



TEST REPORT

Test of: PM-0440-BV

To: KDB 865664 D01 SAR Measurement 100MHz to 6GHz

IEEE1528: 2003

FCC ID: PY7PM-0440

Test Report Serial No:
UL-SAR-RP RP10014935JD08A V2.0

Version 2.0 supersedes previous report versions

This Test Report Is Issued Under The Authority of
Richelieu Quoi, SAR Technology Consultant:

(APPROVED SIGNATORY)

Checked By: Naseer Mirza

(APPROVED SIGNATORY)

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1. Customer Information

Company Name:	Sony Mobile Communications AB
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Address:	Nya Vattentorget 22188 Lund Sweden
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2. Summary of Test Results

Test Name	Specification Reference	Result
Specific Absorption Rate - GSM 850	KDB 865664 D01 SAR Measurement 100MHz to 6 GHz ANSI C95.1-1992	
Specific Absorption Rate - PCS 1900	KDB 865664 D01 SAR Measurement 100MHz to 6 GHz ANSI C95.1-1992	
Specific Absorption Rate - UMTS FDD 5	KDB 865664 D01 SAR Measurement 100MHz to 6 GHz ANSI C95.1-1992	
Specific Absorption Rate - Wi-Fi 802.11b/g/n 2.4 GHz	KDB 865664 D01 SAR Measurement 100MHz to 6 GHz ANSI C95.1-1992	
Specific Absorption Rate- Wi-Fi 802.11a/n/ac 5.0 GHz	KDB 865664 D01 SAR Measurement 100MHz to 6 GHz ANSI C95.1-1992	
Key to Results  = Complied  = Did not comply		

2.1. Highest Standalone Reported SAR**Individual Transmitter Evaluation per Band:**

Exposure Configuration	Technology Band	Mode	Highest Reported 1g -SAR (W/kg)	Equipment Class	Max Rated Source base Avg Power + Max Tolerance [dBm]	Highest Reported 1g-SAR (W/kg)
HEAD (Separation Distance 0mm)	GSM850	Voice	0.797	PCE	24.6	0.797
	PCS1900	Voice	0.372		21.6	
	UMTS FDD 5	RMC	0.724		24.5	
	WLAN 2.4 GHz	802.11b	0.068	DTS	16.1	0.068
	WLAN 5.2/5.3/5.6 GHz	802.11a	0.017	NII	13.6	0.017
	WLAN 5.8 GHz	802.11ac	0.019	DTS	10.8	0.019
Exposure Configuration	Technology Band	Mode	Highest Reported 1g -SAR (W/kg)	Equipment Class	Max Rated Source base Avg Power + Max Tolerance [dBm]	Highest Reported 1g-SAR (W/kg)
HOTSPOT (Separation Distance 10mm)	GSM850	GPRS	1.184	PCE	26.6	1.184
	PCS1900	GPRS	0.792		23.5	
	UMTS FDD 5	RMC	0.935		24.5	
	WLAN 2.4 GHz	802.11b	0.103	DTS	16.1	0.103
	WLAN 5.2/5.3/5.6 GHz	802.11a	0.110	NII	13.6	0.110
	WLAN 5.8 GHz	802.11a	0.027	DTS	12.3	0.027
Exposure Configuration	Technology Band	Mode	Highest Reported 1g -SAR (W/kg)	Equipment Class	Max Rated Source base Avg Power + Max Tolerance [dBm]	Highest Reported 1g-SAR (W/kg)
BODY-WORN (Separation Distance 15mm)	GSM850	Voice	0.700	PCE	24.6	0.765
	PCS1900	Voice	0.351		21.6	
	UMTS FDD 5	RMC	0.765		24.5	
	WLAN 2.4 GHz	802.11b	0.041	DTS	16.1	0.041
	WLAN 5.2/5.3/5.6 GHz	802.11a	0.110	NII	13.6	0.110
	WLAN 5.8 GHz	802.11a	0.027	DTS	12.3	0.027

Note(s):

- As per FCC KDB 447498 D01, Bluetooth maximum source based time average power was below the allowed threshold for both 10 and 15mm separation distances.

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

- $(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm}) \cdot [\sqrt{f_{\text{GHz}}/x}] \text{ W/kg}$ for test separation distances $\leq 50 \text{ mm}$;
where $x = 7.5$ for 1-g SAR, and $x = 18.75$ for 10-g SAR.

For the estimated SAR level calculation, the Maximum Target power + Upper tolerance for Bluetooth = 6.0 + 3.5 = 9.5 dBm (~ 8.91 mW) is considered.

- 10mm Bluetooth estimated SAR level:
Estimated Bluetooth SAR = $(8.91\text{mW}/10\text{mm}) \cdot (\sqrt{2.4 / 7.5}) = 0.184 \text{ W/kg}$
- 15mm Bluetooth estimated SAR level:
Estimated Bluetooth SAR = $(8.91\text{mW}/15\text{mm}) \cdot (\sqrt{2.4 / 7.5}) = 0.123 \text{ W/kg}$

2.2. Highest Reported Simultaneous Transmission SAR:

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna.

Simultaneous Transmitter Evaluation:

Exposure Configuration	Technology Band	Highest Reported 1g SAR (W/kg)	Equipment Class	Max Rated Source base Avg Power + Max Tolerance [dBm]	Highest Reported Sum-SAR 1g-SAR (W/kg)	SPLSR Ratio
HEAD (Separation Distance 0mm)	GSM850	0.797	PCE	24.6	0.865	N/A
	WLAN 2.4GHz	0.068	DTS	16.1		
	GSM850	0.797	PCE	24.6	0.816	N/A
	WLAN 5.0 GHz	0.019	DTS	10.8		
	GSM850	0.797	PCE	24.6	0.814	N/A
	WLAN 5.0 GHz	0.017	NII	13.6		
HOTSPOT (Separation Distance 10mm)	GSM850	1.184	PCE	26.6	1.287	N/A
	WLAN 2.4GHz	0.103	DTS	16.1		
	GSM850	1.184	PCE	26.6	1.368	N/A
	Bluetooth	0.184	DSS	9.5		
BODY-WORN (Separation Distance 15mm)	UMTS FDD 5	0.765	PCE	24.5	0.806	N/A
	WLAN 2.4GHz	0.041	DTS	16.1		
	UMTS FDD 5	0.765	PCE	24.5	0.792	N/A
	WLAN 5.0 GHz	0.027	DTS	12.3		
	UMTS FDD 5	0.765	PCE	24.5	0.875	N/A
	WLAN 5.0 GHz	0.110	NII	13.6		
	UMTS FDD 5	0.765	PCE	24.5	0.888	N/A
	Bluetooth	0.123	DSS	9.5		

Note(s):

1. As per FCC KDB publication 447498 SAR peak location separation ratio (SPLSR) was not required as the sum of the combination of WWAN+WLAN and WWAN+WPAN <1.6 w/kg.
2. Bluetooth estimated SAR level calculation is shown in section 2.1 in this report
3. All the possible simultaneous Transmission possibilities are included in section 4.6 of this report.

2.3. SAR measurement variability and measurement uncertainty analysis:

Exposure Configuration	Technology Band	Measured 1g -SAR (W/Kg)	Equipment Class	Max Meas. Source base Avg Power [dBm]	Ratio of Largest to Smallest SAR Measured
HOTSPOT (Separation Distance 10mm)	GSM850 (Original)	1.080	PCE	26.2	1.06
	GSM850 (Repeated)	1.020			
	UMTS FDD 5 (Original)	0.833		24.0	1.01
	UMTS FDD 5 (Repeated)	0.830			

Note(s):

1. The following step below were followed as per KDB publication 865664 D01:

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

2) When the original **highest measured** SAR is ≥ 0.80 W/kg, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

2.4. Location of Tests

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

2.5.Nominal and Maximum Output power:

Note: The following source based average rated powers for GSM/GPRS/EDGE are without consideration of uplink time slot.

Bands	Power Back-off Not Supported (Speech (Voice Mode))	
	Target (dBm)	Tolerance $\pm$ (dB)
GSM850	33.0	-1.0 ~ +0.6
PCS1900	30.0	-0.6 ~ +0.6

Bands	Power Back-off Not Supported GPRS							
	Tx Slot 1		Tx Slot 2		Tx Slot 3		Tx Slot 4	
	Target (dBm)	Tolerance $\pm$ (dB)	Target (dBm)	Tolerance $\pm$ (dB)	Target (dBm)	Tolerance $\pm$ (dB)	Target (dBm)	Tolerance $\pm$ (dB)
GSM850	33.0	-1.0 ~ +0.6	31.0	-0.6 ~ +0.6	30.0	-0.6 ~ +0.6	29.0	-0.6 ~ +0.6
PCS1900	30.0	-0.6 ~ +0.6	28.0	-0.5 ~ +0.5	27.0	-0.5 ~ +0.5	26.0	-0.5 ~ +0.5

Bands	Power Back-off Not Supported EDGE GMSK (MCS1-4)							
	Tx Slot 1		Tx Slot 2		Tx Slot 3		Tx Slot 4	
	Target (dBm)	Tolerance $\pm$ (dB)	Target (dBm)	Tolerance $\pm$ (dB)	Target (dBm)	Tolerance $\pm$ (dB)	Target (dBm)	Tolerance $\pm$ (dB)
GSM850	33.0	-1.0 ~ +0.6	31.0	-0.6 ~ +0.6	30.0	-0.6 ~ +0.6	29.0	-0.6 ~ +0.6
PCS1900	30.0	-0.6 ~ +0.6	28.0	-0.5 ~ +0.5	27.0	-0.5 ~ +0.5	26.0	-0.5 ~ +0.5

Bands	Power Back-off Not Supported EDGE 8PSK (MCS5-9)							
	Tx Slot 1		Tx Slot 2		Tx Slot 3		Tx Slot 4	
	Target (dBm)	Tolerance $\pm$ (dB)	Target (dBm)	Tolerance $\pm$ (dB)	Target (dBm)	Tolerance $\pm$ (dB)	Target (dBm)	Tolerance $\pm$ (dB)
GSM850	27.0	-1.5 ~ +1.0	25.0	-1.0 ~ +1.0	24.0	-1.0 ~ +1.0	23.0	-1.0 ~ +1.0
PCS1900	26.0	-1.5 ~ +1.0	24.0	-1.0 ~ +1.0	23.0	-1.0 ~ +1.0	22.0	-1.0 ~ +1.0

Bands	Power Back-off Not Supported			
	CS		HS	
	Target (dBm)	Tolerance $\pm$ (dB)	Target (dBm)	Tolerance $\pm$ (dB)
UMTS FDD 5	24.0	-0.7 ~ +0.5	24.0	-0.7 ~ +0.5

Nominal and Maximum Output power (Continued):

Power Back-off Not Supported

WiFi802.11b/g

Channel Number	Frequency (MHZ)	Target(dBm)	Tolerance(dB)	Note
1	2412.0	14.6	-6.08 ~ +0.7	2.4GHz 802.11b (1Mbps)
6	2437.0	15.4	-6.08 ~ +0.7	
11	2462.0	14.1	-6.08 ~ +0.7	
1	2412.0	14.6	-6.08 ~ +0.7	2.4GHz 802.11b (11Mbps)
6	2437.0	15.4	-6.08 ~ +0.7	
11	2462.0	14.1	-6.08 ~ +0.7	
1	2412.0	13.3	-6.08 ~ +0.7	2.4GHz 802.11g (6Mbps)
6	2437.0	14.8	-6.08 ~ +0.7	
11	2462.0	12.8	-6.08 ~ +0.7	
1	2412.0	13.3	-6.08 ~ +0.7	2.4GHz 802.11g (54Mbps)
6	2437.0	14.8	-6.08 ~ +0.7	
11	2462.0	12.8	-6.08 ~ +0.7	

WiFi802.11n

Channel Number	Frequency (MHZ)	Target(dBm)	Tolerance(dB)	Note
1	2412.0	12.8	-6.08 ~ +0.7	2.4GHz 802.11n (MCS0 6.5Mbps)
6	2437.0	14.3	-6.08 ~ +0.7	
11	2462.0	12.3	-6.08 ~ +0.7	
1	2412.0	10.4	-6.08 ~ +0.7	2.4GHz 802.11n (MCS7 65Mbps)
6	2437.0	11.9	-6.08 ~ +0.7	
11	2462.0	9.9	-6.08 ~ +0.7	

Nominal and Maximum Output power (Continued):**Wi-Fi802.11a (5.0 GHz)****Power Back-off Not Supported**

Channel Number	Frequency (MHZ)	Target (dBm) 6 Mbps	Target (dBm) 54 Mbps	Tolerance (dB)	Note
36	5180.0	11.7	9.1	-6.08 ~ +0.7	5.2 GHz
40	5200.0	11.9	9.3	-6.08 ~ +0.7	
44	5220.0	11.9	9.3	-6.08 ~ +0.7	
48	5240.0	11.9	9.3	-6.08 ~ +0.7	
52	5260.0	12.9	10.3	-6.08 ~ +0.7	5.3 GHz
56	5280.0	11.7	9.1	-6.08 ~ +0.7	
60	5300.0	11.7	9.1	-6.08 ~ +0.7	
64	5320.0	11.7	9.1	-6.08 ~ +0.7	
100	5500.0	11.6	9.0	-3.06 ~ +0.7	5.6 GHz
104	5520.0	11.6	9.0	-3.06 ~ +0.7	
108	5540.0	11.6	9.0	-3.06 ~ +0.7	
112	5560.0	11.6	9.0	-3.06 ~ +0.7	
116	5580.0	11.6	9.0	-3.06 ~ +0.7	
132	5660.0	11.6	9.0	-3.06 ~ +0.7	
136	5680.0	11.6	9.0	-3.06 ~ +0.7	
140	5700.0	10.9	8.3	-3.06 ~ +0.7	
149	5745.0	11.6	9.0	-6.08 ~ +0.7	5.8 GHz
153	5765.0	11.6	9.0	-6.08 ~ +0.7	
157	5785.0	11.6	9.0	-6.08 ~ +0.7	
161	5805.0	11.4	8.8	-6.08 ~ +0.7	
165	5825.0	11.4	8.8	-6.08 ~ +0.7	

Wi-Fi802.11n (HT20) / 802.11 ac (VHT20) (5.0 GHz)**Power Back-off Not Supported**

Channel Number	Frequency (MHz)	Target (dBm) 6.5 Mbps	Target (dBm) 65 Mbps	Tolerance (dB)	Note
36	5180.0	11.4	8.6	-6.08 ~ +0.7	5.2 GHz
40	5200.0	11.4	8.6	-6.08 ~ +0.7	
44	5220.0	11.4	8.6	-6.08 ~ +0.7	
48	5240.0	11.4	8.6	-6.08 ~ +0.7	
52	5260.0	12.4	9.6	-6.08 ~ +0.7	5.3 GHz
56	5280.0	11.2	8.4	-6.08 ~ +0.7	
60	5300.0	11.2	8.4	-6.08 ~ +0.7	
64	5320.0	11.2	8.4	-6.08 ~ +0.7	
100	5500.0	11.1	8.3	-3.06 ~ +0.7	5.6 GHz
104	5520.0	11.1	8.3	-3.06 ~ +0.7	
108	5540.0	11.1	8.3	-3.06 ~ +0.7	
112	5560.0	11.1	8.3	-3.06 ~ +0.7	
116	5580.0	11.1	8.3	-3.06 ~ +0.7	
132	5660.0	11.1	8.3	-3.06 ~ +0.7	
136	5680.0	11.1	8.3	-3.06 ~ +0.7	
140	5700.0	11.1	8.3	-3.06 ~ +0.7	
149	5745.0	11.4	8.6	-6.08 ~ +0.7	5.8 GHz
153	5765.0	11.4	8.6	-6.08 ~ +0.7	
157	5785.0	11.4	8.6	-6.08 ~ +0.7	
161	5805.0	11.4	8.6	-6.08 ~ +0.7	
165	5825.0	10.9	8.1	-6.08 ~ +0.7	

Wi-Fi802.11n (HT40) / Wi-Fi802.11ac (5.0 GHz) (VHT40)**Power Back-off Not Supported**

Channel Number	Frequency (MHz)	Target (dBm) 13.5 Mbps	Target (dBm) 135 Mbps	Tolerance (dB)	Note
38	5190.0	10.3	9.4	-6.08 ~ +0.7	5.2 GHz
46	5230.0	10.3	9.4	-6.08 ~ +0.7	
54	5270.0	10.3	9.4	-6.08 ~ +0.7	5.3 GHz
62	5310.0	9.3	8.4	-6.08 ~ +0.7	
102	5510.0	10.1	9.2	-3.06 ~ +0.7	5.6 GHz
110	5550.0	10.1	9.2	-3.06 ~ +0.7	
134	5670.0	10.1	9.2	-3.06 ~ +0.7	
151	5755.0	10.1	9.2	-6.08 ~ +0.7	5.8 GHz
159	5795.0	10.1	9.2	-6.08 ~ +0.7	

Wi-Fi802.11ac (5.0 GHz) (VHT80)**Power Back-off Not Supported**

Channel Number	Frequency (MHZ)	Target (dBm) 13.5 Mbps	Target (dBm) 135 Mbps	Tolerance (dB)	Note
42	5210	9.8	9.1	-6.08 ~ +0.7	5.2 GHz
58	5290	9.8	9.1	-6.08 ~ +0.7	5.3 GHz
106	5530	9.8	9.1	-3.06 ~ +0.7	5.6 GHz
155	5775	9.8	9.1	-6.08 ~ +0.7	5.8 GHz

Nominal and Maximum Output power (Continued):**Power Back-off Not Supported**

Band	BR	EDR	BLE	Tolerance (dB)
Bluetooth	6.0	4.0	0.0	-3.5 ~ +3.5

Note:

1. As per KDB865664 D02 SAR Reporting v01r01, 2.1.4(a), the nominal and maximum average source based rated power, declared by manufacturer are shown in the above tables.
2. These are specified maximum allowed average power for all the wireless modes and frequency bands supported as indicated by manufacturer.

3. Test Specification, Methods and Procedures

3.1. Test Specification

Reference:	865664 D01 SAR Measurement 100 Mhz to 6 GHz
Title:	SAR Measurement Requirements for 100 MHz to 6 GHz
Purpose of Test:	Field probes, tissue dielectric properties, SAR scans, measurement accuracy and variability of the measured results are discussed. The field probe and SAR scan requirements are derived from criteria considered in draft standard IEEE P1528-2011. The similar requirements in Supplement C 01-01 are generally superseded by the procedures in this document, and which are required to be used to qualify for TCB equipment approval.

The Equipment Under Test complied with the Specific Absorption Rate for general population/uncontrolled exposure limit of 1.6 W/kg as specified in FCC 47 CFR part 2 (2.1093) and ANSI C95.1-1992 and has been tested in accordance with the reference documents in section 3.2 of this report.

3.2. Methods and Procedures Reference Documentation

The methods and procedures used were as detailed in:

IEEE 1528: 2003

IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

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.

FCC KDB Publication:

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

KDB 447498 D01 General RF Exposure Guidance v05r01

KDB 648474 D04 Handset SAR v01r01

KDB 941225 D01 SAR test for 3G devices v02

KDB 941225 D02 HSPA and 1x Advanced v02r02

KDB 941225 D03 SAR Test Reduction GSM GPRS EDGE vo1

KDB 941225 D06 Hotspot Mode SAR v01r01

KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r01

KDB 865664 D02 RF Exposure Reporting v01r01

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. Equipment Under Test (EUT)

4.1. Identification of Equipment Under Test (EUT)

Description:	Smartphone Handset					
Brand Name:	Sony					
Type Number:	PM-0440-BV					
Serial Number:	CB5124UMHT	CB5124UMBU	CB5124UMS4	CB5124UMBJ	CB5124UMBG	CB5124UN0T
IMEI Number:	00440254-081197-7	00440254-081196-9	00440254-081279-3	00440254-081193-6	00440254-081192-8	00440254-081348-6
Hardware Version Number:	AP2.0					
Software Version Number:	14.1.G.1.241			s_atp_honami_1_25_1		
FCC ID Number:	PY7PM-0440					
IC Number:	4170B-PM0440					
Country of Manufacture:	China					
Date of Receipt:	01 July 2013					
Note(s):						

1. IMEI: 00440254-081197-7 used to perform GSM850 and PCS1900 SAR measurements only.
2. IMEI: 00440254-081196-9 used to perform UMTS FDD 5 SAR measurements only.
3. IMEI: 00440254-081279-3 used to perform WWAN conducted power measurements only.
4. IMEI: 00440254-081193-6 used to perform WLAN 2.4GHz SAR measurements only.
5. IMEI: 00440254-081192-8 used to perform WLAN 5GHz SAR measurements only.
6. IMEI: 00440254-081348-6 used to perform WLAN conducted power measurements only.

4.2. Description of EUT

The equipment under test (EUT) is a model of GSM/UMTS/LTE mobile phone with integrated antenna and inbuilt Li-Polymer battery.

The EUT supports GSM 850/900/1800/1900MHz bands, UMTS FDD band 1/5/6/19 and LTE FDD bands 1/3/19/21. It also supports GPRS service with multi-slots class 33 and EGPRS service with multi-slots class 33. The HSDPA (Category 10) and HSUPA (Category 6) features are also supported. It has MP3, camera, FM radio, USB memory, GPS receiver, NFC, Mobile High-Definition Link (MHL), Bluetooth (EDR and Bluetooth 4.0), WLAN (802.11 a/b/g/n/ac), Wi-Fi hotspot functions and RFID Capabilities.”

4.3. Modifications Incorporated in the EUT

There were no modification during the course of testing the device

4.4. Accessories

The following accessories were supplied with the EUT during testing:

Description:	Memory Card (2 GB)	Personal Hands-Free Kit (PHF)	Dummy Battery
Brand Name:	None Stated	Sony	None Stated
Model Name or Number:	None Stated	MH750	None Stated
Serial Number:	None Stated	12060C160061850	None Stated
Cable Length and Type:	Not Applicable	~1.2 m	~0.5m
Country of Manufacture:	China	None Stated	None Stated
Connected to Port	Micro SD Slot	3.5mm Audio jack and custom type	Unique to Manufacturer

Note(s):

This Dummy Battery was only used to perform conducted power measurements.

