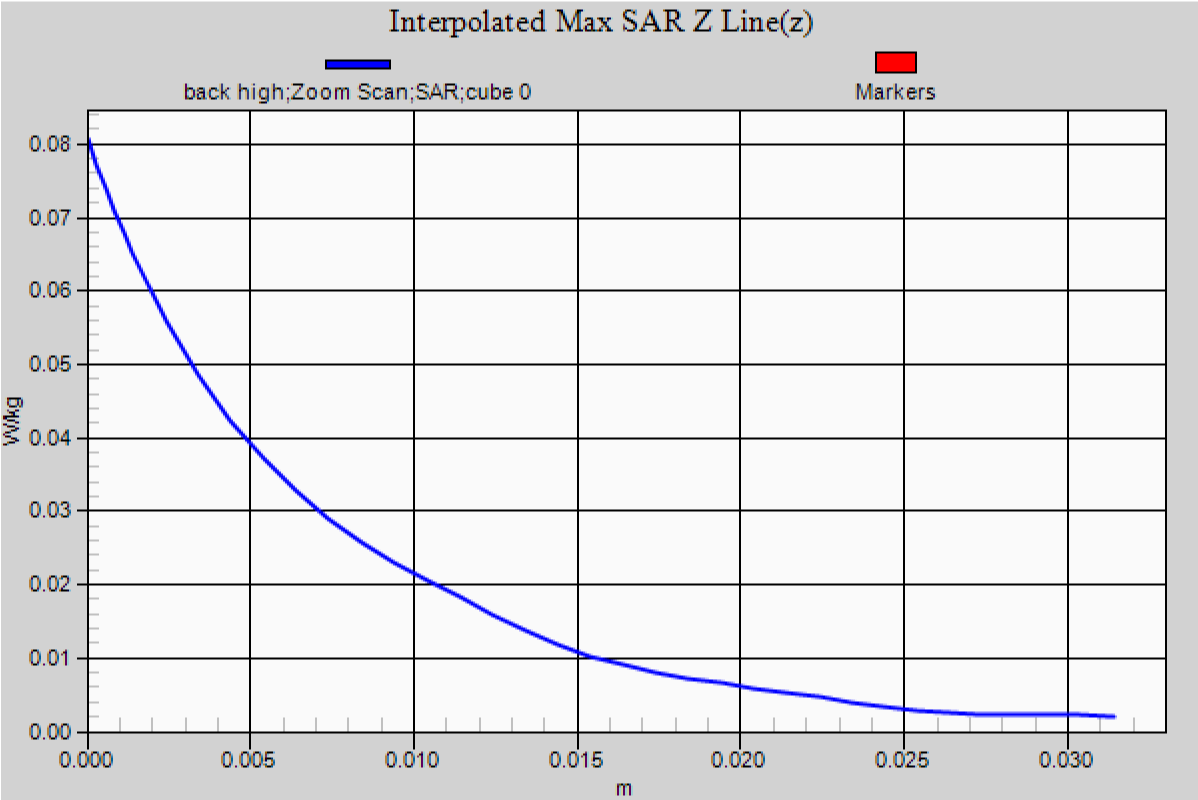
Peak SAR (extrapolated) = 0.0810 W/kg

SAR(1 g) = 0.041 W/kg; SAR(10 g) = 0.020 W/kg

Maximum value of SAR (measured) = 0.0635 W/kg



0 dB = 0.0604 W/kg = -12.19 dBW/kg


Interpolated Max SAR Z Line(z)
back high;Zoom Scan;SAR;cube 0
Markers
W/kg
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

ANNEX B: Calibration Certificate

Annex B.1 Probe Calibration Certificate

CTTL In Collaboration with s p e a g CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

ilac-MRA CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client Tejet Certificate No: Z16-97169

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3717
Calibration Procedure(s)	FD-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	October 19, 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
Power sensor NRP-Z91	101548	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference10dBAttenuator	18N50W-10dB	13-Mar-16(CTTL,No.J16X01547)	Mar-18
Reference20dBAttenuator	18N50W-20dB	13-Mar-16(CTTL, No.J16X01548)	Mar-18
Reference Probe EX3DV4	SN 7307	19-Feb-16(SPEAG,No.EX3-7307_Feb16)	Feb-17
DAE4	SN 1331	21-Jan-16(SPEAG, No.DAE4-1331_Jan16)	Jan -17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	27-Jun-16 (CTTL, No.J16X04776)	Jun-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan -17

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	余斌彬
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Liu Wei	Deputy Director of SEM Department	刘伟

Issued: October 21, 2016

TTL In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005

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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Probe EX3DV4

