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HUAWEI

Accredited testing laboratory

CNAS Registration number: L0310

Report On SAR Test of HSPA+ USB Stick M/N: E353s-6

Test report no. : **SYBH(Z-SAR)011052011-2**
Type identification : **E353s-6**
FCC ID : **QISE353S-6**
Test specification : **ANSI C95.1-1999**
: **EEE 1528-2003**
: **RSS-102 issue 4 (2010)**
: **OET Bulletin 65 Supplement C**

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1 General Information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 1.5. The HUAWEI does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of HUAWEI.

1.1.1 Statement of Compliance

The SAR values found for the E353s-6 are below the maximum recommended levels of 1.6 W/Kg as averaged over any 1 g tissue according to the FCC rule §2.1093, the ANSI/IEEE C 95.1:1999, the NCRP Report Number 86 for uncontrolled environment, according to the Health Canada's Safety Code 6 and the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure.

The measurement together with the test system set-up is described in chapter 2.3 of this test report. A detailed description of the equipment under test can be found in chapter 1.5.

Test engineer:

2011-05-11	**Lu Chaogan**	Lu Chaogan
Date	Name	Signature
2011-05-11	**Alvin Way**	Alvinway
Date	Name	Signature

Approved by:

2011-05-11	**Liu Chunlin**	Liu Chunlin
Date	Name	Signature

1.2 Testing laboratory

Lab Name: Global Compliance & Testing Center (GCTC) of Huawei Technologies Co., Ltd.
Sub-lab Name: SAR Lab of Terminal Reliability Lab
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State of accreditation: The Test laboratory (area of testing) is accredited according to ISO/IEC 17025.
CNAS Registration number: L0310

1.3 Applicant and Manufacturer

Company:	HUAWEI TECHNOLOGIES CO., LTD
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Town:	Shenzhen
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1.4 Details of Test Date

Date of receipt of application:	2011-05-06
Date of receipt of test item:	2011-05-06
Start/Date of test:	2011-05-06
End of test:	2011-05-11

1.5 Test Item

Device Information:			
DUT Name:	HSPA+ USB Stick		
Type Identification:	E353s-6		
FCC ID :	QISE353S-6		
Serial Number:	G3N2A11141200095		
IMEI No:	357260040011289		
Device Type :	portable device		
Exposure Category:	uncontrolled environment / general population		
Test device Production Information	production unit		
Device Operating Configurations:			
Operating Mode(s)	GSM,PCS,UMTS/HSPA+		
Modulation	GMSK,8-PSK,QPSK		
Device Class	B		
GPRS/EGPRS Multislot Class (12)	Max Number of Timeslots in Uplink: 4		
	Max Number of Timeslots in Downlink: 4		
	Max Total Timeslot: 5		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	GSM 850	824.2 ~ 848.8	869.2 ~893.8
	PCS 1900	1850.2 ~1909.8	1930.2 ~1989.8
	WCDMA Band V	824~849	869~894
	WCDMA Band II	1852.4 ~1907.6	1932.4 ~1987.6
Power Class :	1,tested with power level 0 (PCS 1900)		
	4,tested with power level 5 (GSM 850)		
	3, tested with power control all up bits(WCDMA)		
Test Channels (low-mid-high) :	512-661-810 (GSM 1900)		
	128-190-251(GSM 850)		
	2712-2788-2863(WCDMA Band V)		
	9262-9400-9538(WCDMA Band II)		
Hardware Version:	CH2E353SM		
Software Version:	21.132.02.00.864		
Antenna Type :	Internal Antenna		
Tested with host laptop:	Lenovo ThinkPad T61 Lenovo ThinkPad X301		

Table 1: Device information and operating configurations

1.5.1 EUT Description

E353s-6 HSPA+/WCDMA/EDGE/GPRS/GSM dual mode USB Stick is subscriber equipment in the UMTS/GSM system. E353s-6 implement such functions as RF signal receiving/transmitting, HSPA+/WCDMA and EDGE/GPRS/GSM protocol processing, data service etc. Externally it provides USB interface (to connect to the notebook etc.), USIM card interface and Micro SD card interface. E353s-6 has an internal antenna as default.

1.6 Test specification(s)

IEEE Std C95.1 – 1999, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.

IEEE 1528-2003 (April 21, 2003): Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

Supplement C, Edition 01-01 to OET Bulletin 65,Edition 97-01 June 2001: Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions.

RSS-102: Radio Frequency Exposure Compliance of Radiocommunication Apparatus
(All Frequency Bands (Issue 4 of March 2010).

Canada's Safety Code 6: Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz (99-EHD-237)

FCC KDB 447498 D02 SAR Procedures for Dongle Xmtr v02, Published on Nov 16 2009

1.6.1 RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain)	**1.60 mW/g**	8.00 mW/g
Spatial Average SAR** (Whole Body)	0.08 mW/g	0.40 mW/g
Spatial Peak SAR*** (Hands/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

Table 2: RF exposure limits

The limit applied in this test report is shown in **bold** letters.

Notes:

* The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time

** The Spatial Average value of the SAR averaged over the whole body.

*** The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

1.7 Operating conditions during test

1.7.1 General description of test procedures

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

Since the EUT only has the data transfer function, but does not have the voice transfer function, the tests in the band of GSM850 and GSM1900 are performed in the mode of GPRS and EGPRS.The measurements were performed in combination with two host laptops (Lenovo ThinkPad X301 and Lenovo ThinkPad T61). Lenovo ThinkPad T61 laptop has horizontal and vertical USB slot, Lenovo ThinkPad X301 Laptop has horizontal USB slot.

1.7.2 GSM/GPRS/EGPRS Test Configurations

SAR tests for GSM 850 and GSM 1900, a communication link is set up with a base station by air link. Using CMU200 the power lever is set to "5"and "0" in SAR of GSM 850 and GSM 1900. The tests in the band of GSM 850 and GSM 1900 are performed in the mode of GPRS/EGPRS function. Since the GPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslot is 5. The EGPRS class is 12 for this EUT, it has at most 4 timeslots in uplink, and at most 4 timeslots in downlink, the maximum total timeslot is 5.

When SAR tests for EGPRS mode is necessary, GMSK modulation should be used to minimize SAR measurement error due to higher peak-to-average power (PAR) ratios inherent in 8-PSK.