4.5. Support Equipment

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

Description:	Communication Test Set	Communication Test Set	Communication Test Set
Brand Name:	Agilent	Agilent	Agilent
Model Name or Number:	8960 Series 10 (E5515C)	8960 Series 10 (E5515E)	8960 Series 10 (E5515E)
Serial Number:	GB46311280	GB46200666	MY52112050
Cable Length and Type:	~4.0m Utiflex Cable	~4.0m Utiflex Cable	~4.0m Utiflex Cable
Connected to Port:	RF (Input / Output) Air Link	RF (Input / Output) Air Link	RF (Input / Output) Air Link

4.6. Additional Information Related to Testing

Equipment Category	2G GSM / PCS	TDMA 850 / 1900	Voice, GPRS, EDGE	
	3G UMTS Band	FDD 5	RMC12.2 Kbps / HSDPA (Cat 10) / HSUPA (Cat 6)Data	
	Wi-Fi Band	(2.4 / 5.0) GHz	Data 802.11a/b/g/n/ac	
Type of Unit	Portable Transceiver			
Intended Operating Environment:	Within GSM, UMTS, WiFi and <i>Bluetooth</i> Coverage for General Population / Uncontrolled Exposure category.			
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 FDD 5	Communication Test Set configured to allow to EUT to transmit at a maximum power as per KDB 941225 D01.		
	2.4 GHz Wi-Fi 802.11b/g/n	Test Software was used to configure the EUT to transmit at a maximum power of up to 15.3 dBm.		
	5.0 GHz Wi-Fi 802.11a	Test Software was used to configure the EUT to transmit at a maximum power of up to 13.4 dBm.		
	5.0 GHz Wi-Fi 802.11n (HT20 / HT40)	Test Software was used to configure the EUT to transmit at a maximum power of up to 12.9 dBm for HT20 and 10.5 dBm for HT40.		
	5.0 GHz Wi-Fi 802.11ac (VHT20 / VHT40 / VHT80)	Test Software was used to configure the EUT to transmit at a maximum power of up to 13.1 dBm for VHT20, 10.7 dBm for VHT40 and 10.3 dBm for VHT80.		
	<i>Bluetooth</i>	:= 8.91 mW or ~9.5 dBm		
Transmitter Frequency Range:	GSM850	824 to 849 MHz		
	PCS1900	1850 to 1910 MHz		
	UMTS FDD 5	826 to 847 MHz		
	2.4 GHz Wi-Fi 802.11b/g/n	2412 to 2462 MHz		
	5.2 GHz Wi-Fi (20 MHz / 40 MHz / 80 MHz)	5170 to 5250 MHz		
	5.3 GHz Wi-Fi (20 MHz / 40 MHz / 80 MHz)	5250 to 5330 MHz		
	5.6 GHz Wi-Fi (20 MHz / 40 MHz / 80 MHz)	5490 to 5600 MHz		
	5.6 GHz Wi-Fi (20 MHz / 40 MHz)	5650 to 5710 MHz		
	5.8 GHz Wi-Fi (20 MHz / 40 MHz / 80 MHz)	5735 to 5835 MHz		
	<i>Bluetooth</i>	2402 to 2480 MHz		
Transmitter Frequency Allocation of EUT When Under Test:	Bands	Channel Number	Channel Description	Frequency (MHz)
	GSM850	128	Low	824.2
		190	Middle	836.6
		251	High	848.8
	PCS1900	512	Low	1850.2
		661	Middle	1880.0
		810	High	1909.8
	UMTS FDD 5	4132	Low	826.4
		4183	Middle	836.6
		4233	High	846.6

Additional Information Related to Testing (Continued)

Transmitter Frequency Allocation of EUT When Under Test:	Band: 2.4 / 5.0 GHz Wi-Fi 802.11a/n/AC (HT20 / HT40/HT80)						
	Rule	20 MHz BW Ch.#	Frq. (MHz)	40 MHz BW Ch.#	Frq. (MHz)	80 MHz BW Ch.#	Frq. (MHz)
	15.247	1	2412.0				
		6	2437.0				
		11	2462.0				
	5.2 U-NII	36	5180.0	38	5190.0		
		40	5200.0			42	5210.0
		44	5220.0	46	5230.0		
		48	5240.0				
	5.3 U-NII	52	5260.0	54	5270.0		
		56	5280.0			58	5290.0
		60	5300.0	62	5310.0		
		64	5320.0				
	5.6 U-NII	100	5500.0	102	5510.0		
		104	5520.0			106	5530.0
		108	5540.0	110	5550.0		
		112	5560.0				
		116	5580.0				
		132	5660.0	134	5670.0		
		136	5680.0				
140		5700.0					
U-NII or 15.247	149	5745.0	151	5755.0			
	153	5765.0			155	5775.0	
	157	5785.0	159	5795.0			
	161	5805.0					
15.247	165	5825.0					
Modulation(s):	GMSK (GSM/ GPRS): QPSK(UMTS / HSDPA/HSPA): DBPSK, BPSK, CCK (Wi-Fi):					217 Hz	
						0Hz	
						0 Hz	
Modulation Scheme (Crest Factor for technologies SAR tested):	GMSK: GMSK (GPRS850/GPRS1900): DBPSK, BPSK, CCK (Wi-Fi): QPSK(UMTS FDD / HSDPA):					8.3	
						2	
						1	
						1	
Antenna Type:	Internal integral						
Antenna Length:	Unknown						
Number of Antenna Positions:	WWAN ~ UMTS / GSM WWAN Diversity (Rx only) ~ UMTS / GPS WLAN/ BT NFC/Felica					1 fixed	
						1 fixed	
						1 fixed	
						1 fixed	
Power Supply Requirement:	4.2 V (Nominal)						
Battery Type(s):	In built Li-ion						

Additional Information Related to Testing (Continued)**Simultaneous Transmission Combination:**

	WWAN				WLAN		WPAN
	GSM Voice	GPRS/EDGE Data	UMTS Voice	UMTS Data	WiFi 2.4 GHz	WiFi 5.0 GHz	BT
1		X			X		
2				X	X		
3	X				X		
4			X		X		
5	X					X	
6			X			X	
7		X					X
8				X			X
9	X						X
10			X				X

X Simultaneous transmission supported

0 No simultaneous transmission supported

Bluetooth average power measurement is below the rated threshold therefore Individual SAR will not be tested.

Sim_Tx consideration will be based on the estimated SAR level.

WiFi Hotspot Combinations Only				
	WWAN		WLAN	
	GPRS/EDGE Data	UMTS Data	WiFi 2.4GHz	WiFi 5GHz
1	X		X	O
2		X	X	O

5. Deviations from the Test Specification

Test was performed as per reference documents and FCC KDB publication procedures listed in section 3.2 of this report.

Prior to testing the FCC was contacted for SAR evaluation and testing was performed as per response on WiFi 802.11ac. The resulting guidance for each KDB inquiry was obtained as follows:

WiFi802.11ac:

‘Apply usual 802.11 test exclusion considerations, but include 802.11ac SAR for highest 802.11a configuration in each 5 GHz band and each exposure condition.’

For informational purpose: GPRS clas33 / 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. 4-uplink was found to give the highest power reference point measurement on the DASY4 system (unit v/m) for GPRS850 and for GPRS1900 measurements. 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	9.246	4.978
2 uplink	11.37	5.986
3 uplink	12.99	6.764
4 uplink	13.39	7.018

6. Operation and Configuration of the EUT during Testing

6.1. 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 4 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 4 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

Operating Modes (Continued)

- UMTS FDD 5 - RMC 12.2kbps 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 + 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.
- 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.
- 2.4 GHz WiFi802.11b/g/n - Data allocated mode using 'HyperTerminal' software to excise mode 'b', 'g' and 'n', with maximum power of up to 15.3 dBm for 'b' mode and 14.6 dBm for 'g' and 14.2 dBm for 'n' modes.
- 5.0 GHz WiFi802.11a/n/ac - Data allocated mode using 'HyperTerminal' software to excise mode 'a' and 'n', with maximum power of up to 13.4 dBm for 'a' mode, 12.9 dBm for 'n' mode and 13.1 dBm for 'ac' mode.
- As per 648474 D04 SAR Handsets Multi Xmitter and Ant v01, "When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset". Hence, Body worn configurations were not evaluated with PHF attached.

6.1. Configuration and Peripherals

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

- Standalone fully charged battery powered.
- Head, Hotspot Mode 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 modes and configuration that did not overlap with Personal hotspot, SAR evaluation was performed at 15mm separation.
- GPRS clas33 / 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 DASY system. 4-uplink was found to give the highest power reference point measurement for GPRS850 and for GPRS1900 Hotspot mode measurements All settings were performed with the device in a fixed position 'Back facing phantom' at 0mm separation to ensure there were no positioning errors. These measurements were performed for information purpose only.
- GPRS and EDGE Class 33 power measurement were all measured as per FCC pubs. 941225 D03. 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

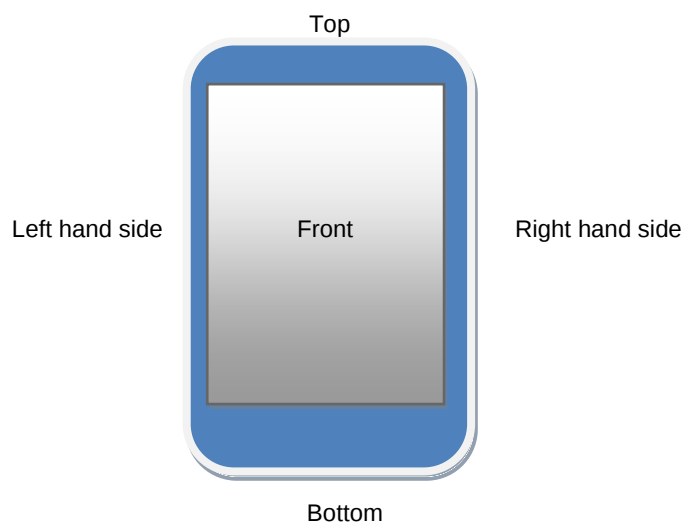
- a) The EUT was placed in a normal operating position where the centre of EUT was aligned with the centre reference point on the flat section of the 'SAM' phantom.
- b) With the EUT touching the phantom at an imaginary centre line. The EUT was aligned with a marked plane (X and Y axis) consisting of 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.

6.2. Configuration Consideration

Technology Antenna	Configuration	Antenna-to-User Separation	Position	Antenna-to-Edge Separation	Evaluation Considered
WWAN	Head	0mm	Touch Left	<25mm	Yes
			Tilt Left	<25mm	Yes
			Touch Right	<25mm	Yes
			Tilt Right	<25mm	Yes
	Hotspot	10mm	Front	<25mm	Yes
			Back	<25mm	Yes
			Top Edge	>25mm	No
			Bottom Edge	<25mm	Yes
			Right Edge	<25mm	Yes
			Left Edge	<25mm	Yes
	Body	15mm	Front	<25mm	Yes
			Back	<25mm	Yes
WLAN	Head	0mm	Touch Left	<25mm	Yes
			Tilt Left	<25mm	Yes
			Touch Right	<25mm	Yes
			Tilt Right	<25mm	Yes
	Hotspot	10mm	Front	<25mm	Yes
			Back	<25mm	Yes
			Top Edge	>25mm	No
			Bottom Edge	<25mm	Yes
			Right Edge	<25mm	Yes
			Left Edge	>25mm	No
	Body	15mm	Front	<25mm	Yes
			Back	<25mm	Yes

Note(s):

- Test distances are as per FCC KDB publication 447498 D01v05 for mobile handsets.



6.3. SAR Test Exclusion Consideration

Frequency Band	Configuration(s)					
	Head	Exclusion Thershold	Hotspot Mode	Exclusion Thershold	Body-worn	Exclusion Thershold
GSM850	No	>3.0	No	>3.0	No	>3.0
PCS1900	No	>3.0	No	>3.0	No	>3.0
UMTS FDD 5	No	>3.0	No	>3.0	No	>3.0
WLAN 2.4 GHz (802.11b)	No	>3.0	No	>3.0	No	>3.0
WLAN 5.0 GHz (802.11a)	No	>3.0	No	>3.0	No	>3.0
WLAN 5.0 GHz (802.11ac) ³	No	>3.0	Yes	<3.0	Yes	<3.0
Bluetooth ¹	N/A	N/A	Yes	<3.0	Yes	<3.0

Note:

- As per KDB 447498 D01 General RF Exposure Guidance v05, The Frequency Bands with Rated Power including Upper tolerance, which qualify for **Standalone SAR Test Exclusion**, are as per the above table.

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] * [\sqrt{f_{(\text{GHz})}}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$$

- $f_{(\text{GHz})}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest *mW* and *mm* before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

For the SAR Test Exclusion consideration, the Maximum Target power + Upper tolerance for Bluetooth = 6.0 + 3.5 = 9.5 dBm (~ 8.91 mW) is considered.

Applying the above formula for *Bluetooth* Hotspot Mode we get:

$$\text{➤ For 2450MHz, } [(8.91)/10] * [\sqrt{2.45}] = 1.4 \leq 3.0$$

Applying the above formula for *Bluetooth* Body-worn we get:

$$\text{➤ For 2450MHz, } [(8.91)/15] * [\sqrt{2.45}] = 0.93 \leq 3.0$$

Hence, testing is not required on *Bluetooth* Hotspot Mode and Body-worn configurations.

- The details for the **Maximum Rated Power** and tolerance(s) can be found in section 2.5.
- The details of SAR Test Exclusion Consideration for WLAN 5.0 GHz 802.11ac is included in section 6.4

6.4. SAR Test Exclusion For WiFi 802.11ac VHT40/ VHT80 Consideration

Frequency (GHz)	Power (mW)	Separation Distance (mm)	Exclusion Threshold Calculation ¹	Test Required (Y / N)	Exposurer Config
WiFi802.11ac HT40					
5.19	12.59	5	5.74	Y	Head
5.19	12.59	10	2.87	N	Hotspot
5.19	12.59	15	1.91	N	Body-worn
5.23	12.59	5	5.76	Y	Head
5.23	12.59	10	2.88	N	Hotspot
5.23	12.59	15	1.92	N	Body-worn
5.27	12.59	5	5.78	Y	Head
5.27	12.59	10	2.89	N	Hotspot
5.27	12.59	15	1.93	N	Body-worn
5.31	10.00	5	4.61	Y	Head
5.31	10.00	10	2.30	N	Hotspot
5.31	10.00	15	1.54	N	Body-worn
5.51	12.02	5	5.64	Y	Head
5.51	12.02	10	2.82	N	Hotspot
5.51	12.02	15	1.88	N	Body-worn
5.55	12.02	5	5.66	Y	Head
5.55	12.02	10	2.83	N	Hotspot
5.55	12.02	15	1.89	N	Body-worn
5.67	12.02	5	5.73	Y	Head
5.67	12.02	10	2.86	N	Hotspot
5.67	12.02	15	1.91	N	Body-worn
5.755	12.02	5	5.77	Y	Head
5.755	12.02	10	2.88	N	Hotspot
5.755	12.02	15	1.92	N	Body-worn
5.795	12.02	5	5.79	Y	Head
5.795	12.02	10	2.89	N	Hotspot
5.795	12.02	15	1.93	N	Body-worn
WiFi802.11ac HT80					
5.21	11.22	5	5.12	Y	Head
5.21	11.22	10	2.56	N	Hotspot
5.21	11.22	15	1.71	N	Body-worn
5.29	11.22	5	5.16	Y	Head
5.29	11.22	10	2.58	N	Hotspot
5.29	11.22	15	1.72	N	Body-worn
5.53	11.22	5	5.28	Y	Head
5.53	11.22	10	2.64	N	Hotspot
5.53	11.22	15	1.76	N	Body-worn
5.775	11.22	5	5.39	Y	Head
5.775	11.22	10	2.70	N	Hotspot
5.775	11.22	15	1.80	N	Body-worn

Note:

1. Threshold : $[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] * [\sqrt{f_{\text{GHz}}}] \leq 3.0$ for 1-g SAR
2. For the SAR Test Exclusion consideration, the Maximum Target power + Upper tolerance for is considered.

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. Conducted Power Measurements**7.2.1. Conducted Average Power Measurement 2G: GSM850****Power Back-off Not Supported**

Band: GSM 850	Burst Avg. Power (dBm)			Frame Average Power (dBm)		
Channel	128	190	251	128	190	251
Frequency (MHz)	824.2	836.4	848.8	824.2	836.4	848.8
GSM (GMSK, 1Tx Slot)	32.9	32.9	32.9	23.9	23.9	23.9
GPRS (GMSK, 1 Tx Slot) - CS1	32.9	32.9	32.9	23.9	23.9	23.9
GPRS (GMSK, 2 Tx Slot) - CS1	31.0	31.1	31.1	25.0	25.1	25.1
GPRS (GMSK, 3 Tx Slot) - CS1	30.3	30.3	30.2	26.0	26.0	25.9
GPRS (GMSK, 4 Tx Slot) - CS1	29.2	29.2	29.2	26.2	26.2	26.2
EDGE (GMSK, 1 Tx Slot) - MCS1	32.9	32.9	32.9	23.9	23.9	23.9
EDGE (GMSK, 2 Tx Slot) - MCS1	31.0	31.1	31.1	25.0	25.1	25.1
EDGE (GMSK, 3 Tx Slot) - MCS1	30.3	30.3	30.2	26.0	26.0	25.9
EDGE (GMSK, 4 Tx Slot) - MCS1	29.2	29.2	29.2	26.2	26.2	26.2
EDGE (8PSK, 1 Tx Slot) - MCS9	27.0	27.0	26.9	18.0	18.0	17.9
EDGE (8PSK, 2 Tx Slot) - MCS9	25.0	25.0	25.0	19.0	19.0	19.0
EDGE (8PSK, 3 Tx Slot) - MCS9	24.0	23.9	23.9	19.7	19.6	19.6
EDGE (8PSK, 4 Tx Slot) - MCS9	23.2	23.1	23.1	20.2	20.1	20.1

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 => $10 \cdot \log(8/4) = 3.01 \text{ dB}$

7.2.2. Conducted Average Power Measurement 2G: PCS1900

Power Back-off Not Supported

Band: PCS 1900	Burst Avg. Power (dBm)			Frame Average Power (dBm)		
Channel	512	661	810	512	661	810
Frequency (MHz)	1850.2	1880	1909.8	1850.2	1880	1909.8
GSM (GMSK, 1Tx Slot)	30.3	30.3	30.3	21.3	21.3	21.3
GPRS (GMSK, 1 Tx Slot) - CS1	30.3	30.3	30.3	21.3	21.3	21.3
GPRS (GMSK, 2 Tx Slot) - CS1	28.5	28.5	28.5	22.5	22.5	22.5
GPRS (GMSK, 3 Tx Slot) - CS1	27.3	27.3	27.3	23.0	23.0	23.0
GPRS (GMSK, 4 Tx Slot) - CS1	26.3	26.3	26.3	23.3	23.3	23.3
EDGE (GMSK, 1 Tx Slot) - MCS1	30.3	30.3	30.3	21.3	21.3	21.3
EDGE (GMSK, 2 Tx Slot) - MCS1	28.5	28.5	28.5	22.5	22.5	22.5
EDGE (GMSK, 3 Tx Slot) - MCS1	27.3	27.3	27.3	23.0	23.0	23.0
EDGE (GMSK, 4 Tx Slot) - MCS1	26.3	26.3	26.3	23.3	23.3	23.3
EDGE (8PSK, 1 Tx Slot) - MCS9	26.1	26.1	26.1	17.1	17.1	17.1
EDGE (8PSK, 2 Tx Slot) - MCS9	24.2	24.2	24.2	18.2	18.2	18.2
EDGE (8PSK, 3 Tx Slot) - MCS9	23.1	23.1	23.1	18.8	18.8	18.8
EDGE (8PSK, 4 Tx Slot) - MCS9	22.1	22.1	22.1	19.1	19.1	19.1

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 => $10 \cdot \log(8/4) = 3.01 \text{ dB}$

7.2.3. Conducted Average Power Measurement 3G:**Power Back-off Not Supported**

Modes		HSDPA				HSUPA					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]
850 (Band 5)	4132 4357	23.7	23.6	23.3	23.3	23.3	21.1	22.1	21.6	23.3	24.0
	4183 4408	23.7	23.7	23.2	23.2	23.0	21.0	22.0	21.4	23.2	24.0
	4233 4458	23.6	23.6	23.2	23.1	22.8	21.0	22.3	21.4	23.1	24.0
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	

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 Agilent 8960 series 10 wireless communications test set which supports 3G / HSDPA release 5 / HSUPA 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: $\Delta_{ACK}, \Delta_{NACK}$ 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 HSUPA

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⁾ Ind ex	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	$B_{alt1}: 47/15$ $B_{alt2}: 47/15$	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: $\Delta_{ACK}, \Delta_{NACK}$ 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 Power Back-off 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.

7.2.4. Conducted Power Measurements Wi-Fi 802.11b/g/n**802.11b/g****Power Back-off Not Supported**

Channel Number	Frequency (MHZ)	TX Power (dBm)	Note
1	2412.0	14.9	2.4GHz 802.11b (1Mbps)
6	2437.0	15.3	
11	2462.0	13.7	
1	2412.0	14.9	2.4GHz 802.11b (11Mbps)
6	2437.0	15.3	
11	2462.0	13.7	
1	2412.0	13.5	2.4GHz 802.11g (6Mbps)
6	2437.0	14.6	
11	2462.0	12.6	
1	2412.0	11.5	2.4GHz 802.11g (54Mbps)
6	2437.0	12.7	
11	2462.0	10.5	

802.11n

Channel Number	Frequency (MHZ)	TX Power (dBm)	Note
1	2412.0	13.1	2.4GHz 802.11n (MCS0 6.5Mbps)
6	2437.0	14.2	
11	2462.0	12.2	
1	2412.0	10.7	2.4GHz 802.11n (MCS7 65Mbps)
6	2437.0	11.8	
11	2462.0	9.8	

7.2.5. Conducted Power Measurements Wi-Fi 802.11a/n (5.0 GHz)
802.11a (5.0 GHz)
Power Back-off Not Supported

Channel Number	Frequency (MHz)	TX Power (dBm) 6 Mbps	TX Power (dBm) 54 Mbps	Note
36*	5180.0	12.0	8.6	5.2 GHz
40	5200.0	12.5	9.0	
44	5220.0	12.1	9.7	
48*	5240.0	12.5	9.7	
52*	5260.0	13.4	10.7	5.3 GHz
56	5280.0	12.1	9.3	
60	5300.0	12.1	9.7	
64*	5320.0	11.7	9.7	
100	5500.0	11.4	9.3	5.6 GHz
104*	5520.0	11.4	9.3	
108	5540.0	11.3	9.2	
112	5560.0	11.3	9.2	
116*	5580.0	11.7	9.5	
132	5660.0	11.7	9.6	
136*	5680.0	11.7	9.6	
140	5700.0	11.1	8.7	
149*	5745.0	11.6	9.3	5.8 GHz
153	5765.0	11.5	9.3	
157*	5785.0	11.6	9.4	
161	5805.0	11.3	9.1	
165*	5825.0	11.2	9.2	

* Default test Channels

**Conducted Power Measurements Wi-Fi802.11a/n (5.0 GHz) (Continued):
802.11n (5.0 GHz) (HT20)**
Power Back-off Not Supported

Channel Number	Frequency (MHZ)	TX Power (dBm) 6.5 Mbps	TX Power (dBm) 65 Mbps	Note
36*	5180.0	11.5	8.8	5.2 GHz
40	5200.0	11.6	9.3	
44	5220.0	12.0	9.2	
48*	5240.0	12.0	9.2	
52*	5260.0	12.9	10.3	5.3 GHz
56	5280.0	11.5	8.9	
60	5300.0	11.6	8.8	
64*	5320.0	11.4	8.8	
100	5500.0	10.8	8.8	5.6 GHz
104*	5520.0	10.8	8.8	
108	5540.0	10.7	8.4	
112	5560.0	10.7	8.6	
116*	5580.0	11.2	9.0	
132	5660.0	11.6	8.6	
136*	5680.0	11.1	9.0	
140	5700.0	11.0	8.8	
149*	5745.0	11.5	8.9	5.8 GHz
153	5765.0	11.4	9.3	
157*	5785.0	11.5	9.1	
161	5805.0	11.3	9.2	
165*	5825.0	11.6	8.7	

* Default test Channels

802.11n (5.0 GHz) (HT40)
Power Back-off Not Supported

Channel Number	Frequency (MHZ)	TX Power (dBm) 13.5 Mbps	TX Power (dBm) 135 Mbps	Note
38	5190.0	10.0	9.9	5.2 GHz
46	5230.0	10.4	10.3	
54	5270.0	10.5	9.4	5.3 GHz
62	5310.0	9.6	8.9	
102	5510.0	9.8	8.9	5.6 GHz
110	5550.0	9.8	8.9	
134	5670.0	10.4	9.6	
151	5755.0	9.9	9.3	5.8 GHz
159	5795.0	9.5	9.2	

Conducted Power Measurements Wi-Fi802.11a/n (5.0 GHz) (Continued):
802.11ac (5.0 GHz) (20 MHz)
Power Back-off Not Supported

