



TEST REPORT



Test of: EB-4063

To: OET Bulletin 65 Supplement C: (2001-01)
IEEE1528:2003

FCC ID: UCE312057A

Test Report Serial No:
UL-SAR-RP90385JD04A V3.0

Version 3.0 Supersedes All Previous Versions

This Test Report Is Issued Under The Authority Of Richelieu Quoi, SAR Technology Consultant:	 (APPROVED SIGNATORY)
Checked By: Richelieu Quoi	 (APPROVED SIGNATORY)
Issue Date:	11 December 2012
Test Dates:	20 November 2012 to 28 November 2012

This report is issued in portable document format (PDF). It is only a valid copy of the report if it is being viewed in PDF format with the following security options not allowed: Changing the document, Selecting text and graphics, Adding or changing notes and form fields.

This report may not be reproduced other than in full, except with the prior written approval of UL. The results in this report apply only to the sample(s) tested.

The Bluetooth® word mark and logos are owned by the Bluetooth SIG, Inc. and any use of such marks by UL. is under license. Other trademarks and trade names are those of their respective owners.

This page has been left intentionally blank.

TABLE OF CONTENTS

1. Customer Information	4
2. Equipment Under Test (EUT)	5
3. Test Specification, Methods and Procedures	12
4. Deviations from the Test Specification.....	13
5. Operation and Configuration of the EUT during Testing	14
6. Summary of Test Results	17
7. Measurements, Examinations and Derived Results	20
8. Measurement Uncertainty	50
Appendix 1. Test Equipment Used.....	57
Appendix 2. Measurement Methods.....	61
Appendix 3. SAR Distribution Scans	63
Appendix 4. Photographs	156
Appendix 5. System Performance Check	195
Appendix 6. Simulated Tissues	201
Appendix 7. DASY4 System Details	202

1. Customer Information

Company Name:	Panasonic Mobile Comms Dev of Europe Ltd
Address:	Panasonic House Willoughby Road Bracknell Berkshire RG12 8FP United Kingdom

2. Equipment Under Test (EUT)

2.1. Identification of Equipment Under Test (EUT)

Description:	Mobile Handset
Brand Name:	NTT Docomo
Model Name or Number:	EB-4063
Serial Number:	None Stated
IMEI Number:	353740050018468
Hardware Version Number:	Rev C
Software Version Number:	ACPU: rupy-jb-10-0391, CCPU: 101035_DCM_00.1
Hardware Revision of GSM Module:	None Stated
Software Revision of GSM Module:	None Stated
FCC ID Number:	UCE312057A
Country of Manufacture:	None Stated
Date of Receipt:	20 November 2012

Note(s):

This sample was used to perform WWAN and WLAN SAR evaluation measurements only.

Description:	Mobile Handset
Brand Name:	NTT Docomo
Model Name or Number:	EB-4063
Serial Number:	None Stated
IMEI Number:	353740050011620
Hardware Version Number:	Rev C-2
Software Version Number:	ACPU: rupy-jb-10-0336 CCPU: 101035_DCM_00.1
Hardware Revision of GSM Module:	None Stated
Software Revision of GSM Module:	None Stated
FCC ID Number:	UCE312057A
Country of Manufacture:	None Stated
Date of Receipt:	20 November 2012

Note(s):

This sample was used to perform WWAN and WLAN conducted power measurements only.

2.2. Description of EUT

The Equipment Under Test is a Smart Phone with GSM 2G Quad Band, 3G Dual band, LTE Uni-Band and Wi-Fi bands. The EUT has GPRS Class 12 / EDGE Class 12, UMTS FDD 1, 5 With HSPA (with HSDPA Category 14 and HSUPA Category 6), LTE Band 1, WLAN 802.11 a/b/g/n, *Bluetooth*, Personal hotspot mode, RFID and wireless charging capabilities.

2.3. Modifications Incorporated in the EUT

EUT (IMEI: 353740050018468) was used for WWAN and WLAN SAR measurements only
EUT (IMEI: 353740050011620) was used for WWAN and WLAN conducted power measurements only.

2.4. Accessories

The following accessories were supplied with the EUT during testing:

Description:	Personal Hands-Free Kit (PHF)
Brand Name:	NTT docomo
Model Name or Number:	Type 02
Serial Number:	None Stated
Cable Length and Type:	~1.15 m
Country of Manufacture:	None Stated
Connected to Port	3.5mm Audio jack and custom type

Description:	Battery
Brand Name:	NTT Docomo
Model Name or Number:	None Stated
Serial Number:	None Stated
Cable Length and Type:	Not Applicable
Country of Manufacture:	None Stated
Connected to Port	5-pin contact

Description:	Micro-SD Memory Card
Brand Name:	Generic
Model Name or Number:	None Stated
Serial Number:	None Stated
Cable Length and Type:	Not applicable
Country of Manufacture:	None Stated
Connected to Port	Dedicated micro-SD card port

2.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Wireless Communication Test Set
Brand Name:	Agilent
Model Name or Number:	8960 Series 10
Serial Number:	GB46311280
Cable Length and Type:	~4.0m Utiflex Cable
Connected to Port:	RF (Input / Output) Air Link

2.6. Additional Information Related to Testing

Equipment Category	GSM/GPRS850, PCS1900/GPRS1900, UMTS FDD 5, WiFi802.11a/b/g/n	
Type of Unit	Portable Transceiver	
Intended Operating Environment:	Within GSM, UMTS and WiFi Coverage	
Transmitter Maximum Output Power Characteristics:	GSM850	Communication Test Set was configured to allow the EUT to transmit at a maximum power using Power Control Level (PCL) setting of 5.
	PCS1900	Communication Test Set was configured to allow the EUT to transmit at a maximum power using Power Control Level (PCL) setting of 0.
	UMTS Band 5	Communication Test Set configured to allow to EUT to transmit at a maximum power as per KDB 941225 D01.
	2.4 GHz WiFi802.11b	Communication Test Set was configured to allow the EUT to transmit at a maximum power of up to 16.6 dBm.
	5.0 GHz Wi-Fi 802.11a/n (HT20 / HT40)	: = 9.6 dBm
	Bluetooth	: = 1.4dBm
Transmitter Frequency Range:	GSM850	824 to 849 MHz
	PCS1900	1850 to 1910 MHz
	UMTS Band 5	826 to 847 MHz
	2.4 GHz WiFi802.11b	2412 to 2462 MHz
	5.0 GHz Wi-Fi 802.11a/n (HT20 / HT40)	5180 to 5825 MHz

Additional Information Related to Testing (Continued):

Transmitter Frequency Allocation of EUT When Under Test:	Channel Number	Channel Description	Frequency (MHz)
	128	Low	824.2
	190	Middle	836.6
	251	High	848.8
	512	Low	1850.2
	661	Middle	1880.0
	810	High	1909.8
	4132	Low	826.4
	4183	Middle	836.6
	4233	High	846.6
	1	Low	2412.0
	6	Middle	2437.0
	11	High	2462.0

Additional Information Related to Testing (Continued)

Transmitter Frequency Allocation of EUT When Under Test:	Channel Number	Frequency (MHz)
	36	5180.0
	38	5190.0
	40	5200.0
	44	5220.0
	46	5230.0
	48	5240.0
	52	5260.0
	54	5270.0
	56	5280.0
	60	5300.0
	62	5310.0
	64	5320.0
	100	5500.0
	102	5510.0
	104	5520.0
	108	5540.0
	110	5550.0
	112	5560.0
	116	5580.0
	118	5590.0
	120	5600.0
	124	5620.0
	126	5630.0
	128	5640.0
	132	5660.0
	134	5670.0
	136	5680.0
	140	5700.0
	149	5745.0
	151	5755.0
	153	5765.0
	157	5785.0
	159	5795.0
	161	5805.0
	165	5825.0

Additional Information Related to Testing (Continued)

Modulation(s):	GMSK (GSM/ GPRS): 217 Hz QPSK(UMTS / HSDPA/HSPA):0Hz DBPSK, CCK (Wi-Fi): 0 Hz FDD (QPSK/ 16QAM): 0 Hz
Modulation Scheme (Crest Factor):	GSMK (GSM): 8.3 GMSK (GPRS): 4 DBPSK, CCK (Wi-Fi): 1 QPSK(UMTS FDD / HSDPA): 1 FDD (QPSK/ 16QAM): 1
Antenna Type:	Internal integral
Antenna Length:	Unknown
Number of Antenna Positions:	1 fixed (WWAN) 1 fixed (WLAN/ <i>Bluetooth</i>) 1 extendable and retractable TV antenna
Power Supply Requirement:	3.8V
Battery Type(s):	Li-ion

3. Test Specification, Methods and Procedures

3.1. Test Specification

Reference:	OET Bulletin 65 Supplement C: (2001-01)
Title:	Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
Purpose of Test:	To determine whether the equipment met the basic restrictions as defined in OET Bulletin 65 Supplement C: (2001-01) using the SAR averaging method as described in the test specification above.

3.2. Methods and Procedures Reference Documentation

The methods and procedures used were as detailed in:

Federal Communications Commission, "Evaluating compliance with FCC Guidelines for human exposure to radio frequency electromagnetic fields", OET Bulletin 65 Supplement C, FCC, Washington, D.C, 20554, 2001.

Thomas Schmid, Oliver Egger and Neils Kuster, "Automated E-field scanning system for dosimetric assessments", IEEE Transaction on microwave theory and techniques, Vol. 44, pp. 105-113, January 1996.

Neils Kuster, Ralph Kastle and Thomas Schmid, "Dosimetric evaluation of mobile communications equipment with know precision", IEICE Transactions of communications, Vol. E80-B, No.5, pp. 645-652, May 1997.

EN 62209-1: 2006

Title: Basic standard for the measurement of specific absorption rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz).

EN 62209-2:2010

Human exposure to radio frequency fields from handheld and body mounted wireless communication devices — Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz) (IEC 62209-2:2010)

KDB 248227 D01 SAR meas for 802 11 a b g v01r02

KDB 447498 D01 General RF Exposure Guidance v05

KDB 648474 D02 SAR Polcy Handsts Multi Xmitter Ant v01r01

KDB 648474 D04 SAR Handsets Multi Xmitter and Ant v01

KDB 941225 D01 SAR test for 3G devices v02

KDB 941225 D03 " SAR Test Reduction GSM/GPRS/EDGE v01"

KDB 941225 D06 "Hot Spot SAR v01"

KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01

KDB 865664 D02 SAR Reporting v01

3.3. Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the methods & procedures section above. Appendix 1 contains a list of the test equipment used.

4. Deviations from the Test Specification

Test was performed as per "KDB 248227 D01 SAR meas for 802.11a/b/g v01r02", "KDB 447498 D01 General RF Exposure Guidance v05", "KDB 648474 D02 SAR Policy Handsets Multi Xmitter Ant v01r01", "KDB 648474 D04 SAR Handsets Multi Xmitter and Ant v01", "KDB 941225 D01 SAR test for 3G devices v02", "KDB 941225 D03 SAR Test Reduction GSM/GPRS/EDGE v01", "KDB 941225 D06 Hot Spot SAR v01", "KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01", "KDB 865664 D02 SAR Reporting v01", according to the handset procedures in IEEE Std 1528-2003 and OET Bulletin 65 Supplement C 01-01. The assessment for Personal Wireless Hotspot was also evaluated as per the FCC KDB 941225 D06 Hot Spot SAR v01".

For technologies bands supporting personal hotspot mode, SAR was evaluated on all the sides and surfaces within 25mm of the transmitting antenna (WWAN or WLAN) as per FCC KDB 941225 D06 Hot Spot SAR v01".

SAR test was performed in the middle channels for WWAN and WLAN. The worst case configuration for both Head and Body test was evaluated in the low and high channels.

The measured maximum conducted power for WLAN 2.45GHz 802.11b/n is 16.6dBm (equivalent to 46 mW) and for WLAN 5GHz is 9.6dBm (equivalent to 9.1mW).

As per FCC kdb pub. *SAR Handsets Multi Xmitter and Ant, v01r05*; when there is simultaneous transmission occurring, stand-alone SAR evaluation is not required when the output power measured is $\leq 2 \cdot P_{ref}$ for the particular band and antenna separation is ≥ 5.0 cm from other antenna.

Output power thresholds for Unlicensed Transmitters

P_{ref}	2.45	5.15 – 5.35	5.47 – 5.85	GHz
	12	6	5	mW

As per table 1 above, since output power measured for;

5.15 to 5.35 GHz maximum output power = 9.1 mW < 12mW ($2 \cdot P_{ref}$)

5.47 to 5.85 GHz maximum output power = 8.5 mW < 10mW ($2 \cdot P_{ref}$)

Stand Alone SAR evaluation is not required for 5.0 GHz WLAN 802.11a/n modes.

GPRS class12 / uplink setup of 1-uplink, 2-uplink, 3-uplink and 4-uplink were all evaluated to find the setting with the highest power reference point (unit v/m) as per the DASY4 system. 2-uplink was found to give the highest power reference point measurement on the DASY4 system (unit v/m). All settings were performed with the device in a fixed position Back facing phantom at 0mm separation to ensure there were no positioning errors. The following values were measured relative to the uplink settings:

GPRS Mode	GPRS850 Power reference (v/m)	GPRS1900 Power reference (v/m)
1 uplink	16.87	3.87
2 uplink	17.85	4.03
3 uplink	17.48	3.89
4 uplink	17.73	3.67

Note: Power reference point measurements are from the DASY4 system and used to check the device power drift although the units are v/m. For informational purpose to ensure the worst case uplink time slot is also verified by the DASY4 SAR system, this was used as per above comment at a fixed point.

5. Operation and Configuration of the EUT during Testing

5.1. Operating Modes

The EUT was tested in the following operating mode(s) unless otherwise stated:

- GSM850 – Voice allocated mode with Communication Test Set configured to allow the EUT to transmit at a maximum power using Power Control Level (PCL) setting of 5.
- GPRS850 – Data allocated mode with Communication Test Set configured to allow the EUT to transmit at a maximum power using Power Control Level (PCL) setting of 5. Tested using 2 Uplink time slots with CS1 for GPRS.
- PCS1900 – Voice allocated mode with Communication Test Set configured to allow the EUT to transmit at a maximum power using Power Control Level (PCL) setting of 0.
- GPRS1900 – Data allocated mode with Communication Test Set configured to allow the EUT to transmit at a maximum power using Power Control Level (PCL) setting of 0. Tested using 2 Uplink time slots with CS1 for GPRS.

GSM850: Power Table Settings used for Test Set	
Power Control Level PCL	Nominal Power (dBm)
0 ... 2	39
3	37
4	35
5	33
6	31
7	29
8	27
9	25
10	23
11	21
12	19
13	17
14	15
15	13
16	11
17	9
18	7
19 ... 31	5

PCS1900: Power Table Settings used for Test Set	
Power Control Level PCL	Nominal Power (dBm)
22 ... 29	Reserved
30	33
31	32
0	30
1	28
2	26
3	24
4	22
5	20
6	18
7	16
8	14
9	12
10	10
11	8
12	6
13	4
14	2
15	0
16 ... 21	Reserved

- UMTS FDD 5 Call allocated mode with Communication Test Set configured to allow the EUT to transmit at a maximum as per KDB 941225 D01.
- UMTS FDD 5 - RMC 12.2kbps + HSUPA With Test loop mode 1 and TPC bits configured to all "1's", Sub-test 5, AG Index set to 21 and E-TFCI set to 81 with Communication Test Set configured to allow to EUT to transmit at a maximum power as per KDB 941225 D01.
- UMTS FDD 5 - RMC 12.2kbps + HSDPA With Test loop mode 1 and TPC bits configured to all "1's", Sub-test 1 with Communication Test Set configured to allow to EUT to transmit at a maximum power as per KDB 941225 D01.

Operating Modes (Continued):

- 2.4 GHz WiFi802.11b/g/n Data allocated mode using 'FTM – Box 3 Ver 0.0.3' software to excise mode 'b', 'g' and 'n', with maximum power of up to 16.6 dBm for 'b' mode and 12.4 dBm for 'g' and 12.7 dBm for 'n' modes.
- 5.0 GHz WiFi802.11a/n Data allocated mode using "FTM – Box 3 Ver 0.0.3' software to excise mode 'a' and 'n', with maximum power of up to 9.6 dBm for 'a' mode and 7.9 dBm for 'n' modes

5.2. Configuration and Peripherals

The EUT was tested in the following configuration(s) unless otherwise stated:

- Standalone fully charged battery powered.
- Head and Body-worn configurations were evaluated.
- The applied FCC body-worn Personal Hotspot orientations where the corresponding edge(s) closest to the user with the most conservative exposure condition were all evaluated at 10 mm from the body. For configuration that did not overlap with Personal hotspot, SAR evaluation was performed at 15mm separation.
- GPRS class 12: setup for 1-uplink, 2-uplink, 3-uplink and 4-uplink were evaluated to find the setting with the highest power reference measurements. 2-uplink was found to give the highest power reference measurement on the DASY4 system. All settings were performed with the device in a fixed position 'Back facing phantom' at 0mm separation to ensure there were no positioning errors.
- GSM, GPRS and EDGE power measurement were all measured as per FCC pubs. 941225 D03 and 941225 D04. Although power reduction was allowed SAR test was performed on GPRS using GMSK. Test reduction was applied to EDGE using GMSK and 8PSK modulation scheme.