SN: 3717

Calibrated: October 19, 2016

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

TTL In Collaboration with s p e a g CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3717

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm($\mu V/(V/m)^2$)[A]	0.50	0.46	0.55	±10.8%
DCP(mV)[B]	99.6	102.5	100.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	203.0	±2.2%
		Y	0.0	0.0	1.0		197.5	
		Z	0.0	0.0	1.0		219.8	

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

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

Certificate No: Z16-97169 Page 4 of 11

TTL In Collaboration with s p e a g CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3717

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity[F]	Conductivity (S/m)[F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	41.9	0.89	9.27	9.27	9.27	0.30	0.80	±12%
835	41.5	0.90	8.93	8.93	8.93	0.14	1.39	±12%
900	41.5	0.97	8.94	8.94	8.94	0.12	1.60	±12%
1750	40.1	1.37	7.70	7.70	7.70	0.17	1.61	±12%
1900	40.0	1.40	7.65	7.65	7.65	0.20	1.49	±12%
2300	39.5	1.67	7.15	7.15	7.15	0.56	0.70	±12%
2450	39.2	1.80	6.96	6.96	6.96	0.40	0.91	±12%
2600	39.0	1.96	6.70	6.70	6.70	0.52	0.80	±12%
5200	36.0	4.66	5.25	5.25	5.25	0.40	1.25	±13%
5300	35.9	4.76	4.98	4.98	4.98	0.40	1.25	±13%
5500	35.6	4.96	4.80	4.80	4.80	0.40	1.28	±13%
5600	35.5	5.07	4.67	4.67	4.67	0.40	1.45	±13%
5800	35.3	5.27	4.57	4.57	4.57	0.44	1.45	±13%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of 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 frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

TTL In Collaboration with s p e a g CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3717

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	55.5	0.96	9.25	9.25	9.25	0.50	0.82	±12%
835	55.2	0.97	8.99	8.99	8.99	0.16	1.54	±12%
900	55.0	1.05	8.93	8.93	8.93	0.23	1.12	±12%
1750	53.4	1.49	7.63	7.63	7.63	0.17	1.79	±12%
1900	53.3	1.52	7.44	7.44	7.44	0.20	1.71	±12%
2300	52.9	1.81	7.06	7.06	7.06	0.55	0.79	±12%
2450	52.7	1.95	7.04	7.04	7.04	0.38	1.12	±12%
2600	52.5	2.16	6.86	6.86	6.86	0.37	1.11	±12%
5200	49.0	5.30	4.47	4.47	4.47	0.45	1.50	±13%
5300	48.9	5.42	4.19	4.19	4.19	0.45	1.55	±13%
5500	48.6	5.65	3.90	3.90	3.90	0.50	1.50	±13%
5600	48.5	5.77	3.68	3.68	3.68	0.50	1.55	±13%
5800	48.2	6.00	3.83	3.83	3.83	0.50	1.70	±13%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of 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.

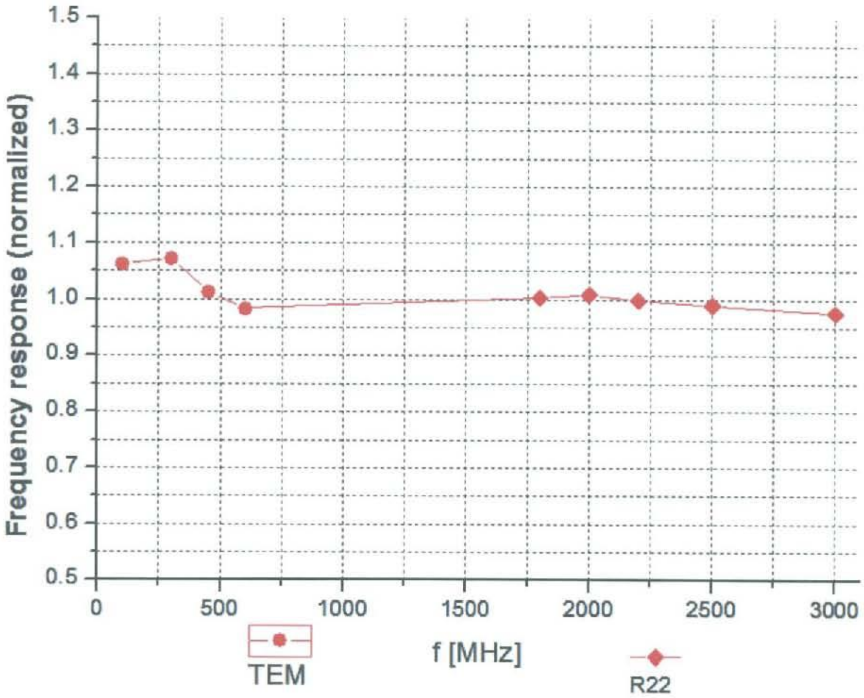
[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