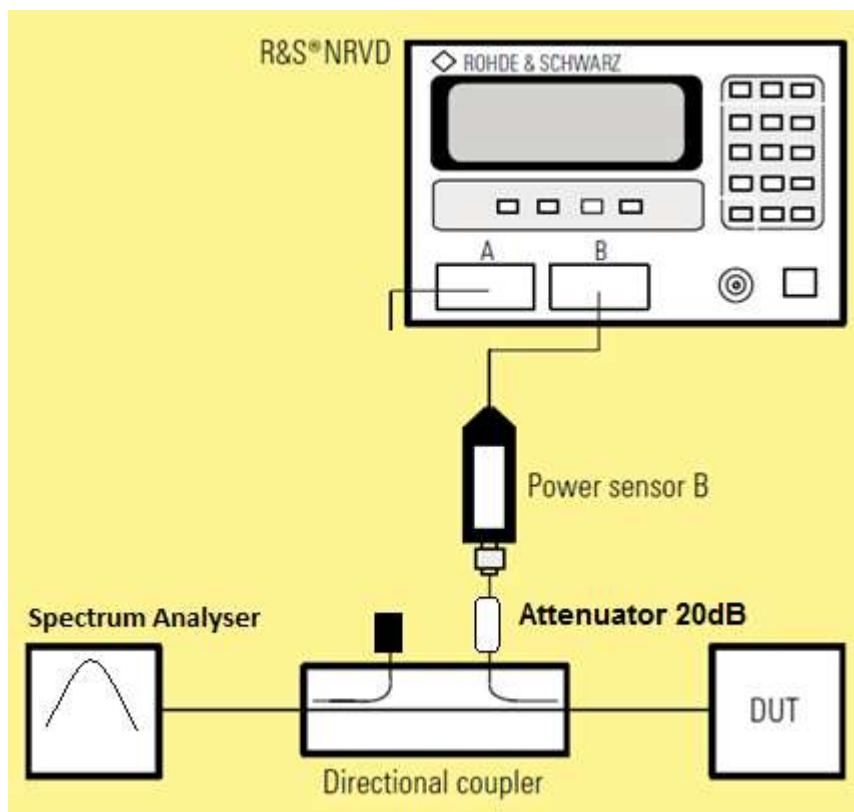
Channel Number	Frequency (MHz)	TX Power (dBm) 6.5 Mbps	TX Power (dBm) 65 Mbps	Note
36*	5180.0	12.0	9.1	5.2 GHz
40	5200.0	11.7	9.1	
44	5220.0	11.8	9.1	
48*	5240.0	11.8	9.2	
52*	5260.0	13.1	10.1	5.3 GHz
56	5280.0	11.8	9.1	
60	5300.0	11.7	9.1	
64*	5320.0	11.7	9.1	
100	5500.0	11.6	9.1	5.6 GHz
104*	5520.0	11.0	8.1	
108	5540.0	11.0	8.8	
112	5560.0	11.0	8.9	
116*	5580.0	10.9	8.0	
132	5660.0	11.3	8.8	
136*	5680.0	10.8	7.9	
140	5700.0	10.9	9.0	
149*	5745.0	11.2	9.1	5.8 GHz
153	5765.0	11.3	9.1	
157*	5785.0	11.3	9.2	
161	5805.0	11.0	9.2	
165*	5825.0	10.9	8.8	

802.11ac (5.0 GHz) (40 MHz)
Power Back-off Not Supported

Channel Number	Frequency (MHz)	TX Power (dBm) ⁹⁸ 13.5 Mbps	TX Power (dBm) ⁹¹ 135 Mbps	Note
38	5190.0	10.2	10.1	5.2 GHz
46	5230.0	10.7	10.1	
54	5270.0	10.3	10.0	5.3 GHz
62	5310.0	9.4	9.0	
102	5510.0	9.4	9.4	5.6 GHz
110	5550.0	9.5	9.3	
134	5670.0	9.5	9.2	
151	5755.0	9.6	9.5	5.8 GHz
159	5795.0	9.7	9.1	

**Conducted Power Measurements Wi-Fi802.11a/n (5.0 GHz) (Continued):
802.11ac (5.0 GHz) (80 MHz)****Power Back-off Not Supported**

Channel Number	Frequency (MHZ)	TX Power (dBm) 13.5 Mbps	TX Power (dBm) 135 Mbps	Note
42	5210.0	10.3	9.8	5.2 GHz
58	5290.0	9.5	9.8	5.3 GHz
106	5530.0	9.6	9.4	5.6 GHz
155	5775.0	9.3	9.2	5.8 GHz

Test setup for power measurements

7.3. Test Results

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

7.3.1. Specific Absorption Rate - GSM 850 Head Configuration 1g

Power Back-off Not Supported

Test Summary:

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.678
Maximum Reported Level (W/kg):	0.797

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	22.8 to 22.8

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
1	Touch Left	190	23.9	24.6	0.515	0.605	1	GMSK
2	Tilt Left	190	23.9	24.6	0.283	0.332	1	GMSK
3	Touch Right	190	23.9	24.6	0.636	0.747	1	GMSK
4	Tilt Right	190	23.9	24.6	0.293	0.344	1	GMSK
5	Touch Right	128	23.9	24.6	0.520	0.611	1	GMSK
6	Touch Right	251	23.9	24.6	0.678	0.797	1	GMSK

Note(s):

1. Voice Mode

7.3.2. Specific Absorption Rate - GSM 850 Hotspot Mode Configuration 1g**Power Back-off Not Supported****Test Summary:**

Tissue Volume:	1g
Maximum Measured Level (W/kg):	1.080
Maximum Reported Level (W/kg):	1.184

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
7	Front	190	26.2	26.6	0.923	1.012	1, 2	GMSK
8	Front	128	26.2	26.6	0.986	1.081	1, 2	GMSK
9	Front	251	26.2	26.6	1.080	1.184	1, 2, 3	GMSK
10	Back	190	26.2	26.6	1.010	1.107	1, 2	GMSK
11	Back	128	26.2	26.6	1.020	1.118	1, 2	GMSK
12	Back	251	26.2	26.6	0.999	1.095	1, 2	GMSK
13	Left	190	26.2	26.6	0.253	0.277	1, 2	GMSK
14	Right	190	26.2	26.6	0.192	0.211	1, 2	GMSK
15	Bottom	190	26.2	26.6	0.034	0.037	1, 2	GMSK

Note(s):

1. Data - SAR measurements were performed using 4 uplink timeslots
2. SAR measurements were performed with the closest edge of the EUT at a separation distance of 10mm from the 'SAM' phantom flat section.
3. As per 865664 D01, the highest SAR measured > 0.8 W/kg has been re-measured and included in the report in section 2.3 under **SAR Measurement Variability and Measurement Uncertainty Analysis Results** Table.

*KDB 941225 D03 - SAR is not required for EDGE technology when the maximum average output power is lower than that measured on the corresponding GPRS channels.

7.3.3. Specific Absorption Rate - GSM 850 Body-Worn Configuration 1g**Power Back-off Not Supported****Test Summary:**

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.596
Maximum Reported Level (W/kg):	0.700

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
16	Front	251	23.9	24.6	0.596	0.700	1, 2, 3	GMSK
17	Back	251	23.9	24.6	0.547	0.643	1, 2, 3	GMSK

Note(s):

1. Voice Mode
2. Highest measured SAR from hotspot mode configuration is 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.

7.3.4. Specific Absorption Rate - PCS 1900 Head Configuration 1g**Power Back-off Not Supported****Test Summary:**

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.347
Maximum Reported Level (W/kg):	0.372

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
18	Touch Left	661	21.3	21.6	0.347	0.372	1	GMSK
19	Tilt Left	661	21.3	21.6	0.097	0.104	1	GMSK
20	Touch Right	661	21.3	21.6	0.217	0.233	1	GMSK
21	Tilt Right	661	21.3	21.6	0.128	0.137	1	GMSK
22	Touch Left	512	21.3	21.6	0.264	0.283	1	GMSK
23	Touch Left	810	21.3	21.6	0.345	0.370	1	GMSK

Note(s):

1. Voice Mode

7.3.5. Specific Absorption Rate - GPRS 1900 Hotspot Mode Configuration 1g**Power Back-off Not Supported****Test Summary:**

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.756
Maximum Reported Level (W/kg):	0.792

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
24	Front	661	23.3	23.5	0.697	0.730	1, 2	GMSK
25	Back	661	23.3	23.5	0.756	0.792	1, 2	GMSK
26	Left	661	23.3	23.5	0.215	0.225	1, 2	GMSK
27	Right	661	23.3	23.5	0.060	0.063	1, 2	GMSK
28	Bottom	661	23.3	23.5	0.158	0.165	1, 2	GMSK
29	Back	512	23.3	23.5	0.731	0.765	1, 2	GMSK
30	Back	810	23.3	23.5	0.737	0.772	1, 2	GMSK

Note(s):

1. Data - SAR measurements were performed using 4 uplink timeslots
2. SAR measurements were performed with the closest edge of the EUT at a separation distance of 10mm from the 'SAM' phantom flat section.

*KDB 941225 D03 - SAR is not required for EDGE technology when the maximum average output power is lower than that measured on the corresponding GPRS channels.

7.3.6. Specific Absorption Rate - PCS 1900 Body-Worn Configuration 1g**Power Back-off Not Supported****Test Summary:**

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.328
Maximum Reported Level (W/kg):	0.351

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
31	Front	661	21.3	21.6	0.312	0.334	1, 2, 3	GMSK
32	Back	661	21.3	21.6	0.328	0.351	1, 2, 3	GMSK

Note(s):

1. Voice Mode
2. Highest measured SAR from hotspot mode configuration is 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.

7.3.7. Specific Absorption Rate - UMTS-FDD 5 Head Configuration 1g**Power Back-off Not Supported****Test Summary:**

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.645
Maximum Reported Level (W/kg):	0.724

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	22.8 to 22.8

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
33	Touch Left	4183	24.0	24.5	0.533	0.598	1	QPSK
34	Tilt Left	4183	24.0	24.5	0.261	0.293	1	QPSK
35	Touch Right	4183	24.0	24.5	0.645	0.724	1	QPSK
36	Tilt Right	4183	24.0	24.5	0.297	0.333	1	QPSK
37	Touch Right	4132	24.0	24.5	0.585	0.656	1	QPSK
38	Touch Right	4233	24.0	24.5	0.624	0.700	1	QPSK

Note(s):

1. Circuit Switch (CS) - RMC 12.2kbps with Test loop mode 1 and TPC bits configured to All "1's"

7.3.8. Specific Absorption Rate - UMTS-FDD 5 Hotspot Mode Configuration 1g Power Back-off Not Supported Test Summary:

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.833
Maximum Reported Level (W/kg):	0.935

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
39	Front	4183	24.0	24.5	0.821	0.921	1, 2	QPSK
40	Front	4132	24.0	24.5	0.794	0.891	1, 2	QPSK
41	Front	4233	24.0	24.5	0.786	0.882	1, 2	QPSK
42	Back	4183	24.0	24.5	0.833	0.935	1, 2, 3	QPSK
43	Back	4132	24.0	24.5	0.798	0.895	1, 2	QPSK
44	Back	4233	24.0	24.5	0.794	0.891	1, 2	QPSK
45	Left Hand Side	4183	24.0	24.5	0.200	0.224	1, 2	QPSK
46	Right Hand Side	4183	24.0	24.5	0.217	0.243	1, 2	QPSK
47	Bottom	4183	24.0	24.5	0.037	0.040	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 measurements were performed with the closest edge of the EUT at a separation distance of 10mm from the 'SAM' phantom flat section.
3. As per 865664 D01, the highest SAR measured > 0.8 W/kg has been re-measured and included in the report in section 2.3 under **SAR Measurement Variability and Measurement Uncertainty Analysis Results** Table.

*KDB 941225 D02 - SAR is not required for RMC+HSPA (HSDPA/HSUPA) channels when the maximum average output power is less than ¼ dB higher than that measured on the corresponding RMC channels and 1g SAR level reported in 'RMC 12.2kbps' is <75% SAR limit.

7.3.9. Specific Absorption Rate - UMTS-FDD 5 Body-Worn Configuration 1g**Power Back-off Not Supported****Test Summary:**

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.682
Maximum Reported Level (W/kg):	0.765

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
48	Front	4183	24.0	24.5	0.682	0.765	1, 2, 3	QPSK
49	Back	4183	24.0	24.5	0.641	0.719	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. SAR measurements were performed with the closest edge of the EUT at a separation distance of 15mm from the 'SAM' phantom flat section.
3. Worst case channel from hotspot mode configuration is used for body-worn configuration.

*KDB 941225 D02 - SAR is not required for RMC+HSPA (HSDPA/HSUPA) channels when the maximum average output power is less than ¼ dB higher than that measured on the corresponding RMC channels and 1g SAR level reported in 'RMC 12.2kbps' is <75% SAR limit.

7.3.10. Specific Absorption Rate - Wi-Fi 2450 Head Configuration 1g**Power Back-off Not Supported****Test Summary:**

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.056
Maximum Reported Level (W/kg):	0.068

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
50	Touch Left	6	15.3	16.1	0.036	0.044	1	DBPSK
51	Tilt Left	6	15.3	16.1	0.021	0.025	1	DBPSK
52	Touch Right	6	15.3	16.1	0.056	0.068	1	DBPSK
53	Tilt Right	6	15.3	16.1	0.022	0.026	1	DBPSK
54	Touch Right	1	14.9	15.3	0.054	0.059	1	DBPSK
55	Touch Right	11	13.7	14.8	0.041	0.053	1	DBPSK

Note(s):

1. WLAN 802.11b 1Mbps (Data Rate with Highest Measured Output Power)

*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

7.3.11. Specific Absorption Rate - Wi-Fi 2450 Hotspot Mode Configuration 1g Power Back-off Not Supported Test Summary:

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.086
Maximum Reported Level (W/kg):	0.103

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
56	Front	6	15.3	16.1	0.001	0.001	1, 2	DBPSK
57	Back	6	15.3	16.1	0.086	0.103	1, 2	DBPSK
58	Left Hand Side	6	15.3	16.1	0.015	0.018	1, 2	DBPSK
59	Bottom	6	15.3	16.1	0.034	0.040	1, 2	DBPSK
60	Back	1	14.9	15.3	0.001	0.001	1, 2	DBPSK
61	Back	11	13.7	14.8	0.050	0.064	1, 2	DBPSK

Note(s):

1. WLAN 802.11b 1Mbps (Data Rate with Highest Measured Output Power)
2. SAR measurements were performed with the closest edge of the EUT at a separation distance of 10mm from the 'SAM' phantom flat section.

*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.

7.3.12. Specific Absorption Rate - Wi-Fi 2450 Body-Worn Configuration 1g

Power Back-off Not Supported

Test Summary:

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.034
Maximum Reported Level (W/kg):	0.041

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
62	Front	6	15.3	16.1	0.019	0.023	1, 2, 3	DBPSK
63	Back	6	15.3	16.1	0.034	0.041	1, 2, 3	DBPSK

Note(s):

1. WLAN 802.11b 1Mbps (Data Rate with Highest Measured Output Power)
2. SAR measurements were performed with the closest edge of the EUT at a separation distance of 15mm from the 'SAM' phantom flat section.
3. Highest measured SAR from hotspot mode configuration is used for body-worn configuration.

*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.

7.3.13. Specific Absorption Rate - Wi-Fi 5GHz Head Configuration 1g

Power Back-off Not Supported

Test Summary:

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.016
Maximum Reported Level (W/kg):	0.019

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	22.5 to 22.5

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
802.11a								
64	Touch Left	48	12.5	12.6	0.016	0.016	1, 4, 5	BPSK
65	Tilt Left	48	12.5	12.6	0.005	0.005	1, 4, 5	BPSK
-	Touch Right	48	12.5	12.6	0.000	0.000	1, 4, 5	BPSK
-	Tilt Right	48	12.5	12.6	0.000	0.000	1, 4, 5	BPSK
66	Touch Left	52	13.4	13.6	0.016	0.017	1, 4, 5	BPSK
-	Touch Left	116	11.7	12.3	0.000	0.000	1, 4, 6	BPSK
-	Touch Left	149	11.6	12.3	0.000	0.000	1, 4, 5	BPSK

Specific Absorption Rate - Wi-Fi 5GHz Head Configuration 1g (Continued)**Power Back-off Not Supported****Test Summary:**

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
802.11ac VHT40								
67	Touch Left	46	10.7	11.0	0.013	0.014	2, 4, 5	BPSK
68	Touch Left	54	10.3	11.0	0.009	0.011	2, 4, 5	BPSK
69	Touch Left	134	9.5	10.8	0.009	0.012	2, 4, 6	BPSK
70	Touch Left	159	9.7	10.8	0.015	0.019	2, 4, 5	BPSK
802.11ac VHT80								
71	Touch Left	42	10.3	10.5	0.010	0.010	3, 4, 5	BPSK
72	Touch Left	58	9.5	10.5	0.012	0.015	3, 4, 5	BPSK
73	Touch Left	106	9.6	10.5	0.008	0.010	3, 4, 6	BPSK
-	Touch Left	155	9.3	10.5	0.000	0.000	3, 4, 5	BPSK

Note(s):

1. WLAN 802.11a 6Mbps
2. WLAN 802.11ac VHT40 13.5 Mbps
3. WLAN 802.11ac VHT80 13.5 Mbps
4. Value measured was below noise floor.
5. For frequency bands with an operating range of ≤ 100 MHz, when the SAR measured for the highest output power channel within is ≤ 0.8 W/kg, SAR for the remaining channels is not required. Per KDB 447498 D01, section 4.3.3
6. For frequency bands with an operating range of ≥ 200 MHz, when the SAR for the highest output power channel within is ≤ 0.4 W/kg, SAR for the remaining channels is not required. Per KDB 447498 D01, section 4.3.3

*KDB 248227 - SAR is not required for 802.11n HT20 / 802.11ac VHT20 channels as the maximum average output power is less than $\frac{1}{4}$ dB higher than 802.11a.

*KDB 248227 - SAR is not required for 802.11n HT40 channels as the maximum average output power is less than $\frac{1}{4}$ dB higher than 802.11ac VHT40.

7.3.14. Specific Absorption Rate - Wi-Fi 5GHz Hotspot Mode Configuration 1g**Power Back-off Not Supported****Test Summary:**

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.105
Maximum Reported Level (W/kg):	0.110

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
74	Front	48	12.5	12.6	0.061	0.062	1, 2, 3	BPSK
75	Back	48	12.5	12.6	0.087	0.089	1, 2, 3	BPSK
76	Left Hand Side	48	12.5	12.6	0.034	0.035	1, 2, 3	BPSK
77	Bottom	48	12.5	12.6	0.019	0.019	1, 2, 3	BPSK
78	Back	52	13.4	13.6	0.105	0.110	1, 2, 3	BPSK
79	Back	116	11.7	12.3	0.008	0.009	1, 2, 4	BPSK
80	Back	149	11.6	12.3	0.023	0.027	1, 2, 4	BPSK

Note(s):

1. WLAN 802.11a 6Mbps
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. For frequency bands with an operating range of ≤ 100 MHz, when the SAR measured for the highest output power channel within is ≤ 0.8 W/kg, SAR for the remaining channels is not required. Per KDB 447498 D01, section 4.3.3
4. For frequency bands with an operating range of ≥ 200 MHz, when the SAR for the highest output power channel within is ≤ 0.4 W/kg, SAR for the remaining channels is not required. Per KDB 447498 D01, section 4.3.3

*KDB 248227 - SAR is not required for 802.11n HT20 / 802.11ac VHT20 channels as the maximum average output power is less than $\frac{1}{4}$ dB higher than 802.11a.

* KDB General RF Exposure Guidance v05, the 802.11n HT40 / 802.11ac VHT40 / 802.11ac VHT80 qualify for SAR Test Exclusion. (Please see section 6.4)

7.3.15. Specific Absorption Rate - Wi-Fi 5GHz Body-Worn Configuration 1g**Power Back-off Not Supported****Test Summary:**

Tissue Volume:	1g
Maximum Measured Level (W/kg):	0.105
Maximum Reported Level (W/kg):	0.110

Environmental Conditions:

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

Results:

Scan No.	EUT Position	Channel Number	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
74	Front	48	12.5	12.6	0.061	0.062	1, 2, 3	BPSK
75	Back	48	12.5	12.6	0.087	0.089	1, 2, 3	BPSK
78	Back	52	13.4	13.6	0.105	0.110	1, 2, 3	BPSK
79	Back	116	11.7	12.3	0.008	0.009	1, 2, 4	BPSK
80	Back	149	11.6	12.3	0.023	0.027	1, 2, 3	BPSK

Note(s):

1. WLAN 802.11a 6Mbps
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.

*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 modes and configuration that overlap with Personal hotspot, SAR evaluation was NOT performed at 15mm separation.

3. For frequency bands with an operating range of ≤ 100 MHz, when the SAR measured for the highest output power channel within is ≤ 0.8 W/kg, SAR for the remaining channels is not required. Per KDB 447498 D01, section 4.3.3
4. For frequency bands with an operating range of ≥ 200 MHz, when the SAR for the highest output power channel within is ≤ 0.4 W/kg, SAR for the remaining channels is not required. Per KDB 447498 D01, section 4.3.3

*KDB 248227 - SAR is not required for 802.11n HT20 / 802.11ac VHT20 channels as the maximum average output power is less than $\frac{1}{4}$ dB higher than 802.11a.

* KDB General RF Exposure Guidance v05, the 802.11n HT40 / 802.11ac VHT40 / 802.11ac VHT80 qualify for SAR Test Exclusion. (Please see section 6.4)

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%	±20.08%
Specific Absorption Rate-GSM / GPRS / EDGE 850 / UMTS FDD 5 Body Configurations 1g	95%	±21.09%
Specific Absorption Rate-PCS 1900 Head Configuration 1g	95%	±23.70%
Specific Absorption Rate-PCS / GPRS / EDGE 1900 Body Configuration 1g	95%	±20.18%
Specific Absorption Rate-Wi-Fi 2450 MHz Head Configuration 1g	95%	±19.79%
Specific Absorption Rate-Wi-Fi 2450 MHz Body Configuration 1g	95%	±19.92%
Specific Absorption Rate-Wi-Fi 5GHz Head Configuration 1g	95%	±20.41%
Specific Absorption Rate-Wi-Fi 5GHz Body Configuration 1g	95%	±20.37%

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.

Note:

1. See Appendix 2 section A.2.3 for table calculations and parameters

Appendix 1. Test Equipment Used

UL 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	-
M1755	DAK Fluid probe	Schmid & Partner Engineering AG	SM DAK 040 CA	1089	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	-	-
A2109	Data Acquisition Electronics	Schmid & Partner Engineering AG	DAE3	417	17 April 2013	12
A2110	Data Acquisition Electronics	Schmid & Partner Engineering AG	DAE3	431	20 Sept 2012	12
A1234	Data Acquisition Electronics	Schmid & Partner Engineering AG	DAE3	450	22 Jan 2013	12
A2077	Probe	Schmid & Partner Engineering AG	EX3 DV4	3814	24 Sep 2012	12
A1185	Probe	Schmid & Partner Engineering AG	ET3 DV6	1528	26 July 2012	12
A1186	Probe	Schmid & Partner Engineering AG	ET3 DV6	1529	22 April 2013	12
A2243	Probe	Schmid & Partner Engineering AG	ES3DV3	3304	31 Aug 2012	12
A2201	900 MHz Dipole Kit	Schmid & Partner Engineering AG	D900V2	035	16 Aug 2012	12
A2200	1900 MHz Dipole Kit	Schmid & Partner Engineering AG	D1900V2	537	14 Aug 2012	12
A2202	2440 MHz Dipole Kit	Schmid & Partner Engineering AG	D2440V2	701	13 Aug 2012	12
A1377	5.0 GHz Dipole Kit	Schmid & Partner Engineering AG	D5GHzV2	1016	20 Feb 2013	12
A1497	Amplifier	Mini-Circuits	zh1-42w (sma)	e020105	Calibrated as part of system	-
A1566	SAM Phantom	Schmid & Partner Engineering AG	SAM (Site 56)	TP-1207	Calibrated before use	-
A1238	SAM Phantom	Schmid & Partner Engineering AG	SAM (Site 56)	TP-1192	Calibrated before use	-
A2125	SAM Phantom	Schmid & Partner Engineering AG	SAM (Site 57)	TP-1031	Calibrated before use	-
A2252	2mm Oval Phantom	Schmid & Partner Engineering AG	ELI5 (Site 57)	1177	Calibrated before use	-
A2124	SAM Phantom	Schmid & Partner Engineering AG	SAM (Site 58)	TP-1020	Calibrated before use	-
A2255	SAM Phantom	Schmid & Partner Engineering AG	SAM (Site 58)	TP-1193	Calibrated before use	-
A215	20 dB Attenuator	Narda	766-20	9402	Calibrated as part of system	-
A1137	3dB Attenuator	Narda	779	04690	Calibrated as part of system	-

UL No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A2263	Digital Camera	Samsung	PL211	9453C90B 607487L	-	-
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	-
G0591	Robot Power Supply	Schmid & Partner Engineering AG	DASY4	F01/5J86A1/C/01	Calibrated before use	-
G0592	Robot Power Supply	Schmid & Partner Engineering AG	DASY53	F125MZ7A1/C/01	Calibrated before use	-
G087	PSU	Thurlby Thandar	CPX200	100701	Calibrated before use	-
M1047	Robot Arm	Staubli	RX908 L	F00/SD8 9A1/A/01	Calibrated before use	-
M1653	Robot Arm	Staubli	RX908 L	F01/5J8 6A1/C/01	Calibrated before use	-
M1680	Robot Arm	Staubli	TX60 L	F12/5MZ7 A1/A/01	Calibrated before use	-
M1159	Signal Generator	Agilent Technologies	E8241A	US42110332	Internal Checked 10 Apr 2013	4
M1647	Signal Generator	Hewlett Packward	8648C	3537A01598	Internal Checked 17 May 2013	4
M1071	Spectrum Analyzer	Agilent	HP8590E	3647U00514	(Monitoring use only)	-
M1270	Digital Thermometer	RS	N/A	N/A	03 May 2013	12
M1651	Digital Thermometer	Dickson	FH325	08021393	03 May 2013	12
M1023	Dual Channel Power Meter	R & S	NRVD	863715/030	06 Jun 2013	12
S256	SAR Lab	UL	Site 56	N/A	Calibrated before use	-
S512	SAR Lab	UL	Site 57	N/A	Calibrated before use	-
S513	SAR Lab	UL	Site 58	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.