Head Configuration

- a) The EUT was placed in a normal operating position with the centre of the ear-piece aligned with the ear canal on the phantom.
- b) With the ear-piece touching the phantom the centre line of the EUT was aligned with an imaginary plane (X and Y axis) consisting of three lines connecting both ears and the mouth.
- c) For the cheek position the EUT was gradually moved towards the cheek until any point of the mouth-piece or keypad touched the cheek.
- d) For the tilted position the EUT was positioned as for the cheek position, and then the horizontal angle was increased by fifteen degrees (the phone keypad was moved away from the cheek by fifteen degrees).
- e) SAR measurements were evaluated at maximum power and the unit was operated for an appropriate period prior to the evaluation in order to minimise the drift.
- f) The device was keyed to operate continuously in the transmit mode for the duration of the test.
- g) The location of the maximum spatial SAR distribution (hot spot) was determined relative to the EUT and its antenna.
- h) The EUT was transmitting at full power throughout the duration of the test powered by a fully charged battery.

Body Configuration

- a) The EUT was placed in a normal operating position where the centre of EUT was aligned with the centre reference point on the flat section of the 'SAM' phantom.
- b) With the EUT touching the phantom at an imaginary centre line. The EUT was aligned with a marked plane (X and Y axis) consisting of two lines.
- c) For the touch-safe position the EUT was gradually moved towards the flat section of the 'SAM' phantom until any point of the EUT touched the phantom.
- d) For position(s) greater than 0mm separation the EUT was positioned as per the touch-safe position, and then the vertical height was decreased/adjusted as required.
- e) SAR measurements were evaluated at maximum power and the unit was operated for an appropriate period prior to the evaluation in order to minimise the drift.
- f) The device was keyed to operate continuously in the transmit mode for the duration of the test.
- g) The location of the maximum spatial SAR distribution (hot spot) was determined relative to the EUT and its antenna.
- h) The EUT was transmitting at full power throughout the duration of the test powered by a fully charged battery.

6. Summary of Test Results

Test Name	Specification Reference	Result
Specific Absorption Rate-GSM 850 Head Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-GPRS 850 Head Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-GPRS 850 Hotspot Mode Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-GSM 850 Body-Worn Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-PCS 1900 Head Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-GPRS 1900 Head Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-GPRS 1900 Hotspot Mode Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-PCS 1900 Body-Worn Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-UMTS-FDD 5 Head Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-UMTS-FDD 5 Hotspot Mode Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-UMTS-FDD 5 Body-Worn Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-Wi-Fi 2450 Head Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-Wi-Fi 2450 Hotspot Mode Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied
Specific Absorption Rate-Wi-Fi 2450 Body-Worn Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied

6.1. SAR Individual Transmitter Evaluation

device, mode	Frequency, (MHz)	Phantom Configuration	P _x (mW)	P _{REF} (mW)	single SAR, W/kg	Remarks
WWAN, GSM	850	Touch Left Antenna Extended	224	60/f	0.524	Routine Evaluation
WWAN, GSM	1900	Front Antenna Extended	126	60/f	0.761	Routine Evaluation
WWAN, UMTS	850	Touch Left Antenna Extended	240	60/f	0.566	Routine Evaluation
WLAN, WiFi802.11b	2450	Touch Right Antenna Extended	46	60/f	0.161	Routine Evaluation
WLAN, WiFi802.11a/n	5150 -5350	N/A	~9.1	6	: =0	{PBT ≤ 2P _{REF} } {d _{WWAN, WLAN} > 5cm}
WLAN, WiFi802.11a/n	5470 -5850	N/A	~8.5	5	: =0	{PBT ≤ 2P _{REF} } {d _{WWAN, WLAN} > 5cm}
BT, Bluetooth	2400	N/A	~ 1.4	12	: =0	{PBT ≤ 2P _{REF} } {d _{WWAN, BT} > 5cm}

Note(s):

1. Simultaneous transmission was not evaluated as the sum of the individual SAR for WWAN and WLAN was < 1.6 W/kg.
2. Bluetooth transmitter thresholds output power "P_{Ref} = 12 mW as listed in KDB 648474.
3. P_x: power level measured by RFI.
4. Single SAR value measured by RFI.
5. The "Antenna-to-Antenna distance and Antenna-to-User distance were provided by the customer.

6.2. SAR Simultaneous Transmitter Evaluation

(x,y)	D(x,y) cm	L(x,y) cm	SPLSR _{xyz}	Sim-Tx SAR	Remarks
(WWAN, BT)	>5	N/A	N/A	N/A	{no stand-alone SAR for BT}
(WWAN, Wi-Fi)	>5	N/A	N/A	N/A	{D(x,y) > 5 } & {Σ _{WWAN, WLAN} < 1.6 W/kg}

6.3. Maximum Measured SAR and scaled up SAR

Technology Mode	Configuration	Channel Number	Mode	Measured output power [dBm]	Maximum Rated Power [dBm]	Measured SAR(W/kg)	Calculated SAR(W/kg)
						1g mass	1g mass
GSM850	Head	190	Data	23.5	24.6	0.524	0.672
	Hotspot	190	Data	23.5	24.6	0.514	0.659
	Body-worn	190	Voice	23.4	23.9	0.442	0.490
PCS1900	Head	661	Voice	20.8	20.9	0.262	0.267
	Hotspot	661	Data	21.0	21.5	0.761	0.854
	Body-worn	661	Voice	20.8	20.9	0.292	0.298
UMTS FDD 5	Head	4183	Data(RMC)	23.8	24.1	0.566	0.609
	Hotspot	4183	Data(RMC)	23.8	24.1	0.547	0.589
	Body-worn	4183	Data(RMC)	23.8	24.1	0.533	0.574
WiFi 802.11b	Head	6	Data	16.6	17.0	0.161	0.177
	Hotspot	6	Data	16.6	17.0	0.091	0.100
	Body-worn	6	Data	16.6	17.0	0.045	0.049

6.4. Location of Tests

All the measurements described in this report were performed at the premises of
RFI Global Services Ltd, Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23
8BG United Kingdom

7. Measurements, Examinations and Derived Results

7.1. General Comments

This section contains test results only.

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to section 8 for details of measurement uncertainties.

7.2. Test Results

For All SAR measurement in this report the SAR limit tested to is 1.6 W/kg

7.2.1. Specific Absorption Rate - GSM 850 Head Configuration 1g**Test Summary:**

Tissue Volume:	1g
Maximum Level (W/kg):	0.510

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 23.0
Temperature Variation in Liquid (°C):	0.0 to 22.9

Results:

EUT Position	Phantom Configuration	Channel Number	Uplink Meas. Burst Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Touch Antenna Retracted	Left	190	23.4	N/A	0.508	1, 2	GMSK
Touch Antenna Extended	Left	190	23.4	N/A	0.510	1, 2	GMSK
Tilt Antenna Retracted	Left	190	23.4	N/A	0.279	1, 2	GMSK
Tilt Antenna Extended	Left	190	23.4	N/A	0.250	1, 2	GMSK
Touch Antenna Retracted	Right	190	23.4	N/A	0.420	1, 2	GMSK
Touch Antenna Extended	Right	190	23.4	N/A	0.416	1, 2	GMSK
Tilt Antenna Retracted	Right	190	23.4	N/A	0.269	1, 2	GMSK
Tilt Antenna Extended	Right	190	23.4	N/A	0.251	1, 2	GMSK

Note(s):

1. Voice Mode
2. SAR test was performed in the middle channel only as the measured levels were < 50% of the SAR limit. as stated in the FCC Public Notice DA 02-1438 by the SCC-34/SC-2.

7.2.2. Specific Absorption Rate - GPRS 850 Head Configuration 1g**Test Summary:**

Tissue Volume:	1g
Maximum Level (W/kg):	0.524

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	22.9 to 22.9

Results:

EUT Position	Phantom Configuration	Channel Number	Uplink Meas. Burst Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Touch Antenna Extended	Left	190	23.5	N/A	0.524	1, 2	GMSK

Note(s):

1. Data (VoIP) - Touch Left Antenna Extended, worst case from GSM Head is used on GPRS Head.
2. SAR measurements were performed using 2 uplink timeslots

7.2.3. Specific Absorption Rate - GPRS 850 Hotspot Mode Configuration 1g**Test Summary:**

Tissue Volume:	1g
-----------------------	----

Maximum Level (W/kg):	0.514
------------------------------	-------

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
---	--------------

Temperature Variation in Liquid (°C):	23.5 to 23.3
--	--------------

Results:

EUT Position	Phantom Configuration	Channel Number	Uplink Meas. Burst Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Front of EUT Facing Phantom Antenna Retracted	Flat (SAM)	190	23.5	N/A	0.490	1, 2, 3	GMSK
Front of EUT Facing Phantom Antenna Extended	Flat (SAM)	190	23.5	N/A	0.514	1, 2, 3	GMSK
Back of EUT Facing Phantom Antenna Retracted	Flat (SAM)	190	23.5	N/A	0.459	1, 2, 3	GMSK
Back of EUT Facing Phantom Antenna Extended	Flat (SAM)	190	23.5	N/A	0.466	1, 2, 3	GMSK
Left Hand Side of EUT Facing Phantom Antenna Retracted	Flat (SAM)	190	23.5	N/A	0.421	1, 2, 3	GMSK
Left Hand Side of EUT Facing Phantom Antenna Extended	Flat (SAM)	190	23.5	N/A	0.491	1, 2, 3	GMSK
Right Hand Side of EUT Facing Phantom Antenna Retracted	Flat (SAM)	190	23.5	N/A	0.253	1, 2, 3	GMSK

Specific Absorption Rate - GPRS 850 Hotspot Mode Configuration 1g (Continued):

EUT Position	Phantom Configuration	Channel Number	Uplink Meas. Burst Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Right Hand Side of EUT Facing Phantom Antenna Extended	Flat (SAM)	190	23.5	N/A	0.298	1, 2, 3	GMSK
Bottom of EUT Facing Phantom Antenna Retracted	Flat (SAM)	190	23.5	N/A	0.249	1, 2, 3	GMSK

Note(s):

1. Data - SAR measurements were performed using 2 uplink timeslots.
2. EUT supports Hotspot: As per FCC KDB procedure SAR measurements were performed with the EUT at a separation distance of 10mm from the 'SAM' phantom flat section.
3. SAR test was performed in the middle channel only as the measured levels were < 50% of the SAR limit. as stated in the FCC Public Notice DA 02-1438 by the SCC-34/SC-2.

*KDB 941225 - SAR is not required for EDGE technology when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding GPRS channels.

7.2.4. Specific Absorption Rate - GSM 850 Body-Worn Configuration 1g**Test Summary:**

Tissue Volume:	1g
Maximum Level (W/kg):	0.442

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	23.5 to 23.3

Results:

EUT Position	Phantom Configuration	Channel Number	Uplink Meas. Burst Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Front of EUT Facing Phantom Antenna Extended	Flat (SAM)	190	23.4	N/A	0.442	1, 2, 3	GMSK
Front of EUT Facing Phantom Antenna Extended	Flat (SAM)	190	23.4	N/A	0.442	1, 2, 3, 4	GMSK

Note(s):

1. Voice Mode
2. Front of EUT Antenna Extended, Worst case configuration from GPRS Hotspot Mode is used on GSM Body-worn configuration.
3. SAR measurements were performed with the closest edge of the EUT at a separation distance of 15mm from the 'SAM' phantom flat section.
4. Personal Hands-Free Kit attached, using the worst-case configuration acquired.

7.2.5. Specific Absorption Rate - PCS 1900 Head Configuration 1g**Test Summary:**

Tissue Volume:	1g
Maximum Level (W/kg):	0.262

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	24.0 to 24.0

Results:

EUT Position	Phantom Configuration	Channel Number	Uplink Meas. Burst Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Touch Antenna Retracted	Left	661	20.8	N/A	0.171	1, 2	GMSK
Touch Antenna Extended	Left	661	20.8	N/A	0.170	1, 2	GMSK
Tilt Antenna Retracted	Left	661	20.8	N/A	0.042	1, 2	GMSK
Tilt Antenna Extended	Left	661	20.8	N/A	0.043	1, 2	GMSK
Touch Antenna Retracted	Right	661	20.8	N/A	0.262	1, 2	GMSK
Touch Antenna Extended	Right	661	20.8	N/A	0.259	1, 2	GMSK
Tilt Antenna Retracted	Right	661	20.8	N/A	0.111	1, 2	GMSK
Tilt Antenna Extended	Right	661	20.8	N/A	0.110	1, 2	GMSK

Note(s):

1. Voice Mode
2. SAR test was performed in the middle channel only as the measured levels were < 50% of the SAR limit. as stated in the FCC Public Notice DA 02-1438 by the SCC-34/SC-2.

7.2.6. Specific Absorption Rate - GPRS 1900 Head Configuration 1g**Test Summary:**

Tissue Volume:	1g
Maximum Level (W/kg):	0.232

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	24.0 to 24.0

Results:

EUT Position	Phantom Configuration	Channel Number	Uplink Meas. Burst Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Touch Antenna Retracted	Right	661	21.0	N/A	0.232	1, 2	GMSK

Note(s):

1. Data (VoIP) - Touch Right Antenna Retracted, worst case from GSM Head is used on GPRS Head.
2. SAR measurements were performed using 2 uplink timeslots.

7.2.7. Specific Absorption Rate - GPRS 1900 Hotspot Mode Configuration 1g Test Summary:

Tissue Volume:	1g
Maximum Level (W/kg):	0.761

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	24.0 to 24.0

Results:

EUT Position	Phantom Configuration	Channel Number	Uplink Meas. Burst Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Front of EUT Facing Phantom Antenna Retracted	Flat (SAM)	661	21.0	N/A	0.505	1, 2, 3	GMSK
Front of EUT Facing Phantom Antenna Extended	Flat (SAM)	661	21.0	N/A	0.555	1, 2, 3	GMSK
Back of EUT Facing Phantom Antenna Retracted	Flat (SAM)	661	21.0	N/A	0.381	1, 2, 3	GMSK
Back of EUT Facing Phantom Antenna Extended	Flat (SAM)	661	21.0	N/A	0.369	1, 2, 3	GMSK
Left Hand Side of EUT Facing Phantom Antenna Retracted	Flat (SAM)	661	21.0	N/A	0.096	1, 2, 3	GMSK
Left Hand Side of EUT Facing Phantom Antenna Extended	Flat (SAM)	661	21.0	N/A	0.094	1, 2, 3	GMSK
Right Hand Side of EUT Facing Phantom Antenna Retracted	Flat (SAM)	661	21.0	N/A	0.099	1, 2, 3	GMSK

Specific Absorption Rate - GPRS 1900 Hotspot Mode Configuration 1g (Continued)

EUT Position	Phantom Configuration	Channel Number	Uplink Meas. Burst Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Right Hand Side of EUT Facing Phantom Antenna Extended	Flat (SAM)	661	21.0	N/A	0.094	1, 2, 3	GMSK
Bottom of EUT Facing Phantom Antenna Retracted	Flat (SAM)	661	21.0	N/A	0.761	1, 2, 3	GMSK

Note(s):

1. Data - SAR measurements were performed using 2 uplink timeslots.
2. EUT supports Hotspot: As per FCC KDB procedure SAR measurements were performed with the EUT at a separation distance of 10mm from the 'SAM' phantom flat section.
3. SAR test was performed in the middle channel only as the measured levels were < 50% of the SAR limit, as stated in the FCC Public Notice DA 02-1438 by the SCC-34/SC-2.

*KDB 941225 - SAR is not required for EDGE technology when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding GPRS channels.

7.2.8. Specific Absorption Rate - PCS 1900 Body-Worn Configuration 1g**Test Summary:**

Tissue Volume:	1g
Maximum Level (W/kg):	0.292

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	24.0 to 24.0

Results:

EUT Position	Phantom Configuration	Channel Number	Uplink Meas. Burst Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Front of EUT Facing Phantom Antenna Extended	Flat (SAM)	661	20.8	N/A	0.261	1, 2, 3	GMSK
Front of EUT Facing Phantom Antenna Extended	Flat (SAM)	661	20.8	N/A	0.292	1, 2, 3, 4	GMSK

Note(s):

1. Voice Mode
2. Front of EUT Antenna Extended, Worst case configuration from GPRS Hotspot Mode is used on GSM Body-worn configuration.
3. SAR measurements were performed with the closest edge of the EUT at a separation distance of 15mm from the 'SAM' phantom flat section.
4. Personal Hands-Free Kit attached, using the worst-case configuration acquired.