According to specification 3GPP TS 51.010, the maximum power of the GSM can do the power reduction for the multi-slot. The allowed power reduction in the multi-slot configuration is as following:

GSM850	Reduction of maximum output power, (dB)		
Number of timeslots in uplink assignment	GPRS (GMSK)	EGPRS (8PSK)	EGPRS (GMSK)
1	0	0	0
2	1.5	0.5	1.5
3	3	2.5	3
4	5	4.5	5

Table 3: The allowed power reduction in the multi-slot configuration of GSM850

GSM1900	Reduction of maximum output power, (dB)		
Number of timeslots in uplink assignment	GPRS (GMSK)	EGPRS (8PSK)	EGPRS (GMSK)
1	0	0	0
2	1.5	1	1.5
3	3.5	3	3.5
4	5.5	5	5.5

Table 4: The allowed power reduction in the multi-slot configuration of GSM1900

1.7.3 WCDMA/HSPDA/HSUPA Test Configurations

1) WCDMA

As the SAR body tests for WCDMA Band II and WCDMA Band V，we established the radio link through call processing. The maximum output power were verified on high, middle and low channels for each test band according to 3GPP TS 34.121 with the following configuration:

1) 12.2kbps RMC, 64,144,384 kbps RMC with TPC set to 'all 1'.

2) Test loop Mode 1.

For the output power, the configurations for the DPCCH and $DPDCH_1$ are as followed (EUT do not support the $DPDCH_{2-n}$)

	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	Spreading Factor	Spreading Code Number	Bits/Slot
DPCCH	15	15	256	0	10
$DPDCH_1$	15	15	256	64	10
	30	30	128	32	20
	60	60	64	16	40
	120	120	32	8	80
	240	240	16	4	160
	480	480	8	2	320
	960	960	4	1	640
$DPDCH_n$	960	960	4	1, 2, 3	640

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits configured to all “1s”. SAR for other spreading codes and multiple DPDCHn, when supported by the EUT, are not required when the maximum average outputs of each RF channel, for each spreading code and DPDCHn configuration, are less than ¼ dB higher than those measured in 12.2 RMC.

2) HSDPA

SAR for body exposure configurations is measured according to the ‘’Body SAR Measurements’’ procedures of 3G device. In addition, body SAR is also measured for HSDPA when the maximum average outputs of each RF channel with HSDPA active is at ¼ dB higher than that measured without HSDPA using 12.2kbps RMC or the maximum SAR 12.2kbps RMC is above 75% of the SAR limit. Body SAR for HSDPA is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration in 12.2 kbps RMC without HSDPA.

HSDPA should be configured according to UE category of a test device. The number of HS-DSCH/ HS-PDSCHs, HAPRQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission condition, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4ms with a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. The β_c and β_d gain factors for DPCCH and DPDCH were set according to the values in the below table, β_{hs} for HS-DPCCH is set automatically to the correct value when ΔACK, ΔNACK, ΔCQI = 8. The variation of the β_c /β_d ratio causes a power reduction at sub-tests 2 - 4.

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

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

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

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 $\beta_d = 15/15$

Table 5: Sub-tests for UMTS Release 5 HSDPA

The measurements were performed with a Fixed Reference Channel (FRC) and H-Set 1 QPSK.

Parameter	Value
Nominal average inf. bit rate	534 kbit/s
Inter-TTI Distance	3 TTI’s
Number of HARQ Processes	2 Processes
Information Bit Payload	3202 Bits
MAC-d PDU size	336 Bits

Number Code Blocks	1 Block
Binary Channel Bits Per TTI	4800 Bits
Total Available SMLs in UE	19200 SMLs
Number of SMLs per HARQ Process	9600 SMLs
Coding Rate	0.67
Number of Physical Channel Codes	5

Table 6: settings of required H-Set 1 QPSK acc. to 3GPP 34.121

HS-DSCH Category	Maximum HS-DSCH Codes Received	Minimum Inter-TTI Interval	Maximum HS-DSCH Transport Block Bits/HS-DSCH TTI	Total Soft Channel Bits
1	5	3	7298	19200
2	5	3	7298	28800
3	5	2	7298	28800
4	5	2	7298	38400
5	5	1	7298	57600
6	5	1	7298	67200
7	10	1	14411	115200
8	10	1	14411	134400
9	15	1	25251	172800
10	15	1	27952	172800
11	5	2	3630	14400
12	5	1	3630	28800
13	15	1	34800	259200
14	15	1	42196	259200
15	15	1	23370	345600
16	15	1	27952	345600

Table 7: HSDPA UE category

3) HSUPA

Body SAR is also measured for HSDPA when the maximum average outputs of each RF channel with HSDPA active is at ¼ dB higher than that measured without HSDPA using 12.2kbps RMC or the maximum SAR 12.2kbps RMC is above 75% of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-set 1 and QPSK for FRC and 12.2kbps RMC configured in Test Loop Mode 1 with power control algorithm 2, according to the highest body SAR configuration in 12.2 kbps RMC without HSPA.

Due to inner loop power control requirements in HSDPA, a commercial communication test set should be used for the output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSDPA should be configured according to the β values indicated below as well as other applicable procedures described in the 'WCDMA Handset' and 'Release 5 HSDPA Data Device' sections of 3G device.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} [1]	β_{ec}	β_{ed}	β_{ec} (SF)	β_{ed} (code)	CM [2] (dB)	MPR (dB)	AG [4] Index	E-TFCI
1	11/15 [3]	15/15 [3]	64	11/15 [3]	22/15	209/225	1039/225	4	1	1.0	0.0	20	75

2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}:47/15 β_{ed2}:47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15[(4)]	15/15[(4)]	64	15/15[(4)]	30/15	24/15	134/15	4	1	1.0	0.0	21	81

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

Note 2: CM = 1 for β_c/β_d = 12/15, β_{hs}/β_c = 24/15. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference

Note 3 : For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1,TF1) to β_c = 10/15 and β_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 β_c = 14/15 and β_d = 15/15

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

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

Table 8: Subtests for HSUPA.

UE E-DCH Category	Maximum E-DCH Codes Transmitted	Number of HARQ Processes	E-DCH TTI(ms)	Minimum Speading Factor	Maximum E-DCH Transport Block Bits	Max Rate (Mbps)
1	1	4	10	4	7110	0.7296
2	2	8	2	4	2798	1.4592
	2	4	10	4	14484	
3	2	4	10	4	14484	1.4592
4	2	8	2	2	5772	2.9185
	2	4	10	2	20000	2.00
5	2	4	10	2	20000	2.00
6 (No DPDCH)	4	8	10	2SF2&2SF4	11484	5.76
	4	4	2		20000	2.00
7 (No DPDCH)	4	8	2	2SF2&2SF4	22996	?
	4	4	10		20000	?