Checked by *R. Dutt* DATE: 26-SEPT-2012

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



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

Accredited by the Swiss Accreditation Service (SAS)

ASSET A2077

Accreditation No.: **SCS 108**

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

Client

RFI

Certificate No: **EX3-3814_Sep12**

CALIBRATION CERTIFICATE

Object

EX3DV4 - SN:3814

Calibration procedure(s)

QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes

Calibration date:

September 24, 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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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	20-Jun-12 (No. DAE4-660_Jun12)	Jun-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

Calibrated by:

Name

Jeton Kastrati

Function

Laboratory Technician

Signature

Approved by:

Katja Pokovic

Technical Manager

Issued: September 24, 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 E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * *frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; 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 EX3DV4

SN:3814

Manufactured: September 2, 2011
Calibrated: September 24, 2012

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3814

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.53	0.50	0.44	± 10.1 %
DCP (mV) ^B	99.9	93.7	98.7	

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	172.6	±3.0 %
			Y	0.00	0.00	1.00	154.1	
			Z	0.00	0.00	1.00	144.1	

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

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

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3814

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)
1450	40.5	1.20	8.56	8.56	8.56	0.19	2.04	± 12.0 %
2450	39.2	1.80	6.89	6.89	6.89	0.33	0.97	± 12.0 %
2600	39.0	1.96	6.81	6.81	6.81	0.34	1.00	± 12.0 %
5200	36.0	4.66	5.06	5.06	5.06	0.42	1.80	± 13.1 %
5300	35.9	4.76	4.73	4.73	4.73	0.42	1.80	± 13.1 %
5500	35.6	4.96	4.54	4.54	4.54	0.45	1.80	± 13.1 %
5600	35.5	5.07	4.26	4.26	4.26	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.50	4.50	4.50	0.45	1.80	± 13.1 %

^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: EX3DV4 - SN:3814

Calibration Parameter Determined in Body Tissue Simulating Media

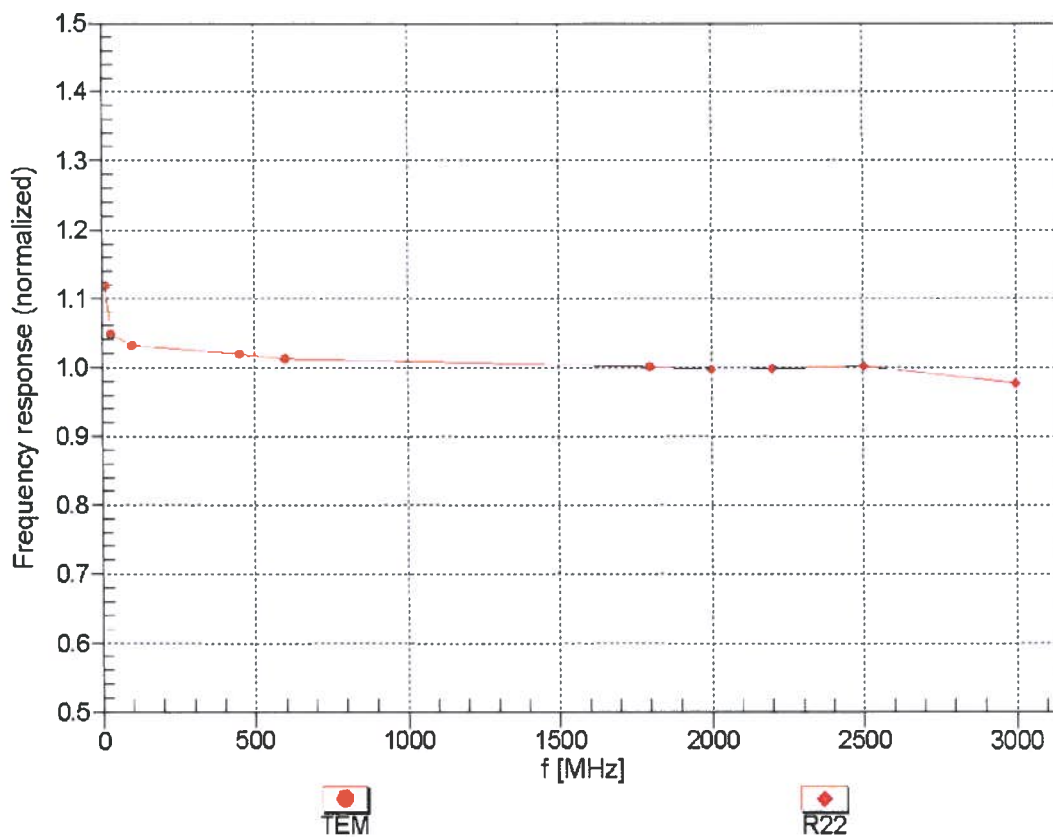
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
1450	54.0	1.30	8.26	8.26	8.26	0.23	1.40	± 12.0 %
2450	52.7	1.95	7.41	7.41	7.41	0.80	0.66	± 12.0 %
2600	52.5	2.16	7.08	7.08	7.08	0.79	0.61	± 12.0 %
3700	51.0	3.55	6.27	6.27	6.27	0.22	2.24	± 13.1 %
5200	49.0	5.30	4.39	4.39	4.39	0.52	1.90	± 13.1 %
5300	48.9	5.42	4.11	4.11	4.11	0.55	1.90	± 13.1 %
5500	48.6	5.65	4.02	4.02	4.02	0.52	1.90	± 13.1 %
5600	48.5	5.77	3.71	3.71	3.71	0.60	1.90	± 13.1 %
5800	48.2	6.00	3.97	3.97	3.97	0.60	1.90	± 13.1 %

^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

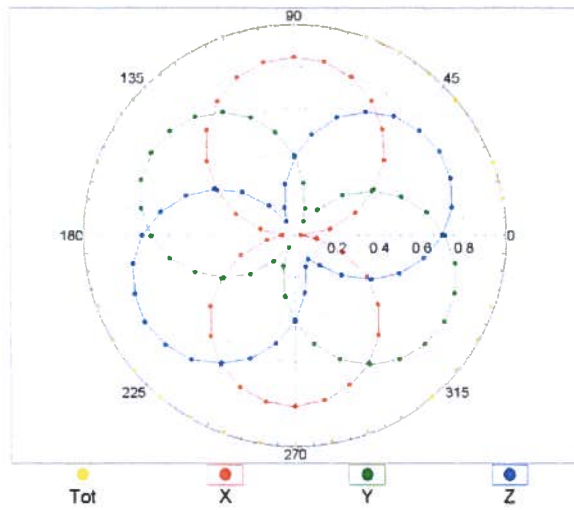
(TEM-Cell:ifi110 EXX, Waveguide: R22)



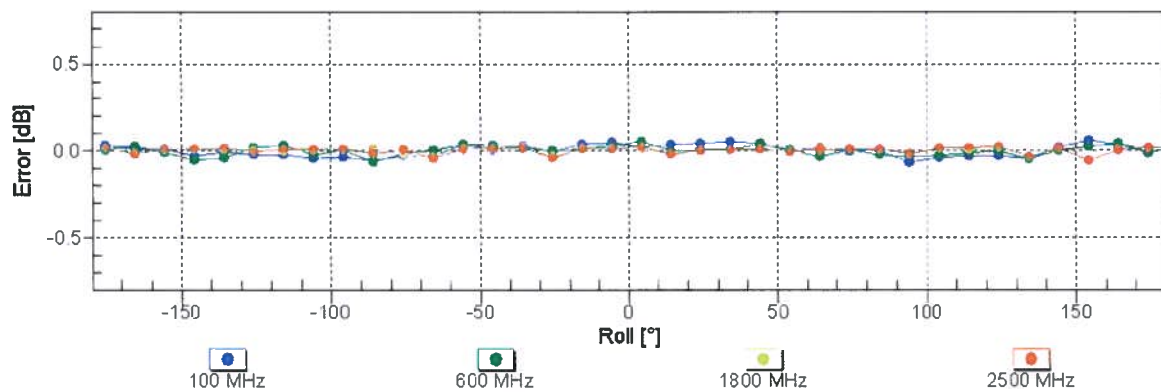
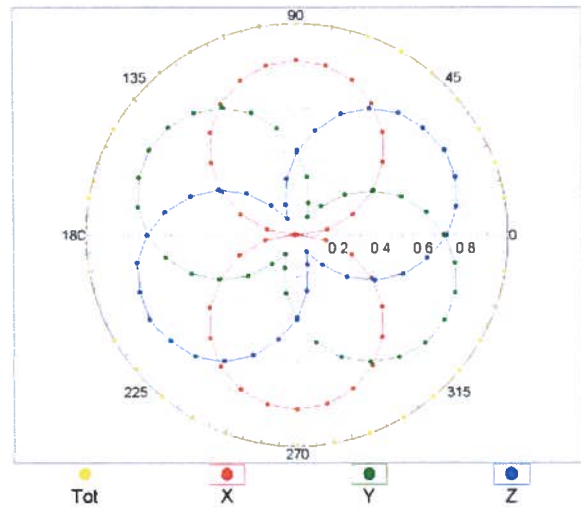
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

$f=600$ MHz, TEM

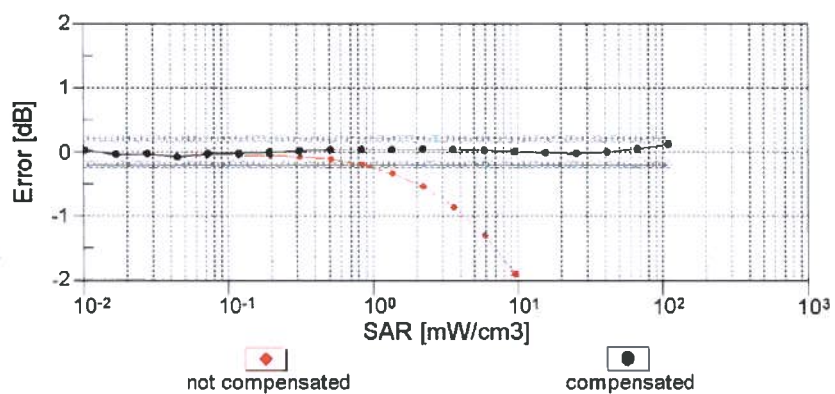
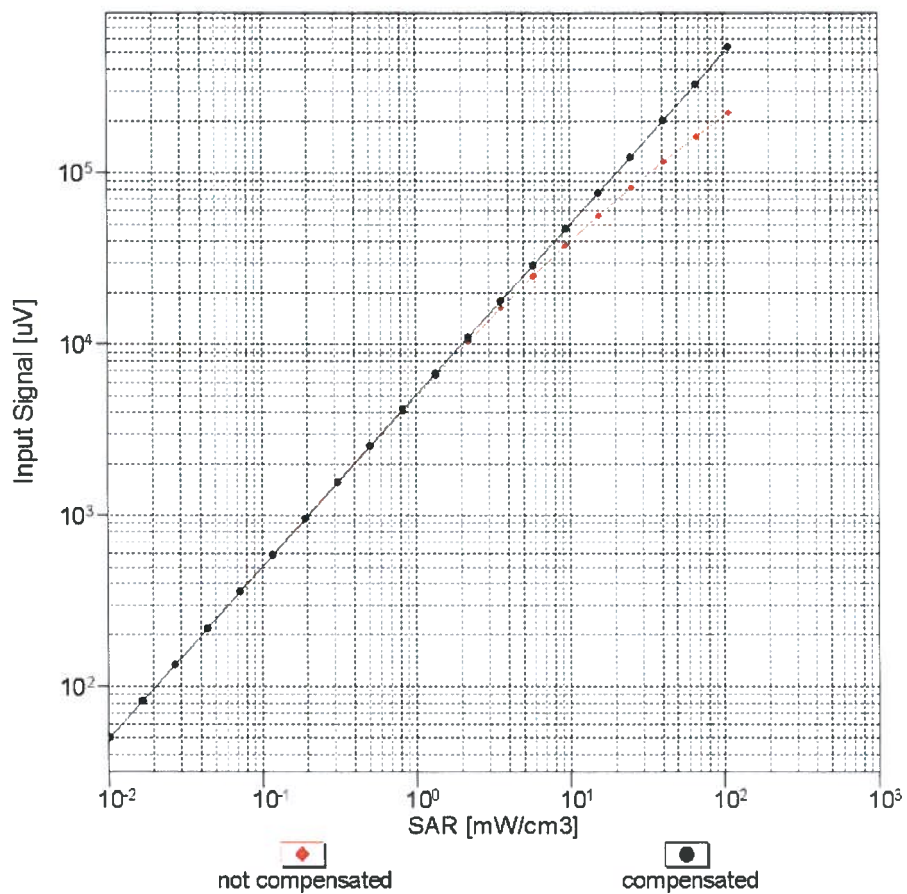


$f=1800$ MHz, R22



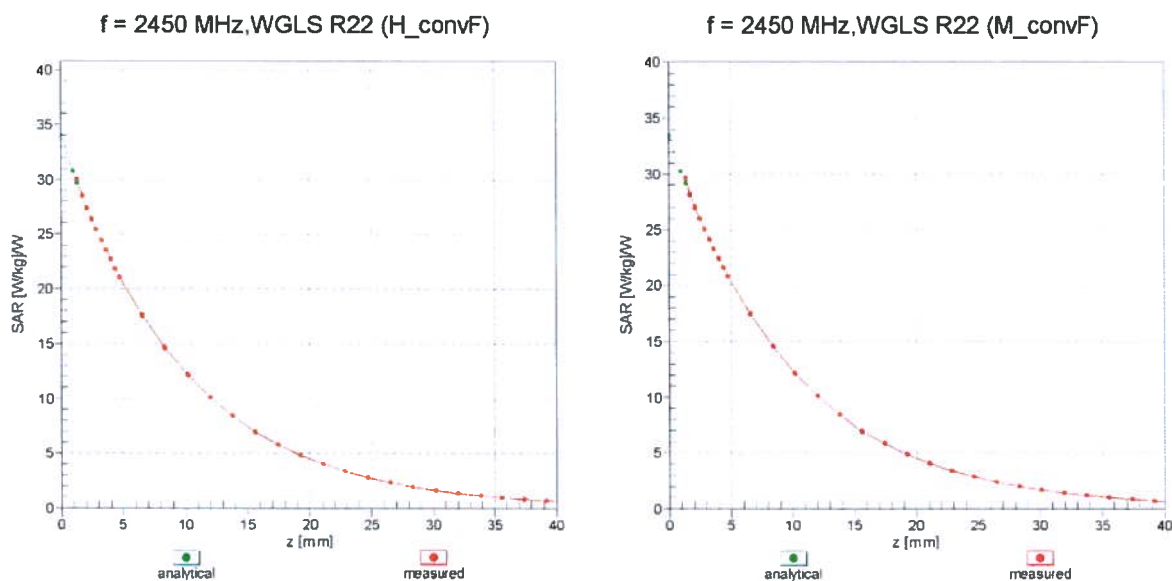
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



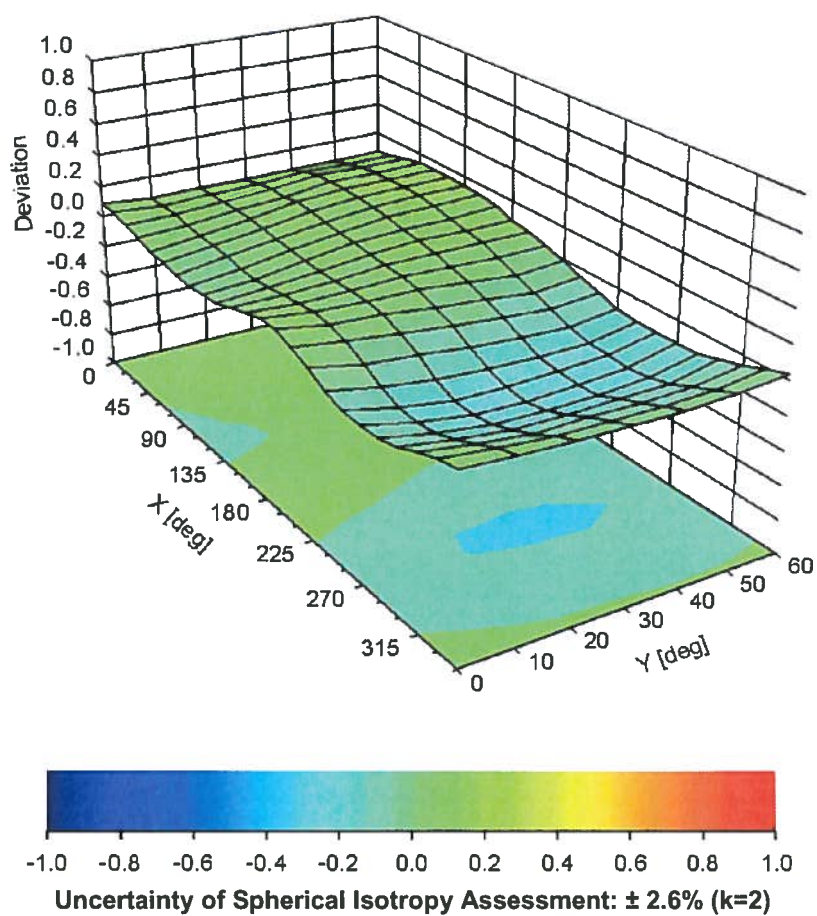
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3814

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-65.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

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Accreditation No.: SCS 108

Client RFI

Certificate No: ET3-1528_Jul12

CALIBRATION CERTIFICATE

Object ET3DV6 - SN:1528

Calibration procedure(s) QA CAL-01.v8, QA CAL-12.v7, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes

Calibration date: July 26, 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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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	20-Jun-12 (No. DAE4-660_Jun12)	Jun-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

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

Issued: July 26, 2012

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



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Accreditation No.: **SCS 108**

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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 E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; 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:1528

Manufactured: March 21, 2000
Calibrated: July 26, 2012

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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1528

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.45	1.86	1.61	± 10.1 %
DCP (mV) ^B	95.5	97.5	100.3	

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	166.6	±1.9 %
			Y	0.00	0.00	1.00	160.4	
			Z	0.00	0.00	1.00	170.5	

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 E²-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:1528

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)
450	43.5	0.87	7.01	7.01	7.01	0.23	2.32	± 13.4 %
750	41.9	0.89	6.37	6.37	6.37	0.49	2.16	± 12.0 %
835	41.5	0.90	6.06	6.06	6.06	0.61	1.95	± 12.0 %
900	41.5	0.97	5.95	5.95	5.95	0.30	3.00	± 12.0 %
1450	40.5	1.20	5.22	5.22	5.22	0.49	2.80	± 12.0 %
1750	40.1	1.37	5.12	5.12	5.12	0.80	2.07	± 12.0 %
1900	40.0	1.40	4.92	4.92	4.92	0.80	2.10	± 12.0 %
2150	39.7	1.53	4.65	4.65	4.65	0.80	2.00	± 12.0 %
2450	39.2	1.80	4.31	4.31	4.31	0.80	1.74	± 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:1528

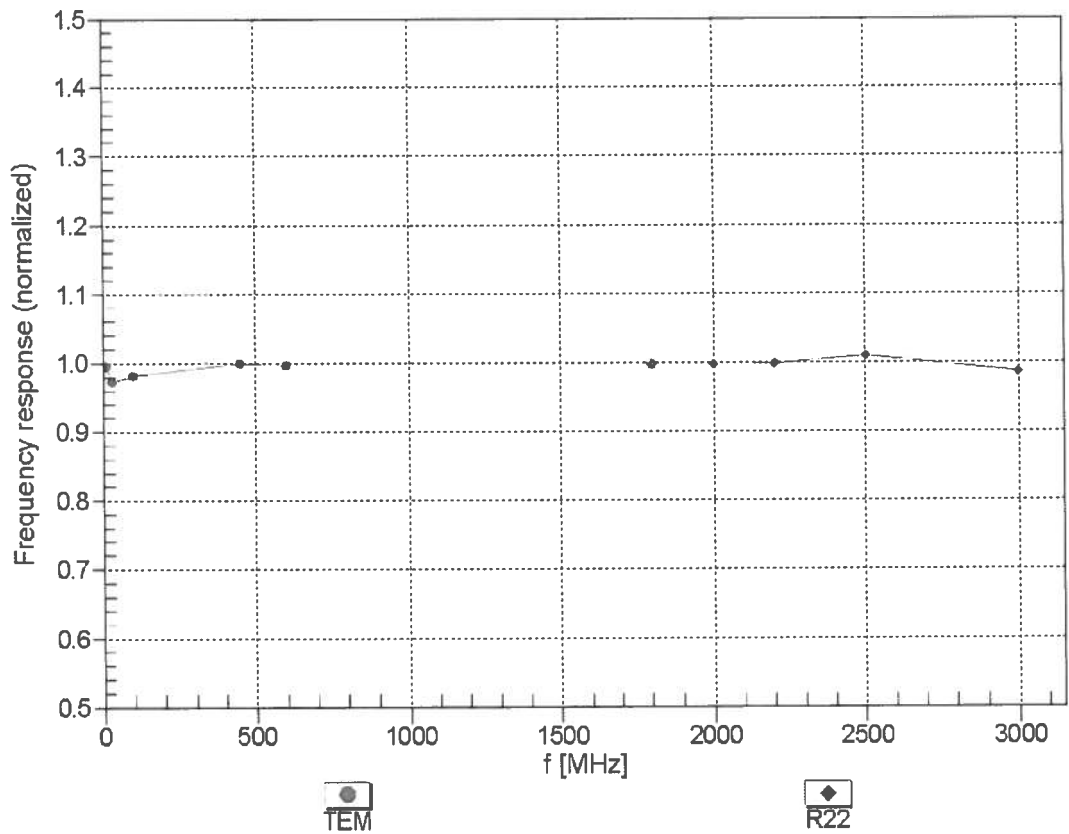
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	56.7	0.94	7.47	7.47	7.47	0.16	2.32	± 13.4 %
750	55.5	0.96	6.17	6.17	6.17	0.33	2.75	± 12.0 %
835	55.2	0.97	5.99	5.99	5.99	0.33	3.00	± 12.0 %
900	55.0	1.05	5.92	5.92	5.92	0.55	2.18	± 12.0 %
1450	54.0	1.30	5.11	5.11	5.11	0.76	2.07	± 12.0 %
1750	53.4	1.49	4.64	4.64	4.64	0.80	2.45	± 12.0 %
1900	53.3	1.52	4.42	4.42	4.42	0.80	2.33	± 12.0 %
2150	53.1	1.66	4.37	4.37	4.37	0.80	1.93	± 12.0 %
2450	52.7	1.95	3.99	3.99	3.99	0.56	0.98	± 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)