7.2.9. Specific Absorption Rate - UMTS-FDD 5 Head Configuration 1g**Test Summary:**

Tissue Volume:	1g
Maximum Level (W/kg):	0.566

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	23.0 to 23.0

Results:

EUT Position	Phantom Configuration	Channel Number	Meas. Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Touch Antenna Retracted	Left	4183	23.8	N/A	0.554	1, 2	QPSK
Touch Antenna Extended	Left	4183	23.8	N/A	0.566	1, 2	QPSK
Tilt Antenna Retracted	Left	4183	23.8	N/A	0.283	1, 2	QPSK
Tilt Antenna Extended	Left	4183	23.8	N/A	0.250	1, 2	QPSK
Touch Antenna Retracted	Right	4183	23.8	N/A	0.492	1, 2	QPSK
Touch Antenna Extended	Right	4183	23.8	N/A	0.478	1, 2	QPSK
Tilt Antenna Retracted	Right	4183	23.8	N/A	0.322	1, 2	QPSK
Tilt Antenna Extended	Right	4183	23.8	N/A	0.305	1, 2	QPSK

Note(s):

1. Circuit Switch (CS) - RMC 12.2kbps with Test loop mode 1 and TPC bits configured to All "1's"
2. SAR test was performed in the middle channel only as the measured levels were < 50% of the SAR limit. as stated in the FCC Public Notice DA 02-1438 by the SCC-34/SC-2.

7.2.10. Specific Absorption Rate - UMTS-FDD 5 Hotspot Mode Configuration 1g**Test Summary:**

Tissue Volume:	1g
-----------------------	----

Maximum Level (W/kg):	0.547
------------------------------	-------

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
---	--------------

Temperature Variation in Liquid (°C):	22.0 to 22.0
--	--------------

Results:

EUT Position	Phantom Configuration	Channel Number	Meas. Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Front of EUT Facing Phantom Antenna Retracted	Flat (SAM)	4183	23.8	N/A	0.537	1, 2, 3	QPSK
Front of EUT Facing Phantom Antenna Extended	Flat (SAM)	4183	23.8	N/A	0.536	1, 2, 3	QPSK
Back of EUT Facing Phantom Antenna Retracted	Flat (SAM)	4183	23.8	N/A	0.490	1, 2, 3	QPSK
Back of EUT Facing Phantom Antenna Extended	Flat (SAM)	4183	23.8	N/A	0.547	1, 2, 3	QPSK
Left Hand Side of EUT Facing Phantom Antenna Retracted	Flat (SAM)	4183	23.8	N/A	0.424	1, 2, 3	QPSK
Left Hand Side of EUT Facing Phantom Antenna Extended	Flat (SAM)	4183	23.8	N/A	0.528	1, 2, 3	QPSK
Right Hand Side of EUT Facing Phantom Antenna Retracted	Flat (SAM)	4183	23.8	N/A	0.350	1, 2, 3	QPSK

Specific Absorption Rate - UMTS-FDD 5 Hotspot Mode Configuration 1g (Continued)

EUT Position	Phantom Configuration	Channel Number	Meas. Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Right Hand Side of EUT Facing Phantom Antenna Extended	Flat (SAM)	4183	23.8	N/A	0.389	1, 2, 3	QPSK
Bottom of EUT Facing Phantom Antenna Retracted	Flat (SAM)	4183	23.8	N/A	0.337	1, 2, 3	QPSK

Note(s):

1. Circuit Switch (CS) - RMC 12.2kbps with Test loop mode 1 and TPC bits configured to All "1's"
2. EUT supports Hotspot: As per FCC KDB procedure SAR measurements were performed with the EUT at a separation distance of 10mm from the 'SAM' phantom flat section.
3. SAR test was performed in the middle channel only as the measured levels were < 50% of the SAR limit. as stated in the FCC Public Notice DA 02-1438 by the SCC-34/SC-2.

*KDB 941225 - SAR is not required for RMC+HSPA (HSDPA/HSUPA) channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding RMC channels.

7.2.11. Specific Absorption Rate - UMTS-FDD 5 Body-Worn Configuration 1g**Test Summary:**

Tissue Volume:	1g
Maximum Level (W/kg):	0.533

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	22.0 to 22.0

Results:

EUT Position	Phantom Configuration	Channel Number	Meas. Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Back of EUT Facing Phantom Antenna Extended	Flat (SAM)	4183	23.8	N/A	0.445	1, 2, 3	QPSK
Back of EUT Facing Phantom Antenna Extended	Flat (SAM)	4183	23.8	N/A	0.533	1, 2, 3, 4	QPSK

Note(s):

1. Circuit Switch (CS) - RMC 12.2kbps with Test loop mode 1 and TPC bits configured to All "1's"
2. Back of EUT Antenna Extended, is worst case and most conservative configuration from Hotspot mode and used for Body-worn Configuration.
3. SAR measurements were performed with the closest edge of the EUT at a separation distance of 15mm from the 'SAM' phantom flat section.
4. Personal Hands-Free Kit attached, using the worst-case configuration acquired.

7.2.12. Specific Absorption Rate - Wi-Fi 2450 Head Configuration 1g**Test Summary:**

Tissue Volume:	1g
Maximum Level (W/kg):	0.161

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	22.4 to 22.4

Results:

EUT Position	Phantom Configuration	Channel Number	Meas. Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Touch Antenna Retracted	Left	6	16.6	N/A	0.099	1, 2	DBPSK
Touch Antenna Extended	Left	6	16.6	N/A	0.100	1, 2	DBPSK
Tilt Antenna Retracted	Left	6	16.6	N/A	0.089	1, 2	DBPSK
Tilt Antenna Extended	Left	6	16.6	N/A	0.090	1, 2	DBPSK
Touch Antenna Retracted	Right	6	16.6	N/A	0.159	1, 2	DBPSK
Touch Antenna Extended	Right	6	16.6	N/A	0.161	1, 2	DBPSK
Tilt Antenna Retracted	Right	6	16.6	N/A	0.143	1, 2	DBPSK
Tilt Antenna Extended	Right	6	16.6	N/A	0.147	1, 2	DBPSK

Note(s):

1. WLAN 802.11b 1Mbps
2. SAR test was performed in the middle channel only as the measured levels were < 50% of the SAR limit. as stated in the FCC Public Notice DA 02-1438 by the SCC-34/SC-2.

*KDB 248227 - SAR is not required for 802.11g/n channels when the maximum average output power is equal to that measured on the corresponding 802.11b channels.

7.2.13. Specific Absorption Rate - Wi-Fi 2450 Hotspot Mode Configuration 1g**Test Summary:**

Tissue Volume:	1g
-----------------------	----

Maximum Level (W/kg):	0.091
------------------------------	-------

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
---	--------------

Temperature Variation in Liquid (°C):	24.0 to 24.0
--	--------------

Results:

EUT Position	Phantom Configuration	Channel Number	Meas. Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Front of EUT Facing Phantom Antenna Retracted	Flat (SAM)	6	16.6	N/A	0.026	1, 2, 3	DBPSK
Front of EUT Facing Phantom Antenna Extended	Flat (SAM)	6	16.6	N/A	0.025	1, 2, 3	DBPSK
Back of EUT Facing Phantom Antenna Retracted	Flat (SAM)	6	16.6	N/A	0.081	1, 2, 3	DBPSK
Back of EUT Facing Phantom Antenna Extended	Flat (SAM)	6	16.6	N/A	0.091	1, 2, 3	DBPSK
Left Hand Side of EUT Facing Phantom Antenna Retracted	Flat (SAM)	6	16.6	N/A	0.016	1, 2, 3	DBPSK
Left Hand Side of EUT Facing Phantom Antenna Extended	Flat (SAM)	6	16.6	N/A	0.016	1, 2, 3	DBPSK
Right Hand Side of EUT Facing Phantom Antenna Retracted	Flat (SAM)	6	16.6	N/A	0.003	1, 2, 3	DBPSK

Specific Absorption Rate - Wi-Fi 2450 Hotspot Mode Configuration 1g (Continued)

EUT Position	Phantom Configuration	Channel Number	Meas. Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Right Hand Side of EUT Facing Phantom Antenna Extended	Flat (SAM)	6	16.6	N/A	0.003	1, 2, 3	DBPSK
Top of EUT Facing Phantom Antenna Retracted	Flat (SAM)	6	16.6	N/A	0.061	1, 2, 3	DBPSK

Note(s):

1. WLAN 802.11b 1Mbps
2. EUT supports Hotspot: As per FCC KDB procedure SAR measurements were performed with the EUT at a separation distance of 10mm from the 'SAM' phantom flat section.
3. SAR test was performed in the middle channel only as the measured levels were < 50% of the SAR limit. as stated in the FCC Public Notice DA 02-1438 by the SCC-34/SC-2.

*KDB 248227 - SAR is not required for 802.11g/n channels when the maximum average output power is equal to that measured on the corresponding 802.11b channels.

The measured maximum conducted power for WLAN 5.0GHz is 9.6dBm (equivalent to 9.1mW). As per FCC kdb pub. *SAR Handsets Multi Xmitter and Ant, v01r05*; when there is simultaneous transmission occurring, stand- alone SAR evaluation is not required when the output power measured is $\leq 2 \cdot P_{ref}$ for the particular band and antenna separation is ≥ 5.0 cm from other antenna.

Output power thresholds for Unlicensed Transmitters

P_{ref}	2.45	5.15 – 5.35	5.47 - 5.85	GHz
	12	6	5	mW

As per table 1 above, since output power measured for;

5.15 to 5.35 GHz maximum output power = 9.1 mW < 12mW ($2 \cdot P_{ref}$)

5.47 to 5.85 GHz maximum output power = 8.5 mW < 10mW ($2 \cdot P_{ref}$)

Stand Alone SAR evaluation is not required for 5.0 GHz WLAN802.11a/n modes.

7.2.14. Specific Absorption Rate - Wi-Fi 2450 Body-Worn Configuration 1g**Test Summary:**

Tissue Volume:	1g
Maximum Level (W/kg):	0.045

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	21.6 to 21.6

Results:

EUT Position	Phantom Configuration	Channel Number	Meas. Avg. Power (dBm)	Power Back-off (dB)	Meas. Level (W/Kg)	Note(s)	Mod.
Back of EUT Facing Phantom Antenna Extended	Flat (SAM)	6	16.6	N/A	0.029	1, 2, 3	DBPSK
Back of EUT Facing Phantom Antenna Extended	Flat (SAM)	6	16.6	N/A	0.045	1, 2, 3, 4	DBPSK

Note(s):

1. WLAN 802.11b 1Mbps
2. Back of EUT Antenna Extended, is worst case and most conservative configuration from Hotspot mode and used for Body-worn Configuration.
3. SAR measurements were performed with the closest edge of the EUT at a separation distance of 15mm from the 'SAM' phantom flat section.
4. Personal Hands-Free Kit attached, using the worst-case configuration acquired.

*The measured maximum conducted power for WLAN 5.0GHz is 9.6dBm (equivalent to 9.1mW). As per FCC kdb pub. *SAR Handsets Multi Xmitter and Ant, v01r05*; when there is simultaneous transmission occurring, stand- alone SAR evaluation is not required when the output power measured is $\leq 2 \cdot P_{ref}$ for the particular band and antenna separation is ≥ 5.0 cm from other antenna.

Output power thresholds for Unlicensed Transmitters

P_{ref}	2.45	5.15 – 5.35	5.47 - 5.85	GHz
	12	6	5	mW

As per table 1 above, since output power measured for;
 5.15 to 5.35 GHz maximum output power = 9.1 mW < 12mW ($2 \cdot P_{ref}$)
 5.47 to 5.85 GHz maximum output power = 8.5 mW < 10mW ($2 \cdot P_{ref}$)

Stand Alone SAR evaluation is not required for 5.0 GHz WLAN802.11a/n modes.

7.2.15. Conducted Average Power Measurement 2G: GSM850

Channel Number	Frequency (MHZ)	Power (dBm)	Avg. Burst Power with consideration for uplink time slot (dBm)	Note
128	824.2	32.3	23.3	Conducted, GMSK
190	836.6	32.4	23.4	Conducted, GMSK
251	848.8	32.5	23.5	Conducted, GMSK

GPRS850 - Measured Average Power without consideration for Uplink time slots:

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
128	824.2	32.3	29.4	27.3	26.3	Conducted, GMSK
190	836.6	32.4	29.5	27.4	26.4	Conducted, GMSK
251	848.8	32.5	29.6	27.5	26.5	Conducted, GMSK

GPRS850 - Calculated Value with consideration for Uplink time slots:

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
128	824.2	23.3	23.4	23.0	23.3	Conducted, GMSK
190	836.6	23.4	23.5	23.1	23.4	Conducted, GMSK
251	848.8	23.5	23.6	23.2	23.5	Conducted, GMSK

EDGE (MCS4 ~ GMSK)**EDGE850 - Measured Average Power without consideration for Uplink time slots:**

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
128	824.2	32.3	29.4	27.3	26.3	Conducted, GMSK
190	836.6	32.4	29.5	27.4	26.4	Conducted, GMSK
251	848.8	32.5	29.6	27.5	26.5	Conducted, GMSK

EDGE850 - Calculated Value with consideration for Uplink time slots:

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
128	824.2	23.3	23.4	23.0	23.3	Conducted, GMSK
190	836.6	23.4	23.5	23.1	23.4	Conducted, GMSK
251	848.8	23.5	23.6	23.2	23.5	Conducted, GMSK

Note:**Scale factor for uplink time slot:**

- 1 Uplink: time slot ratio = 8:1 => $10 \cdot \log(8/1) = 9.03 \text{ dB}$
- 2 Uplink: time slot ratio = 8:2 => $10 \cdot \log(8/2) = 6.02 \text{ dB}$
- 3 Uplink: time slot ratio = 8:3 => $10 \cdot \log(8/3) = 4.26 \text{ dB}$
- 4 Uplink: time slot ratio = 8:4 => $10 \cdot \log(8/4) = 3.01 \text{ dB}$

EDGE (MCS9 ~ 8PSK)**EDGE850 - Measured Average Power without consideration for Uplink time slots:**

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
128	824.2	26.4	23.7	21.9	20.7	Conducted, 8PSK
190	836.6	26.4	23.7	21.9	20.8	Conducted, 8PSK
251	848.8	26.4	23.7	22.0	20.9	Conducted, 8PSK

EDGE850 - Calculated Value with consideration for Uplink time slots:

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
128	824.2	17.4	17.7	17.6	17.7	Conducted, 8PSK
190	836.6	17.4	17.7	17.6	17.8	Conducted, 8PSK
251	848.8	17.4	17.7	17.7	17.9	Conducted, 8PSK

Note:**Scale factor for uplink time slot:**

1. 1 Uplink: time slot ratio = 8:1 => $10 \cdot \log(8/1) = 9.03 \text{ dB}$
2. 2 Uplink: time slot ratio = 8:2 => $10 \cdot \log(8/2) = 6.02 \text{ dB}$
3. 3 Uplink: time slot ratio = 8:3 => $10 \cdot \log(8/3) = 4.26 \text{ dB}$
4. 4 Uplink: time slot ratio = 8:4 => $10 \cdot \log(8/4) = 3.01 \text{ dB}$

7.2.16. Conducted Average Power Measurement 2G: PCS1900

Channel Number	Frequency (MHZ)	GSM TX Power before Test (dBm)	Avg. Burst Power with consideration for uplink time slot (dBm)	Note
512	1850.2	29.6	20.6	Conducted, GMSK
661	1880.0	29.8	20.8	Conducted, GMSK
810	1909.8	29.9	20.9	Conducted, GMSK

GPRS1900 - Measured Average Power Without consideration for Uplink time slots:

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
512	1850.2	29.6	27.1	25.2	23.8	Conducted, GMSK
661	1880.0	29.8	27.0	25.1	23.7	Conducted, GMSK
810	1909.8	29.9	27.1	25.2	23.8	Conducted, GMSK

GPRS1900 - Calculated Value With consideration for Uplink time slots:

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
512	1850.2	20.6	21.1	20.9	20.8	Conducted, GMSK
661	1880.0	20.8	21.0	20.8	20.7	Conducted, GMSK
810	1909.8	20.9	21.1	20.9	20.8	Conducted, GMSK

