SAR TEST REPORT

FCC 47 CFR Part 2.1093
Industry Canada RSS-102

RF-Exposure evaluation of portable equipment

Report Reference No. ....:	G0M-1407-3973-TFC093SR-V01
Testing Laboratory ....:	Eurofins Product Service GmbH
Address ....:	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation ....:	A2LA Accredited Testing Laboratory, Certificate No.: 1983.01 FCC Filed Test Laboratory, Reg.-No.: 96970 IC OATS Filing assigned code: 3470A
Applicant's name ....:	BARTEC PIXAVI AS
Address ....:	Domkirkeplassen 2 4006Stavanger NORWAY
Test specification:	
Standard..:	FCC 47 CFR Part 2 §2.1093 FCC OET Bulletin 65 Supplement C 01-01 IEEE Std. 1528-2003 IEEE Std. 1528 - 2013 IC RSS-102 Issue 4 Safety Code 6 (2009)
Non-standard test method…………..:	None
Test scope………….. ....:	complete Radio compliance test
Equipment under test (EUT):	
Product description	Smartphone
Model No.	ImpactX
Additional Model(s)	GravityX
Brand Name(s)	None
Hardware version	rev B0
Firmware / Software version	Android 4.2.2
Contains	FCC-ID: YML-X7SERIES IC: 9249A-X7SERIES
Test result	**Passed**

Possible test case verdicts:	
- neither assessed nor tested	N/N
- required by standard but not appl. to test object	N/A
- required by standard but not tested	N/T
- not requiredby standard for the test object	N/R
- test object does meet the requirement	P (Pass)
- test object does not meet the requirement	F (Fail)
Testing:	
Date of receipt of test item	2014-08-05
Date (s) of performance of tests	2014-10-22 - 2014-11-07

Compiled by	Matthias Handrik	
Tested by (+ signature) (Responsible for Test)	Matthias Handrik	Handrik
Approved by (+ signature)	Christian Weber	C. Weber
Date of issue	2014-11-17	
Total number of pages	145	

General remarks:

The test results presented in this report relate only to the object tested.
The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

Additional comments:

The additional model GravityX is identical to the model ImpactX. Both models use the same pcb and the same software. Only the mobile communication module is deactivated. Therefore the results for the Bluetooth and WiFi operational modes are applicable to both models.

Version History

Version	Issue Date	Remarks	Revised by
01	2014-11-17	Initial Release	

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1 Equipment (Test item) Description

Description	Smartphone	
Model	ImpactX	
Additional Model(s)	GravityX	
Brand Name(s)	None	
Serial number	None	
Hardware version	rev B0	
Software / Firmware version	Android 4.2.2	
Contains FCC-ID	YML-X7SERIES	
Contains IC	9249A-X7SERIES	
Equipment type	End product	
Prototype or production unit	Identical Prototype	
Device category	Handset	
Environment	General public	
Radio technologies	GSM 850 PCS 1900 W-CDMA FDDII W-CDMA FDDIV W-CDMA FDDV WLAN IEEE 802.11a,b,g,n Bluetooth	
Operating frequency ranges	GSM 850: 824 MHz - 849 MHz PCS 1900: 1850 MHz - 1910 MHz W-CDMA FDDII: 1850 MHz - 1910 MHz W-CDMA FDDIV: 1710 MHz - 1755 MHz W-CDMA FDDV: 824 MHz - 849 MHz WLAN IEEE 802.11 b, g, n: 2412 – 2472 MHz (20 MHz) WLAN IEEE 802.11 a, n: 5180 – 5240 MHz (20 MHz) Bluetooth: 2400 MHz - 2483.5 MHz	
Antenna 1 (WLAN / Bluetooth)	Type	integrated
	Model	M830510
	Manufacturer	Ethertronics
	Gain	1.1 (2.4 GHz) / 3.5 (5 GHz)
Antenna 2 (Mobile Communications)	Type	integrated
	Model	A10340
	Manufacturer	antenova
	Gain	1.7 (850 MHz) / 3.0 dBi (1850 MHz)

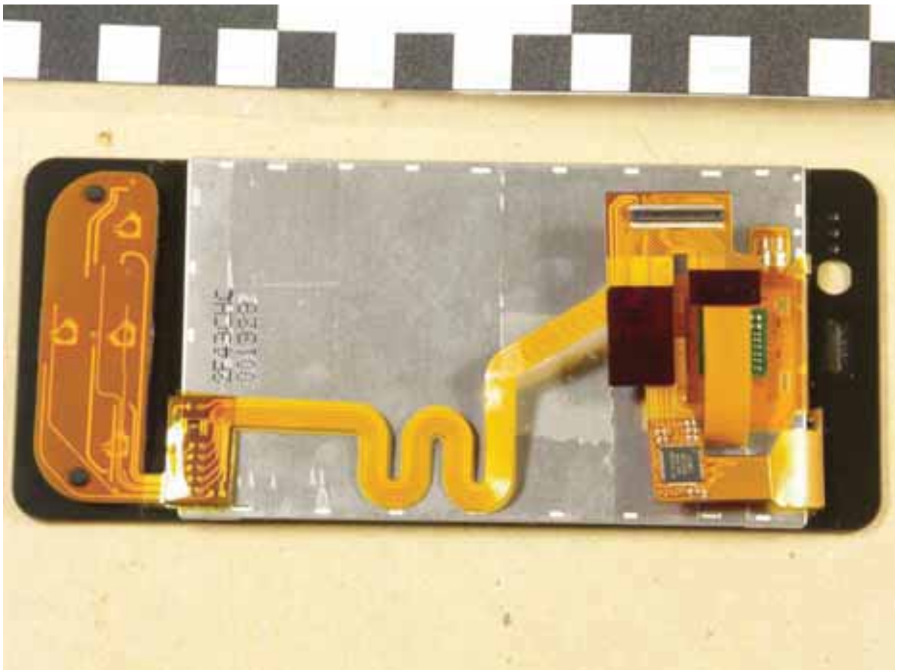
Power supply	V_{NOM}	3.7 VDC (Lithium Battery)
AC/DC-Adaptor	Model	AN4111
	Vendor	ANSMANN
	Input	100V-240V AC - 50/60Hz
	Output	5VDC
Accessories	Cradle	
Manufacturer	BARTEC PIXAVI AS Domkirkeplassen 2 4006Stavanger NORWAY	

1.1 Equipment photos

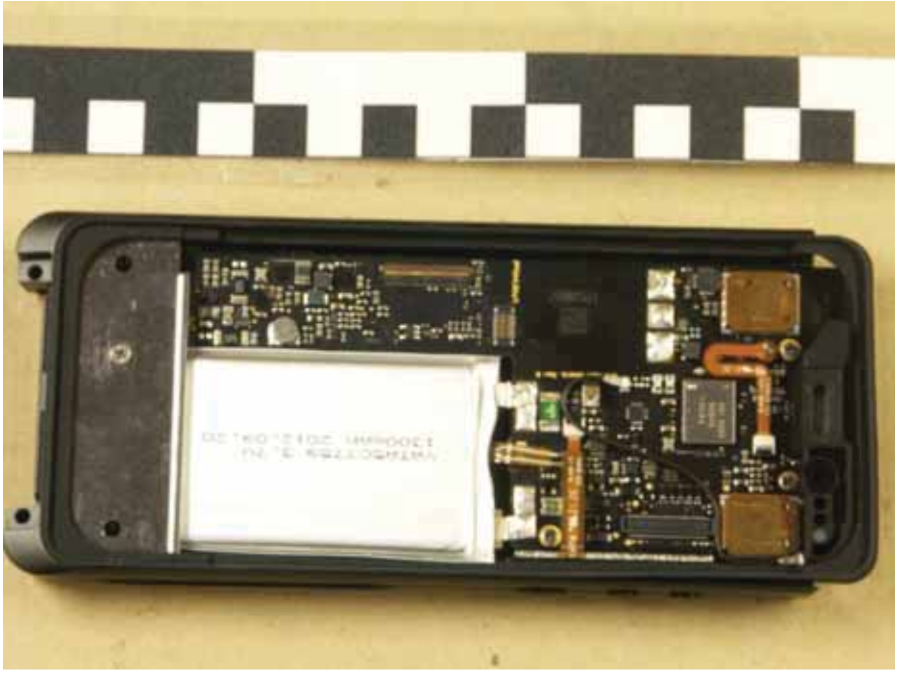
EUT FRONT

EUT BACK

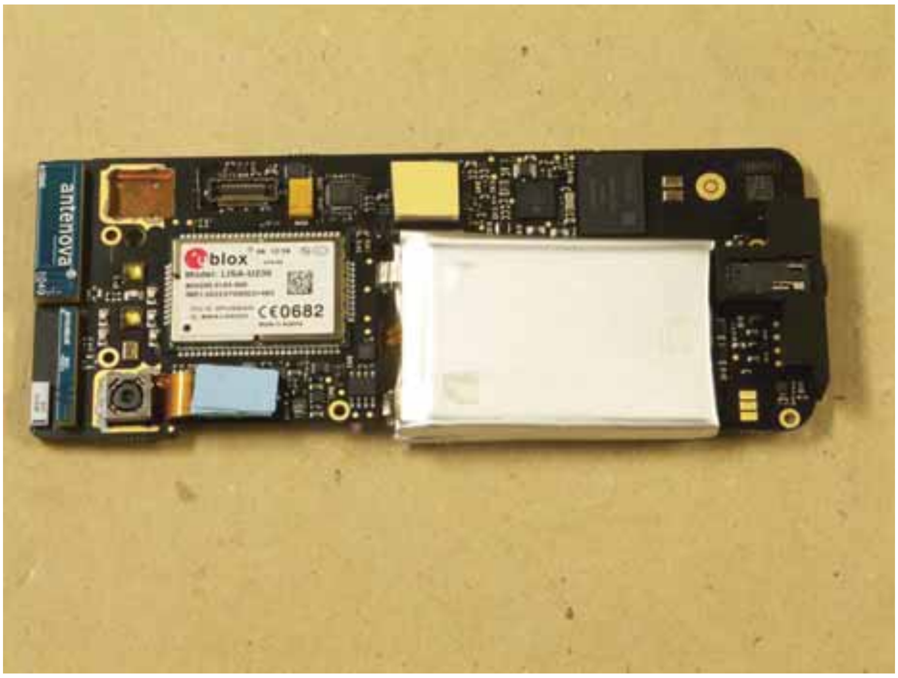
EUT ANTENNA


EUT Display back


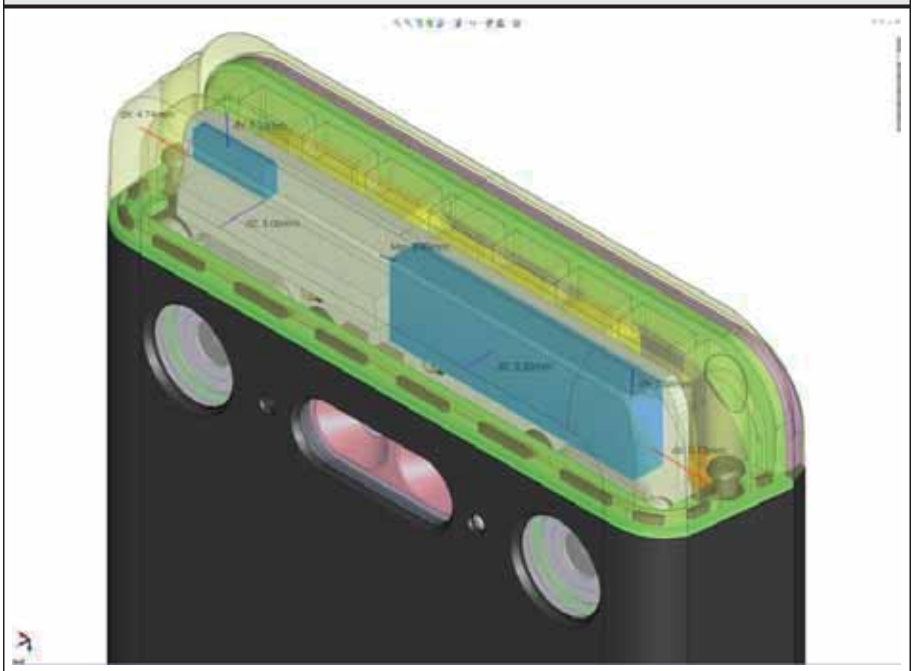
EUT PCB FRONT



EUT PCB BACK



EUT Antenna position



Plane	Distance to outer surface (WiFi Antenna)	Distance to outer surface (3G Antenna)
X	4.74 mm	6.13 mm
Y	3.24 mm	2.88 mm
Z	5.06 mm	3.20 mm