NOTE: When 4 codes are transmitted in parallel, two codes shall be transmitted with SF2 and two with SF4. UE categories 1 to 6 support QPSK only. UE category 7 supports QPSK.(TS25.306-7.3.0)

Table 9: HSUPA UE category

HSDPA	Reduction of maximum output power, (dB)				
	Sub-test 1	Sub-test 2	Sub-test 3	Sub-test 4	/
WCDMA850	0	0.5	1	1	/
WCDMA1900	0	0.5	1	1	/
HSUPA	Reduction of maximum output power, (dB)				
	Sub-test 1	Sub-test 2	Sub-test 3	Sub-test 4	Sub-test 5
WCDMA850	0	2	1	2	0
WCDMA1900	0	2	1	2	0

Table 10: The allowed power reduction in HSDPA and HSUPA mode of WCDMA Band

2 Technical test

2.1 Summary of test results

Band	Position	Channel	Conducted Power	1g Average (W/kg)	Tune-up Power	Extrapolated Result (W/kg)
GPRS850 2TS	Front side 5mm	190	31.21 dBm	1.08	31.50 dBm	1.155
EGPRS850 2TS	Front side 5mm	190	31.26 dBm	1.05	31.50 dBm	1.110
GPRS1900 2TS	Rear side 5mm	810	28.41 dBm	1.09	29.00 dBm	1.249
EGPRS1900 2TS	Rear side 5mm	512	28.39 dBm	**1.12**	29.00 dBm	1.289
W850 RMC	Front side 5mm	4233	21.85 dBm	0.827	23.00 dBm	1.078
W850 HSDPA	Front side 5mm	4233	21.75 dBm	0.779	23.00 dBm	1.039
W850 HSUPA	Front side 5mm	4233	21.62 dBm	0.53	23.00 dBm	0.728
W1900 RMC	Rear side 5mm	9538	22.12 dBm	1.11	23.00 dBm	1.359
W1900 HSDPA	Rear side 5mm	9538	21.93 dBm	1.09	23.00 dBm	1.395
W1900 HSUPA	Rear side 5mm	9538	21.53 dBm	0.748	23.00 dBm	1.049

Table 11: The Maximum SAR_{1g} Values of E353s-6

2.2 Test environment

General Environment conditions in the test area are as follows:

Ambient temperature: 20°C – 24°C
Tissue simulating liquid: 20°C – 24°C
Humidity: 30% – 70%

Exact temperature values for each test are shown in the table(s) under 2.6.or on the measurement plots.

2.3 Measurement and test set-up

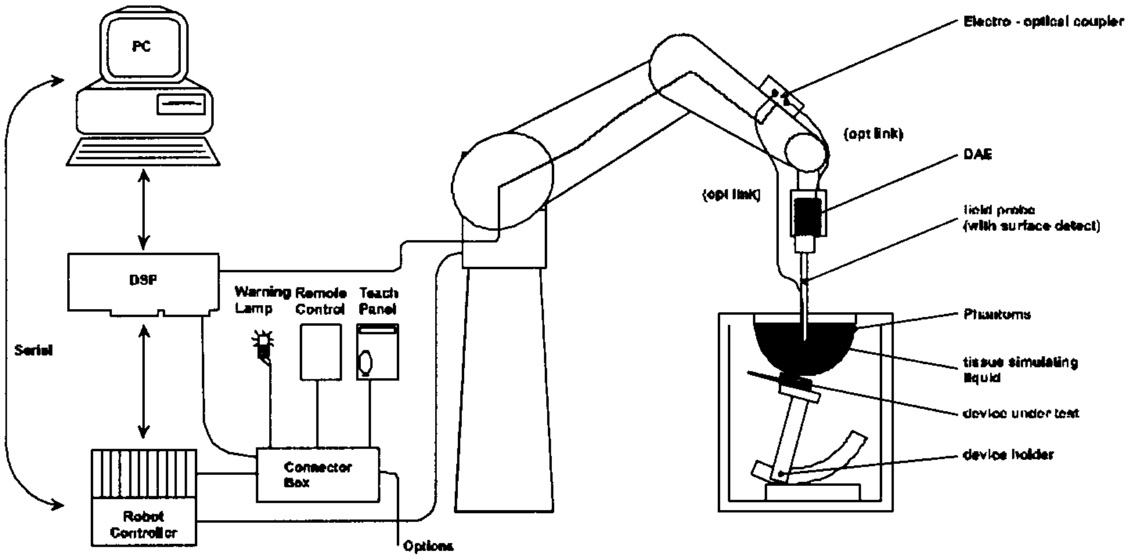
The measurement system is described in chapter 2.4.

The test setup for the system validation can be found in chapter 2.4.14.

A description of positioning and test signal control can be found in chapter 2.5 together with the test results.

2.4 Measurement system

2.4.1 System Description



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

- A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronic (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.
- A unit to operate the optical surface detector which is connected to the EOC.
- The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.
- The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows XP.
- DASY5 software and SEMCAD data evaluation software.
- Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
- The generic twin phantom enabling the testing of left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- System validation dipoles allowing to validate the proper functioning of the system.

2.4.2 Test environment

The DASY5 measurement system is placed at the head end of a room with dimensions: 4.5 x 4 x 3 m^3, the SAM phantom is placed in a distance of 1.3 m from the side walls and 1.1m from the rear wall.
Picture 1 of the photo documentation shows a complete view of the test environment.
The system allows the measurement of SAR values larger than 0.005 mW/g.

2.4.3 Probe description

Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements

Technical data according to manufacturer information	
Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., glycolether)
Calibration	In air from 10 MHz to 2.5 GHz In head tissue simulating liquid (HSL) at 900 (800-1000) MHz and 1.8 GHz (1700-1910 MHz) (accuracy ± 11%; k=2) Calibration for other liquids and frequencies upon request
Frequency	10 MHz to 3 GHz (dosimetry); Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)
Dynamic range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Optical Surface Detection	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces (EX3DV4 only)
Dimensions	Overall length: 337 mm Tip length: 9 mm Body diameter: 10 mm Tip diameter:2.5 mm Distance from probe tip to dipole centers: 1.0 mm
Application	General dosimetry up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms (EX3DV4)

Isotropic E-Field Probe ES3DV3 for Dosimetric Measurements

Technical data according to manufacturer information	
Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)
Dynamic range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones

2.4.4 Phantom description

The used SAM Phantom meets the requirements specified in Edition 01-01 of Supplement C to OET Bulletin 65 for Specific Absorption Rate (SAR) measurements.
The phantom consists of a fibreglass shell integrated in a wooden table. It allows left-hand and right-hand head as well as body-worn measurements with a maximum liquid depth of 18 cm in head position and 22 cm in planar position (body measurements). The thickness of the Phantom shell is 2 mm +/- 0.1 mm.

ear reference point right hand side

ear reference point left hand

reference point flat position

2.4.5 Device holder description

The DASY5 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. This device holder is used for standard mobile phones or PDA's only. If necessary an additional support of polystyrene material is used.

Larger DUT's (e.g. notebooks) cannot be tested using this device holder. Instead a support of bigger polystyrene cubes and thin polystyrene plates is used to position the DUT in all relevant positions to find and measure spots with maximum SAR values.
Therefore those devices are normally only tested at the flat part of the SAM.

2.4.6 Scanning procedure

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

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

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

- The „area scan“ measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The standard scan uses large grid spacing for faster measurement. Standard grid spacing for head measurements is 15 mm in x- and y- dimension. If a finer resolution is needed, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation.
  Results of this coarse scan are shown in annex 2.