EDGE1900 - Measured Average Power Without consideration for Uplink time slots:

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
512	1850.2	29.6	27.1	25.2	23.8	Conducted, GMSK
661	1880.0	29.8	27.0	25.1	23.7	Conducted, GMSK
810	1909.8	29.9	27.1	25.2	23.8	Conducted, GMSK

EGPRS1900 - Calculated Value With consideration for Uplink time slots:

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
512	1850.2	20.6	21.1	20.9	20.8	Conducted, GMSK
661	1880.0	20.8	21.0	20.8	20.7	Conducted, GMSK
810	1909.8	20.9	21.1	20.9	20.8	Conducted, GMSK

Note:**Scale factor for uplink time slot:**

- 1 Uplink: time slot ratio = 8:1 => $10 \cdot \log(8/1) = 9.03 \text{ dB}$
- 2 Uplink: time slot ratio = 8:2 => $10 \cdot \log(8/2) = 6.02 \text{ dB}$
- 3 Uplink: time slot ratio = 8:3 => $10 \cdot \log(8/3) = 4.26 \text{ dB}$
- 4 Uplink: time slot ratio = 8:4 => $10 \cdot \log(8/4) = 3.01 \text{ dB}$

EDGE (MCS9 ~ 8PSK):**EDGE1900 - Measured Average Power Without consideration for Uplink time slots:**

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
512	1850.2	25.8	23.2	21.6	20.2	Conducted, 8PSK
661	1880.0	25.8	23.2	21.6	20.2	Conducted, 8PSK
810	1909.8	25.8	23.2	21.6	20.2	Conducted, 8PSK

EDGE1900 - Calculated Value With consideration for Uplink time slots:

Channel Number	Frequency (MHZ)	Power (dBm) 1Uplink	Power (dBm) 2Uplink	Power (dBm) 3Uplink	Power (dBm) 4Uplink	Note
512	1850.2	16.8	17.2	17.3	17.2	Conducted, 8PSK
661	1880.0	16.8	17.2	17.3	17.2	Conducted, 8PSK
810	1909.8	16.8	17.2	17.3	17.2	Conducted, 8PSK

Note:**Scale factor for uplink time slot:**

- 1 Uplink: time slot ratio = 8:1 => $10 \cdot \log(8/1) = 9.03 \text{ dB}$
- 2 Uplink: time slot ratio = 8:2 => $10 \cdot \log(8/2) = 6.02 \text{ dB}$
- 3 Uplink: time slot ratio = 8:3 => $10 \cdot \log(8/3) = 4.26 \text{ dB}$
- 4 Uplink: time slot ratio = 8:4 => $10 \cdot \log(8/4) = 3.01 \text{ dB}$

7.2.17. Conducted Average Power Measurement 3G

Modes		HSDPA				HSPA					WCDMA
Sets		1	2	3	4	1	2	3	4	5	Voice / RMC 12.2kbps
Band	Channel	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]
UMTS FDD 5	4132	23.4	23.1	22.4	22.3	23.1	23.3	22.4	23.6	22.5	23.5
	4357										
	4183	23.7	22.9	22.7	22.6	23.4	23.5	22.6	23.7	22.8	23.8
	4408										
	4233	23.6	23.2	22.8	22.7	23.2	23.3	22.5	23.6	22.8	23.6
	4458										
β_c		2	12	15	15	11	6	15	2	15	
β_d		15	15	8	4	15	15	9	15	15	
$\Delta ACK, \Delta NACK, \Delta CQI$		8	8	8	8	8	8	8	8	8	
AGV		-	-	-	-	20	12	15	17	21	

* Prior to commencement of SAR testing the module power levels were measured in both HSPA and 3G RMC 12.2kbps modes and compared to ensure the correct mode of operation had been established.

The following tables taken from FCC 3G SAR procedures (KDB 941225 D01 SAR test for 3G devices v02) below were applied using an communications test set which supports 3G / HSDPA release 5 / HSPA release 6.

Sub-test Setup for Release 5 HSDPA

Sub-test	β_c	β_d	B_d (SF)	β_c/β_d	$\beta_{hs}^{(1)}$	SM (dB) ⁽²⁾
1	2/15	15/15	64	2/15	4/15	0.0
2	12/15 ⁽³⁾	15/15 ⁽³⁾	64	12/15 ⁽³⁾	24/15	1.0
3	15/15	8/15	64	15/8	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5

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

Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $B_{hs}/\beta_c = 24/15$

Note 3: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$

Sub-test Setup for Release 6 HSPA

Sub-test	β_c	β_d	B_d (SF)	β_c/β_d	$\beta_{hs}^{(1)}$	B_{oc}	B_{od}	B_{od} (SF)	B_{od} (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	31/15	B_{al1} : 47/15 B_{al2} : 47/15	4	1	2.0	1.0	15	92
4	2/15	15/15	64	2/15	2/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 ⁽⁴⁾	15/15 ⁽⁴⁾	64	15/15 ⁽⁴⁾	24/15	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 $\beta_c/\beta_d = 12/15$, $B_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH AND E-DPCCH for 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: 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: B_{od} can not be set directly; it is set by Absolute Grant Value.

7.2.18. Conducted Power Measurements Wi-Fi 802.11b/g/n 802.11b/g

Channel Number	Frequency (MHZ)	TX Power (dBm)	Note
1	2412.0	16.2	2.4GHz 802.11b (1Mbps)
6	2437.0	16.6	
11	2462.0	15.7	
1	2412.0	15.6	2.4GHz 802.11b (11Mbps)
6	2437.0	16.0	
11	2462.0	14.8	
1	2412.0	11.8	2.4GHz 802.11g (6Mbps)
6	2437.0	12.4	
11	2462.0	11.1	
1	2412.0	10.1	2.4GHz 802.11g (54Mbps)
6	2437.0	10.7	
11	2462.0	9.3	

802.11n

Channel Number	Frequency (MHZ)	TX Power (dBm)	Note
1	2412.0	12.0	2.4GHz 802.11n (MCS0 6.5Mbps)
6	2437.0	12.7	
11	2462.0	11.3	
1	2412.0	10.0	2.4GHz 802.11n (MCS7 65Mbps)
6	2437.0	10.6	
11	2462.0	9.2	

7.2.19. Conducted Power Measurements Wi-Fi 802.11a/n (5.0 GHz) 802.11a (5.0 GHz)

Channel Number	Frequency (MHz)	TX Power (dBm) 6 Mbps	TX Power (dBm) 54 Mbps	Note
36*	5180.0	9.6	7.5	5.2 GHz
40	5200.0	9.4	7.3	
44	5220.0	9.2	7.2	
48*	5240.0	9.1	7.1	
52*	5260.0	8.7	6.9	5.3 GHz
56	5280.0	8.5	6.8	
60	5300.0	8.4	6.7	
64*	5320.0	8.3	6.6	
100	5500.0	8.1	6.4	5.6 GHz
104*	5520.0	8.2	6.5	
108	5540.0	8.3	6.6	
112	5560.0	8.4	6.7	
116*	5580.0	8.6	6.9	
120	5600.0	8.7	7.0	
124*	5620.0	8.9	7.2	
128	5640.0	9.0	7.3	
132	5660.0	9.2	7.4	
136*	5680.0	9.3	7.6	
140	5700.0	9.3	7.6	5.8 GHz
149*	5745.0	Not Supported	Not Supported	
153	5765.0	Not Supported	Not Supported	
157*	5785.0	Not Supported	Not Supported	
161	5805.0	Not Supported	Not Supported	
165*	5825.0	Not Supported	Not Supported	

Note:

* Default test Channels

The measured maximum conducted power for WLAN 5.0GHz is 9.6dBm (equivalent to 9.1mW).
As per FCC kdb pub. *SAR Handsets Multi Xmitter and Ant, v01r05*; when there is simultaneous transmission occurring, stand- alone SAR evaluation is not required when the output power measured is $\leq 2.P_{ref}$ for the particular band and antenna separation is ≥ 5.0 cm from other antenna.

Output power thresholds for Unlicensed Transmitters

P_{ref}	2.45	5.15 – 5.35	5.47 - 5.85	GHz
	12	6	5	mW

As per table 1 above, since output power measured for;
5.15 to 5.35 GHz maximum output power = 9.1 mW < 12mW (2*Pref)
5.47 to 5.85 GHz maximum output power = 8.5 mW < 10mW (2*Pref)

Stand Alone SAR evaluation is not required for 5.0 GHz WLAN 802.11a/n modes.

802.11n (5.0 GHz) (HT20)

Channel Number	Frequency (MHZ)	TX Power (dBm) 6.5 Mbps	TX Power (dBm) 65 Mbps	Note
36*	5180.0	7.9	5.1	5.2 GHz
40	5200.0	7.8	4.8	
44	5220.0	7.6	4.5	
48*	5240.0	7.6	4.5	
52*	5260.0	7.4	4.3	5.3 GHz
56	5280.0	7.4	4.2	
60	5300.0	7.1	4.1	
64*	5320.0	7.1	3.9	
100	5500.0	6.9	3.7	5.6 GHz
104*	5520.0	7.0	3.8	
108	5540.0	7.0	3.9	
112	5560.0	7.2	4.1	
116*	5580.0	7.5	4.2	
120	5600.0	7.5	4.2	
124*	5620.0	7.7	4.4	
128	5640.0	7.8	4.5	
132	5660.0	7.9	4.6	
136*	5680.0	7.9	4.7	
140	5700.0	7.9	4.7	
149*	5745.0	Not Supported	Not Supported	5.8 GHz
153	5765.0	Not Supported	Not Supported	
157*	5785.0	Not Supported	Not Supported	
161	5805.0	Not Supported	Not Supported	
165*	5825.0	Not Supported	Not Supported	

Note:*** Default test Channels**

The measured maximum conducted power for WLAN 5.0GHz is 9.6dBm (equivalent to 9.1mW).
As per FCC kdb pub. *SAR Handsets Multi Xmitter and Ant, v01r05*; when there is simultaneous transmission occurring, stand- alone SAR evaluation is not required when the output power measured is $\leq 2.P_{ref}$ for the particular band and antenna separation is ≥ 5.0 cm from other antenna.

Output power thresholds for Unlicensed Transmitters

P_{ref}	2.45	5.15 – 5.35	5.47 - 5.85	GHz
	12	6	5	mW

As per table 1 above, since output power measured for;
5.15 to 5.35 GHz maximum output power = 9.1 mW < 12mW (2*Pref)
5.47 to 5.85 GHz maximum output power = 8.5 mW < 10mW (2*Pref)

Stand Alone SAR evaluation is not required for 5.0 GHz WLAN802.11a/n modes.

802.11n (5.0 GHz) (HT40)

Channel Number	Frequency (MHz)	TX Power (dBm) 13.5 Mbps	TX Power (dBm) 135 Mbps	Note
38	5190.0	7.7	6.6	5.2 GHz
46	5230.0	7.0	6.3	
54	5270.0	6.8	4.4	5.3 GHz
62	5310.0	6.3	4.0	
102	5510.0	5.9	3.9	5.6 GHz
110	5550.0	5.6	3.7	
118	5590.0	5.2	3.6	
126	5630.0	6.8	4.0	
134	5670.0	6.6	4.0	
151	5755.0	Not Supported	Not Supported	5.8 GHz
159	5795.0	Not Supported	Not Supported	

Note:*** Default test Channels**

The measured maximum conducted power for WLAN 5.0GHz is 9.6dBm (equivalent to 9.1mW).
As per FCC kdb pub. *SAR Handsets Multi Xmitter and Ant, v01r05*; when there is simultaneous transmission occurring, stand- alone SAR evaluation is not required when the output power measured is $\leq 2 \cdot P_{ref}$ for the particular band and antenna separation is ≥ 5.0 cm from other antenna.

Output power thresholds for Unlicensed Transmitters

P_{ref}	2.45	5.15 – 5.35	5.47 - 5.85	GHz
	12	6	5	mW

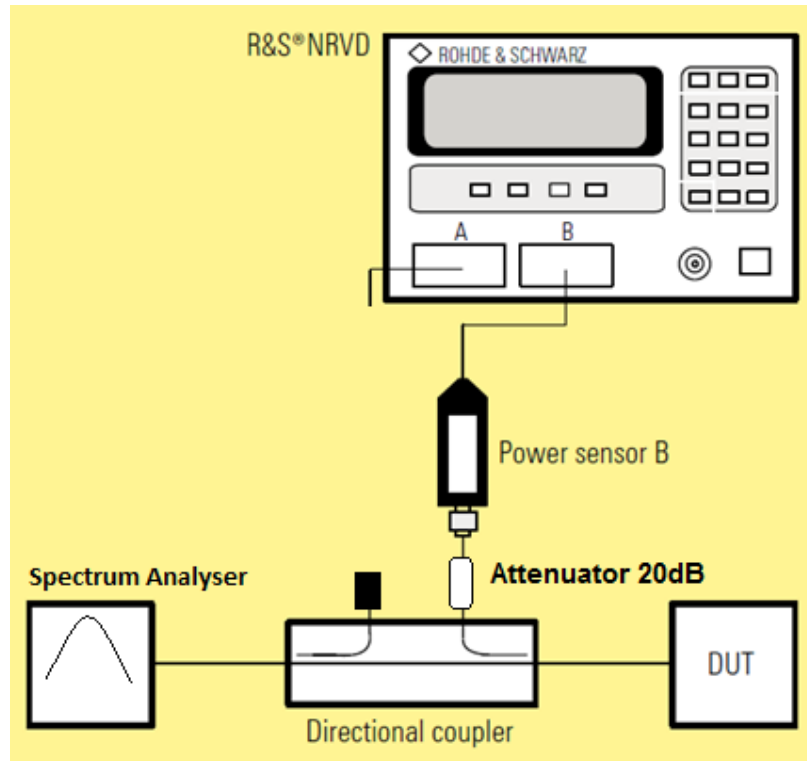
As per table 1 above, since output power measured for;

5.15 to 5.35 GHz maximum output power = 9.1 mW < 12mW ($2 \cdot P_{ref}$)

5.47 to 5.85 GHz maximum output power = 8.5 mW < 10mW ($2 \cdot P_{ref}$)

Stand Alone SAR evaluation is not required for 5.0 GHz WLAN 802.11a/n modes.