Distance from EUT backside antenna cover to cradle 10mm


EUT with Cradle 10mm distance to human body

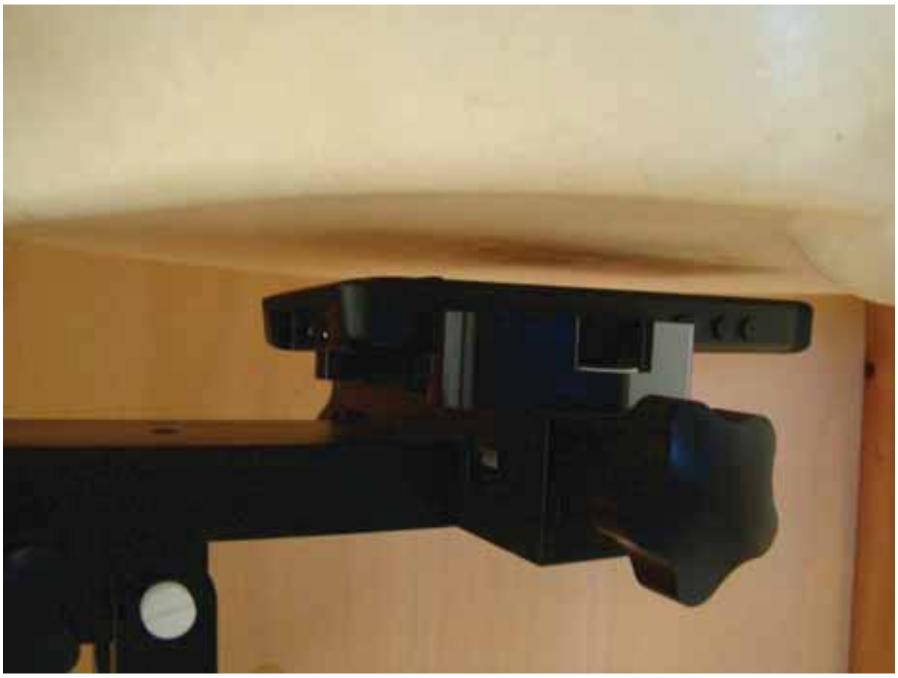

1.2 Equipment setup photos

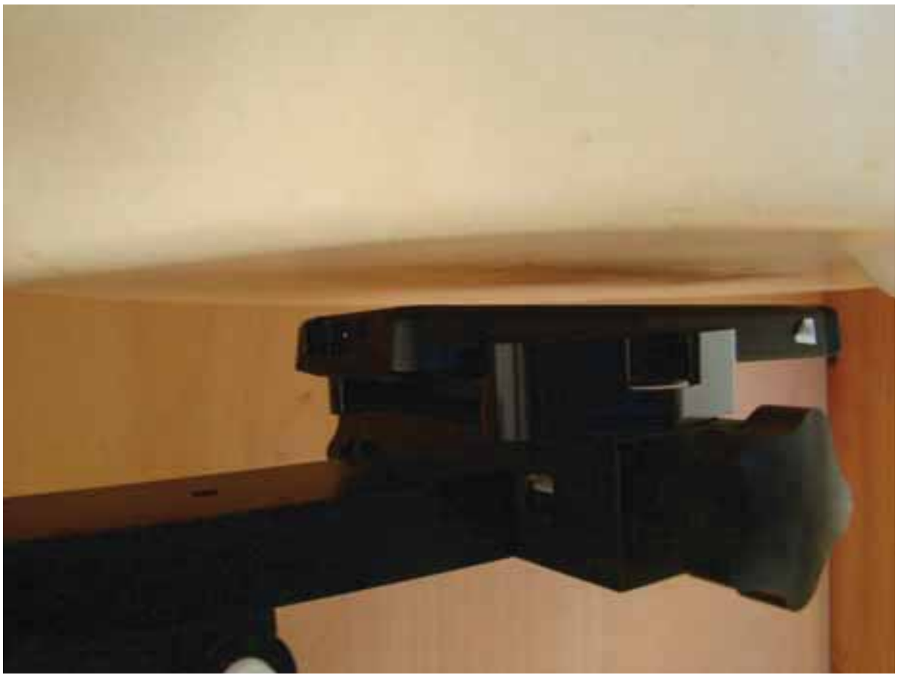
EUT HEAD Right Cheek

EUT HEAD Right Tilted

EUT HEAD Left Cheek


EUT HEAD Left Tilted


EUT FLAT front 10mm distance


EUT FLAT back 10mm distance


1.3 Reference Documents

Document
KDB Publication 447498 : Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Polices
KDB Publication 648474 : SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas
KDB Publication 648474 : Review and Approval Policies for SAR Evaluation of Handsets with Multiple Transmitters and Antennas
KDB Publication 865664 : SAR measurement procedures for devices operating between 100 MHz to 6 GHz
KDB Publication 941225: SAR Measurement Procedures for 3G Devices
KDB Publication 941225: 3GPP R6 HSPA and R7 HSPA+ SAR Guidance
KDB Publication 941225: Recommended SAR Test Reduction Procedures for GSM/GPRS/EDGE
KDB Publication 941225: SAR Test Consideration for LTE Handsets and Data Modems
KDB Publication 447498 : SAR Measurement Procedures for USB Dongle Transmitters
KDB Publication 248227 : SAR Measurement Procedures for 802.11 a/b/g Transmitters
KDB Publication 450824 : SAR Probe Calibration and System Verification considerations for measurements from 150 MHz to 3 GHz

1.4 Supporting Equipment Used During Testing

Product Type*	Device	Manufacturer	Model No.	Comments
SIM	Communication tester	Rohde & Schwarz	CMU 200	
SIM : Simulator (Not Subjected to Test)				

1.5 Supported standalone operating modes

Mode	Modulation	Frequency range	Duty cycle
GSM 850	GMSK	824 MHz - 849 MHz	50%
PCS 1900	GMSK	1850 MHz – 1910 MHz	50%
W-CDMA FDDII	QPSK	1850 MHz - 1910 MHz	100%
W-CDMA FDDIV	QPSK	1710 MHz - 1755 MHz	100%
W-CDMA FDDV	QPSK	824 MHz - 849 MHz	100%
802.11b/n 20MHz	DSSS	2412 – 2472 MHz	100%
802.11g/n 20MHz	OFDM	2412 – 2472 MHz	100%
802.11a/n 20 MHz	OFDM	5180 – 5320 MHz	100%
Bluetooth	GFSK	2400 MHz - 2483.5 MHz	78 %

1.6 Conducted Power Values

Bluetooth

Bluetooth							
Channel	Frequency [MHz]	Peak (Burst) RMS Power [dBm]			Source-based time averaged Power [dBm]		
		BR (GFSK)	EDR (PI/4-DQPSK)	EDR (8-DPSK)	BR (GFSK)	EDR (PI/4-DQPSK)	EDR (8-DPSK)
		DH5	2-DH5	3-DH5	DH5	2-DH5	3-DH5
0	2402	6.20	3.80	3.80	**5.09**	2.69	2.69
39	2441	6.20	4.20	4.20	**5.09**	3.09	3.09
78	2480	5.70	3.80	3.80	4.59	2.69	2.69

WLAN IEEE 802.11b

IEEE 802.11b						
Mode	Channel	Frequency	Source-based time average power [dBm]			
			Data Rate [Mbps]			
			1	2	5.5	11
IEEE 802.11b	1	2412	11.28	11.19	10.83	11.42
	6	2437	11.83	11.78	11.44	11.89
	11	2462	**12.28**	12.03	11.90	12.12

WLAN IEEE 802.11g

IEEE 802.11g										
Mode	Channel	Frequency	Source-based time average power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
IEEE 802.11g	1	2412	11.34	11.15	11.12	11.08	11.25	11.33	11.32	11.25
	6	2437	11.81	11.91	11.82	11.89	11.87	11.86	11.91	12.00
	11	2462	12.31	12.25	12.41	12.42	12.43	12.32	12.39	12.28

WLAN IEEE 802.11n

IEEE 802.11n / 20 MHz / Long Guard Interval / 1 Stream												
Mode	Channel	Frequency	Bandwidth [MHz]	Guard Interval [ns]	Source-based time average power [dBm]							
					Data Rate [Mbps]							
					MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
					6.5	13	19.5	26	39	52	58.5	65
IEEE 802.11n	1	2412	20	400/800	11.38	11.32	11.54	11.42	11.31	11.52	11.50	11.41
	6	2437	20	400/800	12.04	11.94	12.04	12.03	11.96	12.04	12.04	12.00
	11	2462	20	400/800	12.39	12.41	12.40	12.39	12.33	12.44	12.42	12.37

According to KDB 248227 v01r02 SAR measurements for 802.11g are not necessary because the conducted power values are not more than ¼ dB higher than the power values for 802.11b.

According to KDB 248227 v01r02 SAR measurements for 802.11n are not necessary because the conducted power values are not more than ¼ dB higher than the power values for 802.11b.

According to KDB 248227 v01r02 SAR measurements are performed for 802.11b and the lowest data rate of 1 Mbps.

WLAN IEEE 802.11a

IEEE 802.11a											
Mode	Band	Channel	Frequency	Source-based time average power [dBm]							
				Data Rate [Mbps]							
				6	9	12	18	24	36	48	54
IEEE 802.11a	U-NII-1	36	5180	6.47	6.59	6.46	6.61	6.61	6.48	6.52	6.53
		40	5200	6.45	6.44	6.43	6.48	6.47	6.47	6.47	6.40
		44	5220	6.27	6.26	6.26	6.29	6.29	6.29	6.25	6.33
		48	5240	6.26	6.25	6.24	6.30	6.28	6.16	6.23	6.22
	U-NII-2	52	5260								
		56	5280								
		60	5300								
		64	5320								
	U-NII-2e	100	5500								
		104	5520								
		108	5540								
		112	5560								
		116	5580								
		120	5600								
		124	5620								
		128	5640								
		132	5660								
		136	5680								
		140	5700								
	U-NII-3	149	5745								
		153	5765								
		157	5785								
		161	5805								
		165	5825								

WLAN IEEE 802.11n

IEEE 802.11n / 20 MHz / Long Guard Interval / 1 Stream													
Mode	Band	Channel	Frequency	Bandwidth [MHz]	Guard Interval [ns]	Source-based time average power [dBm]							
						Data Rate [Mbps]							
						MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
						6.5	13	19.5	26	39	52	58.5	65
IEEE 802.11n	U-NII-1	36	5180	20	400/800	6.42	6.47	6.37	6.46	6.47	6.47	6.46	6.45
		40	5200			6.41	6.32	6.35	6.33	6.46	6.33	6.31	6.41
		44	5220			6.24	6.27	6.18	6.16	6.28	6.16	6.26	6.20
		48	5240			6.13	6.16	6.17	6.17	6.17	6.16	6.15	6.19
	U-NII-2	52	5260	20	400/800								
		56	5280										
		60	5300										
		64	5320										
	U-NII-2e	100	5500	20	400/800								
		104	5520										
		108	5540										
		112	5560										
		116	5580										
		120	5600										
		124	5620										
		128	5640										
		132	5660										
		136	5680										
		140	5700										
	U-NII-3	149	5745	20	400/800								
		153	5765										
		157	5785										
		161	5805										
		165	5825										

According to KDB 248227 v01r02 SAR measurements for 802.11n are not necessary because the conducted power values are not more than ¼ dB higher than the power values for 802.11a.

According to KDB 248227 v01r02 SAR measurements are performed for 802.11a and the lowest data rate of 6 Mbps.

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GSM 850

GSM850																
Band	Mode	Channel	Frequency [MHz]	Coding	Traffic Mode	Number Timeslots	Power Level	Power TS 1 [dBm]	Power TS 2 [dBm]	Power TS 3 [dBm]	Power TS 4 [dBm]	Power TS 5 [dBm]	Power TS 6 [dBm]	Power TS 7 [dBm]	Power TS 8 [dBm]	Source-based time average Power [dBm]
850	GSM	128	824.2	FR V1	FR V1	1	PCL 5	32.30								23.27
850	GSM	190	836.6	FR V1	FR V1	1	PCL 5	32.30								23.27
850	GSM	251	848.0	FR V1	FR V1	1	PCL 5	32.30								23.27
850	GPRS	128	824.2	CS1	Test Mode A	1	GAMMA 3	32.40								23.37
850	GPRS	190	836.6	CS1	Test Mode A	1	GAMMA 3	32.50								23.47
850	GPRS	251	848.0	CS1	Test Mode A	1	GAMMA 3	32.50								23.47
850	GPRS	128	824.2	CS1	Test Mode A	2	GAMMA 3	31.30	31.30							25.28
850	GPRS	190	836.6	CS1	Test Mode A	2	GAMMA 3	31.40	31.40							25.38
850	GPRS	251	848.0	CS1	Test Mode A	2	GAMMA 3	31.40	31.40							25.38
850	GPRS	128	824.2	CS1	Test Mode A	3	GAMMA 3	29.60	29.60	29.60						25.35
850	GPRS	190	836.6	CS1	Test Mode A	3	GAMMA 3	29.60	29.70	29.70						25.42
850	GPRS	251	848.0	CS1	Test Mode A	3	GAMMA 3	29.60	29.60	29.60						25.35
850	GPRS	128	824.2	CS1	Test Mode A	4	GAMMA 3	28.40	28.40	28.40	28.30					25.38
850	GPRS	190	836.6	CS1	Test Mode A	4	GAMMA 3	28.40	28.40	28.50	28.50					**25.45**
850	GPRS	251	848.0	CS1	Test Mode A	4	GAMMA 3	28.40	28.40	28.40	28.40					25.40
850	EGPRS	128	824.2	MCS1	Test Mode A	1	GAMMA 3	32.40								23.37
850	EGPRS	190	836.6	MCS1	Test Mode A	1	GAMMA 3	32.50								23.47
850	EGPRS	251	848.0	MCS1	Test Mode A	1	GAMMA 3	32.40								23.37
850	EGPRS	128	824.2	MCS1	Test Mode A	2	GAMMA 3	31.30	31.30							25.28
850	EGPRS	190	836.6	MCS1	Test Mode A	2	GAMMA 3	31.40	31.40							25.38
850	EGPRS	251	848.0	MCS1	Test Mode A	2	GAMMA 3	31.40	31.40							25.38
850	EGPRS	128	824.2	MCS1	Test Mode A	3	GAMMA 3	29.60	29.60	29.60						25.35
850	EGPRS	190	836.6	MCS1	Test Mode A	3	GAMMA 3	29.70	29.70	29.60						25.42
850	EGPRS	251	848.0	MCS1	Test Mode A	3	GAMMA 3	29.60	29.60	29.60						25.35
850	EGPRS	128	824.2	MCS1	Test Mode A	4	GAMMA 3	28.40	28.40	28.40	28.47					25.42
850	EGPRS	190	836.6	MCS1	Test Mode A	4	GAMMA 3	28.50	28.40	28.40	28.40					25.43
850	EGPRS	251	848.0	MCS1	Test Mode A	4	GAMMA 3	28.40	28.40	28.40	28.40					25.40
850	EGPRS	128	824.2	MCS5	Test Mode A	1	GAMMA 6	27.00								17.97
850	EGPRS	190	836.6	MCS5	Test Mode A	1	GAMMA 6	27.00								17.97
850	EGPRS	251	848.0	MCS5	Test Mode A	1	GAMMA 6	27.00								17.97
850	EGPRS	128	824.2	MCS5	Test Mode A	2	GAMMA 6	26.80	26.80							20.78
850	EGPRS	190	836.6	MCS5	Test Mode A	2	GAMMA 6	26.90	26.90							20.88
850	EGPRS	251	848.0	MCS5	Test Mode A	2	GAMMA 6	26.80	26.80							20.78
850	EGPRS	128	824.2	MCS5	Test Mode A	3	GAMMA 6	26.20	25.80	25.70						21.66
850	EGPRS	190	836.6	MCS5	Test Mode A	3	GAMMA 6	26.20	25.80	25.90						21.72
850	EGPRS	251	848.0	MCS5	Test Mode A	3	GAMMA 6	26.00	26.40	25.90						21.86
850	EGPRS	128	824.2	MCS5	Test Mode A	4	GAMMA 6	24.90	24.80	24.90	24.80					21.85
850	EGPRS	190	836.6	MCS5	Test Mode A	4	GAMMA 6	25.10	24.90	25.00	24.90					21.98
850	EGPRS	251	848.0	MCS5	Test Mode A	4	GAMMA 6	24.70	24.80	24.70	24.80					21.75