- A „7x7x7 zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous „coarse“ scan. This is a fine 7x7 grid where the robot additionally moves the probe in 7 steps along the z-axis away from the bottom of the Phantom. Grid spacing for the cube measurement is 5 mm in x and y-direction and 5 mm in z-direction. DASY5 is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in annex 2. Test results relevant for the specified standard (see chapter 1.6.) are shown in table form in chapter 2.5.

- A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 2mm steps. This measurement shows the continuity of the liquid and can - depending in the field strength – also show the liquid depth. A z-axis scan of the measurement with maximum SAR value is shown in annex 2.

2.4.7 Spatial Peak SAR Evaluation

The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The basis of the evaluation are the SAR values measured at the points of the fine cube grid consisting of 7 x 7 x 7 points. The algorithm that finds the maximal averaged volume is separated into three different stages.

- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting 'Graph Evaluated'.

- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.

- All neighboring volumes are evaluated until no neighboring volume with a higher average value is found.

Extrapolation

The extrapolation is based on a least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

Interpolation

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff].

Volume Averaging

At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

Advanced Extrapolation

DASY5 uses the advanced extrapolation option which is able to compansate boundary effects on E-field probes.

2.4.8 Data Storage and Evaluation

Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation by SEMCAD

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

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

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

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

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

with V_i = compensated signal of channel i (i = x, y, z)
U_i = input signal of channel i (i = x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

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

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

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

with V_i = compensated signal of channel i (i = x, y, z)
$Norm_i$ = sensor sensitivity of channel i (i = x, y, z)
$[mV/(V/m)^2]$ for E-field Probes
ConvF = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
E_i = electric field strength of channel i in V/m
H_i = magnetic field strength of channel i in A/m

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

$$E_{tot} = (E_x^2 + E_Y^2 + E_z^2)^{1/2}$$

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

$$SAR = (E_{tot}^2 \cdot \sigma) / (\rho \cdot 1000)$$

with SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

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

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

with P_{pwe} = equivalent power density of a plane wave in mW/cm^2
E_{tot} = total electric field strength in V/m
H_{tot} = total magnetic field strength in A/m

2.4.9 Test equipment utilized

This table gives a complete overview of the SAR measurement equipment

Devices used during the test described in chapter 2.5. are marked ☒

	Manufacturer	Device	Type	Serial number	Date of last calibration)*
☒	Schmid & Partner Engineering AG	Dosimetric E-Field Probe	EX3DV4	3736	2010-11-16
☒	Schmid & Partner Engineering AG	835 MHz System Validation Dipole	D835V2	4d095	2011-02-23
☐	Schmid & Partner Engineering AG	900 MHz System Validation Dipole	D900V2	1d063	2011-02-23
☐	Schmid & Partner Engineering AG	1800 MHz System Validation Dipole	D1800V2	2d157	2011-02-23
☒	Schmid & Partner Engineering AG	1900 MHz System Validation Dipole	D1900V2	5d091	2011-02-23
☐	Schmid & Partner Engineering AG	2000 MHz System Validation Dipole	D2000V2	1036	2011-02-23
☒	Schmid & Partner Engineering AG	Data acquisition electronics	DAE4	1236	2010-10-26
☒	Schmid & Partner Engineering AG	Software	DASY 5	N/A	N/A
☒	Schmid & Partner Engineering AG	Twin Phantom	SAM3	TP-1597	N/A
☒	Schmid & Partner Engineering AG	Twin Phantom	SAM4	TP-1620	N/A
☐	Schmid & Partner Engineering AG	ELI Phantom	ELI4	TP-1038	N/A
☐	Rohde & Schwarz	Universal Radio Communication Tester	CMU 200	111379	2010-08-11
☒	Rohde & Schwarz	Universal Radio Communication Tester	CMU 200	111305	2010-08-11
☒	Agilent)*	Network Analyser 300 kHz to 8.5 GHz	E5071B	MY42404956	2011-02-22
☒	Agilent	Dielectric Probe Kit	85070E	2484	N/A
☒	Agilent	Signal Generator	N5181A	MY47420989	2011-02-22
☒	MINI-CIRCUITS	Amplifier	ZHL-42W	QA0746001	N/A
☒	Agilent	Power Meter	E4417A	MY45101339	2011-02-22
☒	Agilent	Power Meter Sensor	E9321A	MY44420359	2011-02-22

Note:

1) Per KDB 450824 D02 requirements for dipole calibration, HUAWEI GCTC SAR lab has adopted three years calibration interval. But each measured dipole is expected to evaluate with the following criteria at least on annual interval.

a) There is no physical damage on the dipole;
b) System validation with specific dipole is within 10% of calibrated value;
c) Return-loss is within 10% of calibrated measurement;
d) Impedance is within 5Ω from the previous measurement.

2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

2.4.10 Tissue simulating liquids: dielectric properties

The following materials are used for producing the tissue-equivalent materials.

(liquids used for tests described in chapter 2.5. are marked with ☒) :

Ingredients (% of weight)	Frequency (MHz)					
frequency band	☐ 450	☒ 835	☐ 900	☐ 1800	☒ 1900	☐ 2450
Tissue Type	Body	Body	Body	Body	Body	Body
Water	51.16	52.4	56.0	69.91	69.91	73.2
Salt (NaCl)	1.49	1.40	0.76	0.13	0.13	0.04
Sugar	46.78	45.0	41.76	0.0	0.0	0.0
HEC	0.52	1.0	1.21	0.0	0.0	0.0
Bactericide	0.05	0.1	0.27	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	0.0	29.96	29.96	26.7

Table 12: Body tissue dielectric properties

Salt: 99+% Pure Sodium Chloride Sugar: 98+% Pure Sucrose
Water: De-ionized, 16MΩ+ resistivity HEC: Hydroxyethyl Cellulose
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100(ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether

Note : Due to their availability body tissue simulating liquids as defined by FCC OET Bulletin 65 Supplement C are generally used for body worn SAR testing.

2.4.11 Tissue simulating liquids: parameters

Used Target Frequency	Measured Tissue		Measured Tissue		Liquid Temp.	Test Date
	Permittivity (+/-5%)	Conductivity [S/m] (+/-5%)	Permittivity	Conductivity [S/m]		
835MHz Body	55.2 (52.40~58.00)	0.97 (0.92~1.02)	54.39	0.9817	20.8°C	2011-5-6
835MHz Body	55.2 (52.40~58.00)	0.97 (0.92~1.02)	53.36	0.9743	20.8°C	2011-5-9
835MHz Body	55.2 (52.40~58.00)	0.97 (0.92~1.02)	53.43	0.9778	20.8°C	2011-5-10
1900MHz Body	53.3 (50.6~56.00)	1.52 (1.44~1.60)	51.53	1.527	20.8°C	2011-5-7
1900MHz Body	53.3 (50.6~56.00)	1.52 (1.44~1.60)	52.08	1.456	20.8°C	2011-5-10
1900MHz Body	53.3 (50.6~56.00)	1.52 (1.44~1.60)	52.08	1.456	20.8°C	2011-5-11

Table 13: Parameter of the body tissue simulating liquid

Note: The dielectric parameters of the tissue-equivalent liquid should be measured under similar ambient conditions and within 2°C of the conditions expected during the SAR evaluation to satisfy protocol requirements.