Test setup for power measurements



8. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Test Name	Confidence Level	Calculated Uncertainty
Specific Absorption Rate-GSM 850/ UMTS FDD 5 Head Configuration 1g	95%	±19.94%
Specific Absorption Rate-GSM / GPRS / EDGE 850 / UMTS FDD 5 Body Configurations 1g	95%	±20.07%
Specific Absorption Rate-PCS 1900 Head Configuration 1g	95%	±20.72%
Specific Absorption Rate-GSM / GPRS / EDGE 1900 Body Configuration 1g	95%	±20.00%
Specific Absorption Rate-Wi-Fi 2450 MHz Head Configuration 1g	95%	±19.47%
Specific Absorption Rate-Wi-Fi 2450 MHz Body Configuration 1g	95%	±19.90%

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

8.1. Specific Absorption Rate Uncertainty -GSM 850 / UMTS FDD 5 Head Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		U _i or U _{eff}
							+ u (%)	- u (%)	
B	Probe calibration	6.000	6.000	normal (k=1)	1.0000	1.0000	6.000	6.000	∞
B	Axial Isotropy	0.250	0.250	normal (k=1)	1.0000	1.0000	0.250	0.250	∞
B	Hemispherical Isotropy	1.300	1.300	normal (k=1)	1.0000	1.0000	1.300	1.300	∞
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	∞
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	∞
B	Linearity	0.600	0.600	Rectangular	1.7321	1.0000	0.346	0.346	∞
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	∞
B	Readout Electronics	0.160	0.160	normal (k=1)	1.0000	1.0000	0.160	0.160	∞
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	Integration Time	1.730	1.730	Rectangular	1.7321	1.0000	0.999	0.999	∞
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Probe Positioning with regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	∞
B	Extrapolation and integration / Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	∞
A	Test Sample Positioning	2.400	2.400	normal (k=1)	1.0000	1.0000	2.400	2.400	10
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	10
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	0.6400	1.848	1.848	∞
A	Liquid Conductivity (measured value)	4.920	4.920	normal (k=1)	1.0000	0.6400	3.149	3.149	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	4.970	4.970	normal (k=1)	1.0000	0.6000	2.982	2.982	5
	Combined standard uncertainty			t-distribution			10.17	10.17	>250
	Expanded uncertainty			k = 1.96			19.94	19.94	>250

8.2. Specific Absorption Rate-GSM / GPRS / EDGE 850 / UMTS FDD 5 Body Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		U _i or U _{eff}
							+ u (%)	- u (%)	
B	Probe calibration	6.000	6.000	normal (k=1)	1.0000	1.0000	6.000	6.000	∞
B	Axial Isotropy	0.250	0.250	normal (k=1)	1.0000	1.0000	0.250	0.250	∞
B	Hemispherical Isotropy	1.300	1.300	normal (k=1)	1.0000	1.0000	1.300	1.300	∞
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	∞
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	∞
B	Linearity	0.600	0.600	Rectangular	1.7321	1.0000	0.346	0.346	∞
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	∞
B	Readout Electronics	0.160	0.160	normal (k=1)	1.0000	1.0000	0.160	0.160	∞
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	Integration Time	1.730	1.730	Rectangular	1.7321	1.0000	0.999	0.999	∞
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Probe Positioning with regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	∞
B	Extrapolation and integration /Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	∞
A	Test Sample Positioning	2.900	2.900	normal (k=1)	1.0000	1.0000	2.900	2.900	10
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	10
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	0.6400	1.848	1.848	∞
A	Liquid Conductivity (measured value)	4.690	4.690	normal (k=1)	1.0000	0.6400	3.002	3.002	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	4.860	4.860	normal (k=1)	1.0000	0.6000	2.916	2.916	5
	Combined standard uncertainty			t-distribution			10.24	10.24	>250
	Expanded uncertainty			k = 1.96			20.07	20.07	>250

8.3. Specific Absorption Rate-PCS 1900 Head Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		u _i or u _{eff}
							+ u (%)	- u (%)	
B	Probe calibration	6.000	6.000	normal (k=1)	1.0000	1.0000	6.000	6.000	∞
B	Axial Isotropy	0.250	0.250	normal (k=1)	1.0000	1.0000	0.250	0.250	∞
B	Hemispherical Isotropy	1.300	1.300	normal (k=1)	1.0000	1.0000	1.300	1.300	∞
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	∞
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	∞
B	Linearity	0.600	0.600	Rectangular	1.7321	1.0000	0.346	0.346	∞
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	∞
B	Readout Electronics	0.160	0.160	normal (k=1)	1.0000	1.0000	0.160	0.160	∞
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	Integration Time	1.730	1.730	Rectangular	1.7321	1.0000	0.999	0.999	∞
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Probe Positioning with Regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	∞
B	Extrapolation and integration / Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	∞
A	Test Sample Positioning	3.800	3.800	normal (k=1)	1.0000	1.0000	3.800	3.800	10
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	10
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	0.6400	1.848	1.848	∞
A	Liquid Conductivity (measured value)	4.900	4.900	normal (k=1)	1.0000	0.6400	3.136	3.136	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	4.880	4.880	normal (k=1)	1.0000	0.6000	2.928	2.928	5
	Combined standard uncertainty			t-distribution			10.57	10.57	>200
	Expanded uncertainty			k = 1.96			20.72	20.72	>200

8.4. Specific Absorption Rate-PCS / GPRS / EDGE 1900 Body Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		U _i or U _{eff}
							+ u (%)	- u (%)	
B	Probe calibration	6.000	6.000	normal (k=1)	1.0000	1.0000	6.000	6.000	∞
B	Axial Isotropy	0.250	0.250	normal (k=1)	1.0000	1.0000	0.250	0.250	∞
B	Hemispherical Isotropy	1.300	1.300	normal (k=1)	1.0000	1.0000	1.300	1.300	∞
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	∞
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	∞
B	Linearity	0.600	0.600	Rectangular	1.7321	1.0000	0.346	0.346	∞
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	∞
B	Readout Electronics	0.160	0.160	normal (k=1)	1.0000	1.0000	0.160	0.160	∞
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	Integration Time	1.730	1.730	Rectangular	1.7321	1.0000	0.999	0.999	∞
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Probe Positioning with regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	∞
B	Extrapolation and integration / Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	∞
A	Test Sample Positioning	2.500	2.500	normal (k=1)	1.0000	1.0000	2.500	2.500	10
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	10
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	0.6400	1.848	1.848	∞
A	Liquid Conductivity (measured value)	4.940	4.940	normal (k=1)	1.0000	0.6400	3.162	3.162	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	4.980	4.980	normal (k=1)	1.0000	0.6000	2.988	2.988	5
	Combined standard uncertainty			t-distribution			10.20	10.20	>250
	Expanded uncertainty			k = 1.96			20.00	20.00	>250

8.5. Specific Absorption Rate-Wi-Fi 2450 MHz Head Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		U _i or U _{eff}
							+ u (%)	- u (%)	
B	Probe calibration	6.000	6.000	normal (k=1)	1.0000	1.0000	6.000	6.000	∞
B	Axial Isotropy	0.250	0.250	normal (k=1)	1.0000	1.0000	0.250	0.250	∞
B	Hemispherical Isotropy	1.300	1.300	normal (k=1)	1.0000	1.0000	1.300	1.300	∞
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	∞
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	∞
B	Linearity	0.600	0.600	Rectangular	1.7321	1.0000	0.346	0.346	∞
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	∞
B	Readout Electronics	0.160	0.160	normal (k=1)	1.0000	1.0000	0.160	0.160	∞
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	Integration Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Probe Positioning with regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	∞
B	Extrapolation and integration / Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	∞
A	Test Sample Positioning	2.000	2.000	normal (k=1)	1.0000	1.0000	2.000	2.000	10
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	10
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	0.6400	1.848	1.848	∞
A	Liquid Conductivity (measured value)	4.410	4.410	normal (k=1)	1.0000	0.6400	2.822	2.822	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	4.930	4.930	normal (k=1)	1.0000	0.6000	2.958	2.958	5
	Combined standard uncertainty			t-distribution			9.93	9.93	>300
	Expanded uncertainty			k = 1.96			19.47	19.47	>300

8.6. Specific Absorption Rate-Wi-Fi 2450 MHz Body Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		U _i or U _{eff}
							+ u (%)	- u (%)	
B	Probe calibration	6.000	6.000	normal (k=1)	1.0000	1.0000	6.000	6.000	∞
B	Axial Isotropy	0.250	0.250	normal (k=1)	1.0000	1.0000	0.250	0.250	∞
B	Hemispherical Isotropy	1.300	1.300	normal (k=1)	1.0000	1.0000	1.300	1.300	∞
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	∞
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	∞
B	Linearity	0.600	0.600	Rectangular	1.7321	1.0000	0.346	0.346	∞
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	∞
B	Readout Electronics	0.160	0.160	normal (k=1)	1.0000	1.0000	0.160	0.160	∞
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	Integration Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Probe Positioning with regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	∞
B	Extrapolation and integration / Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	∞
A	Test Sample Positioning	2.570	2.570	normal (k=1)	1.0000	1.0000	2.570	2.570	10
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	10
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	0.6400	1.848	1.848	∞
A	Liquid Conductivity (measured value)	4.900	4.900	normal (k=1)	1.0000	0.6400	3.136	3.136	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	4.920	4.920	normal (k=1)	1.0000	0.6000	2.952	2.952	5
	Combined standard uncertainty			t-distribution			10.15	10.15	>250
	Expanded uncertainty			k = 1.96			19.90	19.90	>250

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A034	Narda 20W Termination	Narda	374BNM	8706	Calibrated as part of system	-
A1097	SMA Directional Coupler	MidISCO	MDC6223-30	None	Calibrated as part of system	-
A1137	3dB Attenuator	Narda	779	04690	Calibrated as part of system	-
A1174	Dielectric Probe Kit	Agilent Technologies	85070C	Us99360072	Calibrated before use	-
A1328	Handset Positioner	Schmid & Partner Engineering AG	Modification	SD 000 H01 DA	-	-
A1182	Handset Positioner	Schmid & Partner Engineering AG	V3.0	None	-	-
A2110	Data Acquisition Electronics	Schmid & Partner Engineering AG	DAE3	431	20 Sept 2012	12
A2113	Probe	Schmid & Partner Engineering AG	ET3 DV6	1587	11 May 2012	12
A2201	900 MHz Dipole Kit	Schmid & Partner Engineering AG	D900V2	035	16 Aug 2012	12
A1237	1900 MHz Dipole Kit	Schmid & Partner Engineering AG	D1900V2	540	08 Feb 2011	24
A1322	2450 MHz Dipole Kit	Schmid & Partner Engineering AG	D2450V2	725	08 Feb 2011	24
A1497	Amplifier	Mini-Circuits	zhl-42w (sma)	e020105	Calibrated as part of system	-
A1566	SAM Phantom	Schmid & Partner Engineering AG	SAM a (Site 56)	002	Calibrated before use	-
A1238	SAM Phantom	Schmid & Partner Engineering AG	SAM b (Site 56)	001	Calibrated before use	-
A215	20 dB Attenuator	Narda	766-20	9402	Calibrated as part of system	-
A1531	Antenna	AARONIA AG	7025	02458	-	-
M1015	Network Analyser	Agilent Technologies	8753ES	US39172406	09 Oct 2012	12
C1145	Cable	Rosenberger MICRO-COAX	FA147A F003003030	41843-1	Calibrated as part of system	-
C1146	Cable	Rosenberger MICRO-COAX	FA147A F030003030	41752-1	Calibrated as part of system	-
G0528	Robot Power Supply	Schmid & Partner Engineering AG	DASY4	None	Calibrated before use	-

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
G087	PSU	Thurlby Thandar	CPX200	100701	Calibrated before use	-
M1047	Robot Arm	Staubli	RX908 L	F00/SD8 9A1/A/01	Calibrated before use	-
M1159	Signal Generator	Agilent Technologies	E8241A	US42110332	Internal Checked 10 Aug 2012	4
M1071	Spectrum Analyzer	Agilent	HP8590E	3647U00514	(Monitoring use only)	-
M1270	Digital Thermometer	RS	N/A	N/A	Internal Checked 13 May 2012	12
M1023	Dual Channel Power Meter	R & S	NRVD	863715/030	18 July 2012	12
S256	SAR Lab	RFI	Site 56	N/A	Calibrated before use	-

Note:

All the assets were in calibration during the course of testing.

A.1.1. Calibration Certificates

This section contains the calibration certificates and data for the Probe(s) and Dipole(s) used, which are not included in the total number of pages for this report.

The following information is justification to why the listed dipoles calibration period has been extended. This address FCC KDB 450824 D02

Cal Date	Dipole Calibration History									
	Dipole SN: 540, Frequency 1900 MHz									
	Head Parameters					Body Parameters				
	1g (W/Kg)	10g (W/Kg)	Return loss (dB)	Real (Ω)	Imaginary (Ω)	1g (W/Kg)	10g (W/Kg)	Return loss (dB)	Real (Ω)	Imaginary (Ω)
27-Jun-12	Lab Annual Check of dipole		-30.57	49.54	1.41	Lab Annual Check of dipole		-29.80	50.34	2.37
08-Feb-11	40.30	21.00	-27.60	50.50	4.20	40.70	21.60	-23.10	45.60	5.00
26-Jun-09	40.30	21.10	-30.00	48.50	2.70	40.90	21.50	-24.30	44.90	2.80
11-Jun-07	36.10	19.30	-25.40	51.90	5.10	38.00	20.70	-25.30	47.70	4.80
14-Jun-05	38.1	19.90	-25.40	51.90	5.20	39.10	20.70	-24.00	48.10	5.90
04-Jun-03	41.20	21.20	-28.50	50.30	3.80	Dipole calibrated for Head only				
Standard Deviation	2.08	0.85	2.21	1.33	1.46	1.38	0.49	2.64	2.16	1.52
Mean Value	39.20	20.50	27.91			39.68	21.13	25.30		
Relative standard deviation %	5.30%	4.15%	7.93%			3.47%	2.33%	10.42%		

Calibration Certificates (Continued)

Cal Date	Dipole Calibration History									
	Dipole SN: 725, Frequency 2450 MHz									
	Head Parameters					Body Parameters				
	1g (W/Kg)	10g (W/Kg)	Return loss (dB)	Real (Ω)	Imaginary (Ω)	1g (W/Kg)	10g (W/Kg)	Return loss (dB)	Real (Ω)	Imaginary (Ω)
02-July-12	Lab Annual Check of dipole		-20.37	47.27	8.65	Lab Annual Check of dipole		-21.04	48.52	8.72
08-Feb-11	52.90	24.70	-20.50	45.60	7.90	51.90	24.10	-20.20	49.50	9.70
08-Jan-09	52.10	24.30	-23.70	54.40	5.30	52.20	24.70	-23.40	49.00	6.70
17-Jan-07	53.30	24.80	-22.10	52.40	7.70	53.30	24.50	-21.80	47.80	7.70
04-Jan-05	54.5	24.70	-22.30	53.50	7.20	52.90	24.50	-22.20	48.50	7.50
17-Jan-03	54.70	24.50	-22.60	53.00	7.00	52.10	24.10	-21.70	49.00	8.10
Standard Deviation	1.10	0.20	1.28	3.66	1.14	0.59	0.27	1.08	0.58	1.04
[Mean Value]	53.50	24.60	21.93			52.48	24.38	21.72		
Relative standard deviation %	2.05%	0.81%	5.85%			1.13%	1.10%	4.97%		

Note:

1. The dipole history shows that the measured SAR relative standard deviation was all less than 10% for the calibration period. The return loss relative standard deviation was all less than 10 %. And the real and imaginary impedance standard deviation is within 5 (Ω).

Checked by R.D.

17-May-2012

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



S
C
S

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

Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: SCS 108

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

ASSET A2113

Client **RFI**

Certificate No: **ET3-1587_May12**

CALIBRATION CERTIFICATE

Object **ET3DV6 - SN:1587**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes**

Calibration date: **May 11, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	10-Jan-12 (No. DAE4-660_Jan12)	Jan-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: May 11, 2012			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

TSL	tissue simulating liquid
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	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -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}; VR_{x,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 $f \leq 800$ 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.

Probe ET3DV6

SN:1587

Manufactured: May 7, 2001
Calibrated: May 11, 2012

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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1587

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	2.14	1.92	1.79	$\pm 10.1 \%$
DCP (mV) ^B	99.0	97.5	99.1	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.00	0.00	1.00	119.0	$\pm 2.7 \%$
			Y	0.00	0.00	1.00	114.6	
			Z	0.00	0.00	1.00	111.6	

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

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

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1587

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	Depth (mm)	Unct. (k=2)
835	41.5	0.90	6.33	6.33	6.33	0.24	3.00	± 12.0 %
900	41.5	0.97	6.18	6.18	6.18	0.28	3.00	± 12.0 %
1750	40.1	1.37	5.47	5.47	5.47	0.58	2.35	± 12.0 %
1900	40.0	1.40	5.18	5.18	5.18	0.80	1.68	± 12.0 %
2450	39.2	1.80	4.52	4.52	4.52	0.80	1.95	± 12.0 %

^C Frequency validity 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.

^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.

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1587

Calibration Parameter Determined in Body Tissue Simulating Media

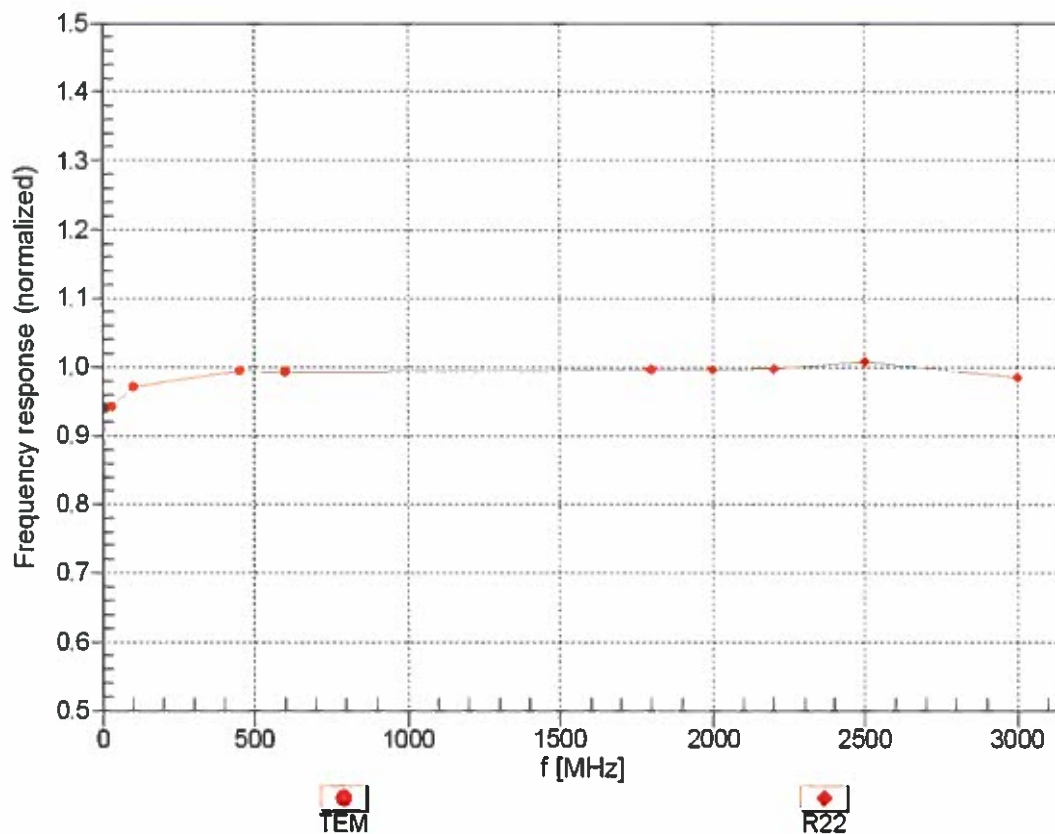
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	55.2	0.97	6.28	6.28	6.28	0.30	3.00	± 12.0 %
900	55.0	1.05	6.26	6.26	6.26	0.37	2.56	± 12.0 %
1750	53.4	1.49	4.92	4.92	4.92	0.74	2.18	± 12.0 %
1900	53.3	1.52	4.69	4.69	4.69	0.77	2.38	± 12.0 %
2450	52.7	1.95	4.13	4.13	4.13	0.80	2.02	± 12.0 %

^C Frequency validity 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.