TTL In Collaboration with speag CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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



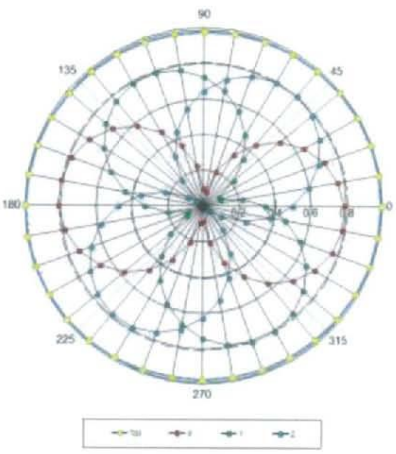
Uncertainty of Frequency Response of E-field: ±7.5% (k=2)

CTTL In Collaboration with s p e a g CALIBRATION LABORATORY

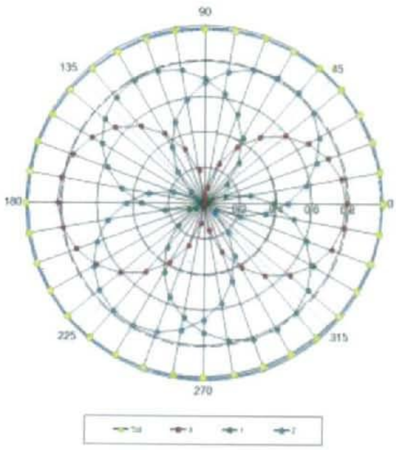
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

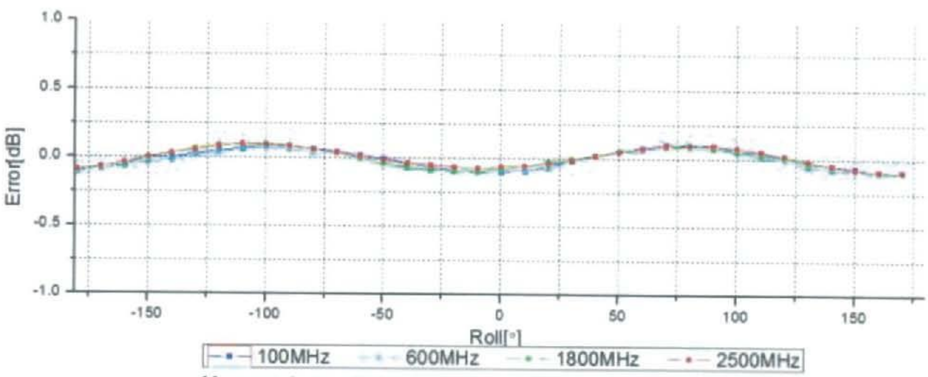
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22