2.4.12 Measurement uncertainty evaluation for SAR test

The overall combined measurement uncertainty of the measurement system is ± 4.6% (K=1).
The expanded uncertainty (k=2) is assessed to be ± 9.3%
This measurement uncertainty budget is suggested by IEEE P1528 and determined by Schmid & Partner Engineering AG. The breakdown of the individual uncertainties is as follows:

Repeatability Budget for System Checkfor the 0.3 - 3GHz range								
Error Sources	Uncertainty Value	Probability Distribution	Divi-sor	c_i 1g	c_i 10g	Standard Uncertainty 1g	Standard Uncertainty 10g	v_i^2 or v_{eff}
Measurement System								
Probe calibration	±1.8%	Normal	1	1	1	±1.8%	±1.8%	∞
Axial isotropy	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
Hemispherical isotropy	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
Linearity	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
Boundary effects	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
Modulation Response	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
System detection limits	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
Readout electronics	±0.0%	Normal	1	1	1	±0.0%	±0.0%	∞
Response time	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
Integration time	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
RF ambient Noise	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
RF ambient Reflection	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
Probe positioner	±0.4%	Rectangular	√3	1	1	±0.2%	±0.2%	∞
Probe positioning	±2.9%	Rectangular	√3	1	1	±1.7%	±1.7%	∞
Max. SAR evaluation	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
Dipole Related								
Dev. of experimental dipole	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
Dipole Axis to Liquid Dist.	±2.0%	Rectangular	√3	1	1	±1.2%	±1.2%	∞
Input power & SAR drift	±3.4%	Rectangular	√3	1	1	±2.0%	±2.0%	∞
Phantom and Set-up								
Phantom uncertainty	±4.0%	Rectangular	√3	1	1	±2.3%	±2.3%	∞
SAR correction	±1.9%	Rectangular	√3	1	0.84	±1.1%	±0.9%	∞
Liquid conductivity (meas.)	±2.5%	Normal	1	0.78	0.71	±2.0%	±1.8%	∞
Liquid permittivity (meas.)	±2.5%	Normal	1	0.26	0.26	±0.6%	±0.7%	∞
Temp. unc. - Conductivity	±1.7%	Rectangular	√3	0.78	0.71	±0.8%	±0.7%	∞
Temp. unc. - Permittivity	±0.3%	Rectangular	√3	0.23	0.26	±0.0%	±0.0%	∞
Combined Std. Uncertainty						±4.7%	±4.6%	
Expanded Std. Uncertainty						**±9.5%**	**±9.3%**	

Table 14: Repeatability Budget for System Check for the 0.3 - 3GHz range

2.4.13 Measurement uncertainty evaluation for system validation

The overall combined measurement uncertainty of the measurement system is ± 10.1%).
The expanded uncertainty (k=2) is assessed to be ± 20.1%
This measurement uncertainty budget is suggested by IEEE P1528 and determined by Schmid & Partner Engineering AG. The breakdown of the individual uncertainties is as follows:

Uncertainty Budget for System Validation for the 0.3 - 6GHz range								
Error Sources	Uncertainty Value	Probability Distribution	Divi-sor	c_i 1g	c_i 10g	Standard Uncertainty 1g	Standard Uncertainty 10g	v_i^2 or v_{eff}
Measurement System								
Probe calibration	±6.55%	Normal	1	1	1	±6.55%	±5.9%	∞
Axial isotropy	±4.7%	Rectangular	√3	1	1	±2.7%	±2.7%	∞
Hemispherical isotropy	±9.6%	Rectangular	√3	0	0	±0.0%	±0.0%	∞
Boundary effects	±1.0%	Rectangular	√3	1	1	±0.6%	±0.6%	∞
Probe linearity	±4.7%	Rectangular	√3	1	1	±2.7%	±2.7%	∞
System detection limits	±1.0%	Rectangular	√3	1	1	±0.6%	±0.6%	∞
Modulation Response	±0.0%	Rectangular	√3	1	1	±0%	±0%	∞
Readout electronics	±0.3%	Normal	1	1	1	±0.3%	±0.3%	∞
Response time	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
Integration time	±0.0%	Rectangular	√3	1	1	±0.0%	±0.0%	∞
RF ambient Noise	±1.0%	Rectangular	√3	1	1	±0.6%	±0.6%	∞
RF ambient Reflections	±1.0%	Rectangular	√3	1	1	±0.6%	±0.6%	∞
Probe positioner	±0.8%	Rectangular	√3	1	1	±0.5	±0.5	∞
Probe positioning	±6.7%	Rectangular	√3	1	1	±3.9	±3.9	∞
Max. SAR evaluation	±20%	Rectangular	√3	1	1	±1.2	±1.2	∞
Dipole								
Deviation of experimental dipole	±5.5%	Rectangular	√3	1	1	±3.2%	±3.2%	∞
Dipole axis to liquid distance	±2.0%	Rectangular	1	1	1	±1.2%	±1.2%	∞
Power drift	±3.4	Rectangular	√3	1	1	±2.0%	±2.0%	∞
Phantom and Set-up								
Phantom uncertainty	±4.0%	Rectangular	√3	1	1	±2.3%	±2.3%	∞
SAR correction	±1.9%	Rectangular	√3	1	0.84	±1.1	±0.9	∞
Liquid conductivity (meas.)	±2.5%	Normal	1	0.78	0.71	±2.0	±1.8	∞
Liquid permittivity (meas.)	±2.5%	Normal	1	0.26	0.26	±06%	±0.7%	∞
Temp. unc. - Conductivity	±1.7%	Rectangular	√3	0.78	0.71	±0.8%	±07%	∞
Temp. unc. - Permittivity	±0.3%	Rectangular	√3	0.23	0.26	±0.0%	±0.0%	∞
Combined Uncertainty						**±10.1%**	**±10.1%**	
Expanded Std. Uncertainty						**±20.2%**	**±20.1%**	