GSM 1900

GSM1900																
Band	Mode	Channel	Frequency [MHz]	Coding	Traffic Mode	Number Timeslots	Power Level	Power TS 1 [dBm]	Power TS 2 [dBm]	Power TS 3 [dBm]	Power TS 4 [dBm]	Power TS 5 [dBm]	Power TS 6 [dBm]	Power TS 7 [dBm]	Power TS 8 [dBm]	Source-based time average Power [dBm]
1900	GSM	512	1850.2	FR V1	FR V1	1	PCL 0	28.30								19.27
1900	GSM	661	1880.0	FR V1	FR V1	1	PCL 0	28.40								19.37
1900	GSM	810	1909.8	FR V1	FR V1	1	PCL 0	28.30								19.27
1900	GPRS	512	1850.2	CS1	Test Mode A	1	GAMMA 3	28.30								19.27
1900	GPRS	661	1880.0	CS1	Test Mode A	1	GAMMA 3	28.40								19.37
1900	GPRS	810	1909.8	CS1	Test Mode A	1	GAMMA 3	28.30								19.27
1900	GPRS	512	1850.2	CS1	Test Mode A	2	GAMMA 3	27.30	27.30							21.28
1900	GPRS	661	1880.0	CS1	Test Mode A	2	GAMMA 3	27.40	27.40							21.38
1900	GPRS	810	1909.8	CS1	Test Mode A	2	GAMMA 3	27.30	27.30							21.28
1900	GPRS	512	1850.2	CS1	Test Mode A	3	GAMMA 3	25.50	25.50	25.50						21.25
1900	GPRS	661	1880.0	CS1	Test Mode A	3	GAMMA 3	25.60	25.60	25.60						21.35
1900	GPRS	810	1909.8	CS1	Test Mode A	3	GAMMA 3	25.50	25.50	25.50						21.25
1900	GPRS	512	1850.2	CS1	Test Mode A	4	GAMMA 3	24.40	24.40	24.30	24.30					21.35
1900	GPRS	661	1880.0	CS1	Test Mode A	4	GAMMA 3	24.40	24.40	24.40	24.40					**21.40**
1900	GPRS	810	1909.8	CS1	Test Mode A	4	GAMMA 3	24.30	24.30	24.30	24.30					21.30
1900	EGPRS	512	1850.2	MCS1	Test Mode A	1	GAMMA 3	28.30								19.27
1900	EGPRS	661	1880.0	MCS1	Test Mode A	1	GAMMA 3	28.40								19.37
1900	EGPRS	810	1909.8	MCS1	Test Mode A	1	GAMMA 3	28.30								19.27
1900	EGPRS	512	1850.2	MCS1	Test Mode A	2	GAMMA 3	27.30	27.30							21.28
1900	EGPRS	661	1880.0	MCS1	Test Mode A	2	GAMMA 3	27.40	27.40							21.38
1900	EGPRS	810	1909.8	MCS1	Test Mode A	2	GAMMA 3	27.30	27.30							21.28
1900	EGPRS	512	1850.2	MCS1	Test Mode A	3	GAMMA 3	25.50	25.50	25.50						21.25
1900	EGPRS	661	1880.0	MCS1	Test Mode A	3	GAMMA 3	25.60	25.60	25.60						21.35
1900	EGPRS	810	1909.8	MCS1	Test Mode A	3	GAMMA 3	25.50	25.50	25.50						21.25
1900	EGPRS	512	1850.2	MCS1	Test Mode A	4	GAMMA 3	24.40	24.30	24.40	24.40					21.38
1900	EGPRS	661	1880.0	MCS1	Test Mode A	4	GAMMA 3	24.40	24.40	24.30	24.40					21.38
1900	EGPRS	810	1909.8	MCS1	Test Mode A	4	GAMMA 3	24.40	24.30	24.40	24.30					21.35
1900	EGPRS	512	1850.2	MCS5	Test Mode A	1	GAMMA 5	24.30								15.27
1900	EGPRS	661	1880.0	MCS5	Test Mode A	1	GAMMA 5	24.40								15.37
1900	EGPRS	810	1909.8	MCS5	Test Mode A	1	GAMMA 5	24.50								15.47
1900	EGPRS	512	1850.2	MCS5	Test Mode A	2	GAMMA 5	24.20	24.50							18.33
1900	EGPRS	661	1880.0	MCS5	Test Mode A	2	GAMMA 5	24.50	24.50							18.48
1900	EGPRS	810	1909.8	MCS5	Test Mode A	2	GAMMA 5	24.10	24.60							18.34
1900	EGPRS	512	1850.2	MCS5	Test Mode A	3	GAMMA 5	23.30	23.50	23.60						19.22
1900	EGPRS	661	1880.0	MCS5	Test Mode A	3	GAMMA 5	23.60	23.80	23.90						19.52
1900	EGPRS	810	1909.8	MCS5	Test Mode A	3	GAMMA 5	23.50	23.80	23.90						19.49
1900	EGPRS	512	1850.2	MCS5	Test Mode A	4	GAMMA 5	22.40	23.00	22.70	22.50					19.66
1900	EGPRS	661	1880.0	MCS5	Test Mode A	4	GAMMA 5	22.30	22.80	22.50	22.50					19.53
1900	EGPRS	810	1909.8	MCS5	Test Mode A	4	GAMMA 5	22.50	22.50	22.80	22.90					19.68

W-CDMA FDD V

W-CDMA FDD V																		
Uplink UARFCN	Uplink Frequency [MHz]	Source-based time averaged Power [dBm]																
		RMC 12.2 kbps	RMC 64 kbps	RMC 144 kbps	RMC 384 kbps	HSDPA Subtest 1	HSDPA Subtest 2	HSDPA Subtest 3	HSDPA Subtest 4	HSUPA Subtest 1	HSUPA Subtest 2	HSUPA Subtest 3	HSUPA Subtest 4	HSUPA Subtest 5	DC-HSDPA Subtest 1	DC-HSDPA Subtest 2	DC-HSDPA Subtest 3	DC-HSDPA Subtest 4
						ßc=2 / ßd=15	ßc=11 / ßd=15	ßc=15 / ßd=8	ßc=15 / ßd=4	ßc=10 / ßd=15 ∆E-DPCCH=6 AG Index = 20 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=6 / ßd=15 ∆E-DPCCH=8 AG Index = 12 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=15 / ßd=9 ∆E-DPCCH=8 AG Index = 15 No. E-TFCIs = 2 E-TFCI = 11, 92	ßc=2 / ßd=15 ∆E-DPCCH=5 AG Index = 17 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=14 / ßd=15 ∆E-DPCCH=7 AG Index = 21 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=2 / ßd=15	ßc=11 / ßd=15	ßc=15 / ßd=8	ßc=15 / ßd=4
4132	826.4	22.05	22.13	22.18	**22.11**	22.04	21.85	21.65	21.37	21.85	22.62	21.65	22.00	21.76				
4182	836.6	22.09	22.06	22.07	22.03	22.07	21.83	21.63	21.38	21.87	22.62	21.45	22.06	21.75				
4233	846.6	21.87	21.86	21.89	21.85	22.07	21.66	21.38	21.16	21.63	22.38	21.36	22.08	21.50				

W-CDMA FDD II

W-CDMA FDD II																		
Uplink UARFCN	Uplink Frequency [MHz]	Source-based time averaged Power [dBm]																
		RMC 12.2 kbps	RMC 64 kbps	RMC 144 kbps	RMC 384 kbps	HSDPA Subtest 1	HSDPA Subtest 2	HSDPA Subtest 3	HSDPA Subtest 4	HSUPA Subtest 1	HSUPA Subtest 2	HSUPA Subtest 3	HSUPA Subtest 4	HSUPA Subtest 5	DC-HSDPA Subtest 1	DC-HSDPA Subtest 2	DC-HSDPA Subtest 3	DC-HSDPA Subtest 4
						ßc=2 / ßd=15	ßc=11 / ßd=15	ßc=15 / ßd=8	ßc=15 / ßd=4	ßc=10 / ßd=15 ∆E-DPCCH=6 AG Index = 20 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=6 / ßd=15 ∆E-DPCCH=8 AG Index = 12 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=15 / ßd=9 ∆E-DPCCH=8 AG Index = 15 No. E-TFCIs = 2 E-TFCI = 11, 92	ßc=2 / ßd=15 ∆E-DPCCH=5 AG Index = 17 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=14 / ßd=15 ∆E-DPCCH=7 AG Index = 21 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=2 / ßd=15	ßc=11 / ßd=15	ßc=15 / ßd=8	ßc=15 / ßd=4
9262	1852.4	**23.05**	23.05	23.02	22.97	23.01	22.30	22.06	21.87	22.22	22.84	21.87	22.94	22.04				
9400	1880.0	22.54	22.52	22.43	22.50	22.45	21.80	21.52	21.32	21.38	22.49	21.39	22.46	21.77				
9538	1907.6	22.65	22.65	22.68	22.71	22.65	21.97	21.75	21.56	22.02	22.77	21.66	22.74	21.90				

W-CDMA FDD IV

W-CDMA FDD IV																		
Uplink UARFCN	Uplink Frequency [MHz]	Source-based time averaged Power [dBm]																
		RMC 12.2 kbps	RMC 64 kbps	RMC 144 kbps	RMC 384 kbps	HSDPA Subtest 1	HSDPA Subtest 2	HSDPA Subtest 3	HSDPA Subtest 4	HSUPA Subtest 1	HSUPA Subtest 2	HSUPA Subtest 3	HSUPA Subtest 4	HSUPA Subtest 5	DC-HSDPA Subtest 1	DC-HSDPA Subtest 2	DC-HSDPA Subtest 3	DC-HSDPA Subtest 4
						ßc=2 / ßd=15	ßc=11 / ßd=15	ßc=15 / ßd=8	ßc=15 / ßd=4	ßc=10 / ßd=15 ∆E-DPCCH=6 AG Index = 20 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=6 / ßd=15 ∆E-DPCCH=8 AG Index = 12 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=15 / ßd=9 ∆E-DPCCH=8 AG Index = 15 No. E-TFCIs = 2 E-TFCI = 11, 92	ßc=2 / ßd=15 ∆E-DPCCH=5 AG Index = 17 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=14 / ßd=15 ∆E-DPCCH=7 AG Index = 21 No. E-TFCIs = 5 E-TFCI = 11, 67	ßc=2 / ßd=15	ßc=11 / ßd=15	ßc=15 / ßd=8	ßc=15 / ßd=4
1312	1712.4	23.50	23.56	23.55	**23.60**	23.51	22.85	22.70	22.40	22.79	23.40	22.50	23.54	22.70				
1413	1732.6	23.37	23.32	23.33	23.35	23.27	22.60	22.45	22.18	22.59	23.28	22.25	23.27	22.52				
1513	1752.6	23.15	23.17	23.22	23.16	23.17	22.50	22.29	22.05	22.47	23.16	22.18	23.12	22.36				

1.7 Standalone Operational Mode Test Exclusion

According to KDB 447498 D01 v05r02 for standalone SAR evaluation the test exclusion power condition is given by

$$\frac{\max Power, mW}{test\ distance, mm} \cdot \sqrt{f_{GHz}} \leq 3.0$$

for test separation distance ≤ 50mm.

For Bluetooth max Power is: 3.2mW, test exclusion is 1.0 ≤ 3.0, Bluetooth were not tested.

1.8 Supported concurrent (multi-transmitter) operating modes

	Bluetooth	WLAN 802.11b/g/a	GSM/UMTS
Bluetooth	N/A	N/A	N/A
WLAN 802.11b/g/a	N/A	N/A	N/A
GSM/UMTS	N/A	N/A	N/A

►No multi-transmitter evaluation

1.9 Supported use cases

Use case	Distance to human body	corresponding test configuration
EUT placed at human head	0 mm	close proximity to the human ear
EUT placed at human body	10 mm (worst case)	body-worn device

1.10 Radio Test Modes

Mode	Settings
GSM 850	Mode = GPRS Duty cycle = 50% Power level = Gamma 3, 4 timeslots Coding = CS1 Antenna = integrated
PCS 1900	Mode = GPRS Duty cycle = 50% Power level = Gamma 3, 4 timeslots Coding = CS1 Antenna = integrated
W-CDMA FDDII	Mode = RMC 12.2 kbps Duty cycle = 100% Power level = TPC Setup: All1 Antenna = integrated
W-CDMA FDDIV	Mode = RMC 384 kbps Duty cycle = 100% Power level = TPC Setup: All1 Antenna = integrated
W-CDMA FDDV	Mode = RMC 384 kbps Duty cycle = 100% Power level = TPC Setup: All1 Antenna = integrated
Bluetooth	Modulation = GFSK Duty cycle = 78% Data rate = 1 Mbps Power level = maximum Antenna = integrated
IEEE 802.11b	Mode = 802.11b Modulation = DSSS Duty cycle = 100% Data rate = 1 Mbps Power level = maximum Antenna = integrated
IEEE 802.11a	Mode = 802.11a Modulation = OFDM Duty cycle = 100% Data rate = 6 Mbps Power level = maximum Antenna = integrated

1.11 Test Positions

Position	Description
LEFT cheek	EUT Left side touching the Head phantom
LET tilt	EUT Left side tilted the Head phantom
RIGHT cheek	EUT side touching the Head phantom
RIGHT tilt	EUT Left side tilted the Head phantom
FRONT-10MM	EUT top side directly touching the phantom.
BACK-10MM	EUT rear side directly touching the phantom.