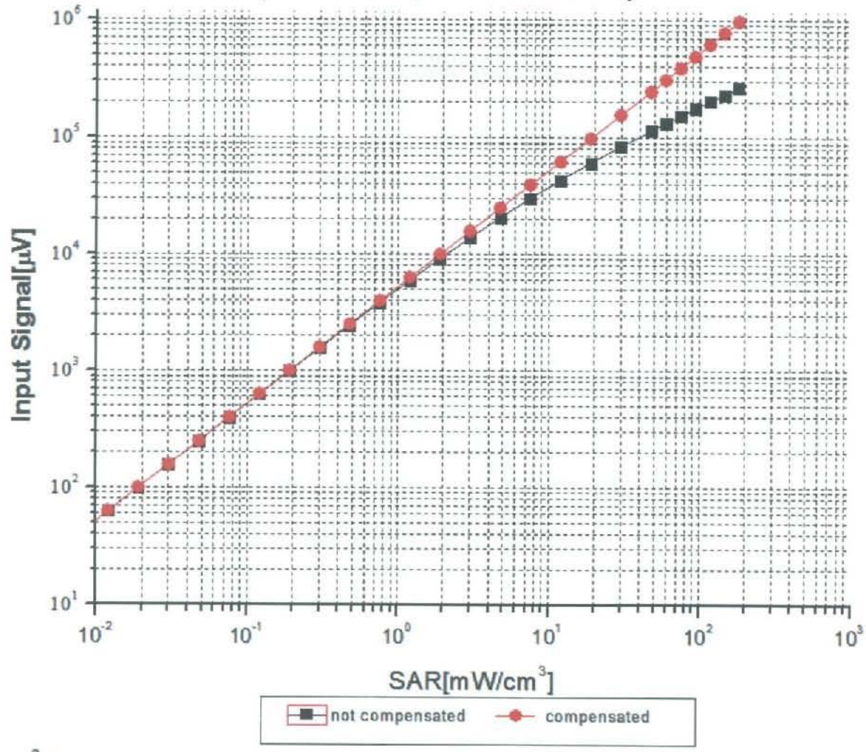


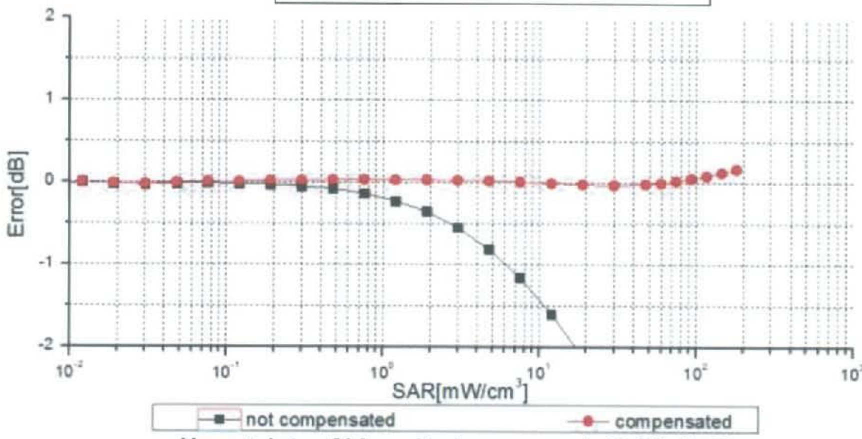
Uncertainty of Axial Isotropy Assessment: ±0.9% (k=2)

CTTL In Collaboration with speag CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)





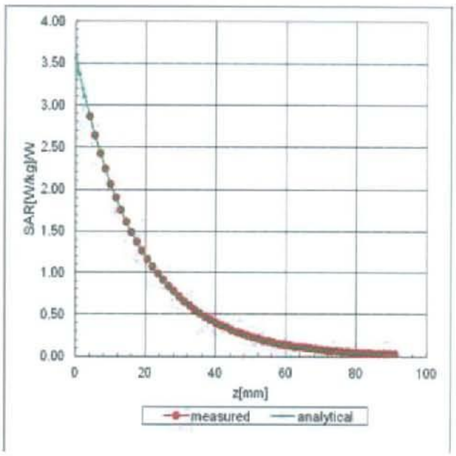
Uncertainty of Linearity Assessment: ±0.9% (k=2)

In Collaboration with
s p e a g
CALIBRATION LABORATORY

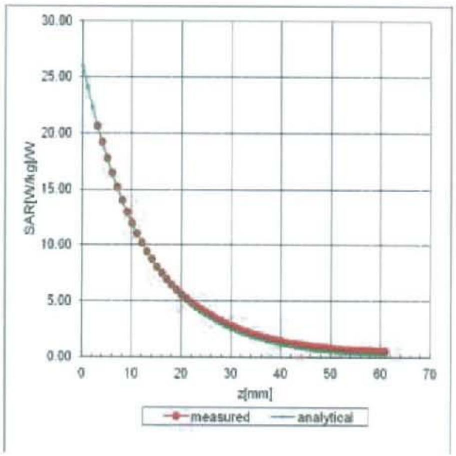
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Conversion Factor Assessment

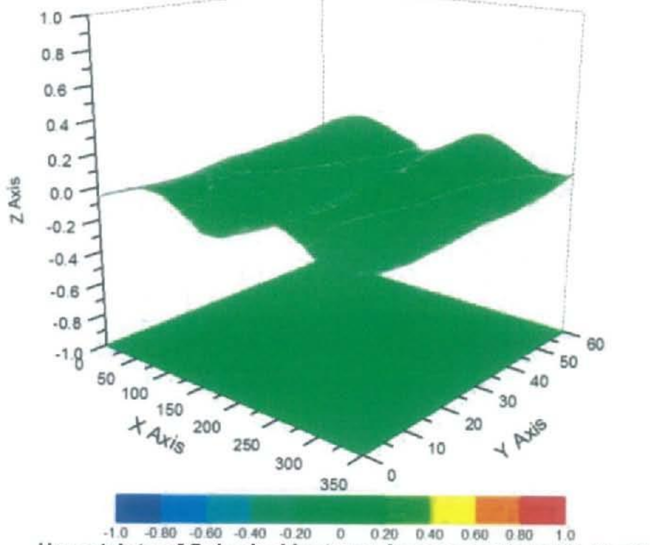
f=900 MHz, WGLS R9(H_convF)



f=1750 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±2.8% (K=2)

TTL In Collaboration with s p e a g CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3717

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	158.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

OET
June 26, 2013

Acceptable Conditions for SAR Measurements Using Probes and Dipoles Calibrated under the SPEAG-TMC Dual-Logo Calibration Program to Support FCC Equipment Certification

The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by TMC (*Telecommunication Metrology Center of MIIT in Beijing, China*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and TMC, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following.