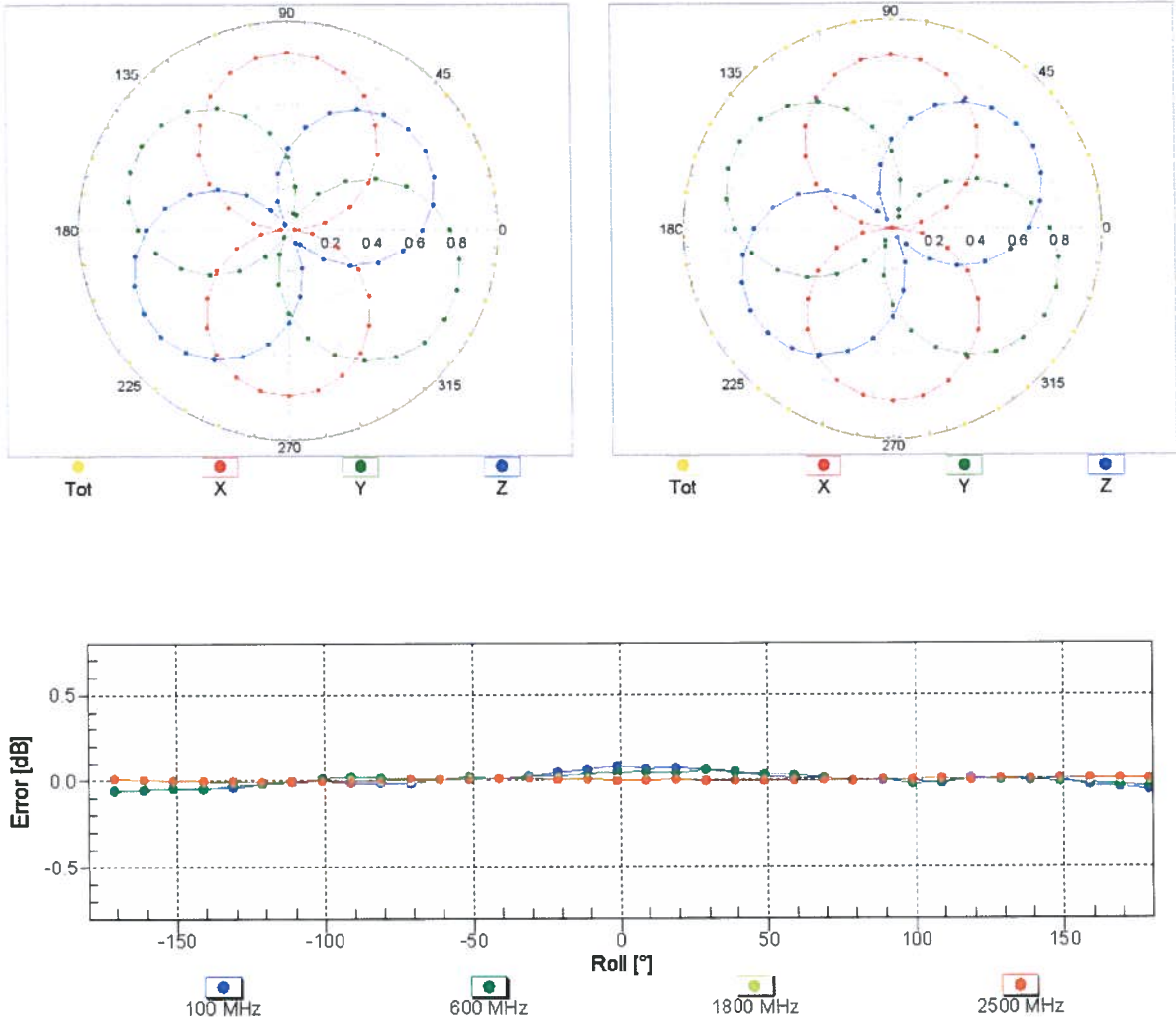


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

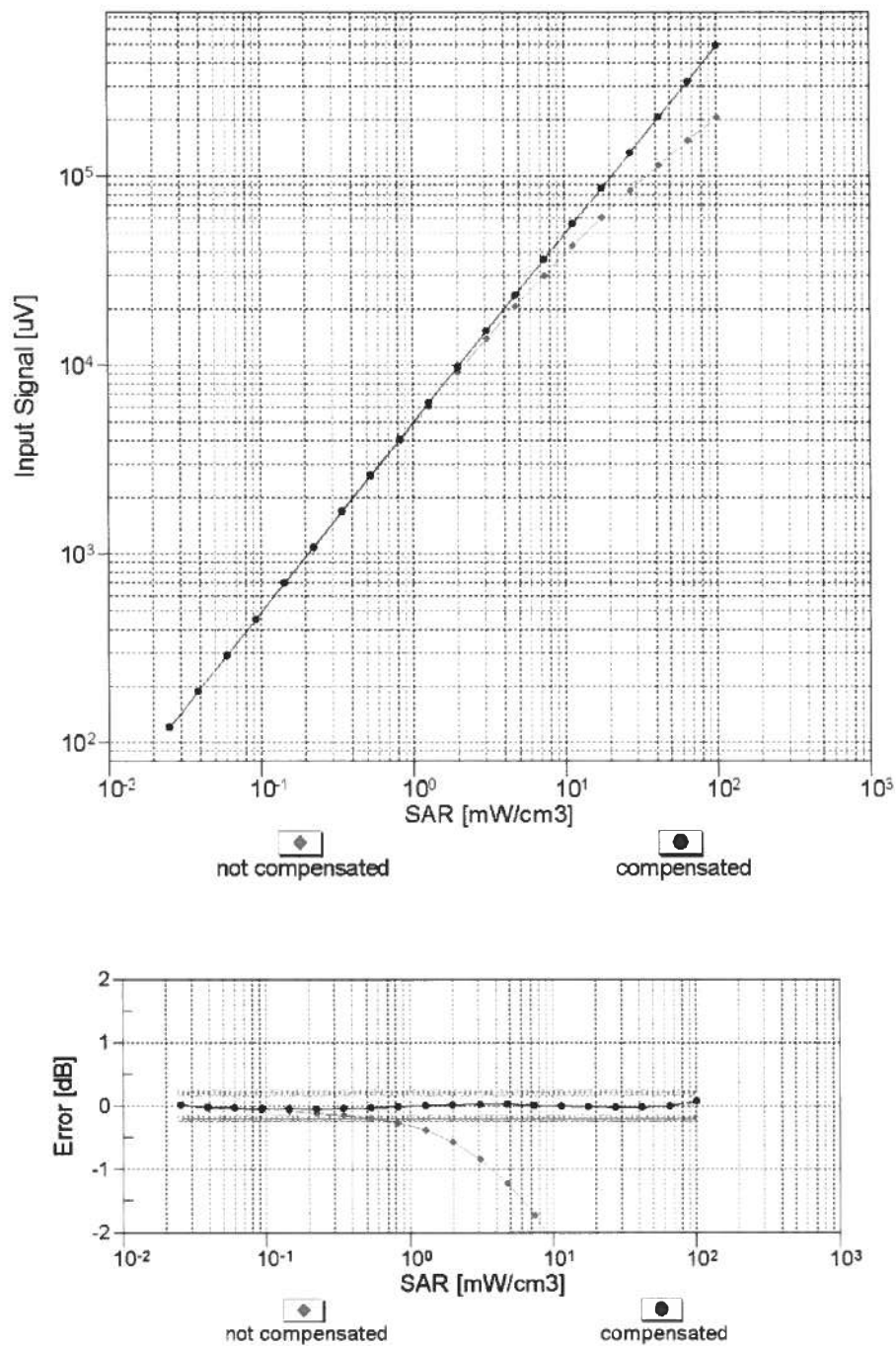
f=600 MHz,TEM

f=1800 MHz,R22



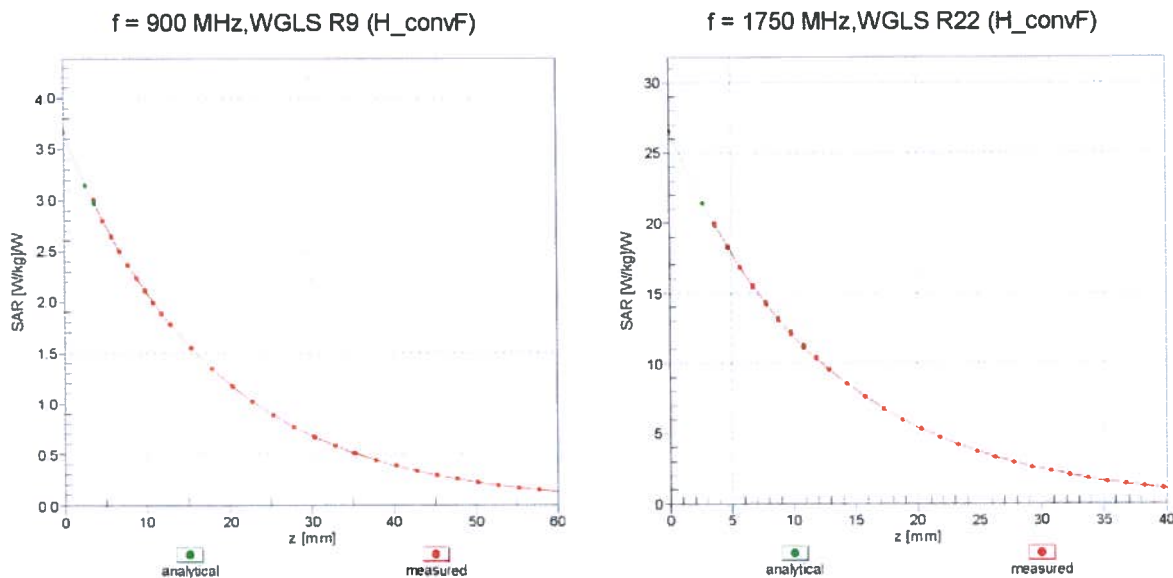
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



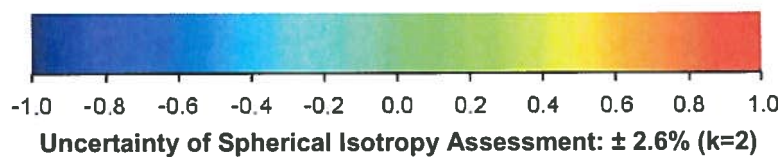
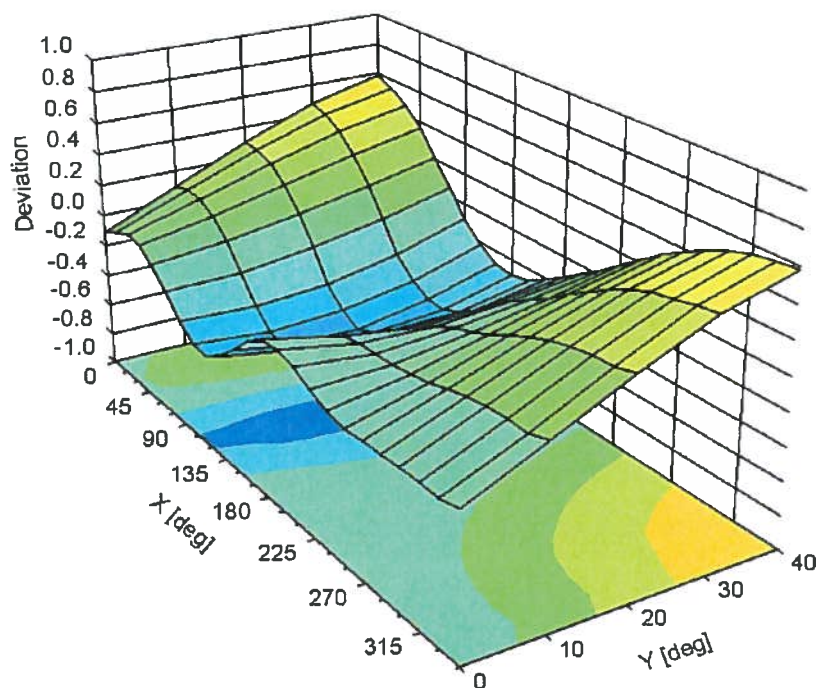
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ET3DV6 - SN:1528

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	18.9
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

checked by: *[Signature]* Date: 2-May-2013

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



S Schweizerischer Kalibrierdienst
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ASSET A1186

Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Client

RFI

Certificate No: **ET3-1529_Apr13**

CALIBRATION CERTIFICATE

Object

ET3DV6 - SN:1529

Calibration procedure(s)

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

Calibration date:

April 22, 2013

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 E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	<i>[Signature]</i>
Approved by:	Katja Pokovic	Technical Manager	<i>[Signature]</i>
Issued: April 22, 2013			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Glossary:

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

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}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ET3DV6

SN:1529

Manufactured: March 21, 2000
Calibrated: April 22, 2013

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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1529

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.68	1.89	1.78	± 10.1 %
DCP (mV) ^B	109.8	99.0	97.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	149.7	±2.5 %
		Y	0.0	0.0	1.0		199.9	
		Z	0.0	0.0	1.0		195.1	

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 E²-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:1529

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)
750	41.9	0.89	6.59	6.59	6.59	0.53	2.04	± 12.0 %
835	41.5	0.90	6.24	6.24	6.24	0.35	2.65	± 12.0 %
900	41.5	0.97	6.13	6.13	6.13	0.40	2.37	± 12.0 %
1450	40.5	1.20	5.20	5.20	5.20	0.46	2.90	± 12.0 %
1750	40.1	1.37	5.13	5.13	5.13	0.80	2.07	± 12.0 %
1900	40.0	1.40	4.93	4.93	4.93	0.80	2.05	± 12.0 %
2100	39.8	1.49	4.93	4.93	4.93	0.80	1.93	± 12.0 %
2450	39.2	1.80	4.30	4.30	4.30	0.80	2.10	± 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:1529

Calibration Parameter Determined in Body Tissue Simulating Media

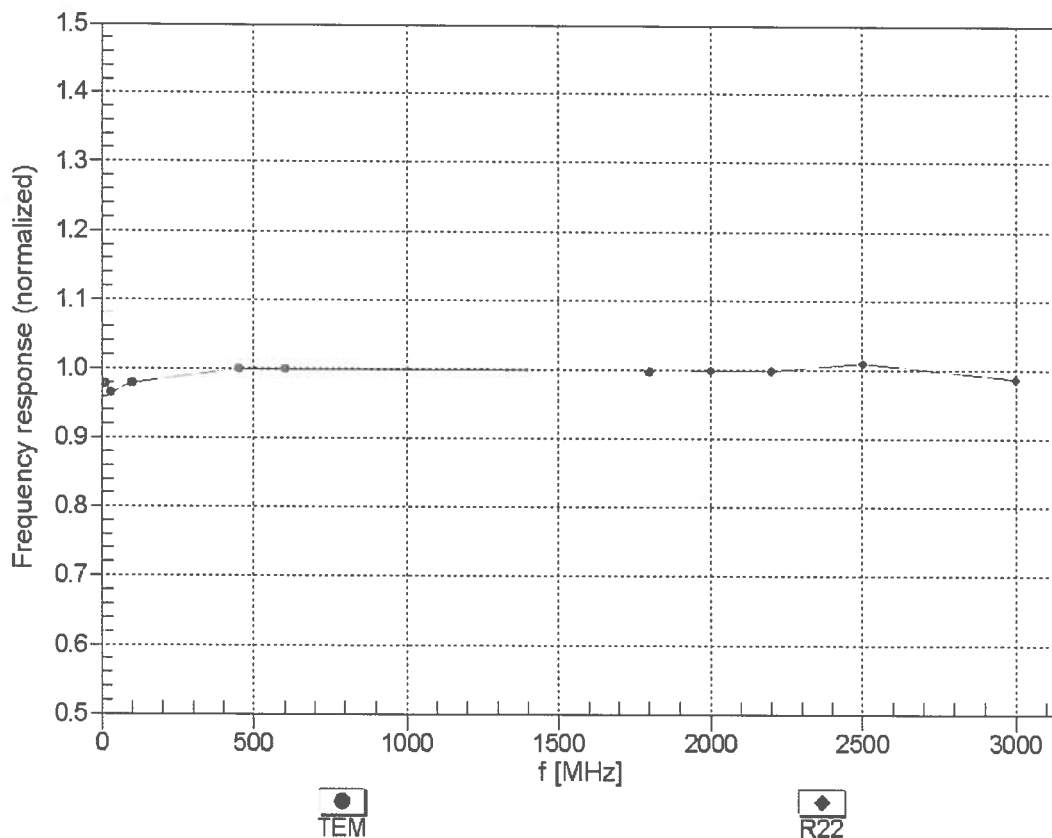
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.31	6.31	6.31	0.43	2.28	± 12.0 %
835	55.2	0.97	6.16	6.16	6.16	0.44	2.29	± 12.0 %
900	55.0	1.05	6.12	6.12	6.12	0.47	2.27	± 12.0 %
1450	54.0	1.30	5.03	5.03	5.03	0.79	1.99	± 12.0 %
1750	53.4	1.49	4.68	4.68	4.68	0.80	2.40	± 12.0 %
1900	53.3	1.52	4.46	4.46	4.46	0.80	2.29	± 12.0 %
2100	53.2	1.62	4.52	4.52	4.52	0.80	2.11	± 12.0 %
2450	52.7	1.95	4.01	4.01	4.01	0.63	2.10	± 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

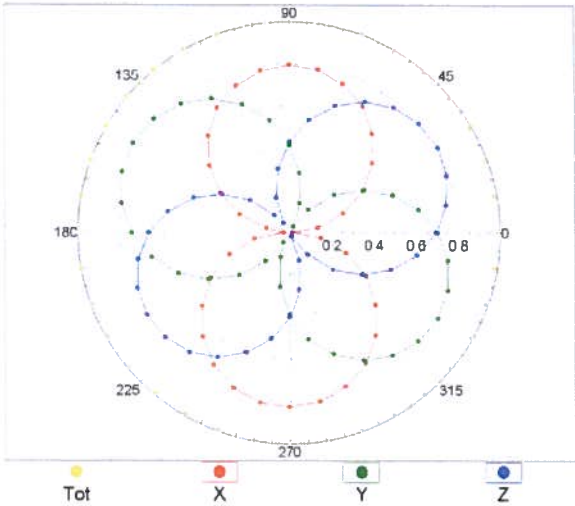
(TEM-Cell:ifi110 EXX, Waveguide: R22)



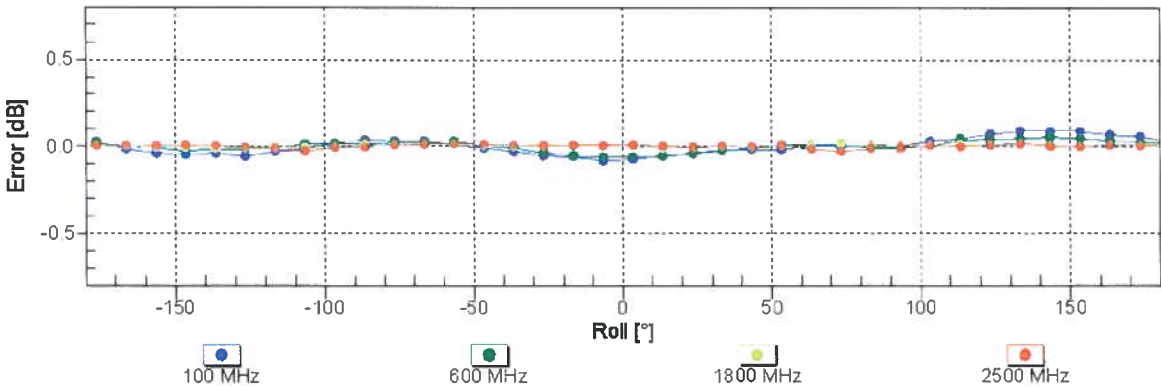
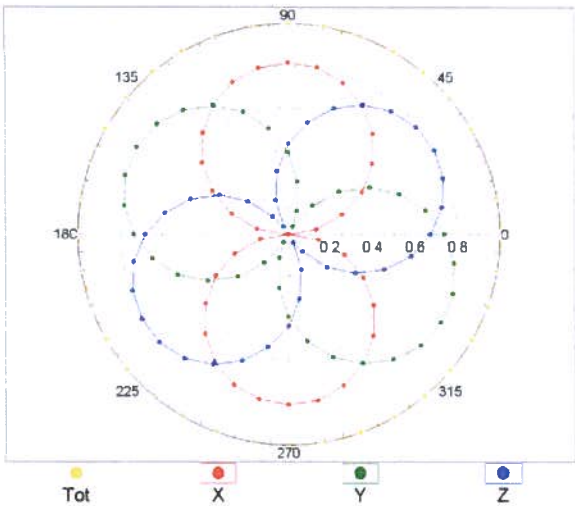
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

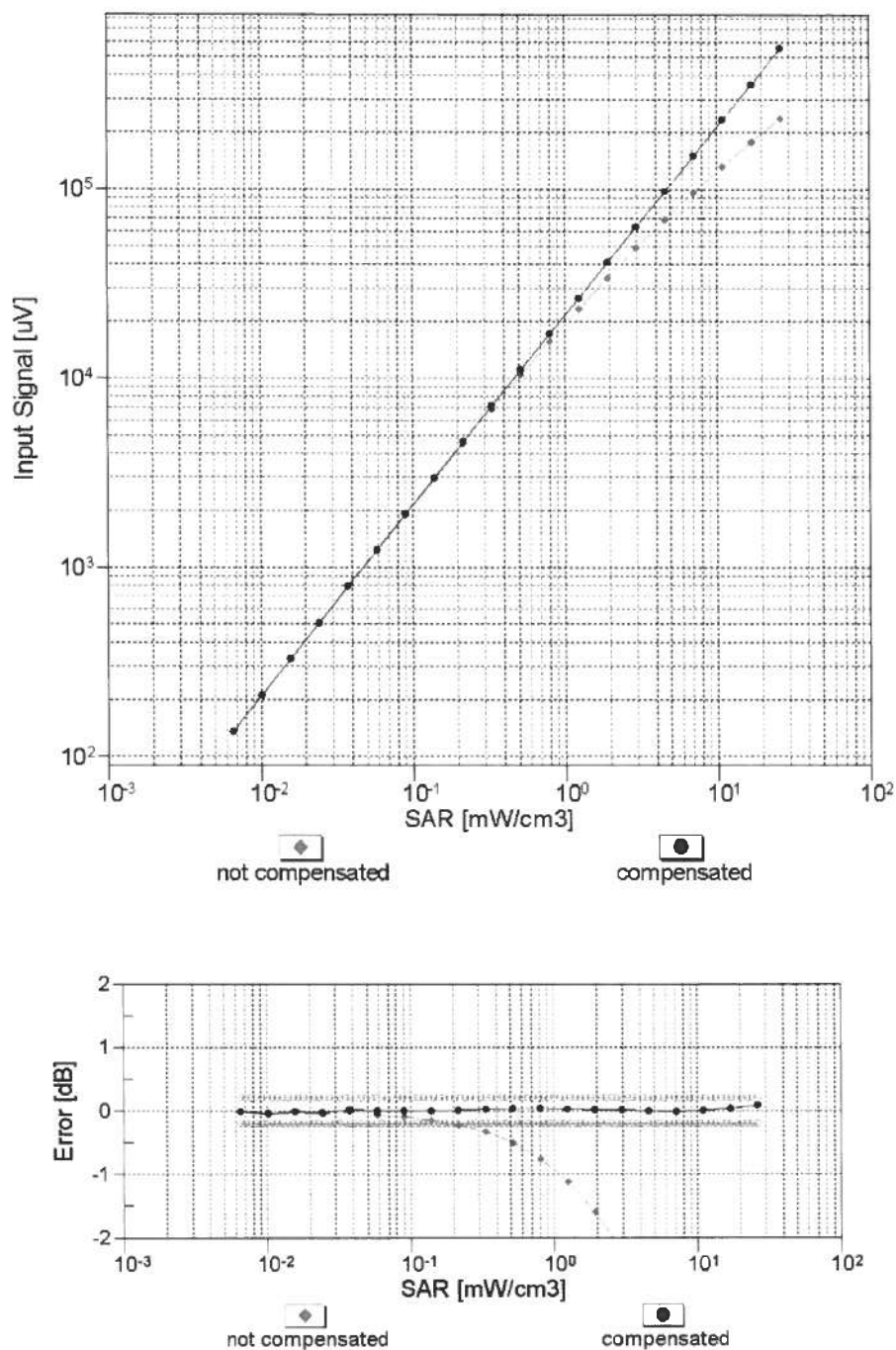


f=1800 MHz,R22



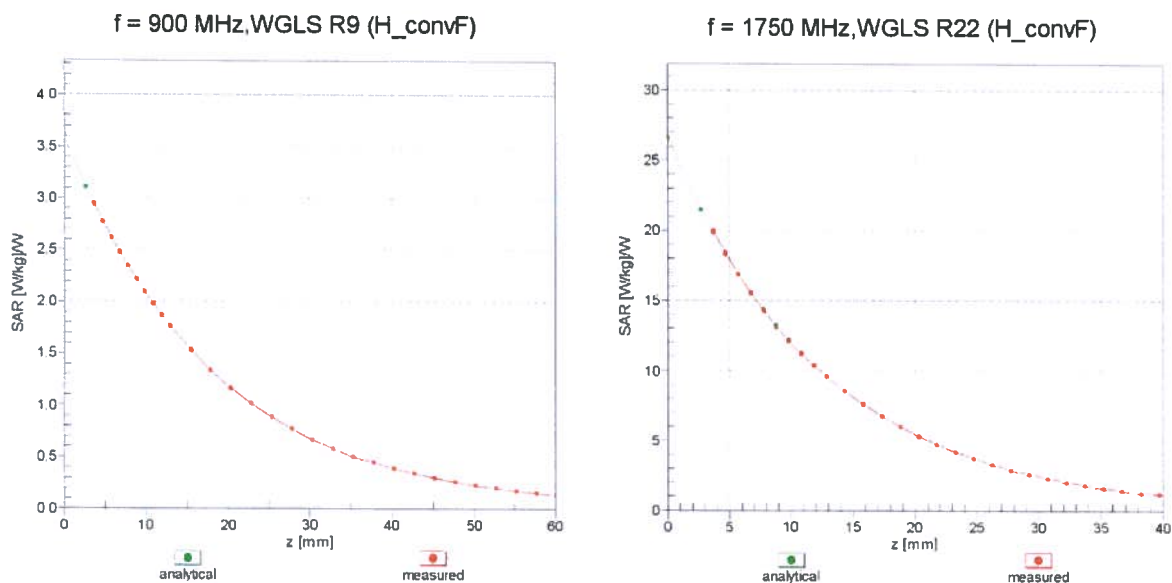
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