1.12 Test Equipment Used During Testing

SAR Measurement					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal. Date**	**Cal. Due**
Stäubli Robot	Stäubli	RX90B L	EF00271	functional test	functional test
Stäubli Robot Controller	Stäubli	CS7MB	EF00272	functional test	functional test
DASY 5 Measurement Server	Schmid& Partner		EF00273	functional test	functional test
Control Pendant	Stäubli		EF00274	functional test	functional test
Dell Computer	Schmid& Partner	Intel	EF00275	functional test	functional test
Data Acquisition Electronics	Schmid& Partner	DAE3V1	EF00276	2014-09	2015-09
Dosimetric E-Field Probe	Schmid& Partner	ET3DV6	EF00279	2014-09	2015-09
Dosimetric E-Field Probe	Schmid& Partner	EX3DV4	EF00826	2014-09	2015-09
System Validation Kit	Schmid& Partner	D300V3	EF00299	2012-09	2015-09
System Validation Kit	Schmid& Partner	D450V3	EF00300	2012-09	2015-09
System Validation Kit	Schmid& Partner	D900V2	EF00281	2012-09	2015-09
System Validation Kit	Schmid& Partner	D1800V2	EF00282	2012-09	2015-09
System Validation Kit	Schmid& Partner	D1900V2	EF00283	2012-09	2015-09
System Validation Kit	Schmid& Partner	D2450V2	EF00284	2012-09	2015-09
System Validation Kit	Schmid& Partner	D5GHZV2	EF00827	2012-11	2015-11
Flat phantom	Schmid& Partner	V 4.4	EF00328	no calibration required	no calibration required
Oval flat phantom	Schmid& Partner	ELI 4	EF00289	functional test	functional test
Mounting Device	Schmid& Partner	V 3.1	EF00287	functional test	functional test
Millivoltmeter	Rohde & Schwarz	URV 5	EF00126	2013-08	2016-08
Power sensor	Rohde & Schwarz	NRV-Z2	EF00125	2013-04	2015-04
RF signal generator	Rohde & Schwarz	SMP 02	EF00165	2013-05	2015-05
Insertion unit	Rohde & Schwarz	URV5-Z4	EF00322	2014-09	2015-09
Directional Coupler	HP	HP 87300B	EF00288	functional test	functional test
Radio Communication Tester	Rohde & Schwarz	CMD65	EF00625	ICO (initial calibration only)	ICO (initial calibration only)
Universal Radio Communication Tester	Rohde & Schwarz	CMU 200	EF00304	2014-05	2015-05
Network Analyzer 300 kHz to 3 GHz	Agilent	8752C	EF00140	2014-06	2015-06
Dielectric Probe Kit	Agilent	85070C	EF00291	functional test	functional test
DAK Probe (200MHz-20GHz)	SPEAG	DAK-3.5	EF00945	2014-09	2015-09
DAK Measurement Software	SPEAG	DAKS	EF00965	no calibration required	no calibration required
DAK Thermometer (-20..110°C)	LKM electronic GmbH	DTM3000	EF00967	2014-09	2015-09

2 Result Summary

OET Bulletin 65 Supplement C, RSS-102					
Product Specific Standard Section	**Requirement – Test**	**Reference Method**	**Maximum SAR [W/kg]**	**Result**	**Remarks**
OET Bulletin 65 Suppl. C Section 2 RSS-102 Section 3	Single-band conformity	KDB Publication 447498 KDB Publication 248227 KDB Publication 865664	ImpactX 1.381	PASS	
OET Bulletin 65 Suppl. C Section 2 RSS-102 Section 3	Single-band conformity	KDB Publication 447498 KDB Publication 248227 KDB Publication 865664	GravityX 0.076	PASS	
OET Bulletin 65 Suppl. C Section 2 RSS-102 Section 3	Multi-band conformity	KDB Publication 447498 KDB Publication 648474 KDB Publication 865664	N/A	N/R	No concurrent transmission modes
Remarks:					

3 Definitions

The specific absorption rate (SAR) is defined as the time derivative of the incremental energy (*dW*) absorbed by (dissipated in) an incremental mass (*dm*) contained in a volume element *(dV*) of a given density (ρ_t), expressed in watts per kilogram (W/kg)

$$SAR = d/dt\ (dW/dm) = d/dt\ (dW/\rho_t dV) = \sigma/\rho_t\ |E_t|^2$$

where

$$dW/dt = \int_V E\ J\ dV = \int_V \sigma E^2 dV$$

3.1 Controlled Exposure

The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category and the general population/uncontrolled exposure limits apply to these devices.

3.2 Uncontrolled Exposure

In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. Awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of a RF safety program. If appropriate, warning signs and labels can also be used to establish such awareness by providing prominent information on the risk of potential exposure and instructions on the risk of potential exposure and instructions on methods to minimize such exposure risks.

3.3 Localized SAR

Compliance with the localized SAR limits is demonstrated using the head and trunk limit because this SAR limit is only half the limbs limit value. The values are obtained by SAR measurements according to EN 62209-2.

4 Localized SAR Measurement Equipment

The measurements were performed with Dasy5 automated near-field scanning system comprised of high precision robot, robot controller, computer, e-field probe, probe alignment unit, phantoms, non-conductive phone positioned and software extension.

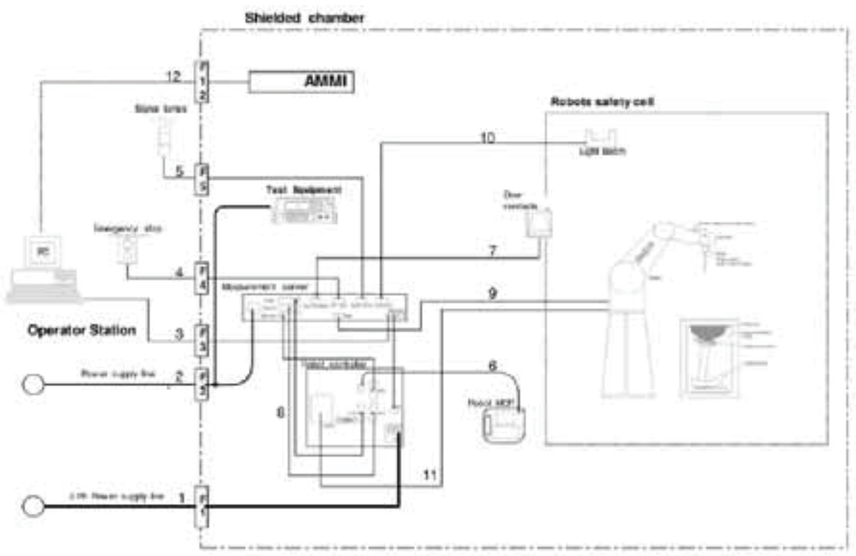
4.1 Complete SAR DASY5 Measurement System

Measurements are performed using the DASY5 automated assessment system made by Schmid& Partner Engineering AG (SPEAG) in Zurich, Switzerland.

DASY 5 SAR Measurement Setup

The following Diagram show the elements involved in the measurement setup.

DASY 5 SAR Measurement Diagram



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

DASY5 SAR Measurement System	
Device	Description:
RX90BL	A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software.
Probe Alignment Unit	A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
Teach Pendant	The Manual Control Pendant (MCP), also called the manual teach pendant, is the user interface to the robot. In DASY, it is used for certain installation and teach procedures
Signal Lamps	External warning lamp which indicates when the robot arm is powered-on and if the robot is under software control or in manual mode (controlled with the teach pendant).
DAE	The data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
E-Field Probes	Isotropic E-Field probe optimized and calibrated for E-field measurements in free space.
EOC	The electro-optical converter (EOC) performs the conversion between optical and electrical signals
Measurement Server	The functions of the measurement server is to perform the time critical task such as signal filtering, surveillance of the robot operation, fast movement interrupts.
Control Computer	A computer operating Windows 2000 or Windows NT with DASY 4 Software.
Control Software	DASY4 and SEMCAD post processing Software
SAM Twin Phantom	The SAM twin phantom enabling testing left-hand and right-hand usage.
Flat Phantom	Flat Phantom (only for body-mounted transceivers operating below 800 MHz).
Tissue simulating liquid	Tissue simulating liquid mixed according to the given recipes.
Device Holder	The device holder for handheld mobile phones.
System Validation Dipoles	System validation dipoles allowing to validate the proper functioning of the system.

4.2 Robot Arm

The DASY5 system uses the high precision robots RX90BL type out of the newer series from Stäubli SA (France).

The RX robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller

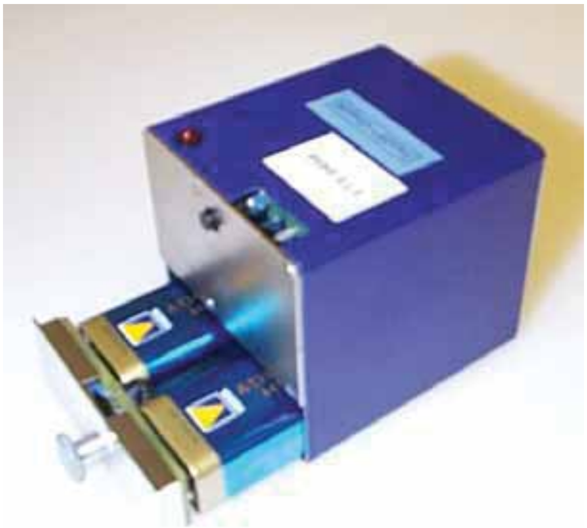
Robot arm

4.3 Data Acquisition Electronics

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE3 is 200M Ohm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.

Data Acquisition Electronics



4.4 Isotropic E-Field Probe≤ 3 GHz

Probe Specifications

Isotropic E-Field Probe ET3DV6

Construction:

One dipole parallel, two dipoles normal to probe axis built-in shielding against static charges.

Calibration:

In air from 10 MHz to 2.5 GHz,
In brain and muscle simulating tissue at Frequencies of 835MHz, 900MHz, 1800MHz, 1900 MHz and 2450 MHz

Frequency:

10MHz to > 3GHz,
Linearity ±0.2dB (30MHz to 3GHz)

Directivity:

±0.2dB in HSL (rotation around probe axis)
±0.4dB in HSL (rotation normal to probe axis)

Dynamic Range:

5µW/g to > 100mW/g

Linearity:

±0.2dB

Dimensions:

Overall Length: 330mm (Tip: 16mm),
Tip Diameter: 6.8mm (Body: 12mm),
Distance from probe tip to dipole centers: 2.7mm

Application:

General dosimetry up to 3 GHz
Compliance tests of mobile phones
Fast automatic scanning in arbitrary phantoms

4.5 Isotropic E-Field Probe ≤ 6 GHz

Probe Specifications

Isotropic E-Field Probe EX3DV4

Construction:

One dipole parallel, two dipoles normal to probe axis built-in shielding against static charges.

Calibration:

In air from 10 MHz to 6 GHz,
In brain and muscle simulating tissue at
Frequencies of 5200, 5500, 5800

Frequency:

10MHz to 6GHz,
Linearity ±0.2dB (30MHz to 6GHz)

Directivity:

±0.3dB in HSL (rotation around probe axis)
±0.5dB in tissue material (rotation normal to probe axis)

Dynamic Range:

10µW/g to > 100mW/g

Linearity:

±0.2dB

Dimensions:

Overall Length: 337mm (Tip: 20mm),
Tip Diameter: 2.5mm (Body: 12mm),
Distance from probe tip to dipole centers: 1mm

Application:

General dosimetry up to 6 GHz
Compliance tests of mobile phones
Fast automatic scanning in arbitrary phantoms

4.6 Test phantom and positioner

The positioner and test phantoms are manufactured by SPEAG. The test phantoms are used for all tests i.e. for both validation testing and device testing. The positioner and test phantom conforms to the requirements of EN 62209 and IEEE 1528.

The SPEAG device holder was used to position the test device in all tests whilst a tripod was used to position the validation dipoles in the test arch.

Probe Positioner	SAM Twin Phantom
	
ELI4 phantom	**Flat phantom**
	

4.7 System Validation Dipoles

A set of calibration dipoles (D900V2, D1900V2, D2450V2, D5GHzV2) is included as a part of the SAR measurement setup. These are used for the validation of the test setup after its installation and prior to the EUT measurements. The calibration dipole is placed in the position normally occupied by the EUT. All calibration dipoles have the same height which allows an exact fitting below the center point of the test phantom. The dipole center is 10mm below the surface of the test phantom.

900MHz Dipole	1900MHz Dipole
	
2450MHz Dipole	**5000MHz Dipole**
	

1750MHz Dipole


5 Single-band SAR Measurement

After successful completion of the tissue and system verification the SAR values of the EUT are measured according to the following description.

5.1 General measurement description

The measurement is performed for each frequency band of the device. If the width of the transmit frequency band exceeds 1% of its center frequency, than the channels at the lowest and highest frequencies should also be tested. Furthermore, if the width of the transmit band exceeds 10% of its center frequency the following formula is used to determine the number of channels:

$$N_C=2 \cdot \text{roundup}[10\cdot(f_{high}- f_{low})/f_c] + 1$$

First the device is tested on the center channel of each frequency band used by the device. An operation mode and configuration with maximum transmit power is established. If battery operated equipment is used, the batteries are fully charged.

SAR measurements are performed using the steps outlined in the next section for all relevant operational modes, EUT configurations and measurement positions.

For the condition (position, configuration, operational mode) that provides the highest spatial-average SAR value on the center channel, the other channels are also tested.

Additionally all other conditions where the spatial-average SAR value is within 3dB of the SAR limit are also tested on all determined test frequencies.

5.2 SAR measurement description

First the local SAR value at a test point within 10mm or less in normal direction from the inner surface of the phantom is measured. This SAR value is used to determine the measurement drift during SAR measurement.

Next an area scan is performed over an area larger than the projection of the EUT with antenna on the surface of the phantom with a spatial grid step of 10mm.

From the scanned SAR distribution the position of maximum SAR value is identified as well as any local SAR maxima within 2dB of the maximum value that are not within the zoom scan volume. (The additional peaks are only measured when the primary peak is within 2dB of the SAR limit.)

The zoom-scan volume constructed on the peak SAR position is scanned with a grid step of 5mm. The measured data are extracted and the local SAR value for each measurement point is calculated. The measured values are interpolated over a fine-mesh within the scan volume and the average SAR value over 10g mass is calculated.

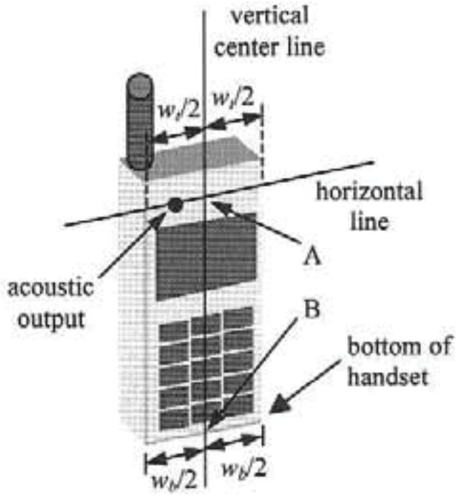
At the end of the measurement the reference point measured at the beginning of the measurement is measured again and from the difference the drift is calculated.