Table 15: Uncertainty Budget for System Validation for the 0.3 - 6GHz range

2.4.14 System validation

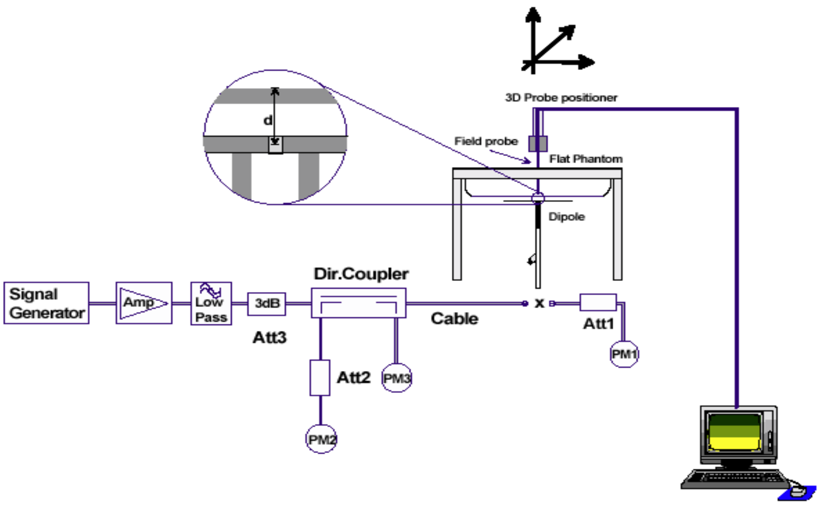
The system validation is performed for verifying the accuracy of the complete measurement system and performance of the software. The system validation is performed with tissue equivalent material according to IEEE P1528 (described above). The following table shows validation results for all frequency bands and tissue liquids used during the tests of the test item described in chapter 1.5.
(graphic plot(s) see annex 1).

System Check	Target SAR (250 mW) (+/-10%)		Measured SAR(250mW)		Liquid Temp.	Test Date
	1-g (mW/g)	10-g (mW/g)	1-g (mW/g)	10-g (mW/g)		
D835V2 Body	2.47 (2.22~2.71)	1.61 (1.45~1.77)	2.62	1.73	20.8°C	2011-5-6
D835V2 Body	2.47 (2.22~2.71)	1.61 (1.45~1.77)	2.68	1.77	20.8°C	2011-5-9
D835V2 Body	2.47 (2.22~2.71)	1.61 (1.45~1.77)	2.63	1.74	20.8°C	2011-5-10
D1900V2 Body	10.2 (9.18~11.22)	5.24 (4.716~5.764)	10.6	5.53	20.8°C	2011-5-7
D1900V2 Body	10.2 (9.18~11.22)	5.24 (4.716~5.764)	10	5.27	20.8°C	2011-5-10
D1900V2 Body	10.2 (9.18~11.22)	5.24 (4.716~5.764)	10.2	5.35	20.8°C	2011-5-11

Table 16: Results system validation

2.4.15 Validation procedure

The validation is performed by using a validation dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a plexiglass spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 250 mW. To adjust this power a power meter is used. The power sensor is connected to the cable before the validation to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the validation to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test (result on plot).
Validation results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system.



2.5 Conducted Power Test

2.5.1 Conducted power measurements

For the measurements a Rohde & Schwarz Radio Communication Tester CMU 200 was used.
The output power was measured using an integrated RF connector and attached RF cable.
The conducted output power was also checked before and after each SAR measurement. The resulting power values were within a 0.2 dB tolerance of the values shown below.

Note: CMU200 measures GSM peak and average output power for active timeslots.
For SAR the time based average power is relevant. The difference in between depends on the duty cycle of the TDMA signal :

No. of timeslots	**1**	**2**	**3**	**4**
Duty Cycle	1 : 8	1: 4	1 : 2.66	1 : 2
Timebased avg. power compared to slotted avg. power	- 9 dB	- 6 dB	- 4.25 dB	- 3 dB

The signalling modes differ as follows :

mode	**coding scheme**	**modulation**
GPRS	CS1 to CS4	GMSK
EDGE	MCS1 to MCS4	GMSK
EDGE	MCS5 to MCS9	8PSK

Apart from modulation change (GMSK/8PSK) coding schemes differ in code rate without influence on the RF signal. Therefore one coding scheme per mode was selected for conducted power measurements.

2.5.2 Conducted power results

GSM850

GSM850 + GPRS (GMSK)		Conducted power (dBm)			Averaged power(dBm)		
		Channel 128	Channel 190	Channel 251	Channel 128	Channel 190	Channel 251
1 tx slot	Before test	32.37	32.17	32.07	23.37	23.17	23.07
	After test	32.35	32.19	32.06	23.35	23.19	23.06
2 tx slots	Before test	31.28	31.21	31.03	25.28	25.21	25.03
	After test	31.29	31.20	31.05	**25.29**	25.20	25.05
3 tx slots	Before test	29.23	29.11	28.94	24.98	24.86	24.69
	After test	29.22	29.12	28.96	24.97	24.87	24.71
4 tx slots	Before test	27.24	27.21	27.05	24.24	24.21	24.05
	After test	27.22	27.20	27.03	24.22	24.2	24.03
GSM850 + EGPRS (8PSK)		Conducted power (dBm)			Averaged power(dBm)		
		Channel 128	Channel 190	Channel 251	Channel 128	Channel 190	Channel 251
1 tx slot	Before test	25.63	25.67	25.78	16.63	16.67	16.78
	After test	25.65	25.66	25.78	16.65	16.66	16.78
2 tx slots	Before test	25.21	25.11	25.05	19.21	19.11	19.05
	After test	25.22	25.09	25.04	**19.22**	19.09	19.04
3 tx slots	Before test	23.04	23.07	23.01	18.79	18.82	18.76
	After test	23.02	23.09	22.99	18.77	18.84	18.74
4 tx slots	Before test	21.03	20.87	21.42	18.03	17.87	18.42
	After test	21.01	20.85	21.41	18.01	17.85	18.41
GSM850 + EGPRS (GMSK)		Conducted power (dBm)			Averaged power(dBm)		
		Channel 128	Channel 190	Channel 251	Channel 128	Channel 190	Channel 251
1 tx slot	Before test	32.39	32.15	32.06	23.39	23.15	23.06
	After test	32.37	32.15	32.05	23.37	23.15	23.05
2 tx slots	Before test	31.23	31.26	31.06	25.23	**25.26**	25.06
	After test	31.21	31.24	31.06	25.21	25.24	25.06
3 tx slots	Before test	29.28	29.17	28.97	25.03	24.92	24.72
	After test	29.27	29.19	28.95	25.02	24.94	24.7
4 tx slots	Before test	27.21	27.24	27.08	24.21	24.24	24.08
	After test	27.19	27.25	27.07	24.19	24.25	24.07

Table 17：Conducted power measurement result (GSM850)