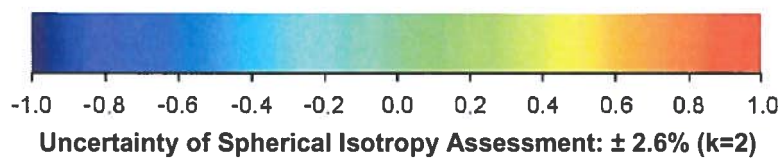
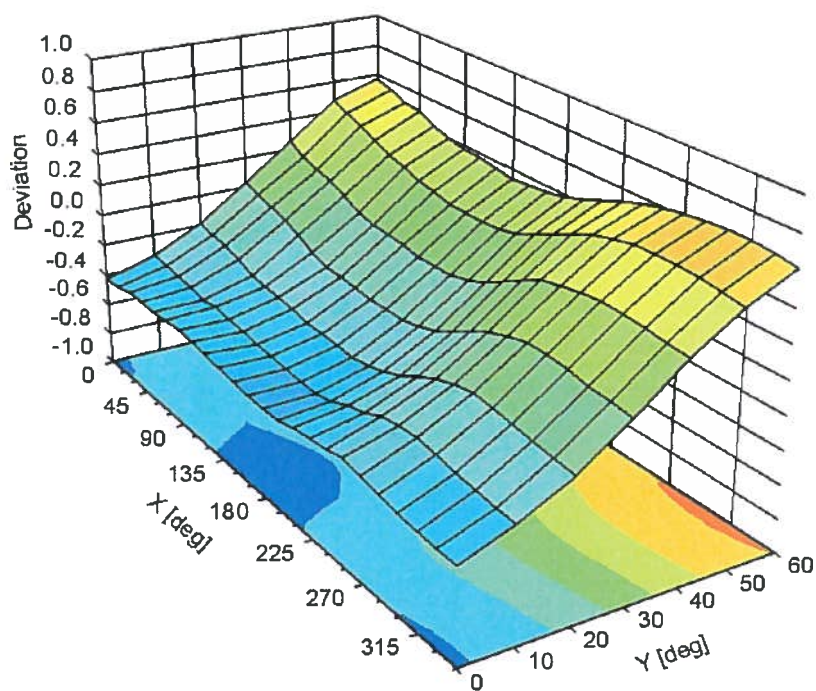
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ET3DV6 - SN:1529

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-6.5
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

checked by R.B. DATE: 18-09-2012

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



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

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Client

RFI

Certificate No: **ES3-3304_Aug12**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3304**

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

Calibration date: **August 31, 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	20-Jun-12 (No. DAE4-660_Jun12)	Jun-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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: September 3, 2012			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Accreditation No.: **SCS 108**

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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 E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * *frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; 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 ES3DV3

SN:3304

Manufactured: August 27, 2010
Calibrated: August 31, 2012

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3304

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.14	1.33	1.33	± 10.1 %
DCP (mV) ^B	104.7	101.1	103.7	

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	146.4	±3.8 %
			Y	0.00	0.00	1.00	159.8	
			Z	0.00	0.00	1.00	158.8	

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

^A The uncertainties of NormX,Y,Z do not affect the E²-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: ES3DV3 - SN:3304

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)
750	41.9	0.89	6.44	6.44	6.44	0.29	1.92	± 12.0 %
835	41.5	0.90	6.17	6.17	6.17	0.27	1.96	± 12.0 %
900	41.5	0.97	6.09	6.09	6.09	0.33	1.75	± 12.0 %
1750	40.1	1.37	5.47	5.47	5.47	0.61	1.36	± 12.0 %
1900	40.0	1.40	5.24	5.24	5.24	0.80	1.18	± 12.0 %
2100	39.8	1.49	5.24	5.24	5.24	0.80	1.16	± 12.0 %
2450	39.2	1.80	4.59	4.59	4.59	0.78	1.22	± 12.0 %
2600	39.0	1.96	4.40	4.40	4.40	0.75	1.28	± 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: ES3DV3 - SN:3304

Calibration Parameter Determined in Body Tissue Simulating Media

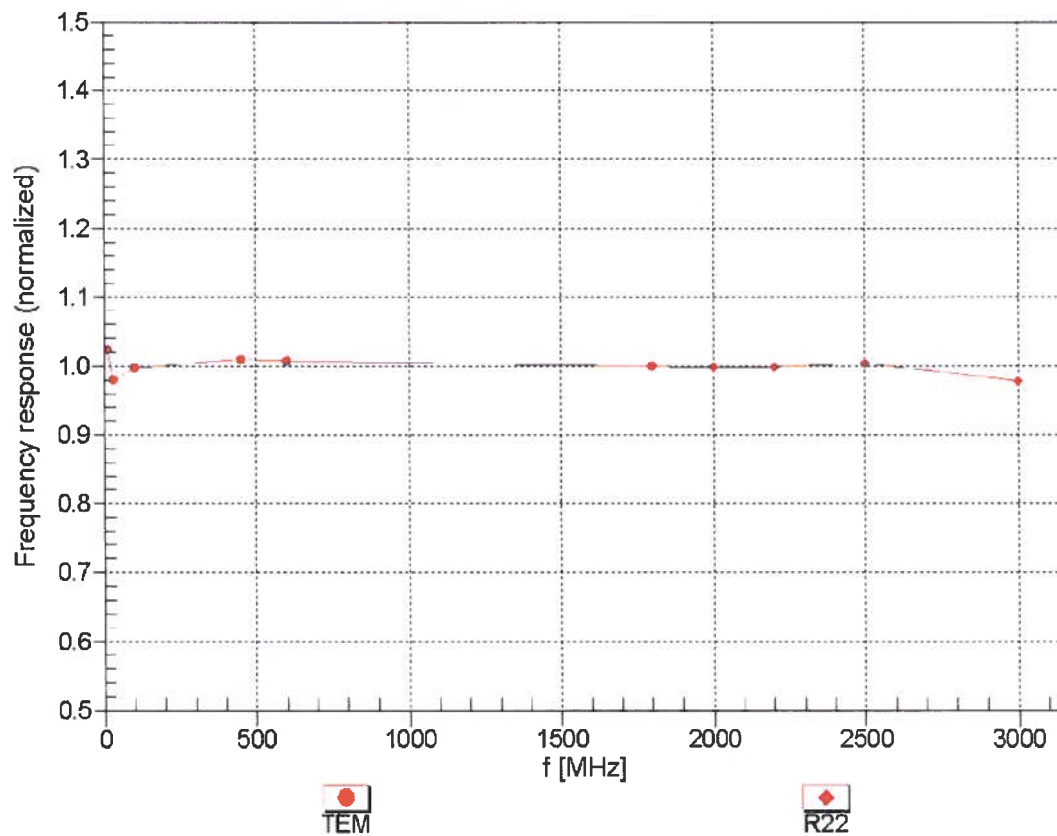
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.25	6.25	6.25	0.58	1.30	± 12.0 %
835	55.2	0.97	6.13	6.13	6.13	0.60	1.32	± 12.0 %
900	55.0	1.05	6.11	6.11	6.11	0.80	1.18	± 12.0 %
1750	53.4	1.49	5.15	5.15	5.15	0.45	1.78	± 12.0 %
1900	53.3	1.52	4.88	4.88	4.88	0.70	1.35	± 12.0 %
2100	53.2	1.62	4.94	4.94	4.94	0.64	1.43	± 12.0 %
2450	52.7	1.95	4.32	4.32	4.32	0.74	1.09	± 12.0 %
2600	52.5	2.16	4.16	4.16	4.16	0.68	0.99	± 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

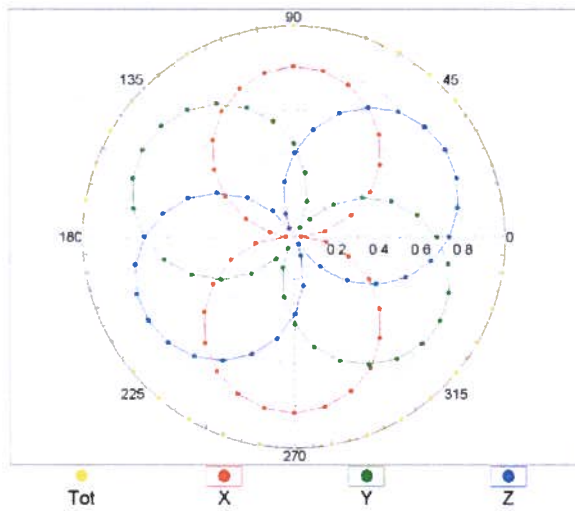
(TEM-Cell:ifi110 EXX, Waveguide: R22)



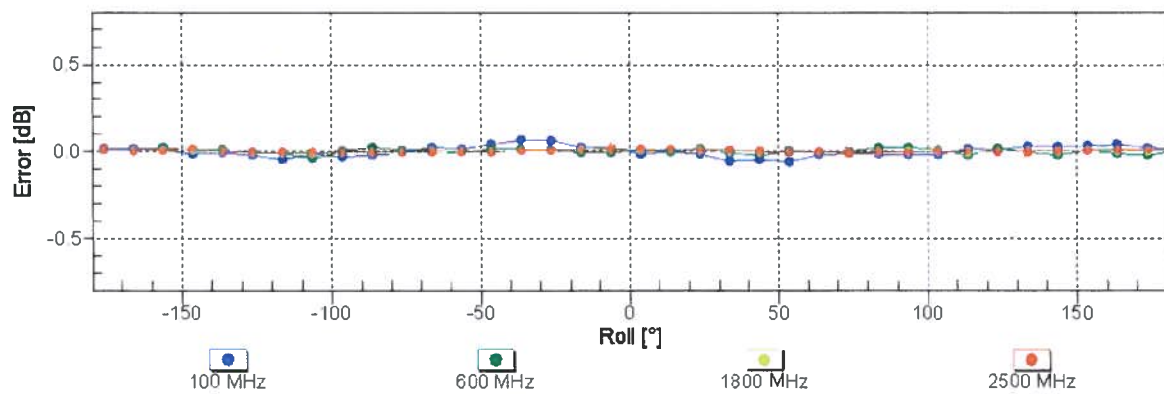
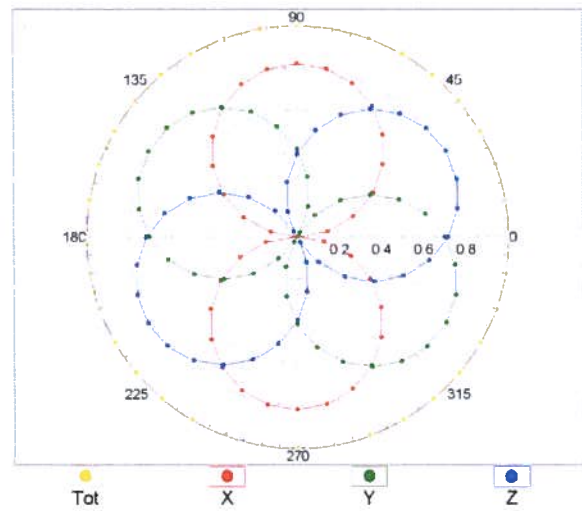
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

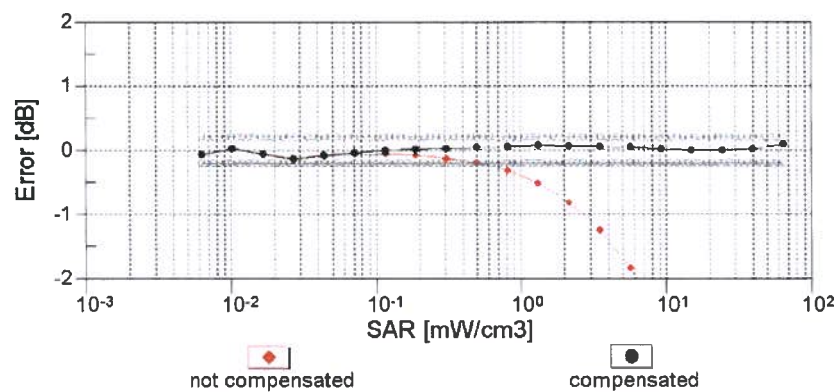
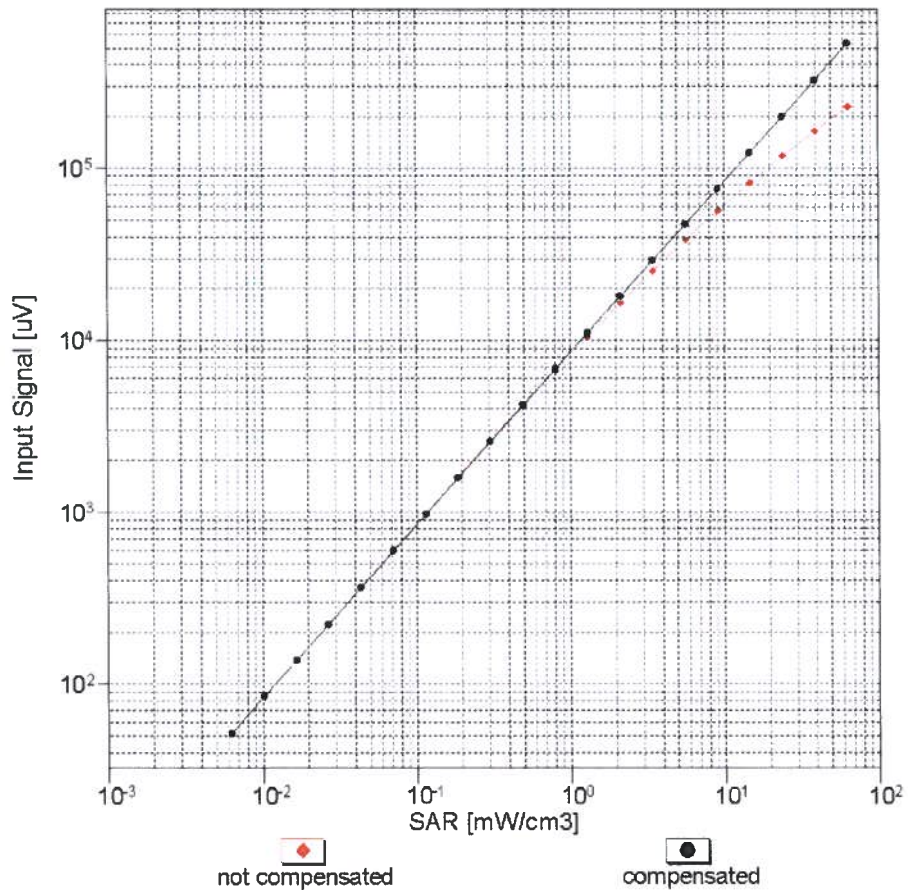


f=1800 MHz,R22



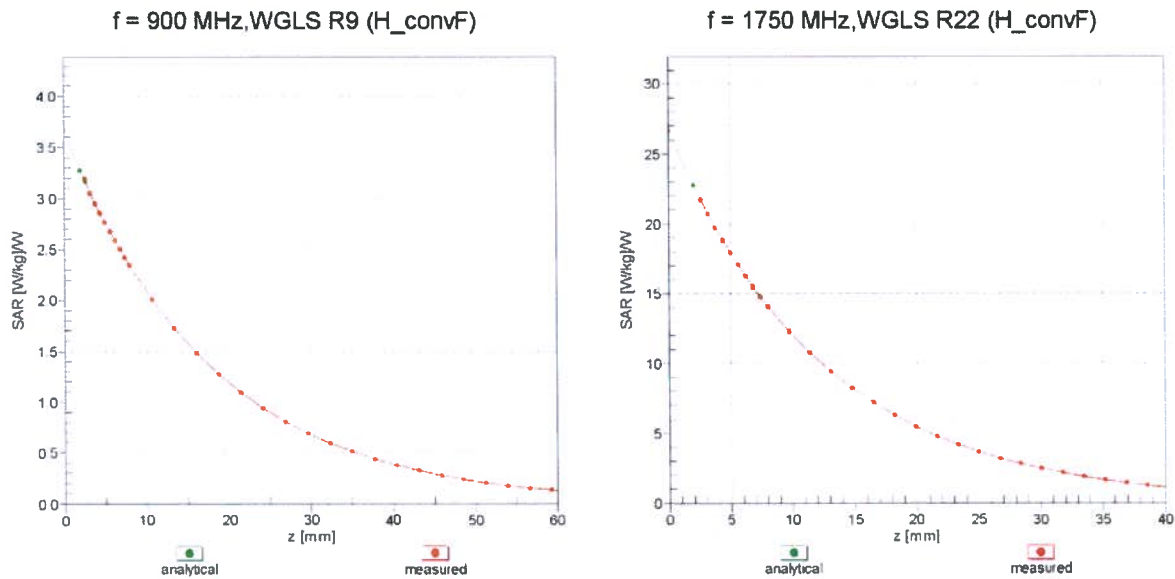
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



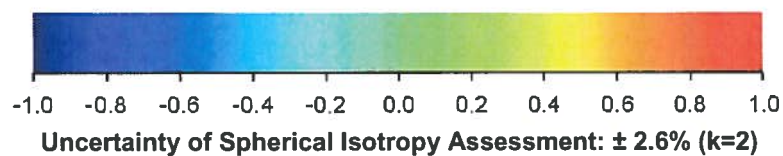
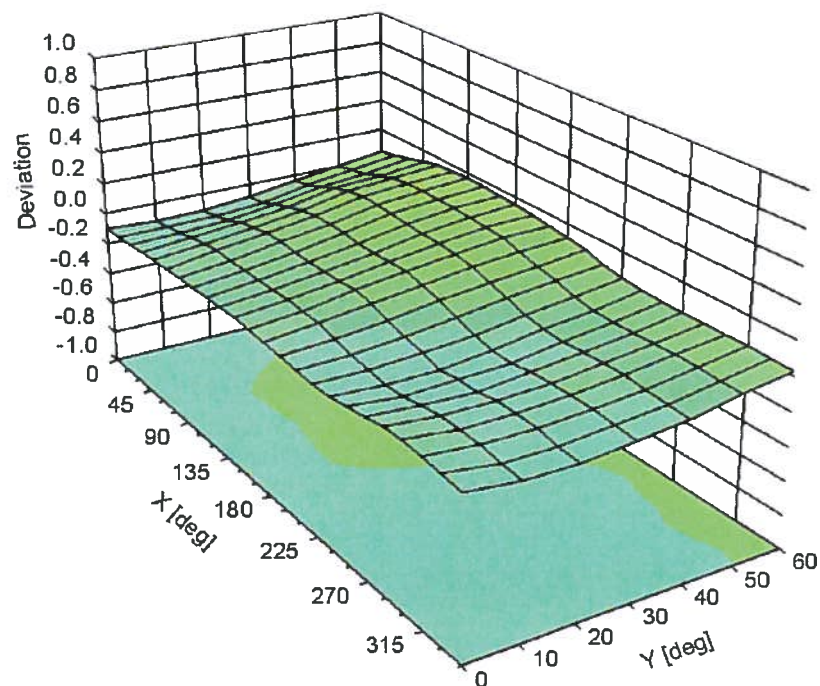
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3304

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	33.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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

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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

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "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
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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:

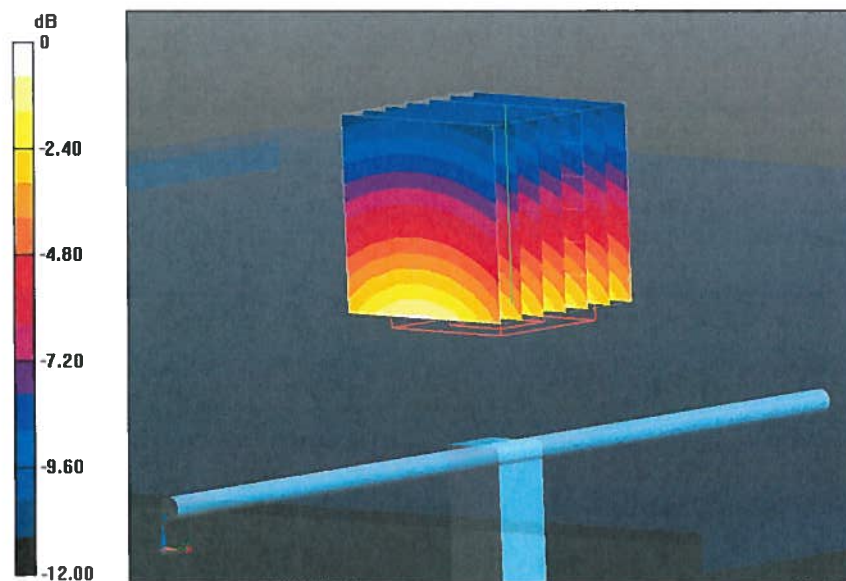
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