^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.

Frequency Response of E-Field

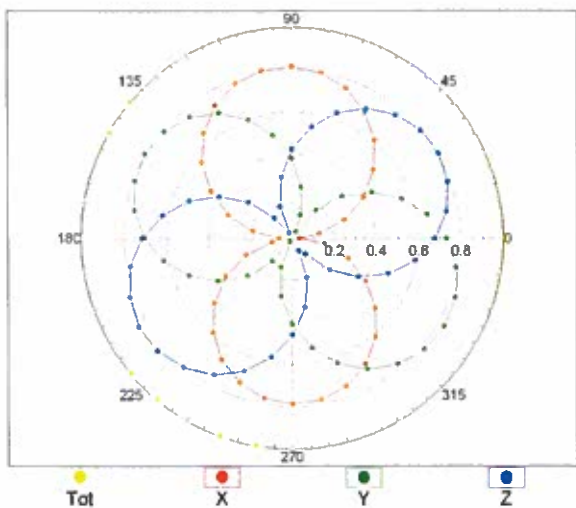
(TEM-Cell:ifi110 EXX, Waveguide: R22)



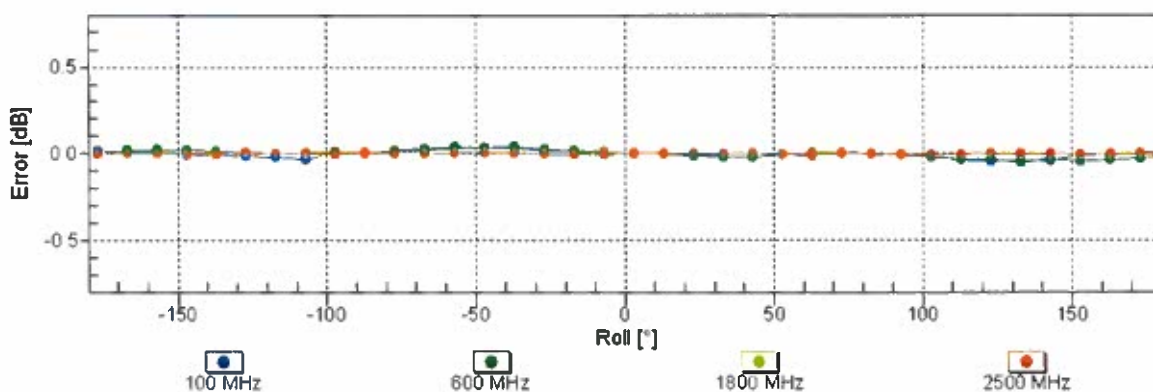
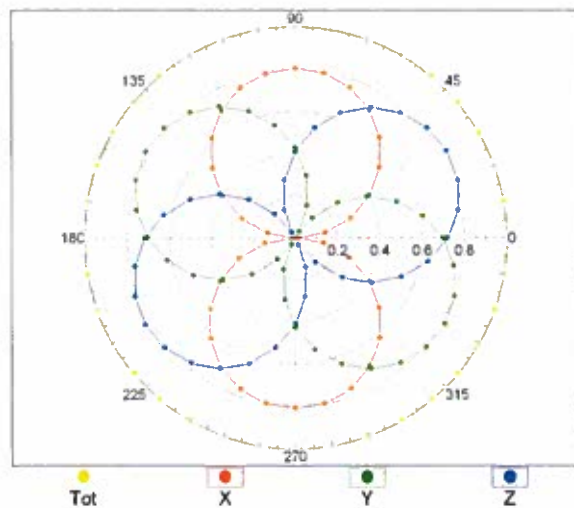
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

$f=600$ MHz,TEM

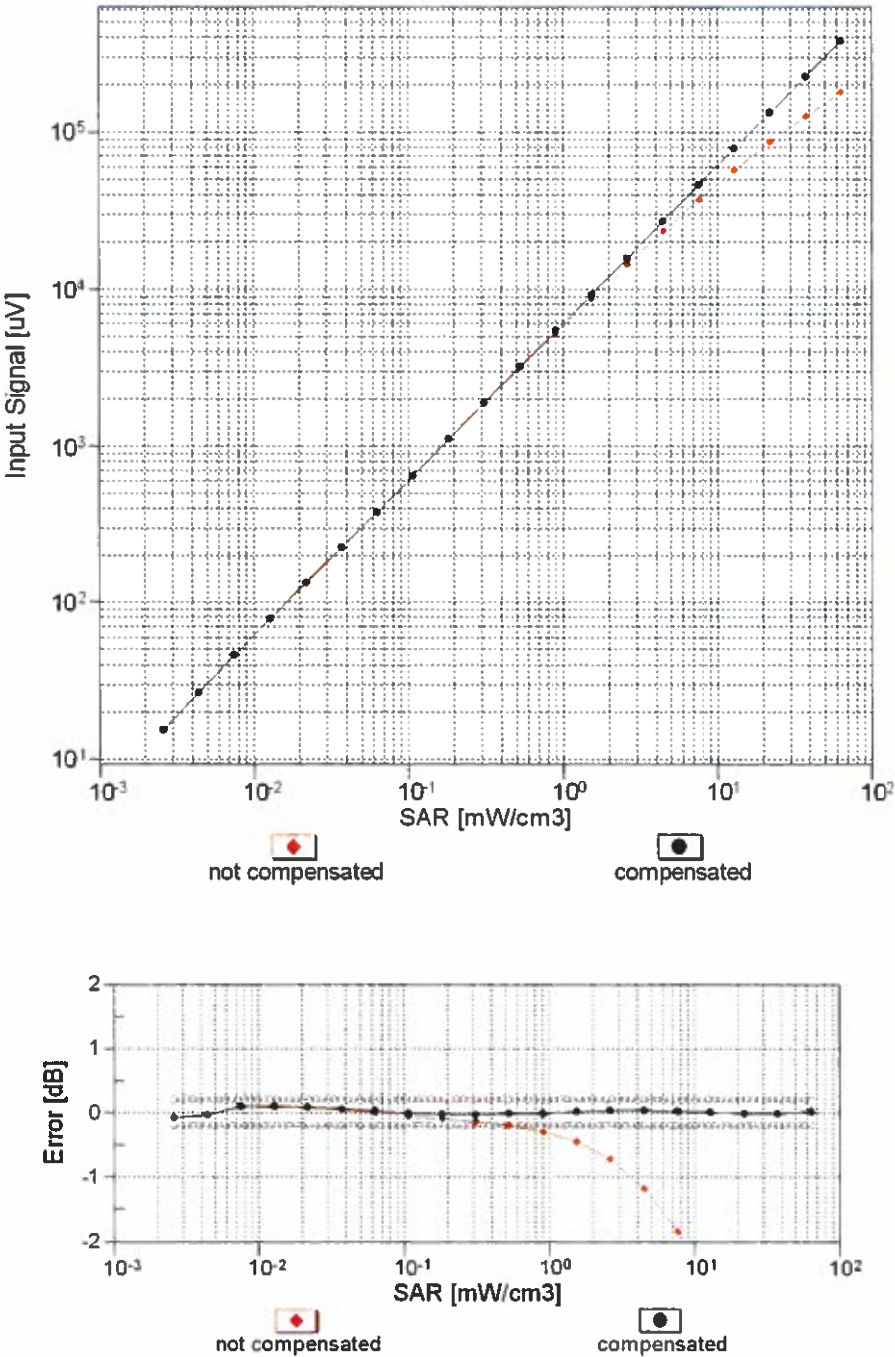


$f=1800$ MHz,R22



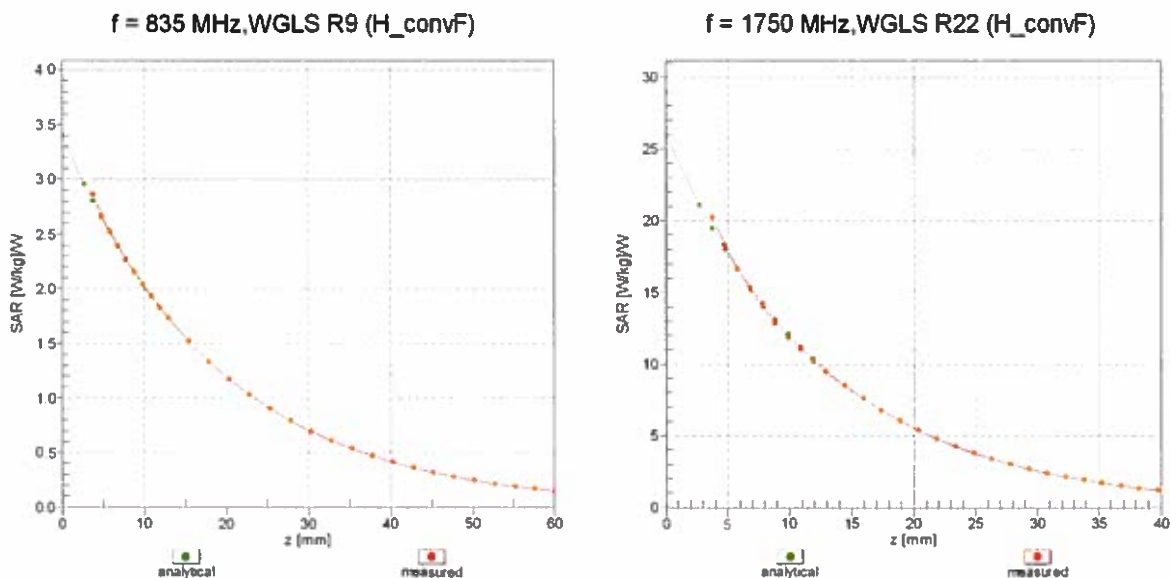
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



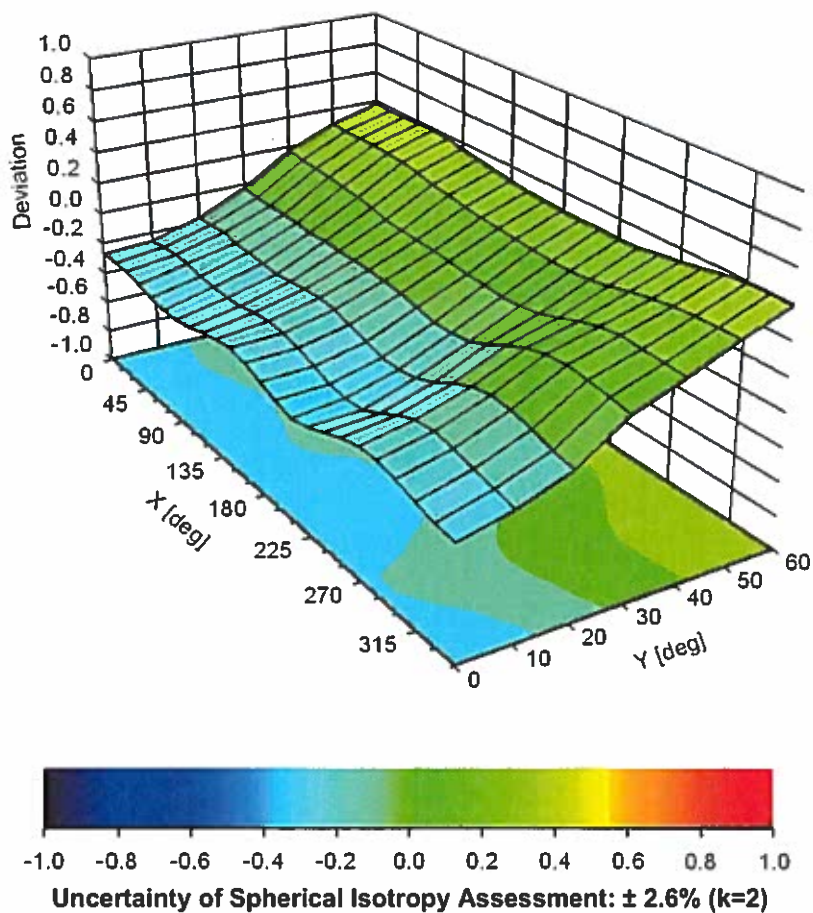
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ET3DV6 - SN:1587

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	72.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	enabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	6.8 mm
Probe Tip to Sensor X Calibration Point	2.7 mm
Probe Tip to Sensor Y Calibration Point	2.7 mm
Probe Tip to Sensor Z Calibration Point	2.7 mm
Recommended Measurement Distance from Surface	4 mm



check by *[Signature]* DATE: 7-August 2012

Accredited by the Swiss Accreditation Service (SAS) *Asset: A2201*
 The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RFI**

Certificate No: **D900V2-035_Aug12**

CALIBRATION CERTIFICATE

Object **D900V2 - SN: 035**

Calibration procedure(s) **QA CAL-05.v8**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 16, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	<i>[Signature]</i>
Approved by:	Katja Pokovic	Technical Manager	<i>[Signature]</i>

Issued: August 16, 2012

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	900 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.97 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	40.6 \pm 6 %	0.96 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.62 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	10.5 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.68 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.74 mW / g \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.0	1.05 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	52.6 \pm 6 %	1.06 mho/m \pm 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.74 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	10.8 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.76 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.96 mW / g \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.8 Ω - 5.8 j Ω
Return Loss	- 24.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.5 Ω - 5.5 j Ω
Return Loss	- 24.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.404 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	February 26, 1998

DASY5 Validation Report for Head TSL

Date: 16.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 035

Communication System: CW; Frequency: 900 MHz

Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.96 \text{ mho/m}$; $\epsilon_r = 40.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.97, 5.97, 5.97); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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

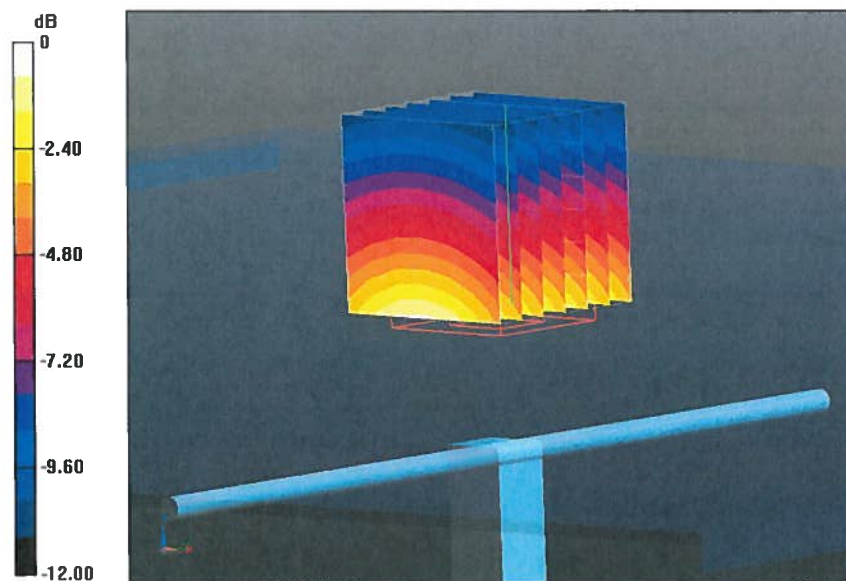
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 56.325 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.926 mW/g