GSM1900

GSM1900 + GPRS (GMSK)		Conducted power (dBm)			Averaged power(dBm)		
		Channel 512	Channel 661	Channel 810	Channel 512	Channel 661	Channel 810
1 tx slot	Before test	29.32	29.42	29.44	20.32	20.42	20.44
	After test	29.32	29.40	29.43	20.32	20.4	20.43
2 tx slots	Before test	28.35	28.36	28.41	22.35	22.36	**22.41**
	After test	28.34	28.34	28.40	22.34	22.34	22.40
3 tx slots	Before test	26.17	26.29	26.31	21.92	22.04	22.06
	After test	26.18	26.29	26.30	21.93	22.04	22.05
4 tx slots	Before test	24.12	24.25	24.33	21.12	21.25	21.33
	After test	24.13	24.24	24.31	21.13	21.24	21.31
GSM1900 + EGPRS (8PSK)		Conducted power (dBm)			Averaged power(dBm)		
		Channel 512	Channel 661	Channel 810	Channel 512	Channel 661	Channel 810
1 tx slot	Before test	24.91	25.02	25.04	15.91	16.02	16.04
	After test	24.90	25.00	25.03	15.90	16.00	16.03
2 tx slots	Before test	24.07	24.11	24.09	18.07	**18.11**	18.09
	After test	24.06	24.09	24.09	18.06	18.09	18.09
3 tx slots	Before test	22.09	22.11	22.1	17.84	17.86	17.85
	After test	22.07	22.11	22.12	17.82	17.86	17.87
4 tx slots	Before test	20.08	20.11	20.09	17.08	17.11	17.09
	After test	20.09	20.11	20.07	17.09	17.11	17.07
GSM1900 + EGPRS (GMSK)		Conducted power (dBm)			Averaged power(dBm)		
		Channel 512	Channel 661	Channel 810	Channel 512	Channel 661	Channel 810
1 tx slot	Before test	29.35	29.44	29.41	20.35	20.44	20.41
	After test	29.36	29.44	29.43	20.36	20.44	20.43
2 tx slots	Before test	28.37	28.38	28.43	22.37	22.38	**22.43**
	After test	28.39	28.37	28.42	22.39	22.37	22.42
3 tx slots	Before test	26.19	26.27	26.35	21.94	22.02	22.10
	After test	26.19	26.28	26.35	21.94	22.03	22.10
4 tx slots	Before test	24.16	24.28	24.36	21.16	21.28	21.36
	After test	24.15	24.29	24.34	21.15	21.29	21.34

Table 18：Conducted power measurement result (GSM1900)

WCDMA Band V

WCDMA Band V		Conducted Power (dBm)		
		Channel 4132	Channel 4282	Channel 4233
12.2kbps RMC	Before test	21.87	21.83	21.85
	After test	21.87	21.84	21.84
64kbps RMC	Before test	21.82	21.85	21.91
	After test	21.85	21.84	**21.90**
144kbps RMC	Before test	21.86	21.87	21.86
	After test	21.85	21.87	21.86
384kbps RMC	Before test	21.88	21.84	21.89
	After test	21.86	21.85	21.88
WCDMA Band V +HSDPA		Conducted Power (dBm)		
		Channel 4132	Channel 4282	Channel 4233
Sub Test - 1	Before test	21.88	**21.89**	21.75
	After test	21.87	21.88	21.76
Sub Test - 2	Before test	21.12	21.05	21.03
	After test	21.10	21.06	21.04
Sub Test - 3	Before test	21.03	20.96	20.95
	After test	21.02	20.98	20.94
Sub Test - 4	Before test	21.01	20.98	20.97
	After test	21.03	20.98	20.95
WCDMA Band V +HSUPA		Conducted Power (dBm)		
		Channel 4132	Channel 4282	Channel 4233
Sub Test - 1	Before test	21.37	21.65	**21.78**
	After test	21.36	21.67	21.77
Sub Test - 2	Before test	20.43	20.58	20.51
	After test	20.44	20.26	20.53
Sub Test - 3	Before test	21.72	21.12	21.05
	After test	21.71	21.13	21.05
Sub Test - 4	Before test	20.45	20.51	20.32
	After test	20.45	20.50	20.35
Sub Test - 5	Before test	21.70	21.56	21.60
	After test	21.68	21.56	21.62

Table 19：Conducted power measurement result (WCDMA 800)

WCDMA Band II

WCDMA Band II		Conducted Power (dBm)		
		Channel 9262	Channel 9400	Channel 9538
12.2kbps RMC	Before test	22.47	22.35	22.12
	After test	22.45	22.34	22.10
64kbps RMC	Before test	22.42	22.31	22.08
	After test	22.40	22.30	22.06
144kbps RMC	Before test	22.39	22.29	22.09
	After test	22.37	22.29	22.07
384kbps RMC	Before test	**22.48**	22.32	22.17
	After test	22.46	22.31	22.15
WCDMA Band II +HSDPA		Conducted Power (dBm)		
		Channel 9262	Channel 9400	Channel 9538
Sub Test - 1	Before test	**22.38**	22.25	21.93
	After test	22.36	22.23	21.92
Sub Test - 2	Before test	21.67	21.53	21.28
	After test	21.66	21.52	21.26
Sub Test - 3	Before test	21.61	21.46	21.18
	After test	20.60	21.45	21.16
Sub Test - 4	Before test	21.65	21.51	21.16
	After test	21.63	21.50	21.16
WCDMA Band II +HSUPA		Conducted Power (dBm)		
		Channel 9262	Channel 9400	Channel 9538
Sub Test - 1	Before test	21.47	**21.61**	21.53
	After test	21.47	21.60	21.53
Sub Test - 2	Before test	19.67	19.59	19.45
	After test	19.67	19.58	19.44
Sub Test - 3	Before test	20.50	20.51	20.73
	After test	20.49	20.51	20.73
Sub Test - 4	Before test	20.05	19.86	19.91
	After test	20.04	19.84	19.90
Sub Test - 5	Before test	21.44	21.48	21.53
	After test	21.42	21.48	21.52

Table 20：Conducted power measurement result (WCDMA 1900)

Note: 1) Average power numbers: The maximum power numbers are marks in **bold**.

2) To verify if the output changes within the tolerance before and after each SAR test, please see the power drift of each test in chapter 2.6.

3) For SAR testing the EUT was set to multislot class based on the maximum averaged conducted power.

2.6 Test Results

GSM 850 (GSM/GPRS/EGPRS)