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

Peak SAR (extrapolated) = 3.926 mW/g

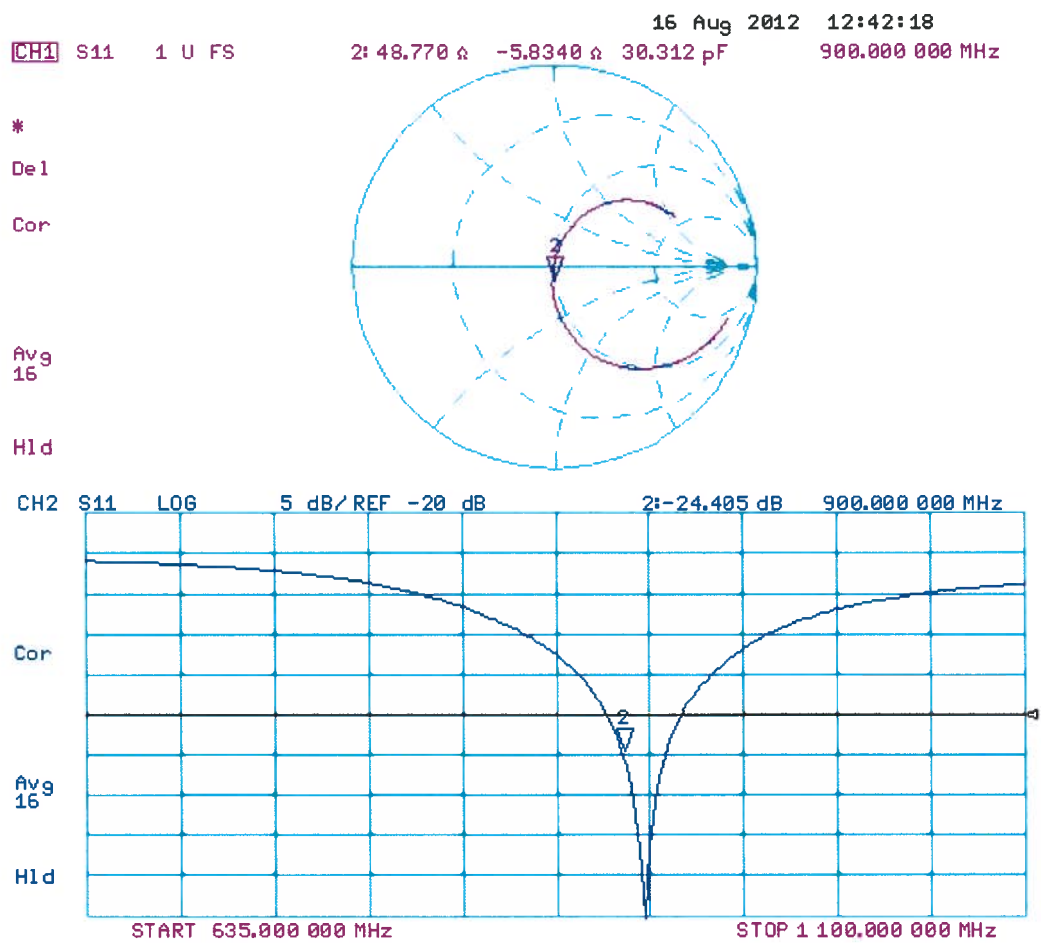
SAR(1 g) = 2.62 mW/g; SAR(10 g) = 1.68 mW/g

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: $f = 900 \text{ MHz}$; $\sigma = 1.06 \text{ mho/m}$; $\epsilon_r = 52.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.94, 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:

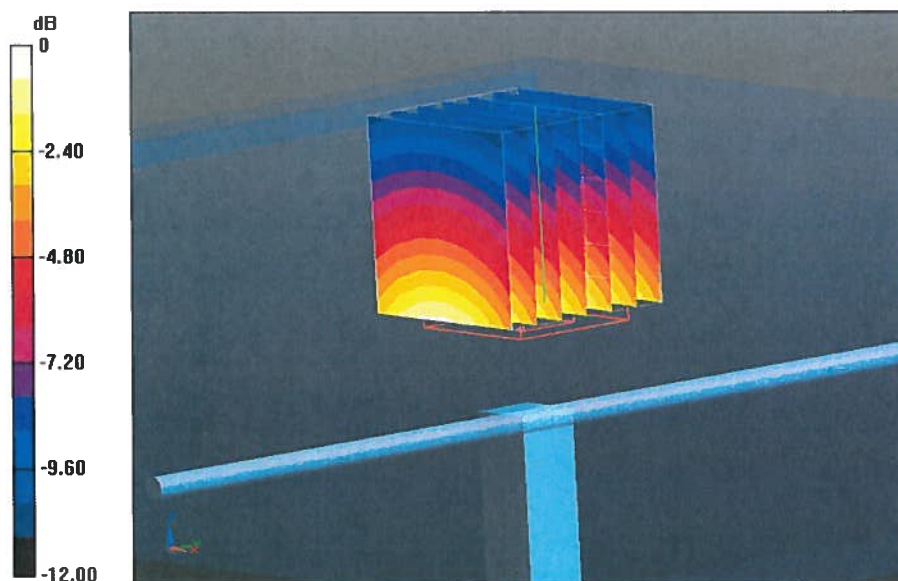
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 4.184 mW/g

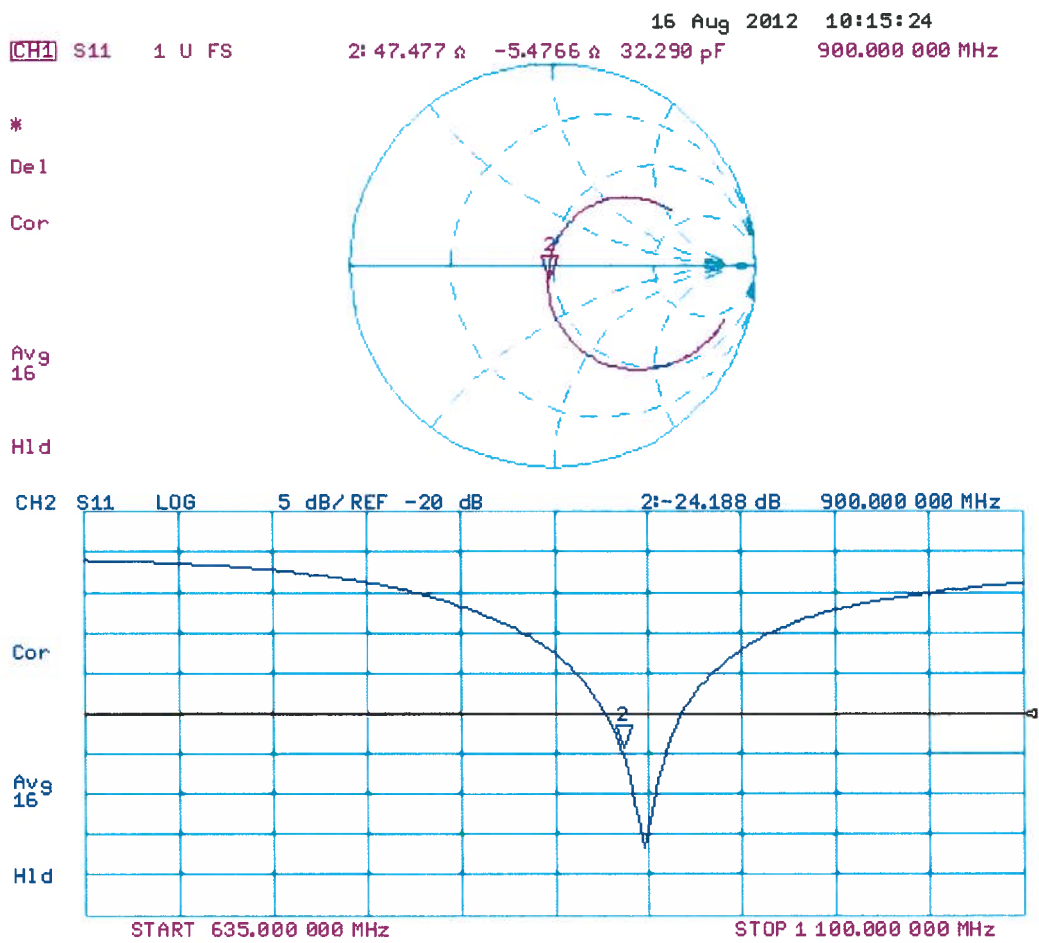
SAR(1 g) = 2.74 mW/g; SAR(10 g) = 1.76 mW/g

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





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

Checked by: *[Signature]* Date: *Sept 1 2012*

Accredited by the Swiss Accreditation Service (SAS) *ASSET: A2290*
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RFI**

Certificate No: **D1900V2-537_Aug12**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 537**

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

Calibration date: **August 14, 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 $(22 \pm 3)^\circ\text{C}$ 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	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:	Israa El-Naouq	Laboratory Technician	<i>[Signature]</i>
Approved by:	Katja Pokovic	Technical Manager	<i>[Signature]</i>

Issued: August 14, 2012

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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.

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	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	39.9 $\pm$ 6 %	1.38 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	9.78 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.4 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	5.16 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.7 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	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.5 $\pm$ 6 %	1.53 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	10.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.5 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	5.37 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.4 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.1 Ω - 5.7 j Ω
Return Loss	- 24.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.0 Ω - 5.2 j Ω
Return Loss	- 21.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.181 ns
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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	March 22, 2001

DASY5 Validation Report for Head TSL

Date: 14.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 537

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ mho/m; $\epsilon_r = 39.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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

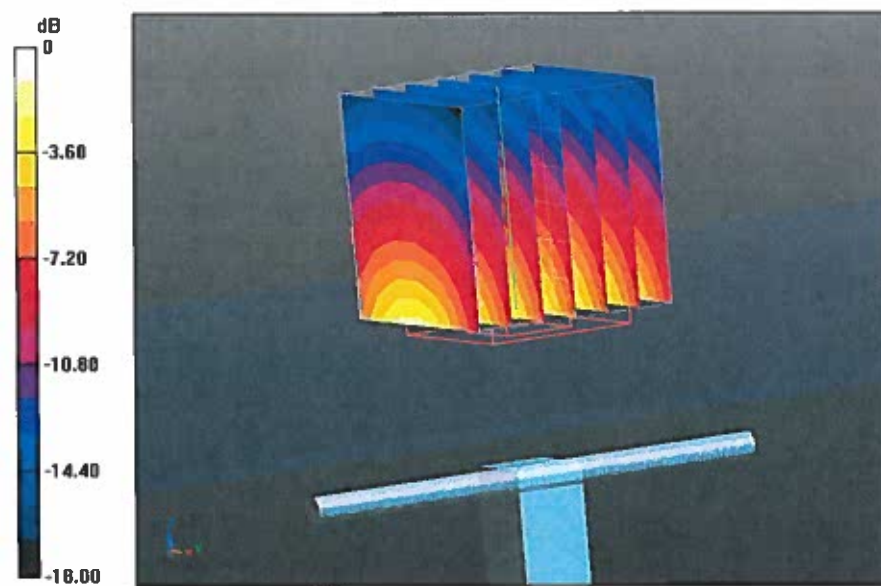
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.874 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 17.436 mW/g

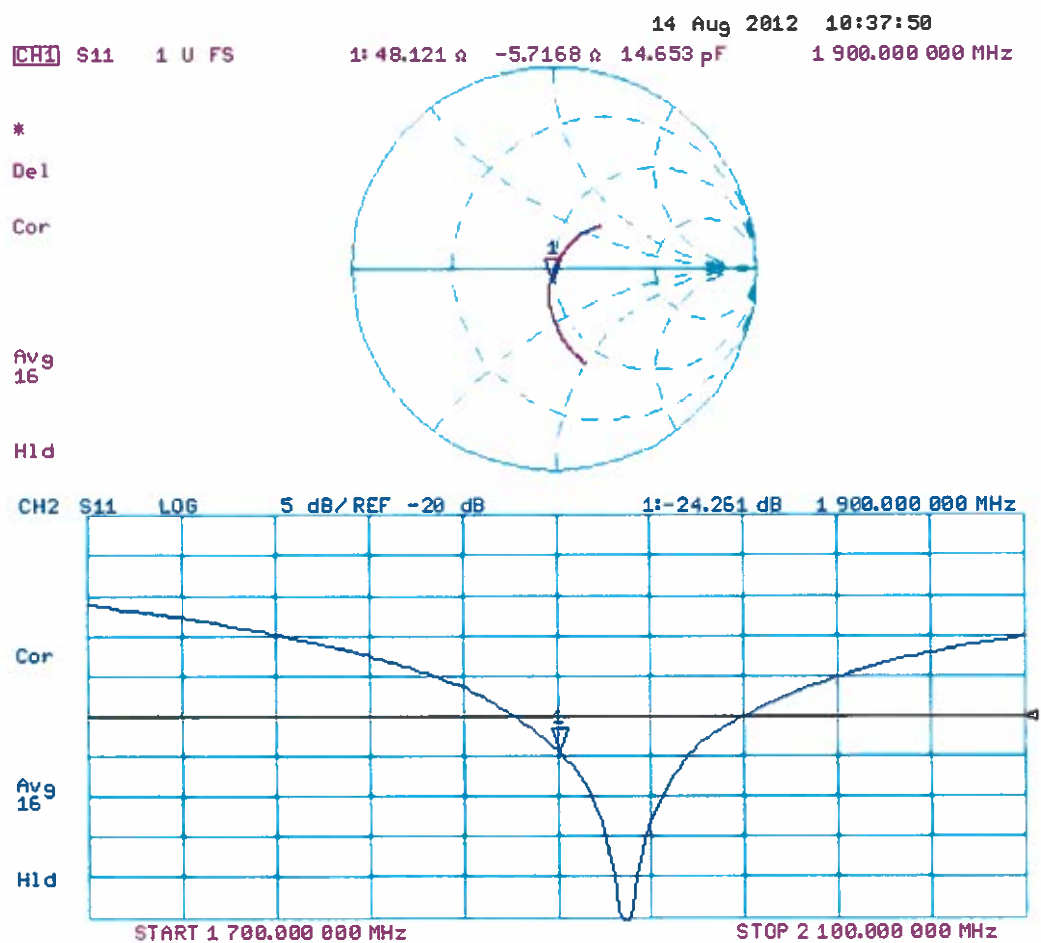
SAR(1 g) = 9.78 mW/g; SAR(10 g) = 5.16 mW/g

Maximum value of SAR (measured) = 11.9 W/kg



0 dB = 11.9 W/kg = 21.51 dB W/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 14.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 537

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.53$ mho/m; $\epsilon_r = 52.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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

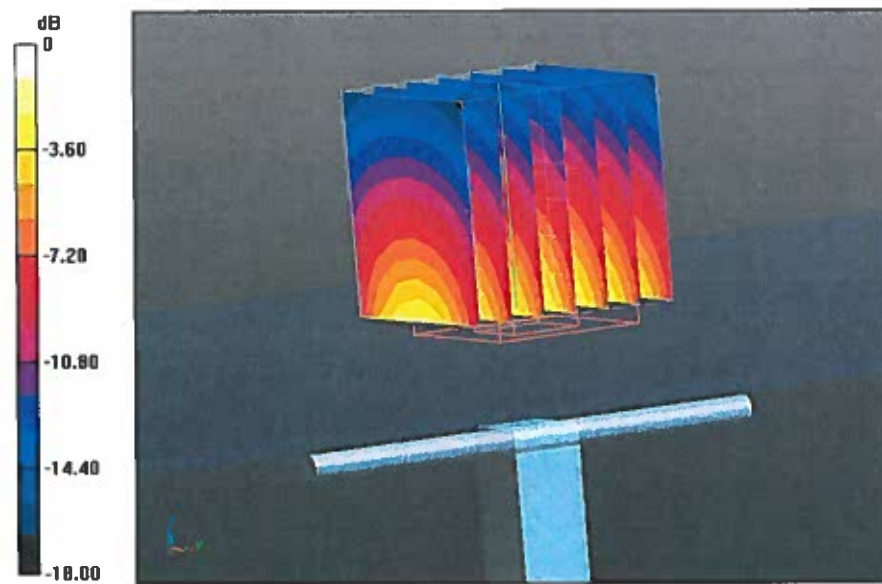
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.874 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 17.899 mW/g

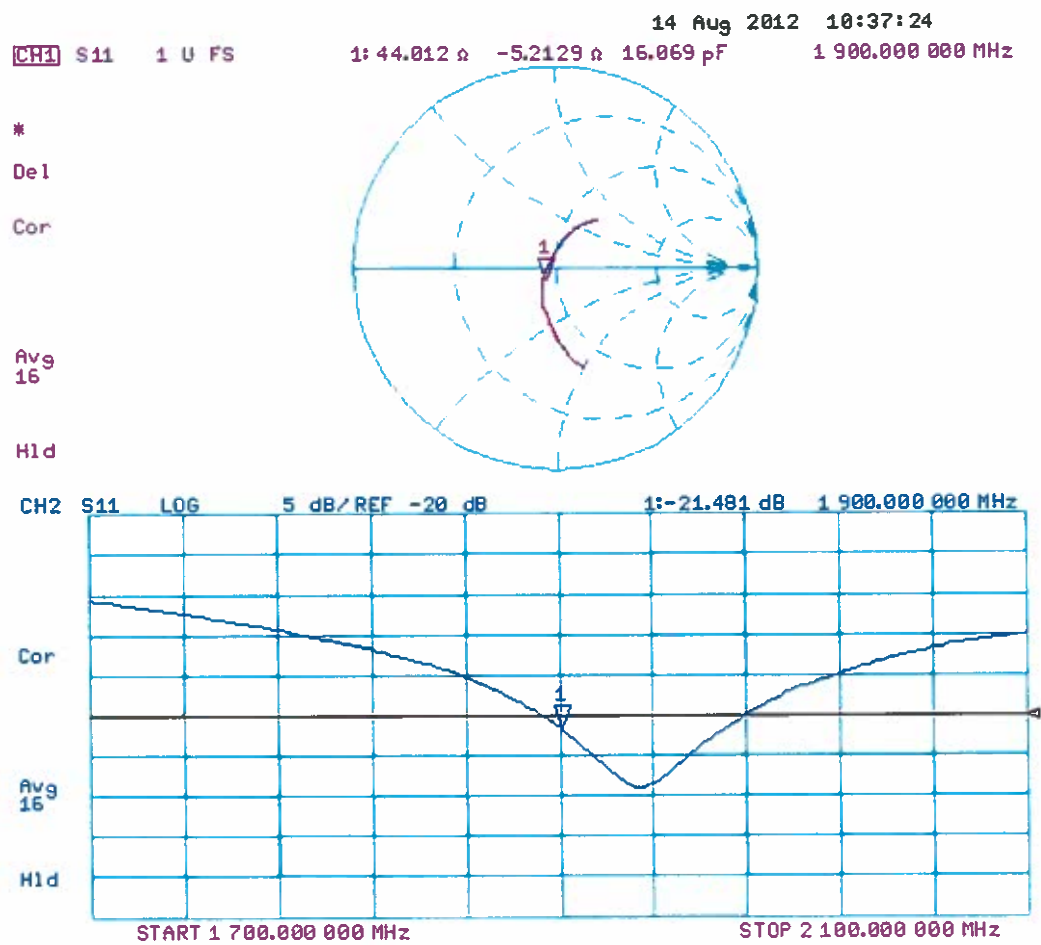
SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.37 mW/g

Maximum value of SAR (measured) = 12.8 W/kg



0 dB = 12.8 W/kg = 22.14 dB W/kg

Impedance Measurement Plot for Body TSL





Checked by *R. D.* DATE: 7 ^{Sept} August 2012

Accredited by the Swiss Accreditation Service (SAS) *ASSET A 2202*
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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RFI**

Certificate No: **D2440V2-701_Aug12**

CALIBRATION CERTIFICATE

Object **D2440V2 - SN: 701**

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

Calibration date: **August 13, 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 $(22 \pm 3)^{\circ}\text{C}$ 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	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

Calibrated by: **Israe El-Naouq** **Function**
Laboratory Technician

Signature

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

Issued: August 13, 2012

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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.

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	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	39.2 $\pm$ 6 %	1.81 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	52.3 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	6.06 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.2 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 $\pm$ 0.2) °C	51.3 $\pm$ 6 %	1.99 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	52.0 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	6.09 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.1 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.4 Ω - 8.2 j Ω
Return Loss	- 21.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8 Ω - 6.9 j Ω
Return Loss	- 21.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.141 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 24, 2000

DASY5 Validation Report for Head TSL

Date: 13.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2440 MHz; Type: D2440V2; Serial: D2440V2 - SN: 701

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.81$ mho/m; $\epsilon_r = 39.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

Dipole Calibration for Head Tissue/ $P_{in}=250$ mW, $d=10$ mm/Zoom Scan (7x7x7)/Cube 0:

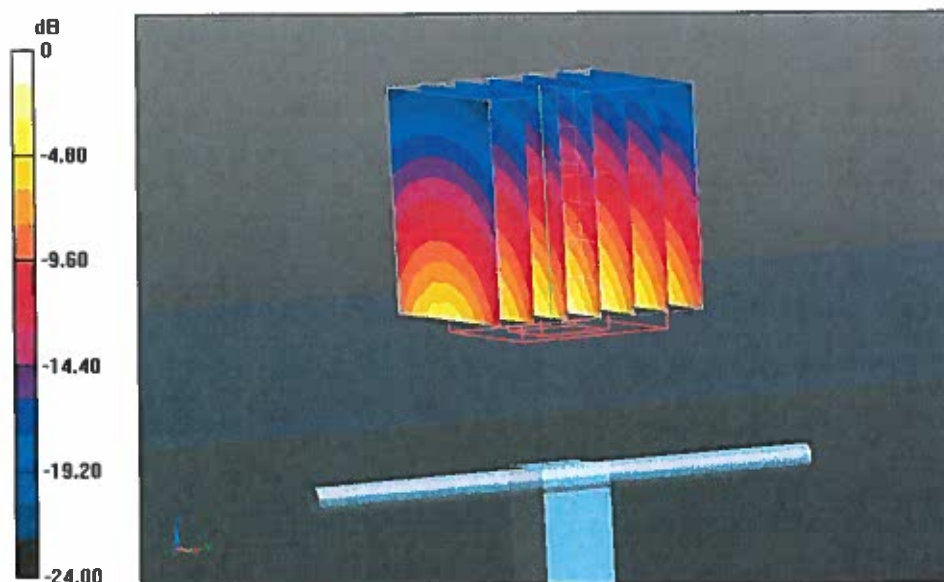
Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 99.955 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 27.027 mW/g

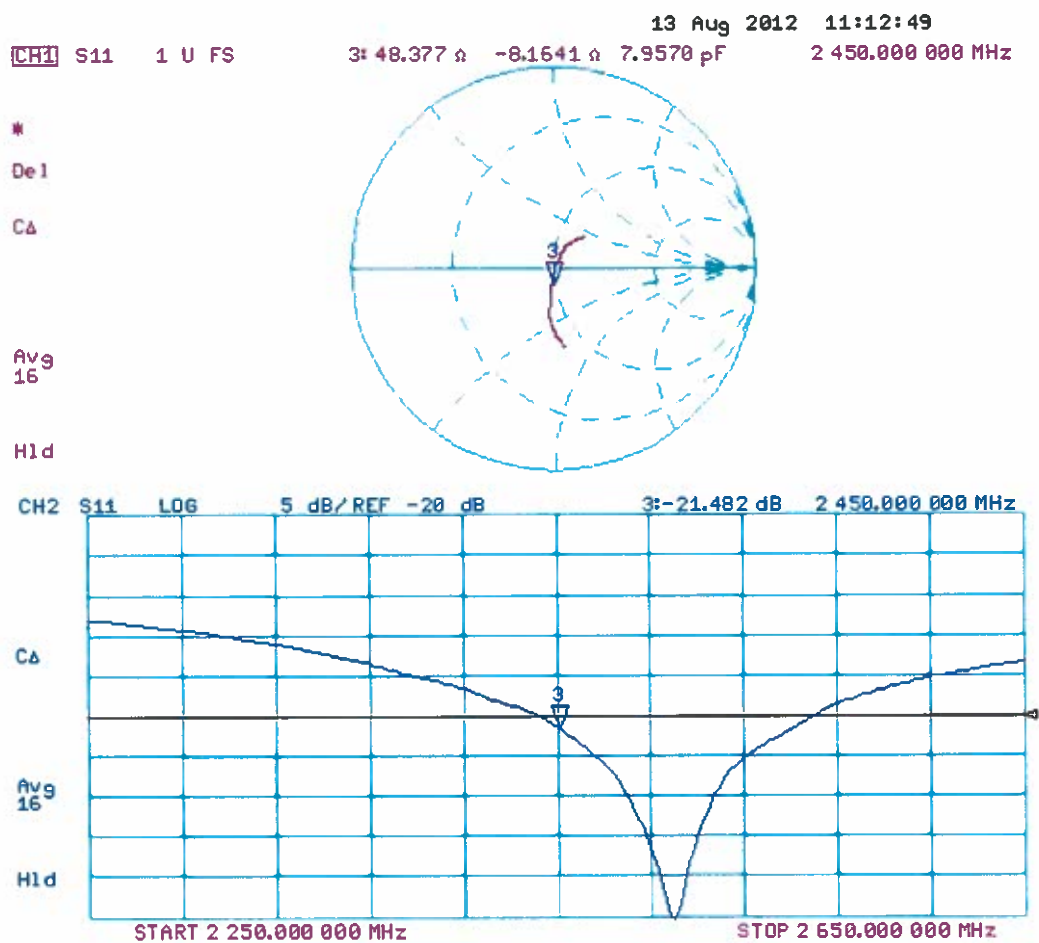
SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.06 mW/g