1) The agreement established between SPEAG and TMC is only applicable to calibration services performed by TMC where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. This agreement is subject to renewal at the end of each calendar year between SPEAG and TMC. TMC shall inform the FCC of any changes or early termination to the agreement.
2) Only a subset of the calibration services specified in the SPEAG-TMC agreement, while it remains valid, are applicable to SAR measurements performed using such equipment for supporting FCC equipment certification. These are identified in the following.
   a) Calibration of dosimetric (SAR) probes EX3DVx, ET3DVx and ES3DVx.
      i) Free-space E-field and H-field probes, including those used for HAC (hearing aid compatibility) evaluation, temperature probes, other probes or equipment not identified in this document, when calibrated by TMC, are excluded and cannot be used for measurements to support FCC equipment certification.
      ii) Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics are handled according to the requirements of KDB 865664; that is, "Until standardized procedures are available to make such determination, the applicability of a signal specific probe calibration for testing specific wireless modes and technologies is determined on a case-by-case basis through KDB inquiries, including SAR system verification requirements."
   b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
   c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
   d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the TMC QA protocol (a separate attachment to this document).
   e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by TMC.
   f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 or higher version systems.

3) The SPEAG-TMC agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by TMC under this SPEAG-TMC Dual-Logo calibration agreement are equivalent to the calibration services provided by SPEAG. TMC shall, upon request, provide copies of documentation to the FCC to substantiate program implementation.
   a) The Inter-laboratory Calibration Evaluation (ILCE) stated in the TMC QA protocol shall be performed between SPEAG and TMC at least once every 12 months. The ILCE acceptance criteria defined in the TMC QA protocol shall be satisfied for the TMC, SPEAG and FCC agreements to remain valid.
   b) Check of Calibration Certificate (CCC) shall be performed by SPEAG for all calibrations performed by TMC. Written confirmation from SPEAG is required for TMC to issue calibration certificates under the SPEAG-TMC Dual-Logo calibration program. Quarterly reports for all calibrations performed by TMC under the program are also issued by SPEAG.
   c) The calibration equipment and measurement system used by TMC shall be verified before each calibration service according to the specific reference SAR probes, dipoles, and DAE calibrated by SPEAG. The results shall be reproducible and within the defined acceptance criteria specified in the TMC QA protocol before each actual calibration can commence. TMC shall maintain records of the measurement and calibration system verification results for all calibrations.
   d) Quality Check of Calibration (QCC) certificates shall be performed by SPEAG at least once every 12 months. SPEAG shall visit TMC facilities to verify the laboratory, equipment, applied procedures and plausibility of randomly selected certificates.
4) A copy of this document, to be updated annually, shall be provided to TMC clients that accept calibration services according to the SPEAG-TMC Dual-Logo calibration program, which should be presented to a TCB (*Telecommunication Certification Body*), to facilitate FCC equipment approval.
5) TMC shall address any questions raised by its clients or TCBs relating to the SPEAG-TMC Dual-Logo calibration program and inform the FCC and SPEAG of any critical issues.

Change Note: Revised on June 26 to clarify the applicability of PMR and Bundled probe calibrations according to the requirements of KDB 865664.

Annex B.2 DAE4 Calibration Certificate

In Collaboration with
speag
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

CALIBRATION
No. L0570

Client : Tejet

Certificate No: J16-97048

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 1327
Calibration Procedure(s)	FD-Z11-2-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	April 15, 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
Process Calibrator 753	1971018	01-July-14 (CTTL, No:J14X02147)	July-15

	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: April 18, 2016

Certificate No: J16-97048 Page 1 of 3

TTL In Collaboration with speag CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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 report provide only calibration results for DAE, it does not contain other performance test results.

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , 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	404.880 ± 0.15% (k=2)	404.737 ± 0.15% (k=2)	404.934 ± 0.15% (k=2)
Low Range	3.99344 ± 0.7% (k=2)	3.99268 ± 0.7% (k=2)	3.99828 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	188° ± 1 °