Test Position	Test channel /Frequency	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Front Side 5mm	251/836.6	GPRS850 2TS	0.993	0.629	0.046	1.6	20.8°C
	190/836.6		**1.080**	0.683	-0.107	1.6	20.8°C
	128/836.6		0.975	0.620	0.073	1.6	20.8°C
Rear Side 5mm	251/848.8	GPRS850 1TS	0.892	0.547	0.094	1.6	20.8°C
	190/836.6		0.848	0.523	-0.092	1.6	20.8°C
	128/824.2		0.817	0.503	0.090	1.6	20.8°C
Rear Side 5mm	251/848.8	GPRS850 2TS	0.986	0.602	-0.010	1.6	20.8°C
	190/836.6		0.925	0.568	-0.132	1.6	20.8°C
	128/824.2		0.870	0.541	-0.107	1.6	20.8°C
Rear Side 5mm	190/836.6	GPRS850 3TS	0.792	0.484	0.158	1.6	20.8°C
Rear Side 5mm	251/848.8	GPRS850 4TS	0.866	0.534	0.117	1.6	20.8°C
	190/836.6		0.836	0.514	-0.048	1.6	20.8°C
	128/824.2		0.737	0.461	-0.078	1.6	20.8°C
Left Side 5mm	190/836.6	GPRS850 2TS	0.318	0.223	0.056	1.6	20.8°C
Right Side 5mm	251/836.6	GPRS850 2TS	0.923	0.597	-0.053	1.6	20.8°C
	190/836.6		0.919	0.594	-0.169	1.6	20.8°C
	128/836.6		0.834	0.543	-0.009	1.6	20.8°C
Front Side 5mm	251/848.8	EGPRS850 1TS	0.948	0.579	-0.021	1.6	20.8°C
	190/836.6		0.928	0.585	-0.010	1.6	20.8°C
	128/824.2		0.744	0.480	0.100	1.6	20.8°C
Front Side 5mm	251/848.8	EGPRS850 2TS	1.020	0.646	-0.093	1.6	20.8°C
	190/836.6		1.050	0.667	-0.099	1.6	20.8°C
	128/824.2		0.918	0.584	0.165	1.6	20.8°C
Front Side 5mm	251/848.8	EGPRS850 3TS	0.885	0.558	-0.029	1.6	20.8°C
	190/836.6		0.880	0.559	-0.058	1.6	20.8°C
	128/824.2		0.748	0.480	-0.198	1.6	20.8°C
Front Side 5mm	251/848.8	EGPRS850 4TS	0.959	0.595	-0.056	1.6	20.8°C
	190/836.6		0.941	0.595	-0.004	1.6	20.8°C
	128/824.2		0.768	0.488	0.086	1.6	20.8°C

Table 21: Test results (GSM 850)

GSM 1900 (GSM/GPRS/EGPRS)

Test Position	Test channel /Frequency	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Rear Side 5mm	810/1909.8	GPRS1900 1TS	0.994	0.565	-0.030	1.6	20.8°C
	661/1880		0.919	0.535	-0.108	1.6	20.8°C
	512/1850.2		0.923	0.544	-0.027	1.6	20.8°C
Rear Side 5mm	810/1909.8	GPRS1900 2TS	1.090	0.619	-0.018	1.6	20.8°C
	661/1880		1.020	0.593	-0.095	1.6	20.8°C
	512/1850.2		1.030	0.605	-0.020	1.6	20.8°C
Rear Side 5mm	810/1909.8	GPRS1900 3TS	0.901	0.513	0.003	1.6	20.8°C
	661/1880		0.838	0.489	-0.035	1.6	20.8°C
	512/1850.2		0.866	0.514	0.110	1.6	20.8°C
Rear Side 5mm	810/1909.8	GPRS1900 4TS	0.937	0.534	0.014	1.6	20.8°C
	661/1880		0.876	0.512	-0.031	1.6	20.8°C
	512/1850.2		0.915	0.541	0.016	1.6	20.8°C
Front Side 5mm	661/1880	GPRS1900 2TS	0.669	0.406	-0.105	1.6	20.8°C
Left Side 5mm	661/1880	GPRS1900 2TS	0.252	0.152	-0.001	1.6	20.8°C
Right Side 5mm	661/1880	GPRS1900 2TS	0.631	0.375	-0.173	1.6	20.8°C
Rear Side 5mm	810/1909.8	EGPRS1900 1TS	1.080	0.602	0.100	1.6	20.8°C
	661/1880		0.977	0.562	0.034	1.6	20.8°C
	512/1850.2		1.010	5.830	0.009	1.6	20.8°C
Rear Side 5mm	810/1909.8	EGPRS1900 2TS	1.110	0.620	-0.014	1.6	20.8°C
	661/1880		1.100	0.626	0.014	1.6	20.8°C
	512/1850.2		**1.120**	0.648	0.006	1.6	20.8°C
Rear Side 5mm	810/1909.8	EGPRS1900 3TS	0.977	0.547	-0.186	1.6	20.8°C
	661/1880		0.922	0.531	0.079	1.6	20.8°C
	512/1850.2		0.945	0.550	-0.061	1.6	20.8°C
Rear Side 5mm	810/1909.8	EGPRS1900 4TS	1.020	0.572	-0.062	1.6	20.8°C
	661/1880		0.957	0.548	-0.123	1.6	20.8°C
	512/1850.2		0.998	0.580	-0.019	1.6	20.8°C

Table 22: Test results (GSM 1900)

Note:

1) The value with **bold** is the maximum SAR value.

2) Upper and lower frequencies were measured at the worst position.

3) The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.

4) Tests in body position were performed with 5 mm air gap between DUT and SAM.

WCDMA Band V (WCDMA/HSDPA/HSUPA)

Test Position	Test channel /Frequency	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Rear Side 5mm	4182/836.4	RMC	0.676	0.420	-0.165	1.6	20.8°C
Left Side 5mm	4182/836.4	RMC	0.257	0.184	-0.073	1.6	20.8°C
Right Side 5mm	4182/836.4	RMC	0.517	0.332	0.034	1.6	20.8°C
Front Side 5mm	4233/846.6	RMC	**0.827**	0.523	-0.117	1.6	20.8°C
	4182/836.4		0.734	0.465	0.185	1.6	20.8°C
	4132/826.4		0.637	0.408	-0.049	1.6	20.8°C
Front Side 5mm	4233/846.6	HSDPA	0.779	0.490	0.105	1.6	20.8°C
Front Side 5mm	4233/846.6	HSUPA	0.530	0.335	-0.118	1.6	20.8°C

Table 23: Test results (WCDMA850)

WCDMA Band II (WCDMA/HSDPA/HSUPA)

Test Position	Test channel /Frequency	Test Mode	SAR Value (W/kg)		Power Drift(dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Front Side 5mm	9400/1880	RMC	0.632	0.391	-0.089	1.6	20.8°C
Left Side 5mm	9400/1880	RMC	0.319	0.194	-0.193	1.6	20.8°C
Right Side 5mm	9400/1880	RMC	0.581	0.346	0.066	1.6	20.8°C
Rear Side 5mm	9538/1907.6	RMC	**1.110**	0.630	-0.019	1.6	20.8°C
	9400/1880		0.869	0.509	-0.023	1.6	20.8°C
	9262/1852.4		0.796	0.474	-0.038	1.6	20.8°C
Rear Side 5mm	9538/1907.6	HSDPA	1.090	0.619	-0.102	1.6	20.8°C
Rear Side 5mm	9538/1907.6	HSUPA	0.748	0.430	-0.079	1.6	20.8°C

Table 24: Test results (WCDMA1900)

Note:
1) The value with **bold** is the maximum SAR value.
2) Upper and lower frequencies were measured at the worst position.
3) The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.
4) Tests in body position were performed with 5 mm air gap between DUT and SAM.