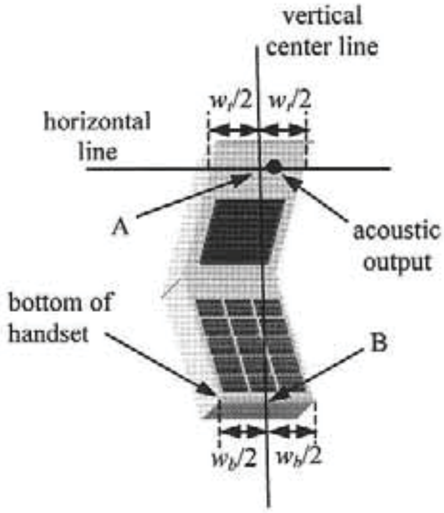
5.3 Reference lines and points for Handsets

For all measurement positions of the EUT, the EUT has to be place in a specific orientation with respect to the phantom. The orientation of the EUT relative to the phantom is defined by reference lines and points.

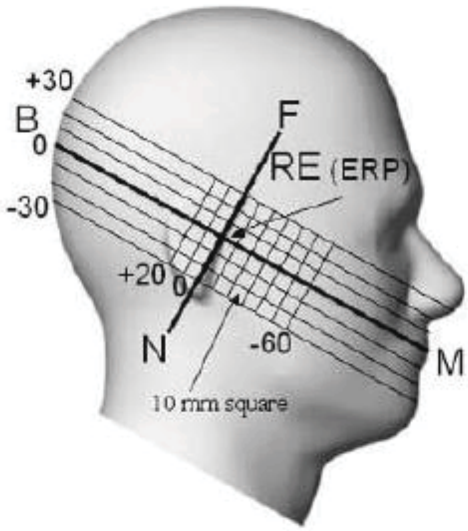
According to IEEE 1528, the reference lines and points shall be positioned at the EUT as shown in the following figure.

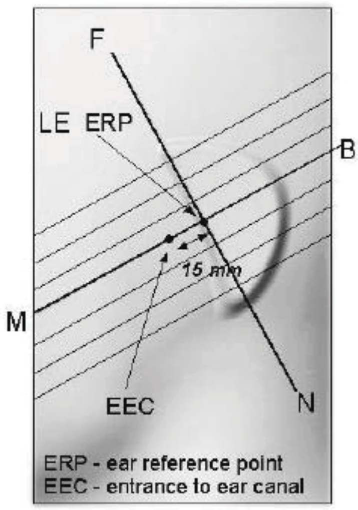
Reference lines and points on EUT acc. to IEEE 1528





Reference lines and points on human head acc. to IEEE 1528

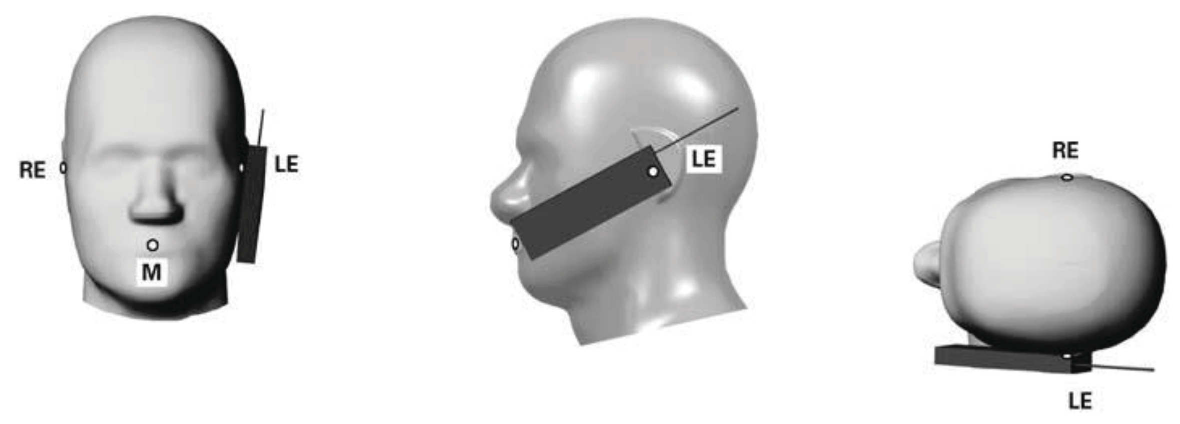




5.4 Test positions relative to the Head

Cheek position

Cheek positions according to IEEE 1528

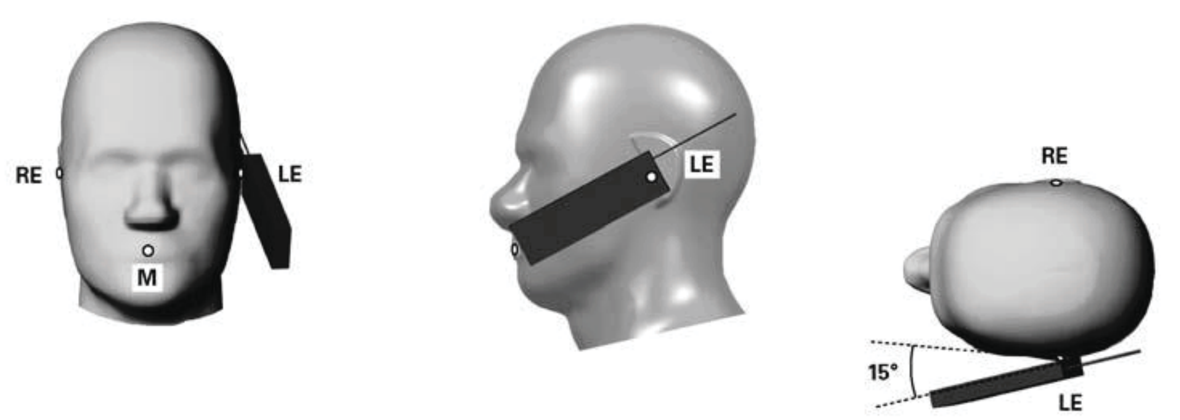


The handset is positioned close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure), such that the plane defined by the vertical centerline and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom. Next the handset is translated towards the phantom along the line passing through RE and LE until handset point A touches the pinna at the ERP.

While the handset is maintained in this plane, it is rotated around the LE-RE line until the vertical centerline is in the plane normal to the plane containing B-M and N-F lines, i.e., the Reference Plane. Then it is rotated around the vertical centerline until the handset (horizontal line) is parallel to the N-F line. While the vertical centerline is maintained in the Reference Plane, point A is kept on the line passing through RE and LE, and the handset is maintained in contact with the pinna, the handset is rotated about the N-F line until any point on the handset is in contact with a phantom point below the pinna on the cheek.

Tilt position

Tilt positions according to IEEE 1528

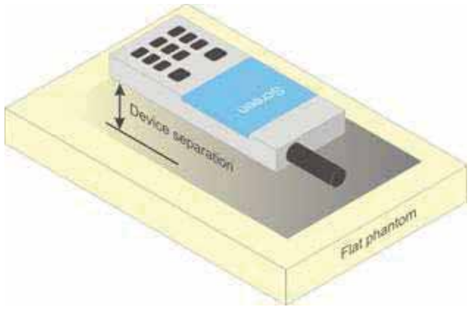


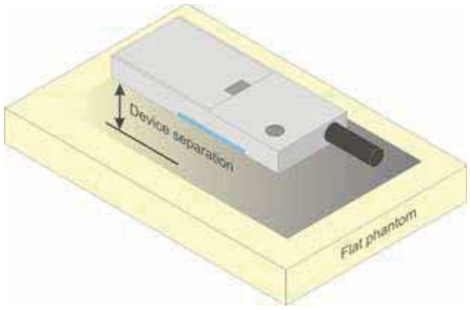
First the EUT is placed in the cheek position. Next the handset is moved away from the pinna along the line passing through RE and LE far enough to allow a rotation of the handset away from the cheek by 15°. Then the handset is rotated around the horizontal line by 15°.

The handset is moved towards the phantom on the line passing through RE and LE until any part of the handset touches the ear. The tilt position is obtained when the contact point is on the pinna. See Figure. If contact occurs at any location other than the pinna, e.g., the antenna at the back of the phantom head, the angle of the handset should be reduced. In this case, the tilt position is obtained if any point on the handset is in contact with the pinna and a second point on the handset is in contact with the phantom, e.g., the antenna with the back of the head

5.5 Test positions relative to the human body

Body positions according to IEEE 1528





In body worn configuration the device is positioned parallel to the phantom surface with either top or bottom side of the EUT facing against the phantom.

The separation distance of the EUT is selected according to the use case of the EUT (e.g. with belt clip or holster).

5.6 Measurement Uncertainty

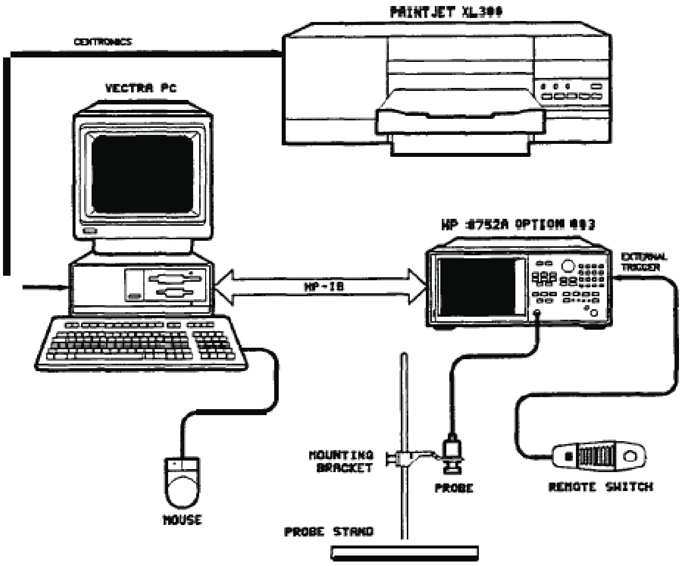
Measurement Uncertainty according to IEEE 1528							
Error Description	**Uncertainty Value**	**Probability Distribution**	**Div.**	**c_i (1g)**	**c_i (10g)**	**Std. Unc. 1g**	**Std. Unc. 10g**
Measurement System							
Probe Calibration	±6.55%	N	1	1	1	±6.55%	±6.55%
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%
Hemispherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%
Modulation Response	±2.4%	R	$\sqrt{3}$	1	1	±1.4%	±1.4%
System Detection Limits	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%
Boundary effects	±2.0%	R	$\sqrt{3}$	1	1	±1.2%	±1.2%
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%
Response Time	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%
Integration Time	±2.6%	R	$\sqrt{3}$	1	1	±1.5%	±1.5%
RF Ambient Noise	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%
RF Ambient Reflections	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%
Probe Positioner	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%
Probe Positioning	±6.7%	R	$\sqrt{3}$	1	1	±3.9%	±3.9%
Post processing	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%
Test Sample Related							
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%
Test Sample Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%
Power Scaling	±0%	R	$\sqrt{3}$	1	1	±0%	±0%
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%
Phantom and Setup Related							
Phantom Uncertainty	±7.9%	R	$\sqrt{3}$	1	1	±4.6%	±4.6%
SAR correction	±1.9%	R	$\sqrt{3}$	1	0.84	±1.1%	±0.9%
Liquid conductivity (measured)	±2.5%	N	1	0.78	0.71	±2.0%	±1.8%
Liquid permittivity (measured)	±2.5%	N	1	0.26	0.26	±0.1%	±0.1%
Temperature uncertainty - Conductivity	±5.2%	R	$\sqrt{3}$	0.78	0.71	±2.3%	±2.1%
Temperature uncertainty - Permittivity	±0.8%	R	$\sqrt{3}$	0.23	0.26	±0.1%	±0.1%
Combined Standard Uncertainty						±12.8%	±12.7%
Expanded Standard Uncertainty						**±25.6%**	**±25.4%**

6 Test ConditionsandResults

6.1 Test Conditions and Results – Tissue Validation

Tissue Validation acc. toFCC OET Bulletin 65 Suppl. C / IC RSS-102					Verdict: PASS
Test according to measurement reference	Reference Method				
	OET Bulletin 65 Supplement C				
Target Values					
Frequency [MHz]	Head		Body		Permitted tolerance [%]
	Relative dielectric constant ε_r	Conductivity σ [S/m]	Relative dielectric constant ε_r	Conductivity σ [S/m]	
150	52.3	0.76	61.9	0.80	≤±5
300	45.3	0.87	58.2	0.92	≤±5
450	43.5	0.87	56.7	0.94	≤±5
835	41.5	0.90	55.2	0.97	≤±5
900	41.5	0.97	55.0	1.05	≤±5
915	41.5	0.98	55.0	1.06	≤±5
1450	40.5	1.20	54.0	1.30	≤±5
1610	40.3	1.29	53.8	1.40	≤±5
1800 – 2000	40.0	1.40	53.3	1.52	≤±5
2450	39.2	1.80	52.7	1.95	≤±5
3000	38.5	2.40	52.0	2.73	≤±5
5200	36.0	4.66	49.0	5.30	≤±5
5500	35.6	4.96	48.6	5.65	≤±5
5800	35.3	5.27	48.2	6.00	≤±5

Test setup



Test procedure

1. The dielectric probe kit is calibrated using the standards air, short circuit and deionized water
2. The tissue simulating liquid is measured using the dielectric probe
3. Target values are compared to the measurement values and deviations are determined

Test results

Frequency [MHz]	Tissue	Measured ε_r	Target ε_r	Deltaε_r [%]	Measuredσ [S/m]	Target σ [S/m]	Delta σ [%]
900	Head	40.25	41.5	-03.01	1.01	0.97	04.12
1900	Head	39.22	40.0	-01.95	1.37	1.40	-02.14
1750	Head	39.56	40.1	-01.35	1.38	1.37	00.73
900	Body	52.61	55.0	-04.35	1.08	1.05	02.86
1900	Body	50.67	53.3	-04.93	1.55	1.52	01.97
1750	Body	54.41	53.4	01.89	1.54	1.49	03.36
2450	Body	50.56	52.7	-04.06	2.02	1.95	03.59
5200	Body	47.55	49.0	-02.96	5.56	5.30	04.91

Comments:

6.2 Test Conditions and Results – System Validation

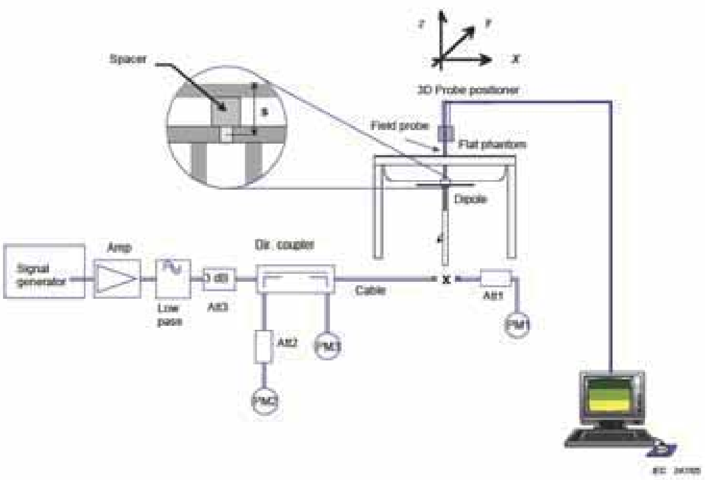
System Validation acc. to FCC OET Bulletin 65 Suppl. C / IC RSS-102	Verdict: PASS
Test according to measurement reference	Reference Method
	OET Bulletin 65 Supplement C / IEEE 1528
Test frequency range	Tested frequencies
	900 MHz, 1750 MHz, 1900 MHz, 2450 MHz, 5200 MHz
Test mode	unmodulated CW

Target Values

Frequency [MHz]	Target SAR value [W/kg (1g)]	Permitted tolerance [%]
900 Head	2.64 @ 250mW	≤±10
900 Body	2.76 @ 250mW	≤±10
1750 Head	9.33 @ 250mW	≤±10
1750 Body	9.50 @ 250mW	≤±10
1900 Head	9.78 @ 250mW	≤±10
1900 Body	10.2 @ 250mW	≤±10
2450 Body	12.9 @ 250mW	≤±10
5200 Body	7.42 @ 100mW	≤±10

The target reference values are taken from the calibration sheets (see annex)

Test setup



Test procedure

1. The dipole antenna input power is set to 250mW
2. The reference dipole is positioned under the phantom
3. With the dipole antenna powered the SAR value is measured
4. The measured SAR values are compared to the target SAR values

Test results				
Frequency [MHz]	Input power [mW]	Measured SAR value [W/kg (1g)]	Target SAR value [W/kg (1g)]	Delta [%]
900 Head	250	2.88	2.64	09.09
900 Head	250	2.82	2.64	06.82
1750 Head	250	8.93	9.33	-04.29
1750 Head	250	8.88	9.33	-04.82
1900 Head	250	9.61	9.78	-01.74
1900 Head	250	9.68	9.78	-01.02
900 Body	250	2.88	2.76	04.35
1900 Body	250	9.98	10.2	-02.16
1900 Body	250	10	10.2	-01.96
1750 Body	250	9.16	9.50	-03.58
2450 Body	250	14.13	12.9	09.53
5200 Body	100	8.12	7.42	09.43
Comments:				

6.3 Test Conditions and Results – Standalone SAR Measurement

Standalone SAR acc. to FCC OET Bulletin 65 Suppl. C / IC RSS-102	Verdict: PASS
Test according to measurement reference	Reference Method
	FCC OET Bulletin 65 Supplement C / IC RSS-102 Issue 4
Room temperature	22.0 – 22.6 °C
Liquid depth	15.5 cm
Environment	general public

Limits

Region	Occupational SAR values [W/kg]	General public SAR values [W/kg]
Whole body average SAR	0.4	0.08
Localized SAR (Head and trunk) SAR averaging mass = 10g	8	1.6
Localized SAR (Limbs) SAR averaging mass = 10g	20	4

Test results

Mode	Position	Channel	Frequency [MHz]	Drift [dB]	Measure SAR [W/kg (1g)]	*Scaling Factor	Reported SAR [W/kg (1g)]	SAR Limit [W/kg (1g)]
GSM 850	Right Touch	190	836.6	-0.09	0.582	1.413	**0.822	1.6
GSM 850	Right Tilt	190	836.6	0.04	0.445	1.413	0.629	1.6
GSM 850	Left Touch	190	836.6	0.01	0.428	1.413	0.605	1.6
GSM 850	Left Tilt	190	836.6	0.04	0.361	1.413	0.510	1.6
GSM 850	Flat Back 10mm	190	836.6	-0.07	0.295	1.413	**0.417	1.6
GSM 850	Flat Front 10mm	190	836.6	0.09	0.139	1.413	0.196	1.6
GSM 1900	Right Touch	661	1880	-0.10	0.184	1.429	0.263	1.6
GSM 1900	Right Tilt	661	1880	-0.20	0.199	1.429	**0.284	1.6
GSM 1900	Left Touch	661	1880	0.05	0.189	1.429	0.270	1.6
GSM 1900	Left Tilt	661	1880	-0.05	0.151	1.429	0.216	1.6
GSM 1900	Flat Back 10mm	661	1880	0.06	0.111	1.429	**0.159	1.6
GSM 1900	Flat Front 10mm	661	1880	-0.05	0.058	1.429	0.083	1.6
UMTS FDD V	Right Touch	4182	836.6	-0.07	0.362	1.413	**0.512	1.6
UMTS FDD V	Right Tilt	4182	836.6	-0.01	0.302	1.413	0.427	1.6
UMTS FDD V	Left Touch	4182	836.6	0.01	0.267	1.413	0.377	1.6
UMTS FDD V	Left Tilt	4182	836.6	0.04	0.232	1.413	0.328	1.6
UMTS FDD V	Flat Back 10mm	4182	836.6	0.01	0.174	1.413	**0.246	1.6
UMTS FDD V	Flat Front 10mm	4182	836.6	0.05	0.085	1.413	0.120	1.6
UMTS FDD II	Right Touch	9262	1852.4	0.15	0.324	1.413	0.458	1.6

UMTS FDD II	Right Tilt	9262	1852.4	0.06	0.350	1.413	**0.495	1.6
UMTS FDD II	Left Touch	9262	1852.4	-0.05	0.268	1.413	0.379	1.6
UMTS FDD II	Left Tilt	9262	1852.4	0.04	0.302	1.413	0.427	1.6
UMTS FDD II	Flat Back 10mm	9262	1852.4	0.04	0.187	1.413	**0.264	1.6
UMTS FDD II	Flat Front 10mm	9262	1852.4	-0.10	0.142	1.413	0.201	1.6
UMTS FDD IV	Right Touch	1312	1712.4	-0.03	0.822	1.413	1.161	1.6
UMTS FDD IV	Right Touch	1413	1732.6	-0.15	0.707	1.413	0.999	1.6
UMTS FDD IV	Right Touch	1513	1752.6	-0.05	0.599	1.413	0.846	1.6
UMTS FDD IV	Right Tilt	1312	1712.4	-0.03	0.977	1.413	**1.381	1.6
UMTS FDD IV	Right Tilt	1413	1732.6	-0.09	0.811	1.413	1.146	1.6
UMTS FDD IV	Right Tilt	1513	1752.6	0.06	0.684	1.413	0.966	1.6
UMTS FDD IV	Left Touch	1312	1712.4	-0.03	0.727	1.413	1.027	1.6
UMTS FDD IV	Left Touch	1413	1732.6	-0.15	0.549	1.413	0.777	1.6
UMTS FDD IV	Left Touch	1513	1752.6	-0.06	0.482	1.413	0.681	1.6
UMTS FDD IV	Left Tilt	1312	1712.4	0.07	0.574	1.413	0.811	1.6
UMTS FDD IV	Left Tilt	1413	1732.6	0.13	0.714	1.413	1.009	1.6
UMTS FDD IV	Left Tilt	1513	1752.6	0.06	0.863	1.413	1.219	1.6
UMTS FDD IV	Flat Back 10mm	1312	1712.4	0.07	0.577	1.413	**0.815	1.6
UMTS FDD IV	Flat Back 10mm	1413	1732.6	-0.02	0.503	1.413	0.711	1.6
UMTS FDD IV	Flat Back 10mm	1513	1752.6	0.04	0.428	1.413	0.605	1.6
UMTS FDD IV	Flat Front 10mm	1312	1712.4	0.00	0.268	1.413	0.379	1.6
WLAN 2.4 GHz	Flat Front 10mm	11	2462	0.03	0.032	1.585	0.051	1.6
WLAN 2.4 GHz	Flat Back 10mm	11	2462	0.08	0.048	1.585	**0.076	1.6
WLAN 5 GHz	Flat Front 10mm	36	5180	-0.03	0.028	1.585	**0.044	1.6
WLAN 5 GHz	Flat Back 10mm	36	5180	0.03	0.000	1.585	0.000	1.6
Overall maximum SAR value [W/kg (1g)]							**1.381**	**1.6**
Comments:*tune up tolerance / conducted power = scaling factor ** attached measurement plot: highest SAR value for the communication system								

SAR measurements were started with the highest power channel of the transmission band under investigation. Other measurement channels were omitted when the SAR value of the highest power channel was below 0.8 W/kg according to KDB 248227 v01r02.

According to KDB 865664 D02 v01r01 only the SAR plots for the highest SAR results for each EUT configuration and operating condition are given in the “SAR Results” part of the report.

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S Schweizerischer Kalibrierdienst
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Accreditation No.: SCS 108

Client **Eurofins**

Certificate No: DAE3-522_Sep14

CALIBRATION CERTIFICATE

Object: DAE3 - SD 000 D03 AA - SN: 522

Calibration procedure(s): QA CAL-06.v28
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: September 17, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	01-Oct-13 (No:13976)	Oct-14
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-14 (in house check)	In house check: Jan-15
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-14 (in house check)	In house check: Jan-15

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V.

Issued: September 17, 2014

Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

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

Calibration Factors	X	Y	Z
High Range	404.208 ± 0.02% (k=2)	403.882 ± 0.02% (k=2)	404.721 ± 0.02% (k=2)
Low Range	3.96428 ± 1.50% (k=2)	3.95728 ± 1.50% (k=2)	3.97367 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	56.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200036.59	-0.80	-0.00
Channel X	+ Input	20007.79	3.33	0.02
Channel X	- Input	-20000.37	5.45	-0.03
Channel Y	+ Input	200037.53	0.19	0.00
Channel Y	+ Input	20004.45	0.10	0.00
Channel Y	- Input	-20001.11	4.89	-0.02
Channel Z	+ Input	200039.93	2.29	0.00
Channel Z	+ Input	20002.07	-2.13	-0.01
Channel Z	- Input	-20005.14	0.85	-0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.68	-0.01	-0.00
Channel X	+ Input	200.76	0.21	0.11
Channel X	- Input	-198.84	0.67	-0.34
Channel Y	+ Input	2000.56	0.01	0.00
Channel Y	+ Input	200.46	-0.01	-0.00
Channel Y	- Input	-199.17	0.26	-0.13
Channel Z	+ Input	2000.50	0.01	0.00
Channel Z	+ Input	199.91	-0.66	-0.33
Channel Z	- Input	-201.19	-1.73	0.87

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-3.99	-5.30
	- 200	7.38	5.55
Channel Y	200	0.38	-0.28
	- 200	-0.60	-0.29
Channel Z	200	15.86	15.99
	- 200	-17.84	-18.37

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-1.68	-1.76
Channel Y	200	7.39	-	-1.38
Channel Z	200	6.24	5.61	-

4. AD-Converter Values with inputs shorted

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

	High Range (LSB)	Low Range (LSB)
Channel X	15741	16854
Channel Y	15714	14825
Channel Z	16054	16288

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	1.56	0.18	2.94	0.60
Channel Y	0.07	-1.10	1.20	0.53
Channel Z	0.39	-0.91	1.96	0.57

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

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

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

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

9. Power Consumption (Typical values for information)

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

ET00279

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S Schweizerischer Kalibrierdienst
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Accreditation No.: **SCS 108**

Client **Eurofins**

Certificate No: **ET3-1711_Sep14**

CALIBRATION CERTIFICATE

Object	ET3DV6 - SN:1711
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	September 22, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: September 23, 2014

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF.*
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep 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
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 ≤ 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 *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ET3DV6

SN:1711

Manufactured: August 7, 2002
Calibrated: September 22, 2014

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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1711

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.88	1.85	2.05	± 10.1 %
DCP (mV)[B]	100.1	100.6	99.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	267.4	±3.5 %
		Y	0.0	0.0	1.0		280.5	
		Z	0.0	0.0	1.0		275.0	

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

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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1711

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
450	43.5	0.87	7.37	7.37	7.37	0.25	2.86	± 13.3 %
750	41.9	0.89	6.76	6.76	6.76	0.56	1.96	± 12.0 %
900	41.5	0.97	6.31	6.31	6.31	0.30	3.00	± 12.0 %
1750	40.1	1.37	5.25	5.25	5.25	0.69	2.19	± 12.0 %
1810	40.0	1.40	5.21	5.21	5.21	0.80	2.02	± 12.0 %
1950	40.0	1.40	5.04	5.04	5.04	0.80	2.02	± 12.0 %
2150	39.7	1.53	4.83	4.83	4.83	0.80	1.92	± 12.0 %
2450	39.2	1.80	4.45	4.45	4.45	0.80	1.63	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1711