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



0 dB = 16.8 W/kg = 24.51 dB W/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2440 MHz; Type: D2440V2; Serial: D2440V2 - SN: 701

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 51.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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

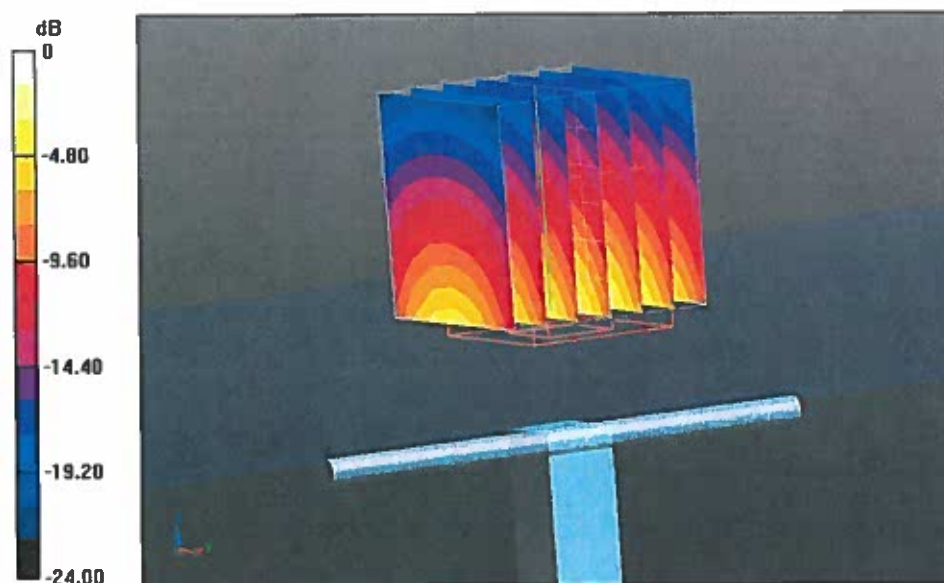
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.149 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 26.944 mW/g

SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.09 mW/g

Maximum value of SAR (measured) = 17.1 W/kg



0 dB = 17.1 W/kg = 24.66 dB W/kg

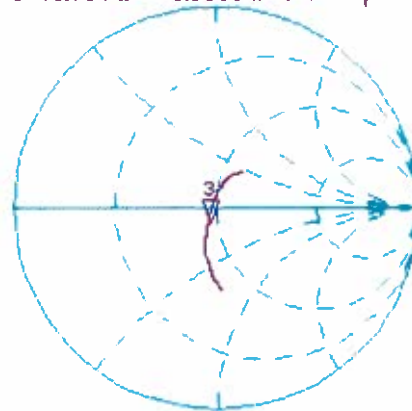
Impedance Measurement Plot for Body TSL

13 Aug 2012 11:12:17
 CH1 S11 1 U FS 3: 45.754 Ω -6.8809 Ω 9.4409 pF 2 450.000 000 MHz

*
 De1
 CA

Avg
 16

H1d

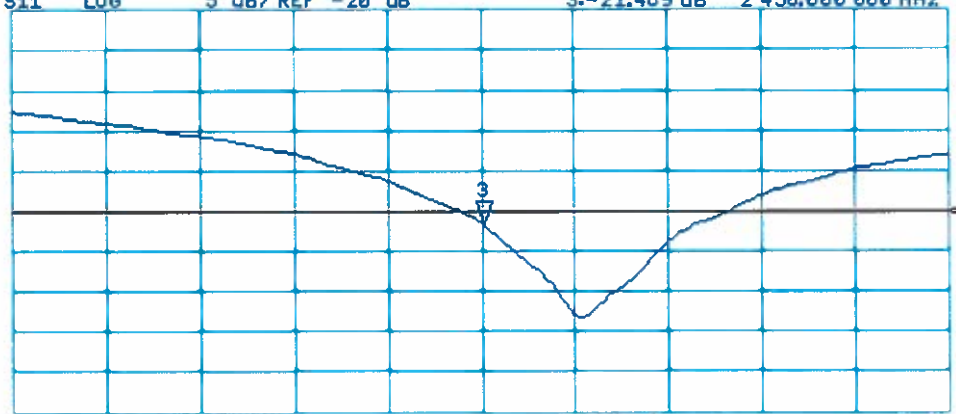


CH2 S11 LOG 5 dB/REF -20 dB 3:-21.489 dB 2 450.000 000 MHz

CA

Avg
 16

H1d



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz



checked by [signature]

DATE: 26-FEB-2013

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**

A1377

Certificate No: **D5GHzV2-1016_Feb13**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1016**

Calibration procedure(s) **QA CAL-22.v2
Calibration procedure for dipole validation kits between 3-6 GHz**

Calibration date: **February 20, 2013**

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	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_Dec12)	Dec-13
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-12)	In house check: Oct-13

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

Issued: February 20, 2013

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- b) 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:

- c) 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	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz $\pm$ 1 MHz 5500 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	34.7 $\pm$ 6 %	4.47 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.88 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.1 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.3 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	34.2 $\pm$ 6 %	4.74 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.5 W / kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.5 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.9 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.9 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.9 ± 6 %	5.36 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.58 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	5.71 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.98 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.0 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	45.9 ± 6 %	6.12 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.51 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.6 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	52.7 Ω - 9.7 j Ω
Return Loss	- 20.2 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	48.5 Ω - 0.8 j Ω
Return Loss	- 35.3 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	57.1 Ω + 7.1 j Ω
Return Loss	- 20.6 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	53.2 Ω - 9.1 j Ω
Return Loss	- 20.6 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	48.7 Ω - 0.2 j Ω
Return Loss	- 37.3 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	57.1 Ω + 8.7 j Ω
Return Loss	- 19.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 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	November 14, 2003

DASY5 Validation Report for Head TSL

Date: 20.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1016

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: $f = 5200$ MHz; $\sigma = 4.47$ S/m; $\epsilon_r = 34.7$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.74$ S/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.05$ S/m; $\epsilon_r = 33.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 28.12.2012, ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.875 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 29.2 W/kg

SAR(1 g) = 7.88 W/kg; SAR(10 g) = 2.26 W/kg

Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.120 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 33.0 W/kg

SAR(1 g) = 8.34 W/kg; SAR(10 g) = 2.38 W/kg

Maximum value of SAR (measured) = 20.1 W/kg

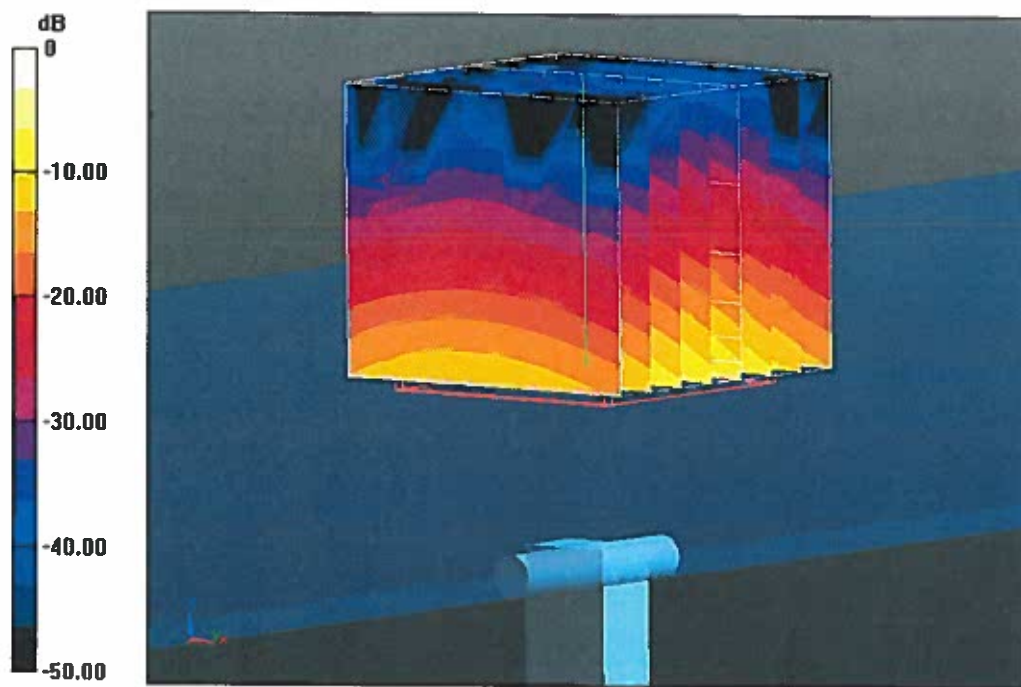
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 61.682 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 32.4 W/kg

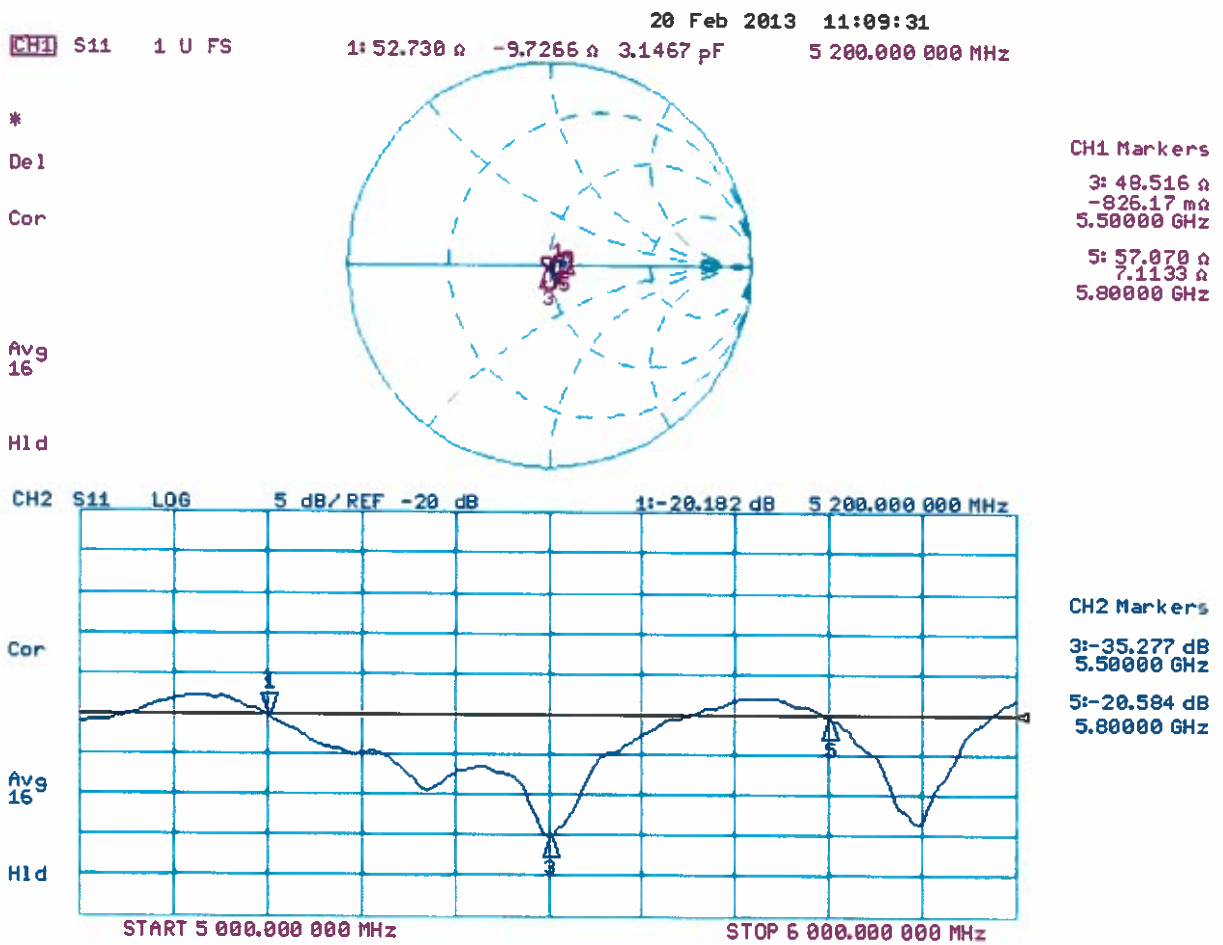
SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (measured) = 19.1 W/kg



0 dB = 19.1 W/kg = 12.81 dBW/kg

Impedance Measurement Plot for Head TSL



Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1016

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: $f = 5200$ MHz; $\sigma = 5.36$ S/m; $\epsilon_r = 46.9$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.71$ S/m; $\epsilon_r = 46.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.12$ S/m; $\epsilon_r = 45.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.43, 4.43, 4.43); Calibrated: 28.12.2012, ConvF(4.38, 4.38, 4.38); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 60.072 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 30.6 W/kg

SAR(1 g) = 7.58 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 18.0 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.550 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 35.1 W/kg

SAR(1 g) = 7.98 W/kg; SAR(10 g) = 2.23 W/kg

Maximum value of SAR (measured) = 19.5 W/kg

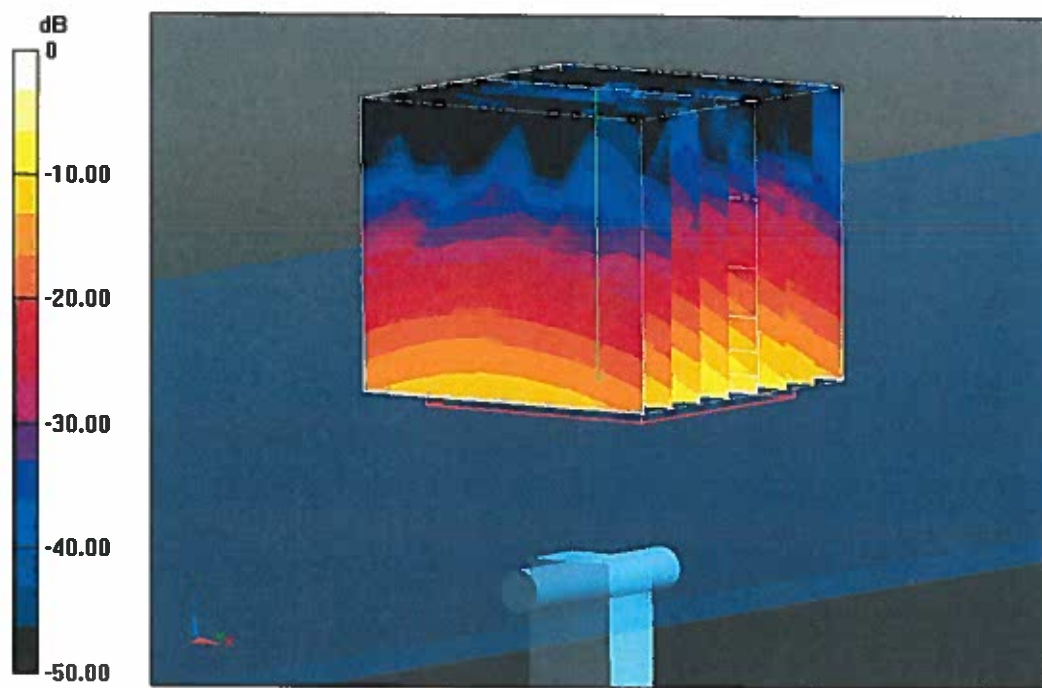
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 56.431 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 35.6 W/kg

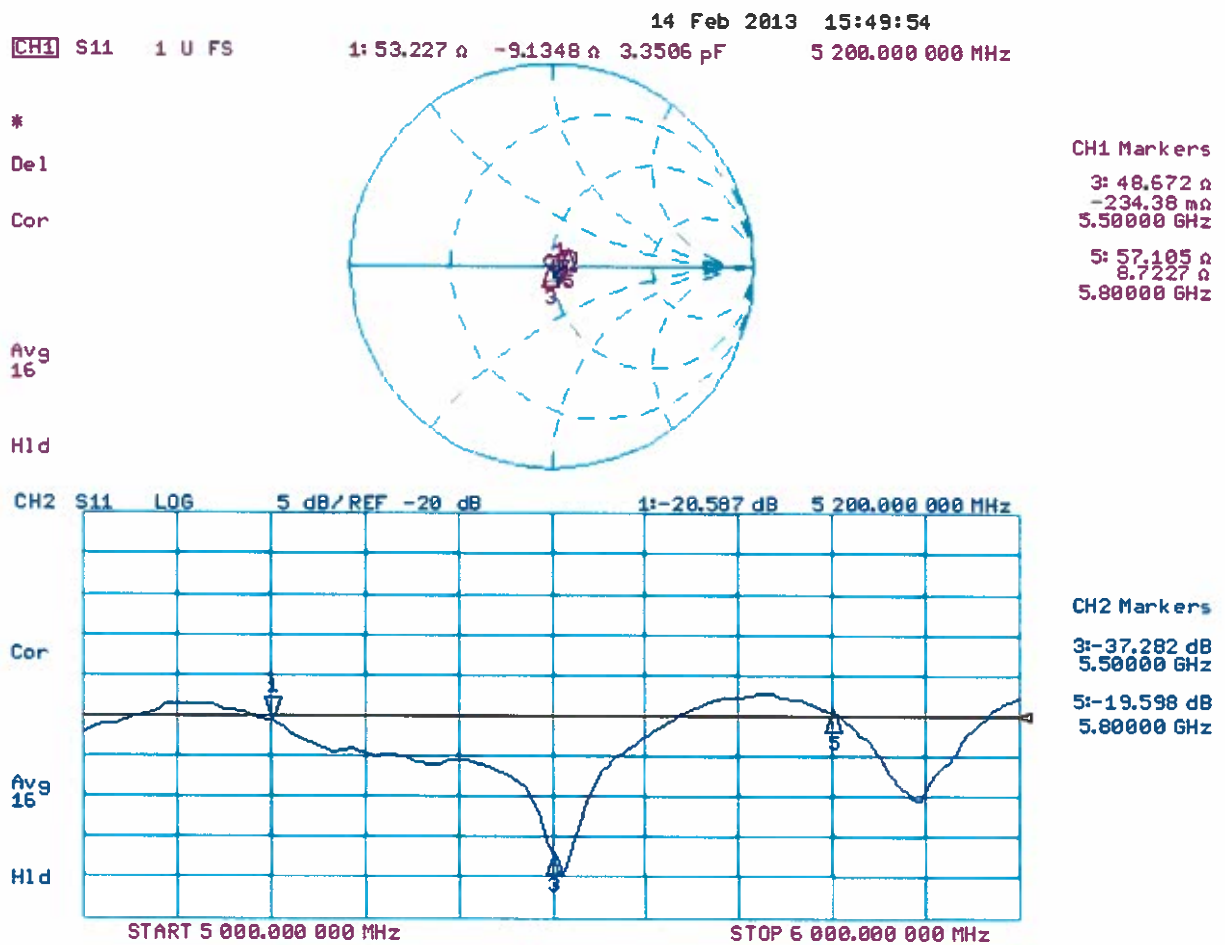
SAR(1 g) = 7.51 W/kg; SAR(10 g) = 2.09 W/kg

Maximum value of SAR (measured) = 18.8 W/kg



0 dB = 18.8 W/kg = 12.74 dBW/kg

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 were 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 < 2.0 GHz, 7x7x7 matrix for measurement 2.0 GHz to 3.0 GHz, and 7x7x12 for > 5.0 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 865664 D01 SAR Measurement 100 MHz to 6MHz

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

SAR measurements were performed in accordance with 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 FCC KDB publication 865664 D01.

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 for frequency below 2.0 GHz, above 2.0GHz up to 3.0 GHz 7x7x7 cube of 343 points and a 7x7x12 cube of 588 points for frequency 5.0 GHz and above 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 7x7x7 or 7x7x12 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.

A.2.3. Measurement Uncertainty Tables

A.2.3.1 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	2.600	2.600	normal (k=1)	1.0000	1.0000	2.600	2.600	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)	5.000	5.000	normal (k=1)	1.0000	0.6400	3.200	3.200	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	5.000	5.000	normal (k=1)	1.0000	0.6000	3.000	3.000	5
	Combined standard uncertainty			t-distribution			10.24	10.24	>250
	Expanded uncertainty			k = 1.96			20.08	20.08	>250

A.2.3.2 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		v _i or v _{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	4.200	4.200	normal (k=1)	1.0000	1.0000	4.200	4.200	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)	5.000	5.000	normal (k=1)	1.0000	0.6400	3.200	3.200	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	5.000	5.000	normal (k=1)	1.0000	0.6000	3.000	3.000	5
	Combined standard uncertainty			t-distribution			10.76	10.76	>250
	Expanded uncertainty			k = 1.96			21.09	21.09	>250

A.2.3.5 Specific Absorption Rate-PCS 1900 Head Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		v _i or v _{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	6.500	6.500	normal (k=1)	1.0000	1.0000	6.500	6.500	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)	5.000	5.000	normal (k=1)	1.0000	0.6400	3.200	3.200	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	5.000	5.000	normal (k=1)	1.0000	0.6000	3.000	3.000	5
	Combined standard uncertainty			t-distribution			11.85	11.85	>200
	Expanded uncertainty			k = 2			23.70	23.70	>200

A.2.3.6 Specific Absorption Rate-PCS / GPRS / EDGE 1900 Body Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		v _i or v _{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	2.800	2.800	normal (k=1)	1.0000	1.0000	2.800	2.800	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)	5.000	5.000	normal (k=1)	1.0000	0.6400	3.200	3.200	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	5.000	5.000	normal (k=1)	1.0000	0.6000	3.000	3.000	5
	Combined standard uncertainty			t-distribution			10.30	10.30	>250
	Expanded uncertainty			k = 1.96			20.18	20.18	>250

A.2.3.7 Specific Absorption Rate-Wi-Fi 2450 MHz Head Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		v _i or v _{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	2.180	2.180	normal (k=1)	1.0000	1.0000	2.180	2.180	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)	5.000	5.000	normal (k=1)	1.0000	0.6400	3.200	3.200	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	5.000	5.000	normal (k=1)	1.0000	0.6000	3.000	3.000	5
	Combined standard uncertainty			t-distribution			10.10	10.10	>300
	Expanded uncertainty			k = 1.96			19.79	19.79	>300

A.2.3.8 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	2.470	2.470	normal (k=1)	1.0000	1.0000	2.470	2.470	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)	5.000	5.000	normal (k=1)	1.0000	0.6400	3.200	3.200	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	5.000	5.000	normal (k=1)	1.0000	0.6000	3.000	3.000	5
	Combined standard uncertainty			t-distribution			10.16	10.16	>250
	Expanded uncertainty			k = 1.96			19.92	19.92	>250

A.2.3.9 Specific Absorption Rate-Wi-Fi 5GHz Head Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		v _i or v _{eff}
							+ u (%)	- u (%)	
B	Probe calibration	6.550	6.550	normal (k=1)	1.0000	1.0000	6.550	6.550	∞
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	2.090	2.090	normal (k=1)	1.0000	1.0000	2.090	2.090	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)	5.000	5.000	normal (k=1)	1.0000	0.6400	3.200	3.200	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	5.000	5.000	normal (k=1)	1.0000	0.6000	3.000	3.000	5
	Combined standard uncertainty			t-distribution			10.41	10.41	>400
	Expanded uncertainty			k = 1.96			20.41	20.41	>400

A.2.3.10 Specific Absorption Rate-Wi-Fi 5GHz Body Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		v _i or v _{eff}
							+ u (%)	- u (%)	
B	Probe calibration	6.550	6.550	normal (k=1)	1.0000	1.0000	6.550	6.550	∞
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	1.980	1.980	normal (k=1)	1.0000	1.0000	1.980	1.980	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)	5.000	5.000	normal (k=1)	1.0000	0.6400	3.200	3.200	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	5.000	5.000	normal (k=1)	1.0000	0.6000	3.000	3.000	5
	Combined standard uncertainty			t-distribution			10.39	10.39	>400
	Expanded uncertainty			k = 1.96			20.37	20.37	>400