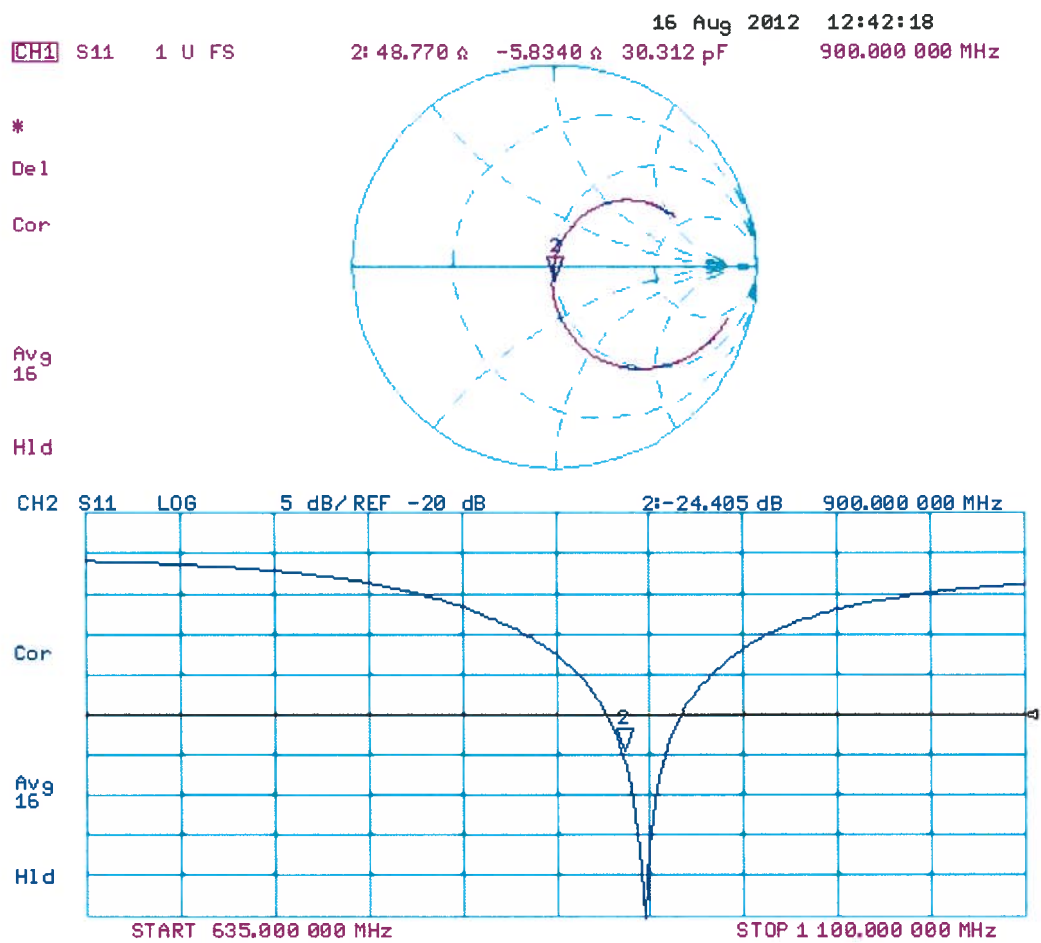
SAR(1 g) = 2.62 mW/g; SAR(10 g) = 1.68 mW/g

Maximum value of SAR (measured) = 3.06 W/kg



0 dB = 3.06 W/kg = 9.71 dB W/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 035

Communication System: CW; Frequency: 900 MHz

Medium parameters used: $f = 900$ MHz; $\sigma = 1.06$ mho/m; $\epsilon_r = 52.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.94, 5.94, 5.94); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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

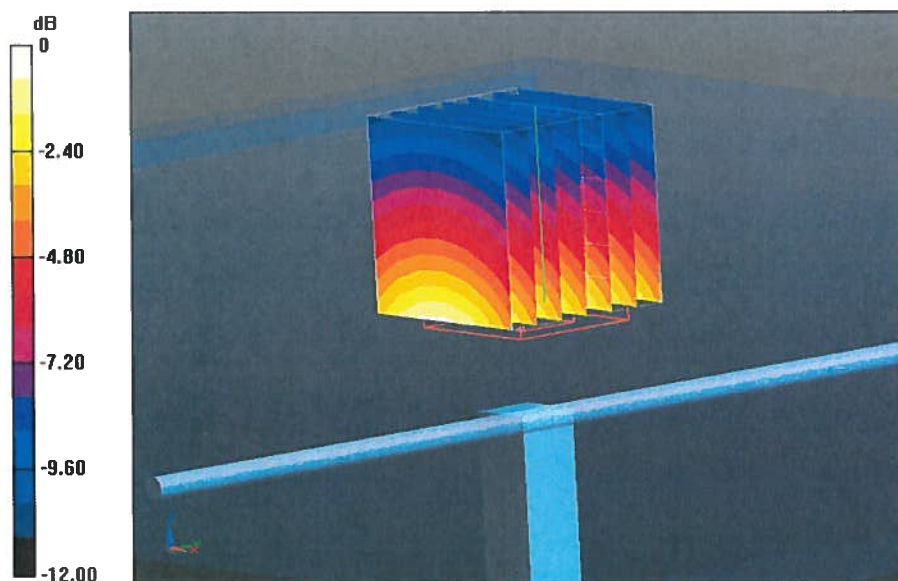
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.325 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 4.184 mW/g

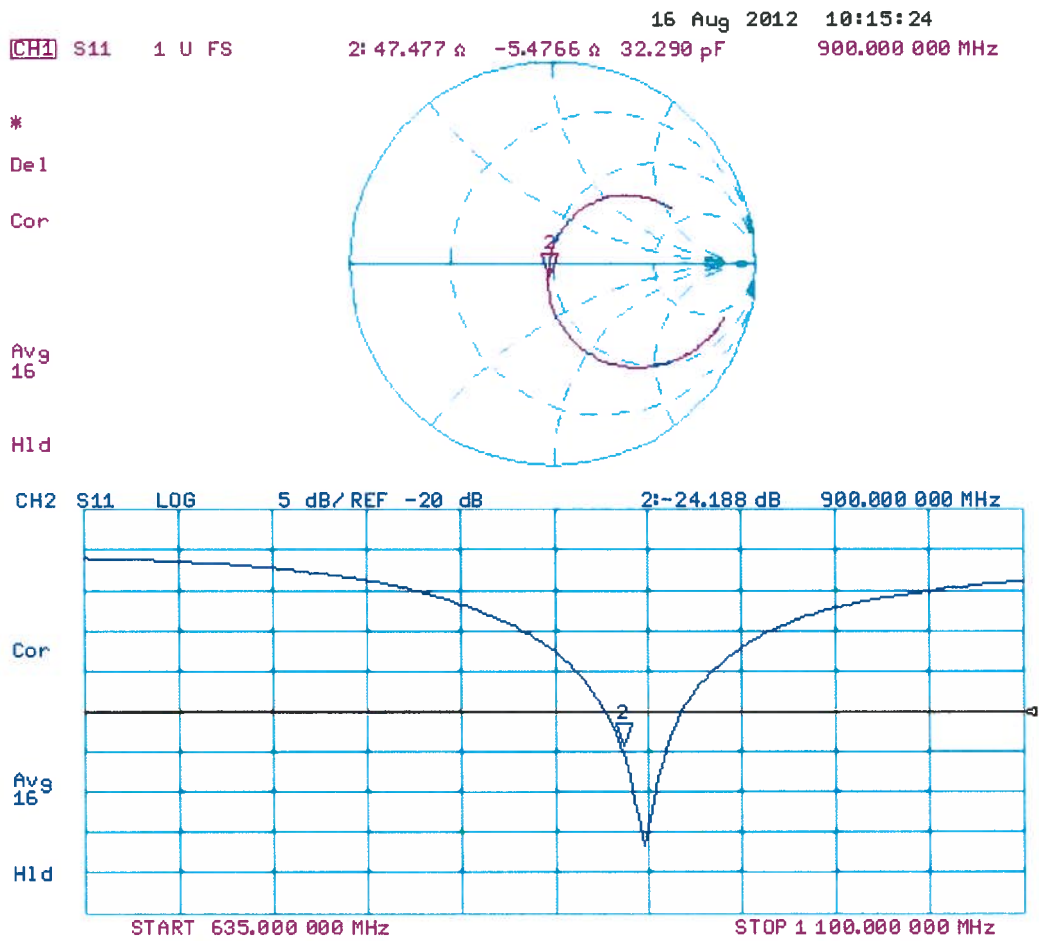
SAR(1 g) = 2.74 mW/g; SAR(10 g) = 1.76 mW/g

Maximum value of SAR (measured) = 3.18 W/kg



0 dB = 3.18 W/kg = 10.05 dB W/kg

Impedance Measurement Plot for Body TSL



ASSET: A/237 - checked by *KS*
21/02/2011

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



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

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

Accreditation No.: **SCS 108**

Client **RFI**

Certificate No: **D1900V2-540_Feb11**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 540**

Calibration procedure(s) **QA CAL-05.v8
Calibration procedure for dipole validation kits**

Calibration date: **February 08, 2011**

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 EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by: **Dimce Iliev** **Function: Laboratory Technician** **Signature: *Dimce Iliev***

Approved by: **Katja Pokovic** **Technical Manager** **Signature: *Katja Pokovic***

Issued: February 8, 2011

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 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

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.

Measurement Conditions

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

DASY Version	DASY5	V52.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
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	39.8 \pm 6 %	1.41 mho/m \pm 6 %
Head TSL temperature during test	(21.0 \pm 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR normalized	normalized to 1W	40.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.3 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.25 mW / g
SAR normalized	normalized to 1W	21.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.0 mW / g \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.8 ± 6 %	1.55 mho/m ± 6 %
Body TSL temperature during test	(21.2 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.3 mW / g
SAR normalized	normalized to 1W	41.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.7 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.43 mW / g
SAR normalized	normalized to 1W	21.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.6 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.5 Ω + 4.2 j Ω
Return Loss	- 27.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.6 Ω + 5.0 j Ω
Return Loss	- 23.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 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.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 26, 2001

DASY5 Validation Report for Head TSL

Date/Time: 07.02.2011 15:18:47

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:540

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL U12 BB

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.41$ mho/m; $\epsilon_r = 39.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

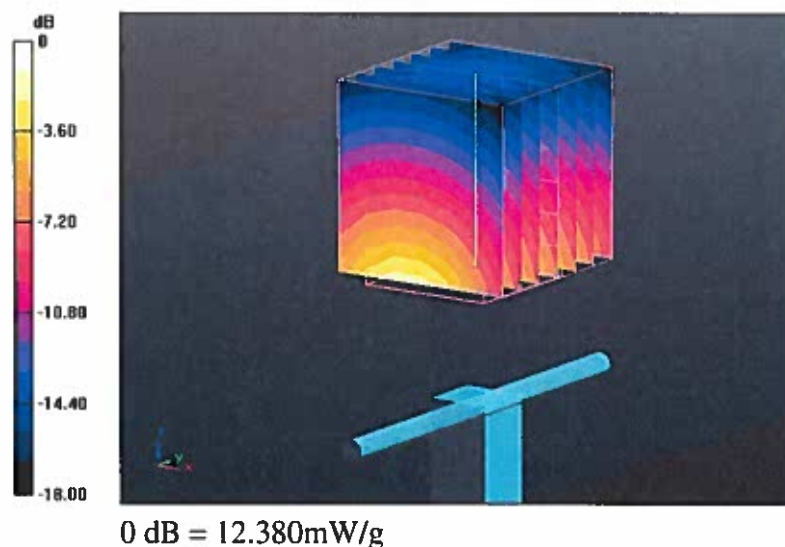
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.936 V/m; Power Drift = 0.04 dB

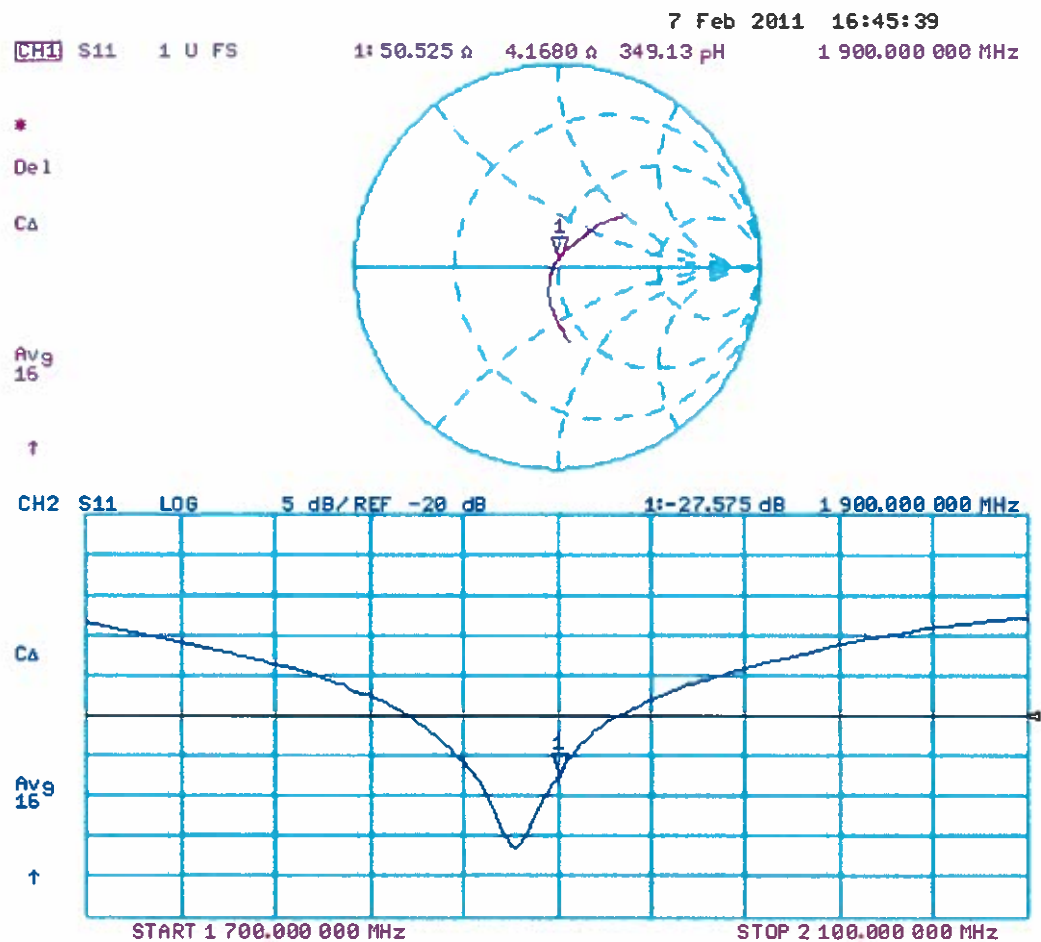
Peak SAR (extrapolated) = 18.544 W/kg

SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.25 mW/g

Maximum value of SAR (measured) = 12.384 mW/g



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date/Time: 08.02.2011 12:04:35

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:540

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL U12 BB

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.55$ mho/m; $\epsilon_r = 52.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

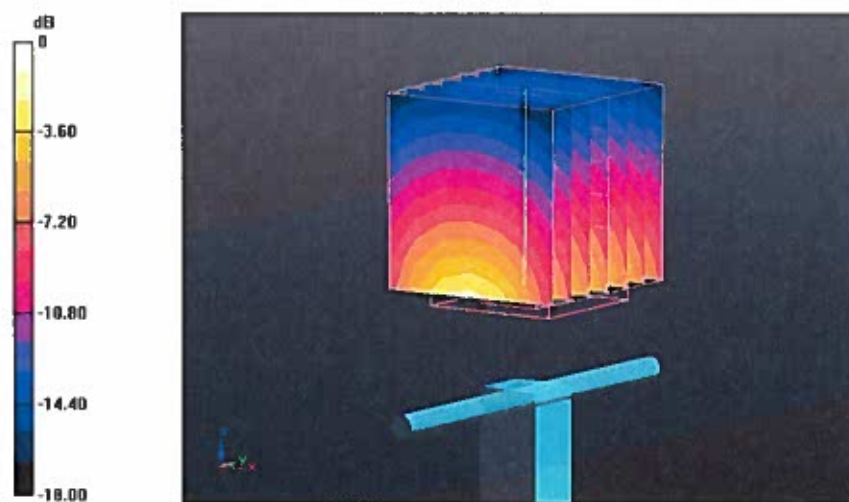
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.899 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 17.597 W/kg

SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.43 mW/g

Maximum value of SAR (measured) = 13.038 mW/g



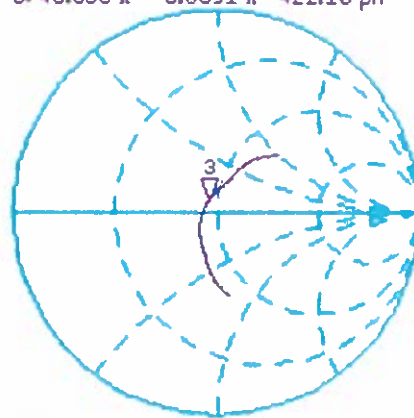
0 dB = 13.040mW/g

Impedance Measurement Plot for Body TSL

8 Feb 2011 10:45:02
 CH1 S11 1 U FS 3: 45.568 Ω 5.0391 Ω 422.10 pF 1 900.000 000 MHz

*
 De1
 CA

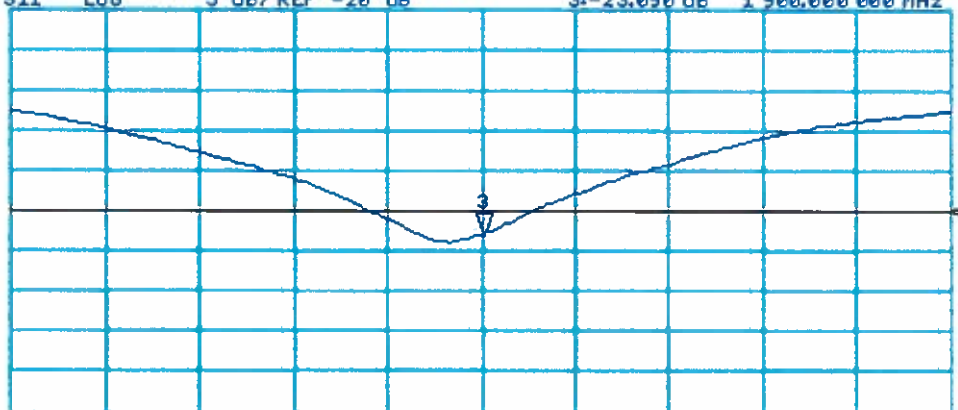
Avg
 16



CH2 S11 LOG 5 dB/REF -20 dB 3: -23.090 dB 1 900.000 000 MHz

CA

Avg
 16



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz

ASSET! A1322 - Checked by *RB*

21/02/2011

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



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

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

Accreditation No.: **SCS 108**

Client **RFI**

Certificate No: **D2450V2-725_Feb11**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 725**

Calibration procedure(s) **QA CAL-05.v8
Calibration procedure for dipole validation kits**

Calibration date: **February 08, 2011**

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 EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	<i>D. Iliev</i>
Approved by:	Katja Pokovic	Technical Manager	<i>K. Pokovic</i>

Issued: February 8, 2011

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 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

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.

Measurement Conditions

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

DASY Version	DASY5	V52.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	39.1 \pm 6 %	1.73 mho/m \pm 6 %
Head TSL temperature during test	(21.0 \pm 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.0 mW / g
SAR normalized	normalized to 1W	52.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	52.9 mW /g \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.13 mW / g
SAR normalized	normalized to 1W	24.5 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.7 mW /g \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	1.94 mho/m ± 6 %
Body TSL temperature during test	(21.0 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 mW / g
SAR normalized	normalized to 1W	52.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	51.9 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.04 mW / g
SAR normalized	normalized to 1W	24.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.1 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$45.6 \Omega + 7.9 j\Omega$
Return Loss	- 20.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.5 \Omega + 9.7 j\Omega$
Return Loss	- 20.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 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.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 16, 2002

DASY5 Validation Report for Head TSL

Date/Time: 07.02.2011 14:34:55

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:725

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL U12 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.74$ mho/m; $\epsilon_r = 39.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

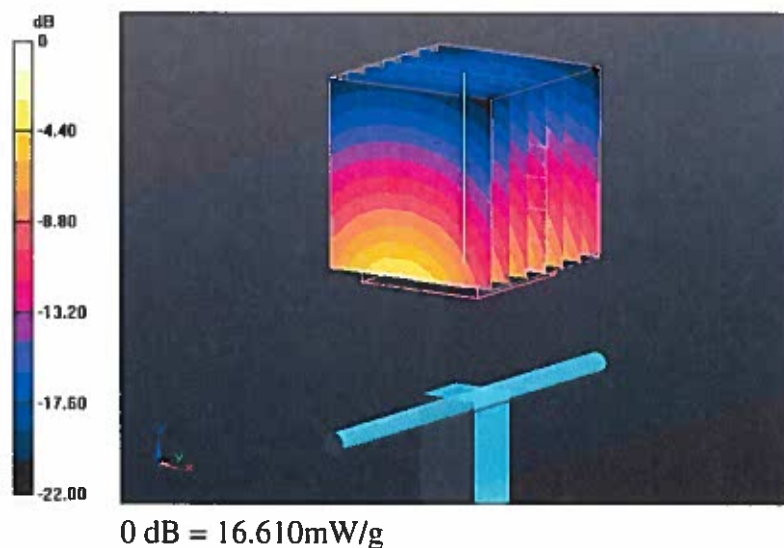
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.3 V/m; Power Drift = 0.05 dB

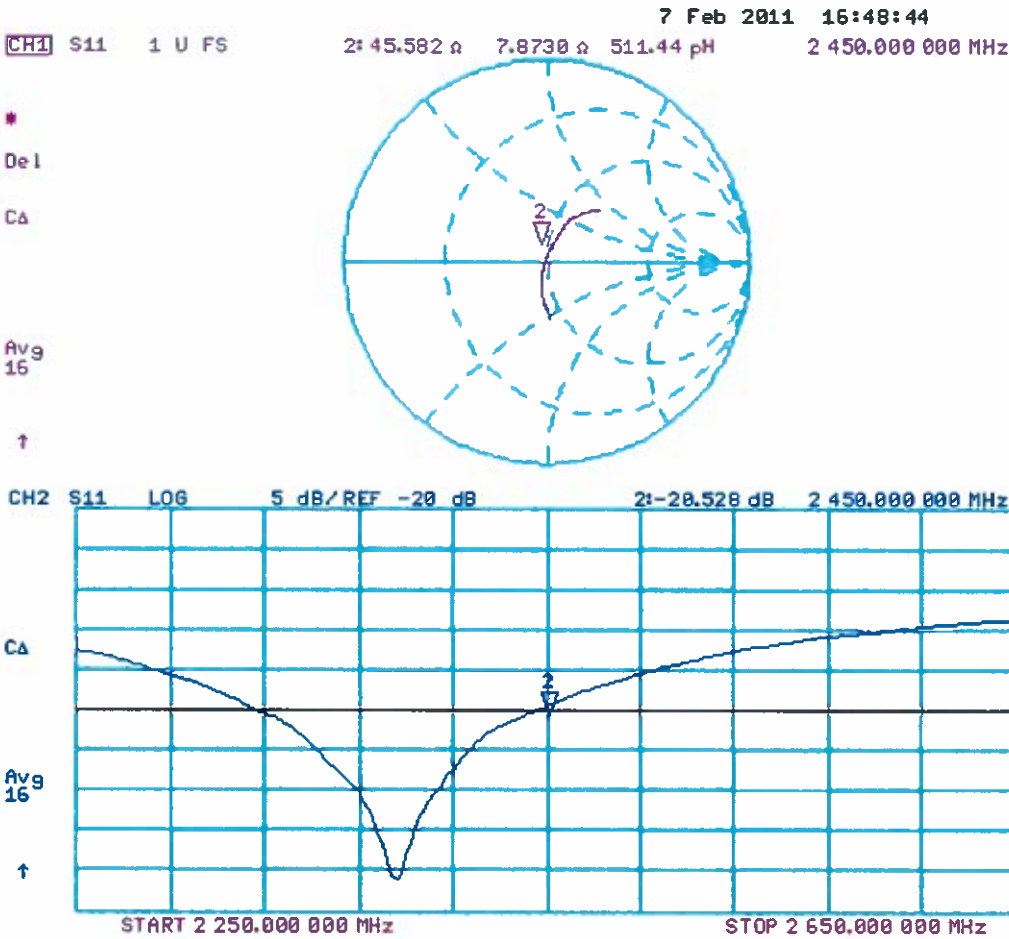
Peak SAR (extrapolated) = 26.701 W/kg

SAR(1 g) = 13 mW/g; SAR(10 g) = 6.13 mW/g

Maximum value of SAR (measured) = 16.608 mW/g



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date/Time: 08.02.2011 12:48:13

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:725

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL U12 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.95$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

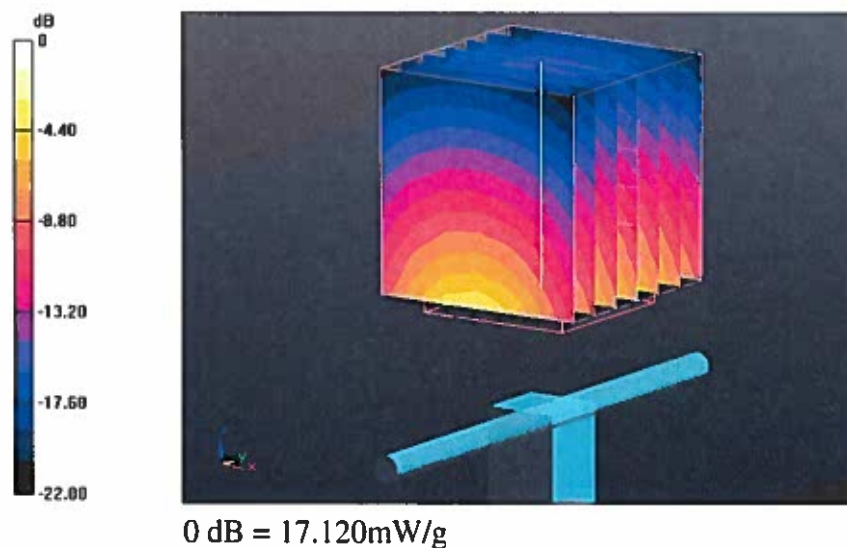
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.406 V/m; Power Drift = -0.08 dB

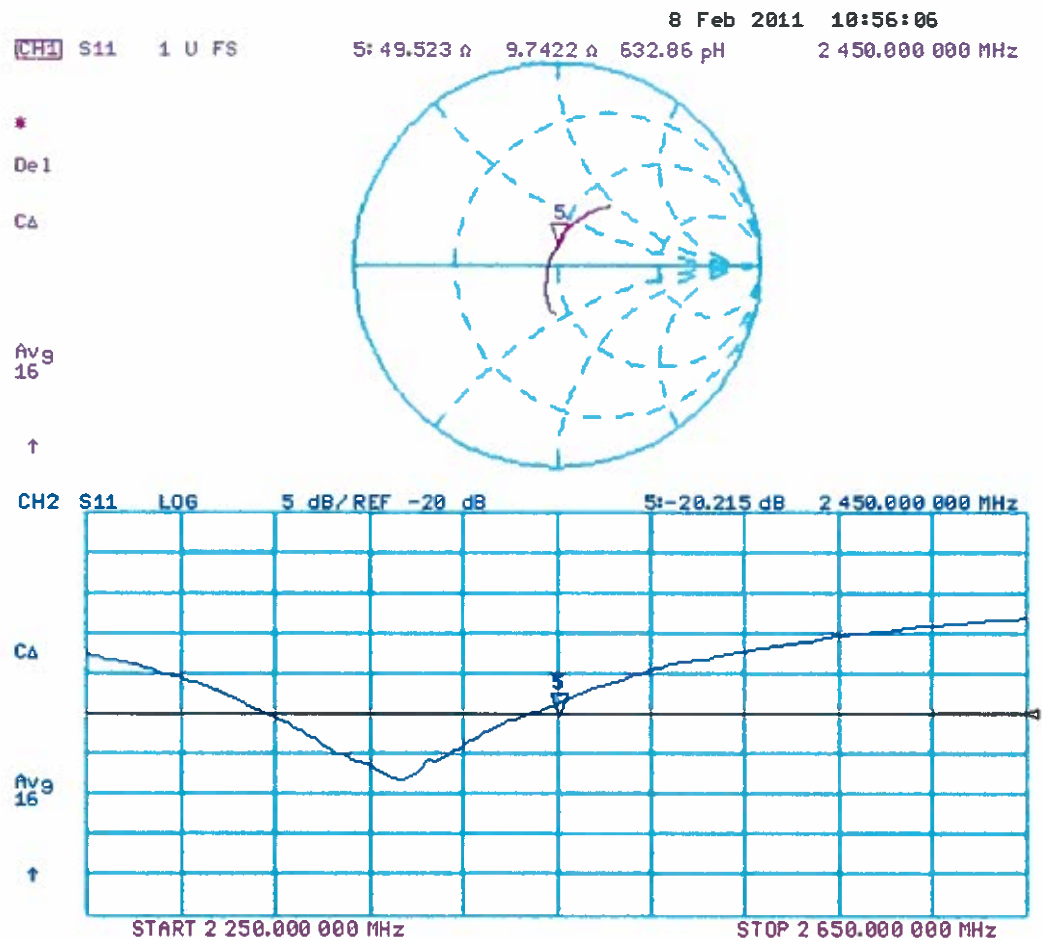
Peak SAR (extrapolated) = 27.401 W/kg

SAR(1 g) = 13 mW/g; SAR(10 g) = 6.04 mW/g

Maximum value of SAR (measured) = 17.121 mW/g



Impedance Measurement Plot for Body TSL



Appendix 2. Measurement Methods

A.2.1. Evaluation Procedure

The Specific Absorption Rate (SAR) evaluation was performed in the following manner:

- a) (i) The evaluation was performed in an applicable area of the phantom depending on the type of device being tested. For devices worn about the ear during normal operation, both the left and right ear positions were evaluated at the centre frequency of the band at maximum power. The side, which produced the greatest SAR, determined which side of the phantom would be used for the entire evaluation. The positioning of the head worn device relative to the phantom was dictated by the test specification identified in section 3.1 of this report.

(ii) For body worn devices or devices which can be operated within 20 cm of the body, the flat section of the SAM phantom was used where the size of the device(s) is normal. For bigger devices and base station the 2mm Oval phantom is used for evaluation. The type of device being evaluated dictated the distance of the EUT to the outer surface of the phantom flat section.
- b) The SAR was determined by a pre-defined procedure within the DASY4 software. The exposed region of the phantom was scanned near the inner surface with a grid spacing of 20mm x 20mm or appropriate resolution.
- c) A 5x5x7 matrix for measurement < 4.5 GHz and 7x7x9 for > 4.5 GHz was performed around the greatest spatial SAR distribution found during the area scan of the applicable exposed region. SAR values were then calculated using a 3-D spline interpolation algorithm and averaged over spatial volumes of 1 and 10 grams.
- d) If the EUT had any appreciable drift over the course of the evaluation, then the EUT was re-evaluated. Any unusual anomalies over the course of the test also warranted a re-evaluation.

A.2.2. Specific Absorption Rate (SAR) Measurements to OET Bulletin 65 Supplement C: (2001-01)

Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields

SAR measurements were performed in accordance with Appendix D of the standard FCC OET Bulletin 65 Supplement C: 2001, IEEE 1528 and FCC KDB procedures, against appropriate limits for each measurement position in accordance with the standard. In some cases the FCC was contacted using a PBA or KDB process to ensure test is performed correctly.

The test was performed in a shielded enclosure with the temperature controlled to remain between +18.0°C and +25.0°C. The tissue equivalent material fluid temperature was controlled to give a maximum variation of $\pm 2.0^\circ\text{C}$

Prior to any SAR measurements on the EUT, system Check and material dielectric property measurements were conducted. In the absence of a detailed procedure within the specification, system Check and material dielectric property measurements were performed in accordance with Appendix C and Appendix D of FCC OET Bulletin 65 Supplement C: 2001 and FCC KDB publication 450824.

Following the successful system Check and material dielectric property measurements, a SAR versus time sweep shall be performed within 10 mm of the phantom inner surface. If the EUT power output is stable after three minutes then the measurement probe will perform a coarse surface level scan at each test position in order to ascertain the location of the maximum local SAR level. Once this area had been established, a 5x5x7 cube of 175 points below 4.5 GHz and above 4.5GHz 7x7x9 cube of 441 points (5 mm spacing in each axis $\approx 27\text{g}$) will be centred at the area of concern. Extrapolation and interpolation will then be carried out on the 27g of tissue and the highest averaged SAR over a 1g cube determined.

Once the maximum interpolated SAR measurement is complete; the coarse scan is visually assessed to check for secondary peaks within 50% of the maximum SAR level. If there are any further SAR measurements required, extra 5x5x7 or 7x7x9 cubes shall be centred on each of these extra local SAR maxima.

At the end of each position test case a second time sweep shall be performed to check whether the EUT has remained stable throughout the test.