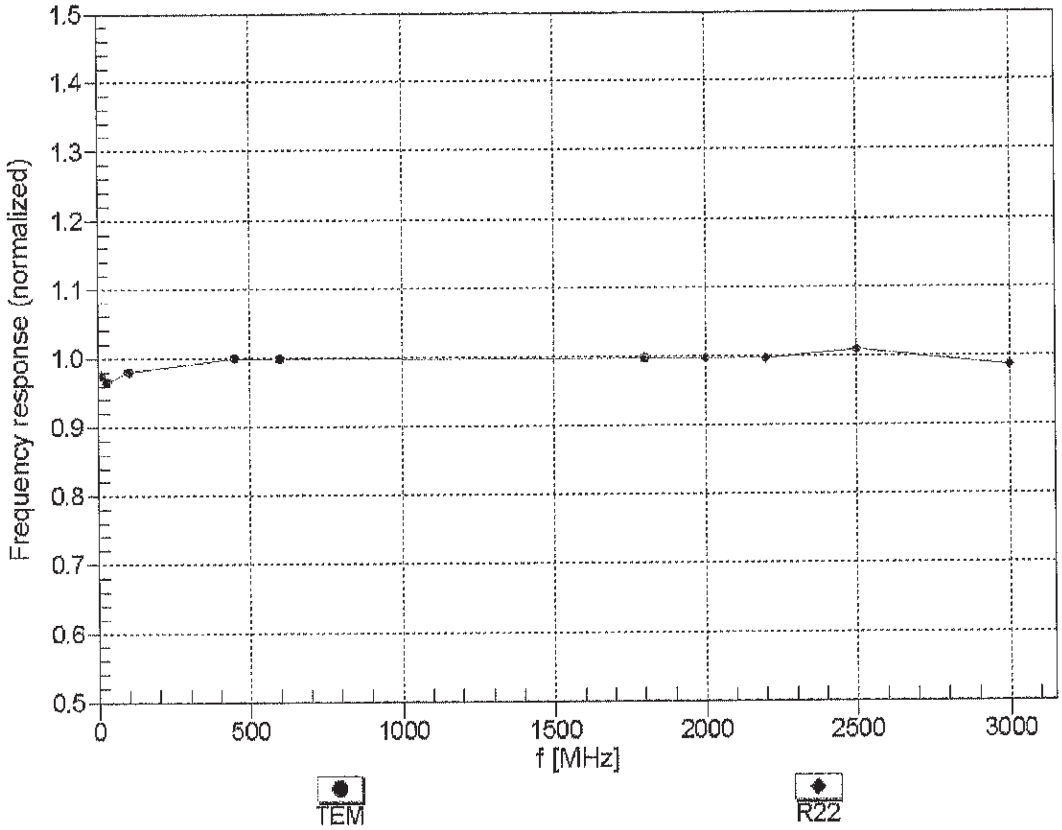
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
450	56.7	0.94	7.52	7.52	7.52	0.19	2.15	± 13.3 %
750	55.5	0.96	6.26	6.26	6.26	0.28	2.85	± 12.0 %
900	55.0	1.05	6.05	6.05	6.05	0.32	3.00	± 12.0 %
1750	53.4	1.49	4.74	4.74	4.74	0.80	2.46	± 12.0 %
1810	53.3	1.52	4.63	4.63	4.63	0.80	2.44	± 12.0 %
1950	53.3	1.52	4.67	4.67	4.67	0.80	2.35	± 12.0 %
2150	53.1	1.66	4.46	4.46	4.46	0.80	1.99	± 12.0 %
2450	52.7	1.95	4.08	4.08	4.08	0.68	1.24	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

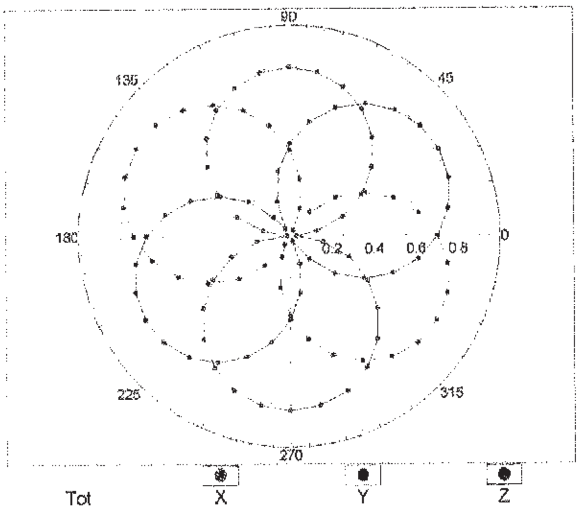
(TEM-Cell:ifi110 EXX, Waveguide: R22)



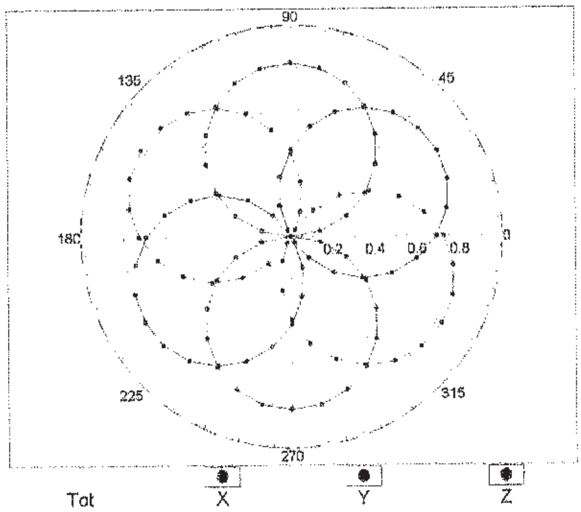
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

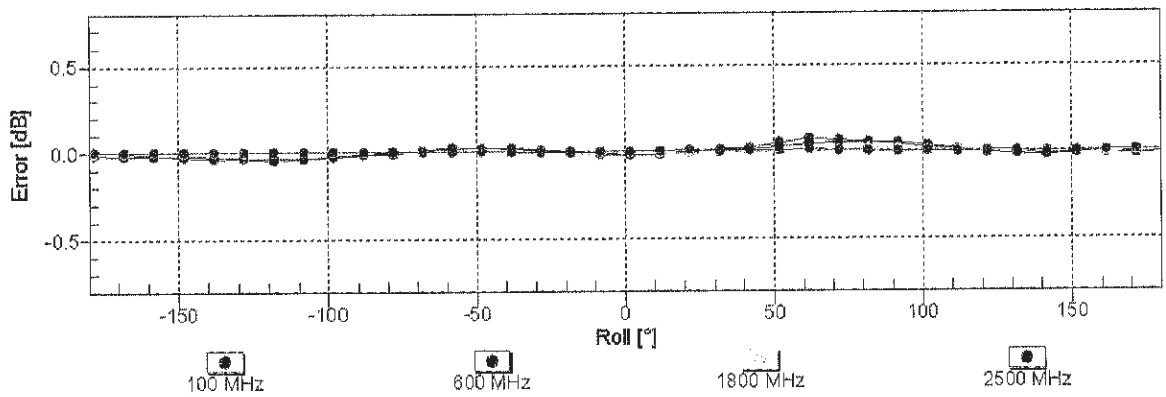
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



f=1800 MHz,R22

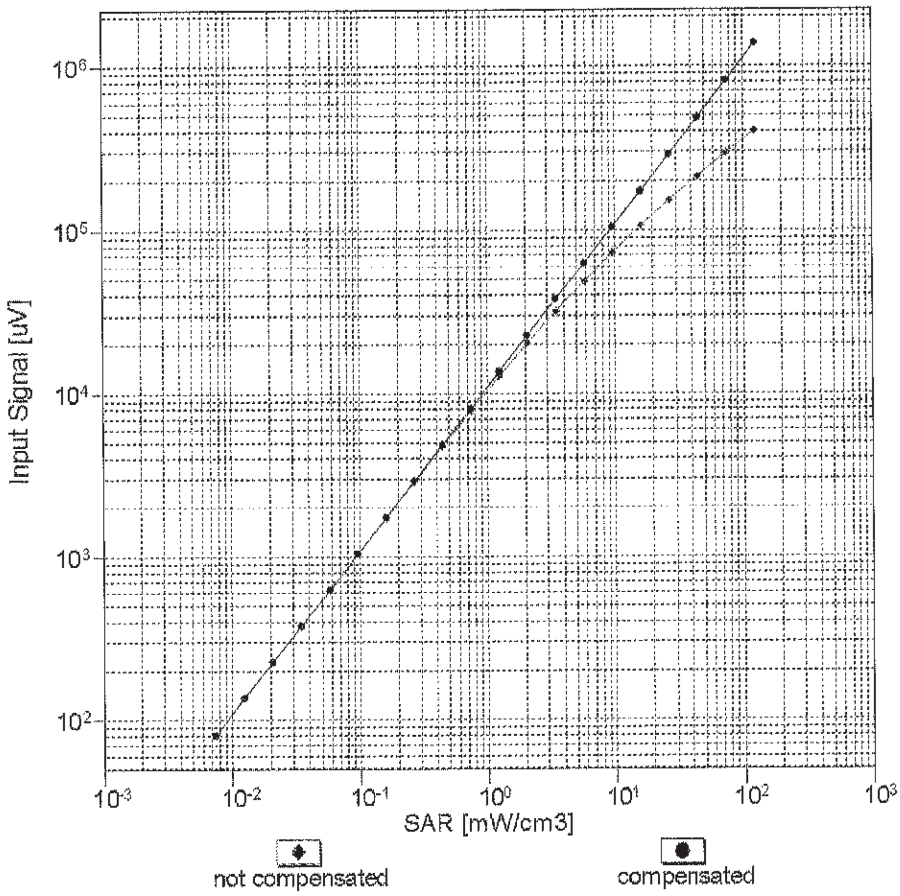


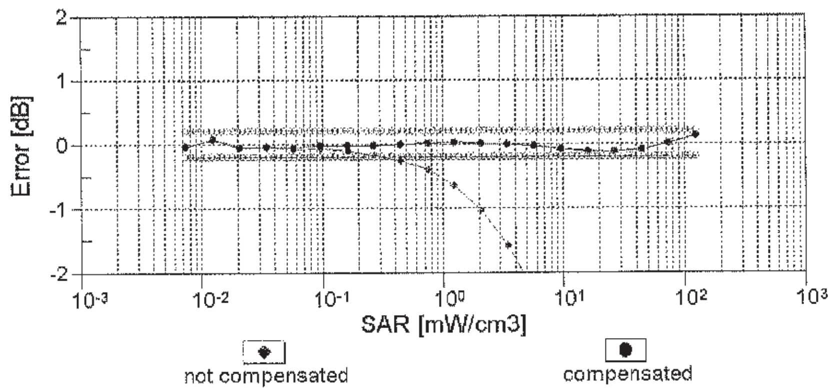


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

(TEM cell , f_{eval}= 1900 MHz)

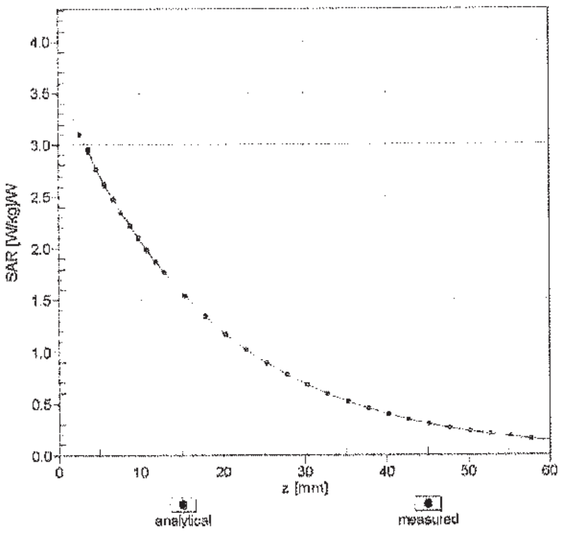




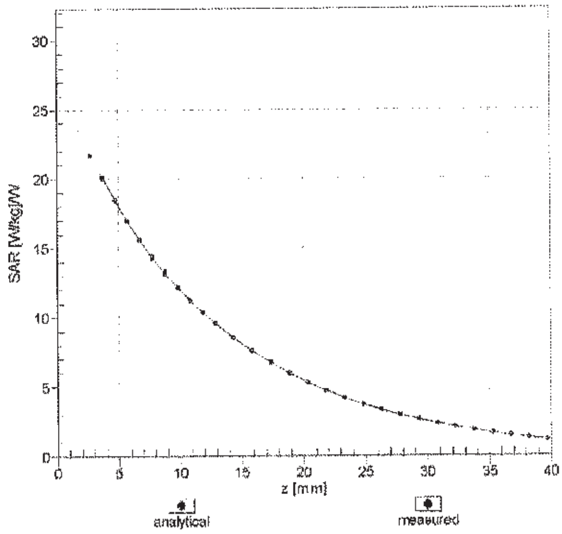
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

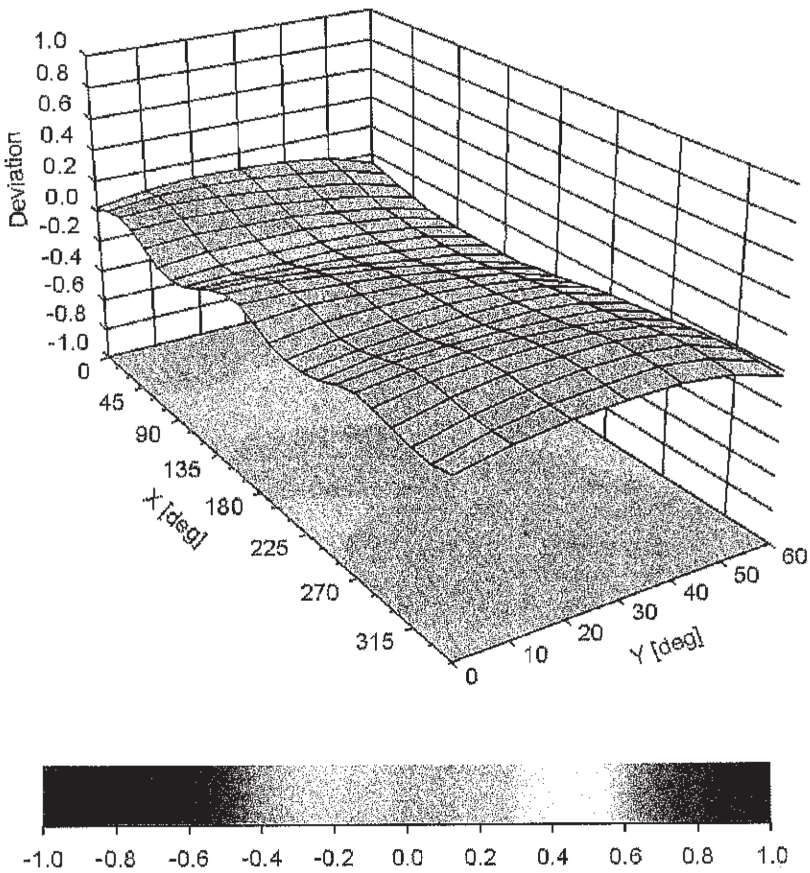


f = 1810 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1711

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-108.2
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

EF00876

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Accreditation No.: SCS 108

Client Eurofins

Certificate No: EX3-3893_Sep14

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3893

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

Calibration date: September 24, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: September 24, 2014

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep 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
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3893

Manufactured: October 9, 2012
Calibrated: September 24, 2014

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3893

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.56	0.42	0.33	± 10.1 %
DCP (mV)[B]	97.9	101.7	96.5	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	128.8	±3.3 %
		Y	0.0	0.0	1.0		129.5	
		Z	0.0	0.0	1.0		143.2	

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:3893

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
2600	39.0	1.96	7.50	7.50	7.50	0.28	0.97	± 12.0 %
5200	36.0	4.66	5.42	5.42	5.42	0.30	1.80	± 13.1 %
5500	35.6	4.96	5.05	5.05	5.05	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.78	4.78	4.78	0.40	1.80	± 13.1 %

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

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

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

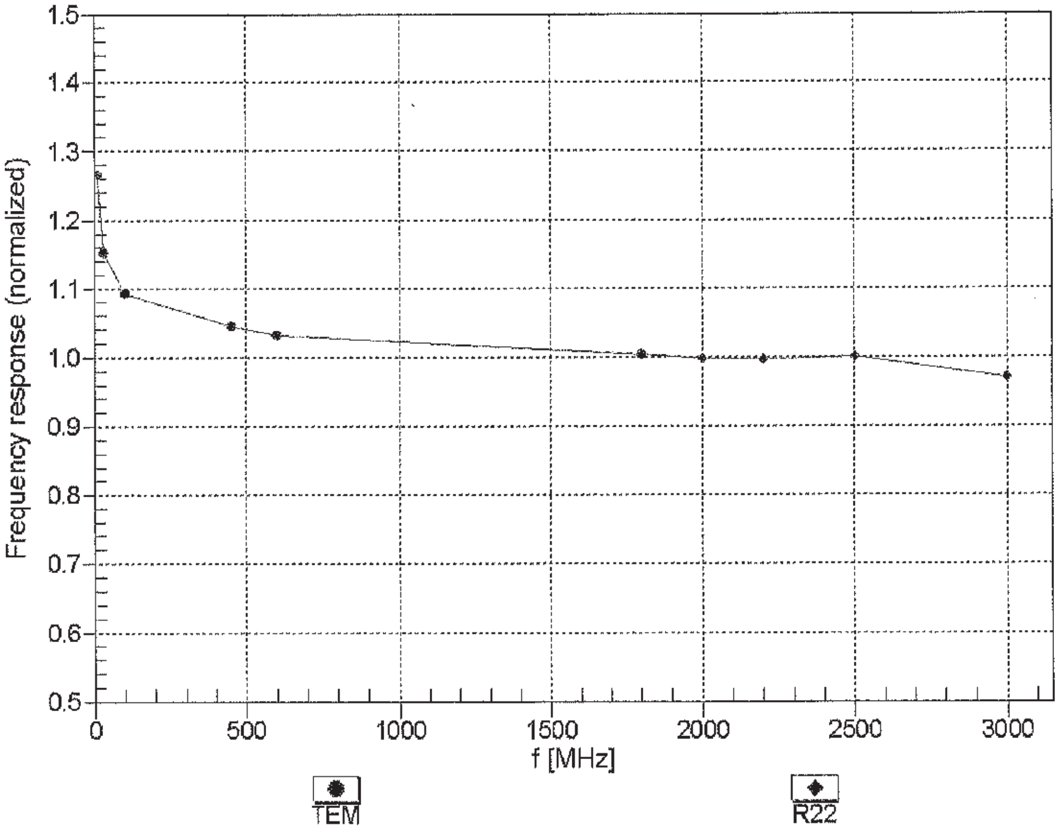
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3893

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
2600	52.5	2.16	7.52	7.52	7.52	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.64	4.64	4.64	0.40	1.90	± 13.1 %
5500	48.6	5.65	4.25	4.25	4.25	0.40	1.90	± 13.1 %
5800	48.2	6.00	4.32	4.32	4.32	0.45	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

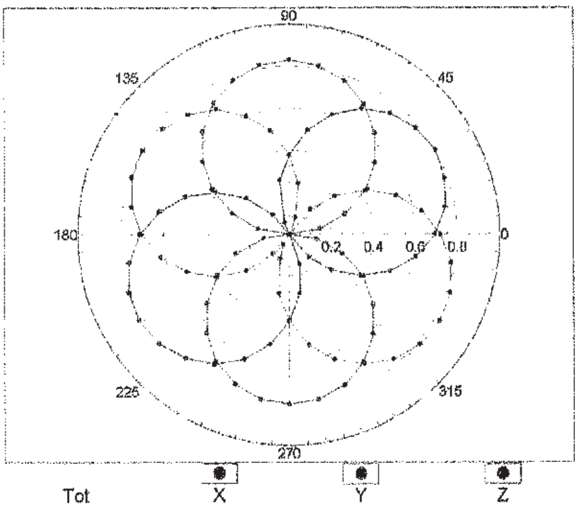
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



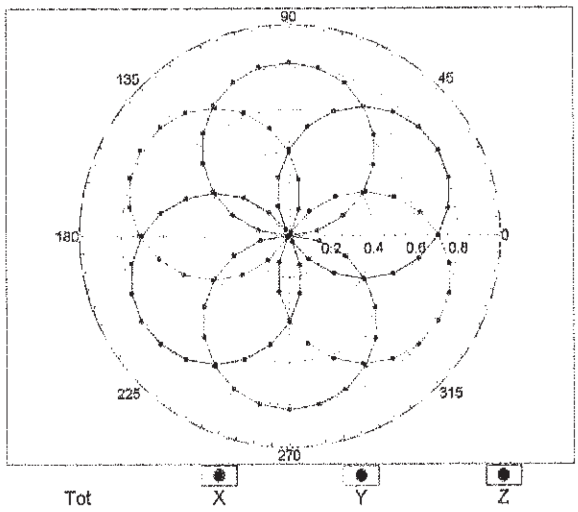
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

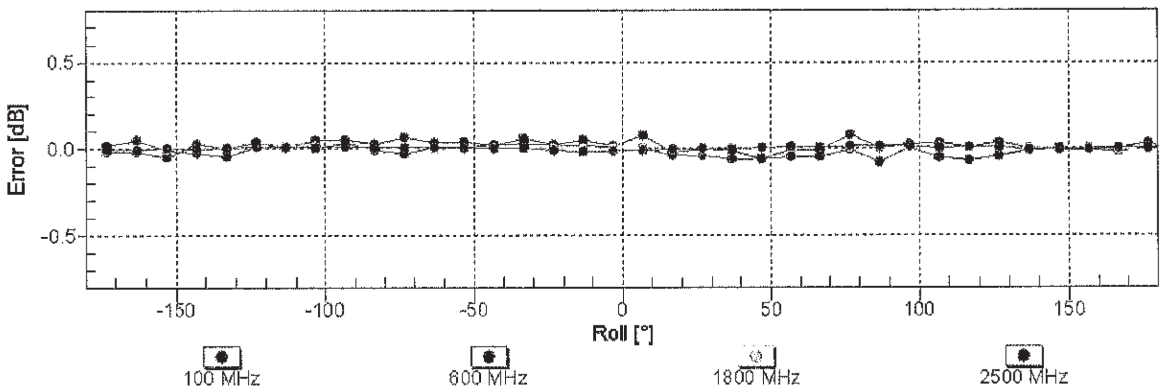
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



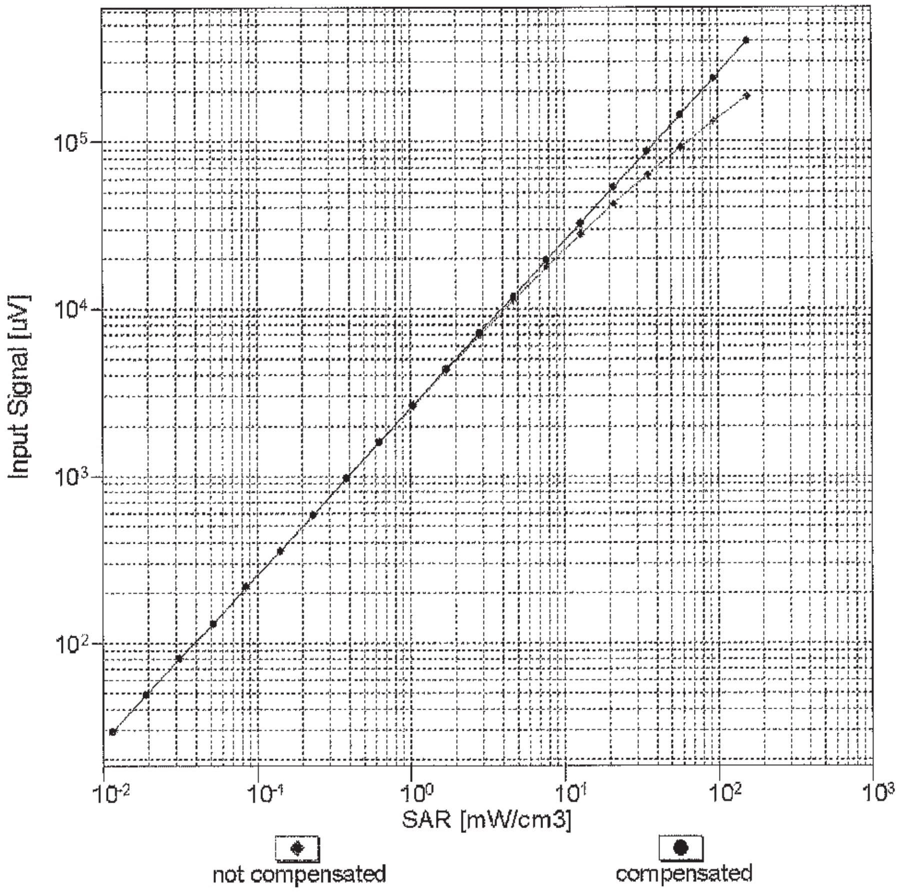
f=1800 MHz,R22

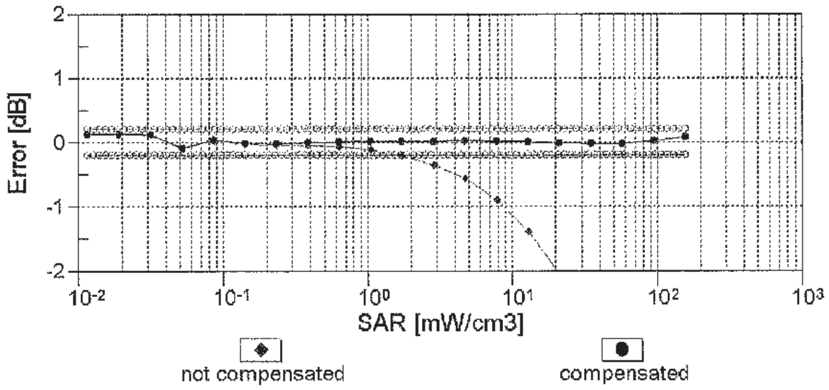




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

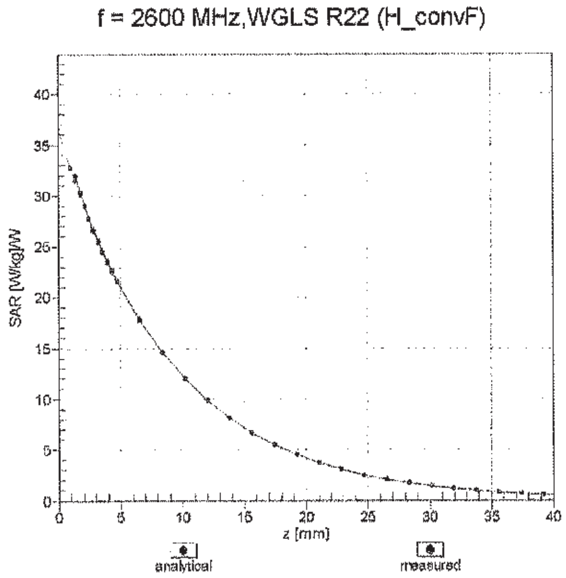
Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

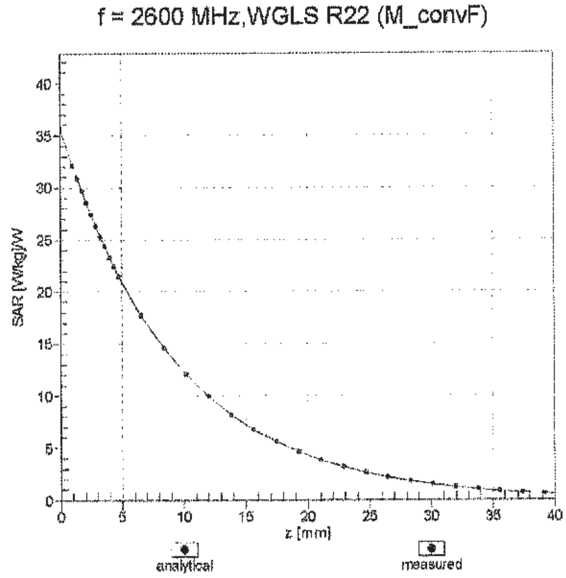




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

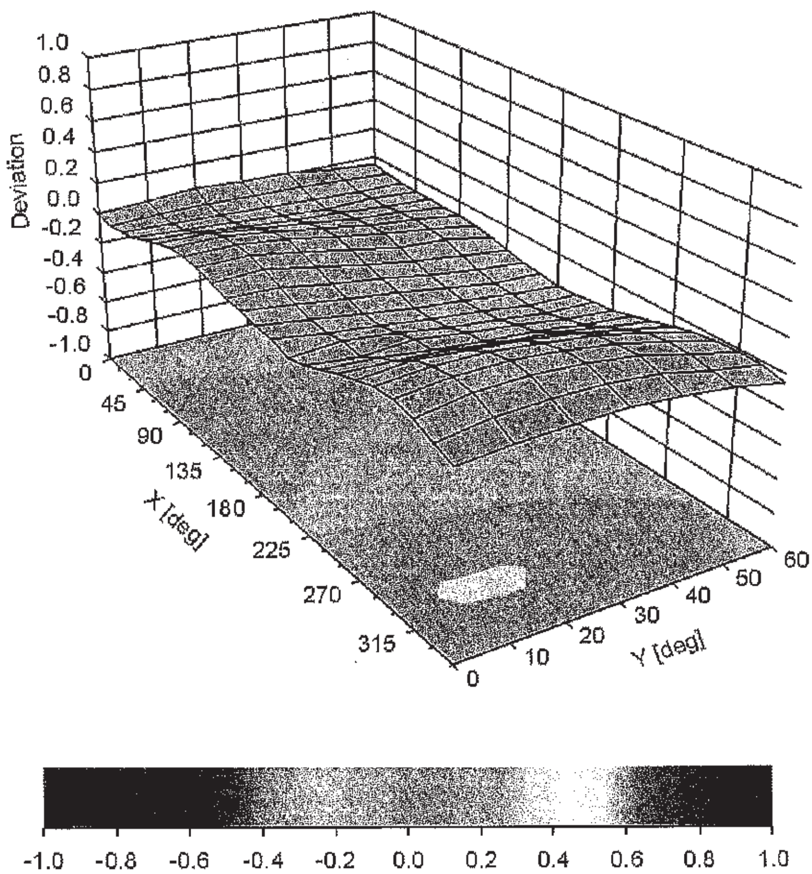
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3893

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-23.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm