Annex D Description of Test Position

Annex D.1 SAM Phantom Shape

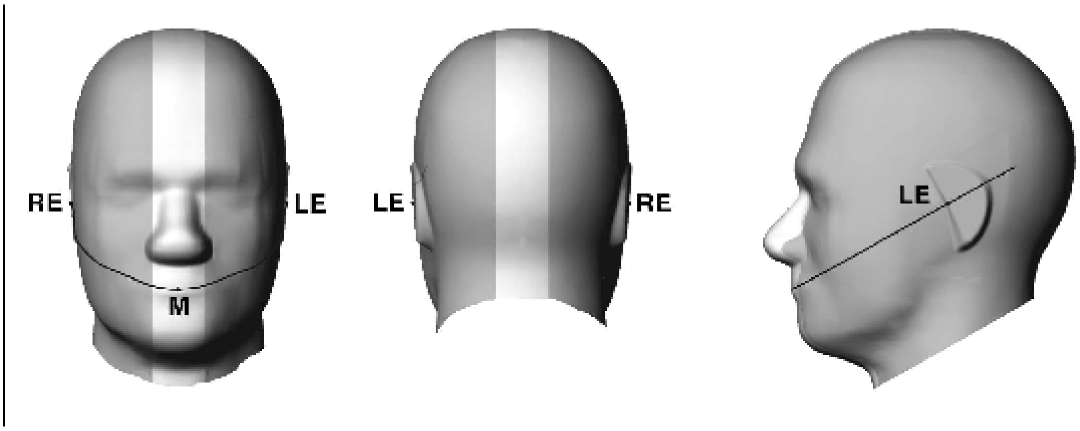

Figure D-1 front, back, and side views of SAM (model for the phantom shell). Full-head model is for illustration purposes only-procedures in this recommended practice are intended primarily for the phantom setup of Figure D-2. Note: The center strip including the nose region has a different thickness tolerance.

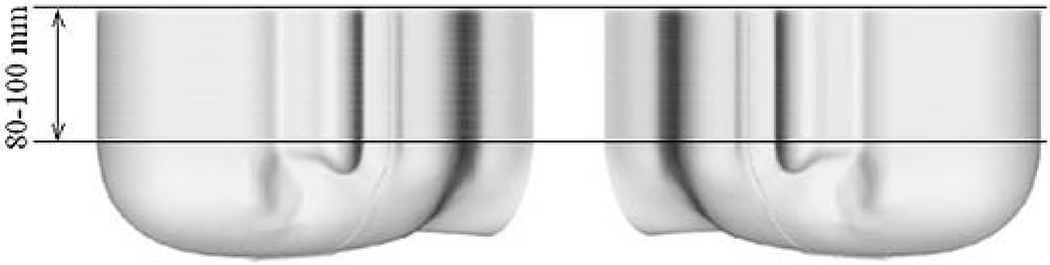

Figure D-2 Sagittally bisected phantom with extended perimeter (shown placed on its side as used for SAR measurements)

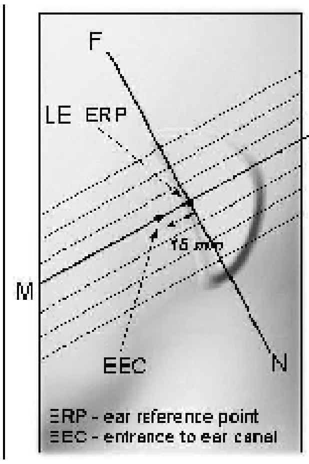

Figure D-3 Close-up side view of phantom showing the ear region, N-F and B-M lines, and seven cross-sectional plane locations

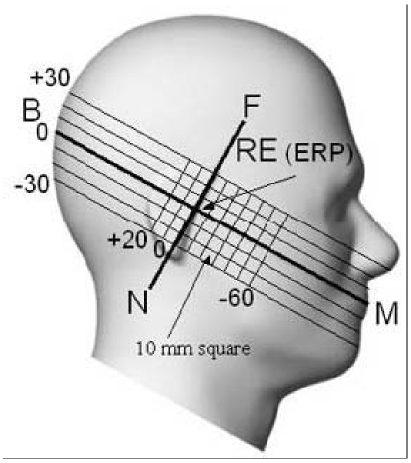

Figure D-4 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

Annex D.2 EUT constructions

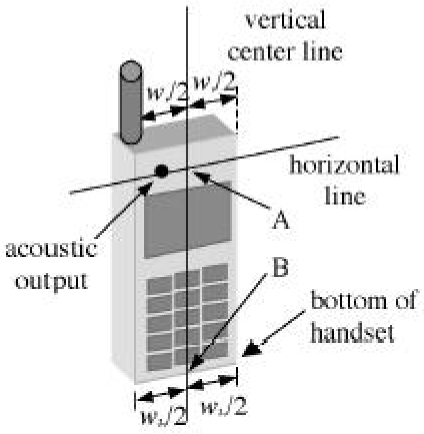

Figure D-5a Handset vertical and horizontal reference lines-"fixed case"

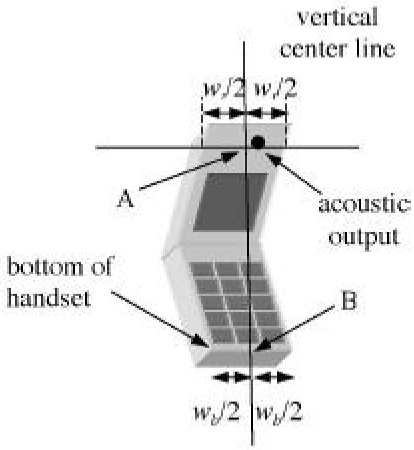

Figure D-5b Handset vertical and horizontal reference lines-"clam-shell case"

Annex D.3 Definition of the "cheek" position

a) Position the device with the vertical centre line of the body of the device and the horizontal line crossing the centre of the ear piece in a plane parallel to the sagittal plane of the phantom ("initial position" see Figure 1-7). While maintaining the device in this plane, align the vertical centre line with the reference plane containing the three ear and mouth reference points (M, RE and LE) and align the centre of the ear piece with the line RE-LE;

b) Translate the mobile phone box towards the phantom with the ear piece aligned with the line LE-RE until the phone touches the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the box until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost.

Annex D.4 Definition of the "tilted" position

a) Position the device in the "cheek" position described above;

b) While maintaining the device in the reference plane described above and pivoting against the ear, move it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost.

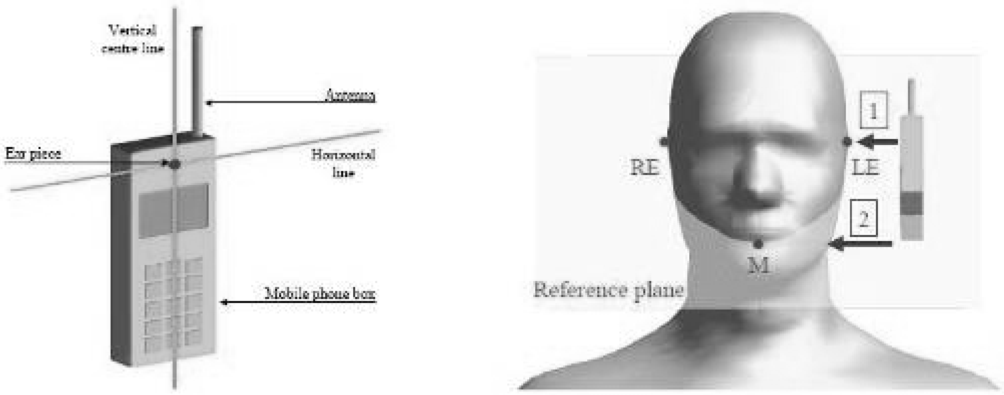

Figure D-6 Definition of the reference lines and points, on the phone and on the phantom and initial position

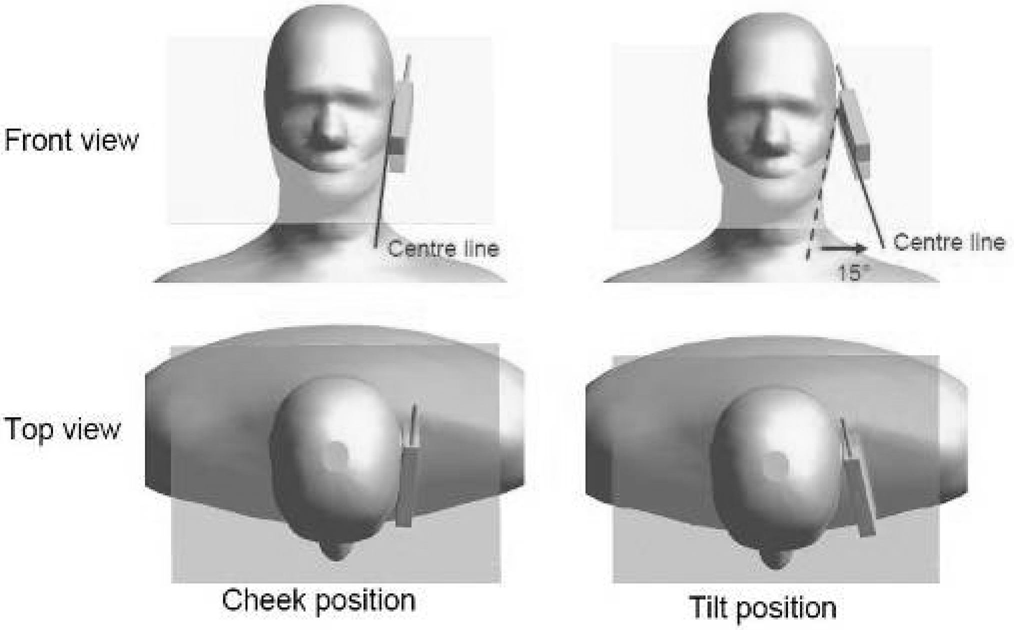

Figure D-7 “Cheek” and “tilt” positions of the mobile phone on the left side

Annex E Calibration certificate

Annex E.1 Probe Calibration certificate

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **SGS SH (Auden)**

Certificate No: **ES3-3088_Nov09**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3088
Calibration procedure(s)	QA CAL-01.v6, QA CAL-23.v3 and QA CAL-25.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	November 19, 2009

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	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41495277	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41498087	1-Apr-09 (No. 217-01030)	Apr-10
Reference 3 dB Attenuator	SN: S5054 (3c)	31-Mar-09 (No. 217-01026)	Mar-10
Reference 20 dB Attenuator	SN: S5086 (20b)	31-Mar-09 (No. 217-01028)	Mar-10
Reference 30 dB Attenuator	SN: S5129 (30b)	31-Mar-09 (No. 217-01027)	Mar-10
Reference Probe ES3DV2	SN: 3013	2-Jan-09 (No. ES3-3013_Jan09)	Jan-10
DAE4	SN: 660	29-Sep-09 (No. DAE4-660_Sep09)	Sep-10

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-09)	In house check: Oct10

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

Issued: November 24, 2009

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

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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	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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003

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 effect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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.

Probe ES3DV3

SN:3088

Manufactured:	July 20, 2005
Last calibrated:	December 22, 2008
Recalibrated:	November 19, 2009

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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DASY - Parameters of Probe: ES3DV3 SN:3088

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.32	1.27	1.26	± 10.1%
DCP (mV)[B]	94.2	94.4	94.3	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dBuV	C	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	300.0	± 1.5%
			Y	0.00	0.00	1.00	300.0	
			Z	0.00	0.00	1.00	300.0	

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 maximum devation from linear response applying recatangular distribution and is expressed for the square of the field value.

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DASY - Parameters of Probe: ES3DV3 SN:3088

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz][C]	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
900	± 50 / ± 100	41.5 ± 5%	0.97 ± 5%	5.84	5.84	5.84	0.90	1.06 ± 11.0%
1810	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	5.00	5.00	5.00	0.38	1.75 ± 11.0%
1900	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	4.97	4.97	4.97	0.48	1.53 ± 11.0%
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	4.40	4.40	4.40	0.43	1.79 ± 11.0%

[C] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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DASY - Parameters of Probe: ES3DV3 SN:3088

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz]	Validity [MHz][C]	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
900	± 50 / ± 100	55.0 ± 5%	1.05 ± 5%	5.68	5.68	5.68	0.97	1.07 ± 11.0%
1810	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.76	4.76	4.76	0.41	1.88 ± 11.0%
1900	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.58	4.58	4.58	0.36	2.13 ± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	4.20	4.20	4.20	0.69	1.04 ± 11.0%

[C] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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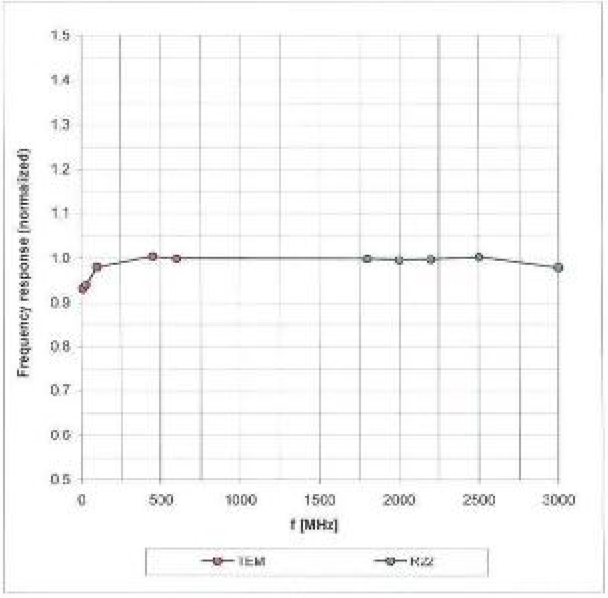
ES3DV3 SN:3088 November 19, 2009

Frequency Response of E-Field

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



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

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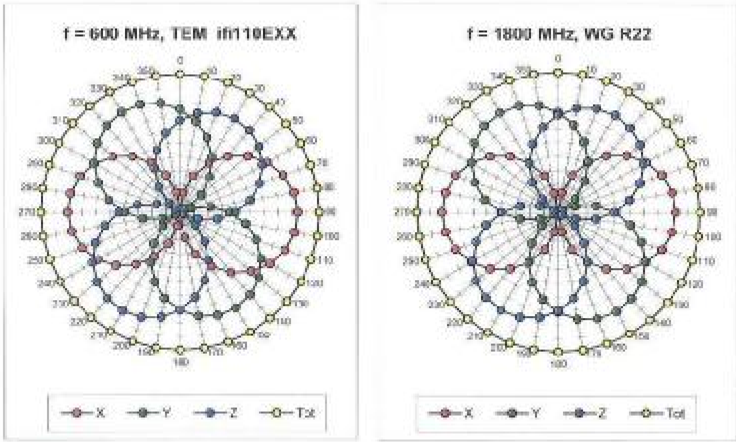
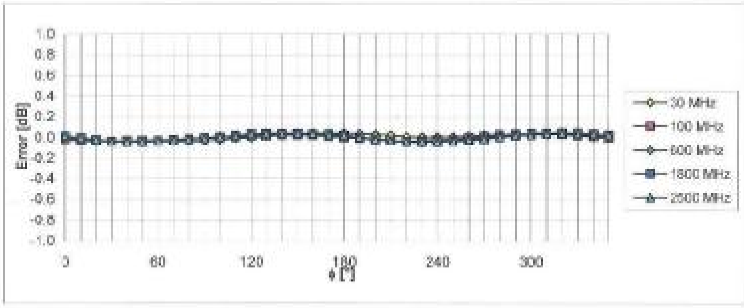
Receiving Pattern (φ), ϑ = 0°





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

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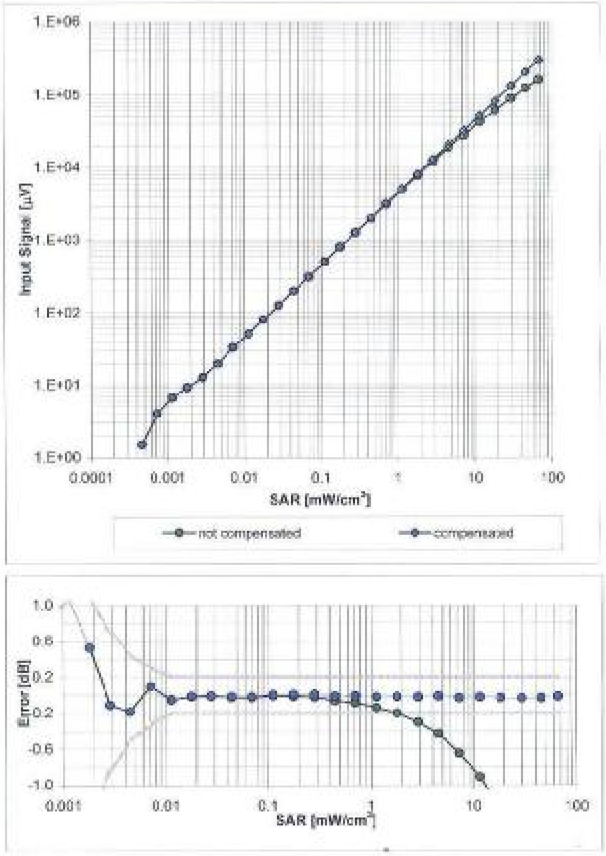
ES3DV3 SN:3088 November 19, 2009

Dynamic Range f(SAR_{head})

(Waveguide R22, f = 1800 MHz)



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

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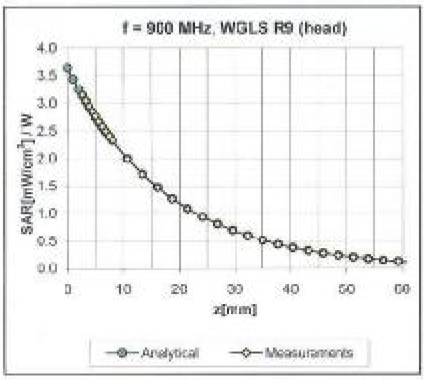
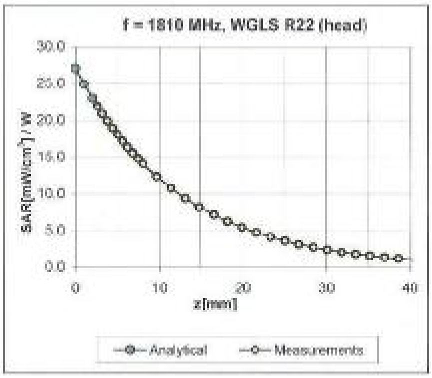
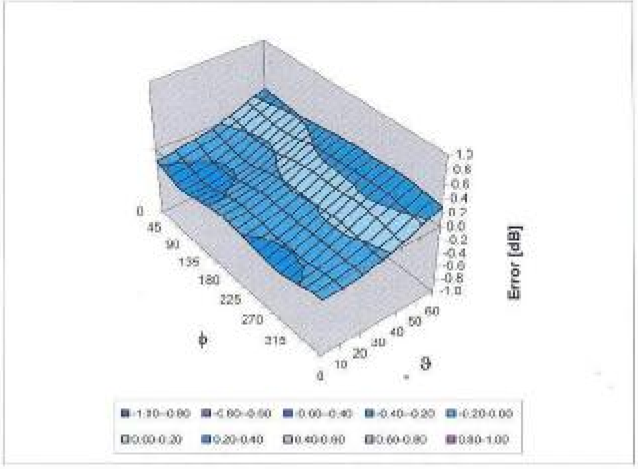
Conversion Factor Assessment





Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz



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

ES3DV3 SN:3088 November 19, 2009

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4.0 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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Annex E.2 DAE Calibration certificate

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Accreditation No.: **SCS 108**

Client **SGS – SH (Auden)**

Certificate No: **DAE3-569_Nov09**

CALIBRATION CERTIFICATE

Object	DAE3 - SD 000 D03 AA - SN: 569
Calibration procedure(s)	QA CAL-06.v12 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	November 18, 2009

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	1-Oct-09 (No: 9055)	Oct-10
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Calibrator Box V1.1	SE UMS 006 AB 1004	05-Jun-09 (in house check)	In house check: Jun-10

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	R&D Director	i.V.

Issued: November 18, 2009

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Accreditation No.: **SCS 108**

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 Convertor 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:* 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.

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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	404.766 ± 0.1% (k=2)	404.352 ± 0.1% (k=2)	404.129 ± 0.1% (k=2)
Low Range	3.94150 ± 0.7% (k=2)	3.93629 ± 0.7% (k=2)	3.95193 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	264.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	200000.4	3.78	0.00
Channel X	+ Input	20001.03	0.33	0.00
Channel X	- Input	-19995.39	5.31	-0.03
Channel Y	+ Input	200010.9	3.93	0.00
Channel Y	+ Input	19997.76	-2.84	-0.01
Channel Y	- Input	-20002.85	-3.05	0.02
Channel Z	+ Input	200008.6	4.33	0.00
Channel Z	+ Input	19999.62	-0.89	-0.00
Channel Z	- Input	-20001.79	0.01	0.01

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	1999.7	-0.28	-0.01
Channel X	+ Input	199.60	-0.40	-0.20
Channel X	- Input	-201.13	-1.23	0.62
Channel Y	+ Input	2000.0	0.02	0.00
Channel Y	+ Input	199.28	-0.82	-0.41
Channel Y	- Input	-201.40	-1.50	0.75
Channel Z	+ Input	1999.9	-0.17	-0.01
Channel Z	+ Input	198.61	-1.39	-0.70
Channel Z	- Input	-201.65	-1.75	0.88

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	-3.14	-5.24
	- 200	6.52	4.85
Channel Y	200	7.98	7.35
	- 200	-8.52	-8.82
Channel Z	200	-5.05	-5.64
	- 200	3.96	4.09

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	-	2.19	0.12
Channel Y	200	2.65	-	3.55
Channel Z	200	1.86	-0.43	-

Certificate No: DAE3-569_Nov09 Page 4 of 5

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	16392	14986
Channel Y	15762	16421
Channel Z	16298	16514

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	-0.18	-1.21	0.79	0.33
Channel Y	-0.61	-1.80	0.79	0.30
Channel Z	-0.97	-2.37	-0.10	0.36

6. Input Offset Current

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

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.2000	199.8
Channel Y	0.2000	204.0
Channel Z	0.2001	204.9

8. Low Battery Alarm Voltage (verified during pre test)

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

9. Power Consumption (verified during pre test)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.0	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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Annex E.3 Dipole Calibration certification

D835V2

(8)

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

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

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

Accreditation No.: SCS 108

Client: SGS SH (Auden)

Certificate No: D835V2-4d070_Dec08

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d070
Calibration procedure(s)	QA CAL-05.v7 Calibration procedure for dipole validation kits
Calibration date:	December 15, 2008
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	08-Oct-08 (No. 217-00898)	Oct-09
Power sensor HP 8481A	US37292783	08-Oct-08 (No. 217-00898)	Oct-09
Reference 20 dB Attenuator	SN: 5086 (20g)	01-Jul-08 (No. 217-00864)	Jul-09
Type-N mismatch combination	SN: 5047.2 / 06327	01-Jul-08 (No. 217-00867)	Jul-09
Reference Probe ES3DV2	SN: 3025	28-Apr-08 (No. ES3-3025_Apr08)	Apr-09
DAE4	SN: 601	14-Mar-08 (No. DAE4-601_Mar08)	Mar-09

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-07)	In house check: Oct-09
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

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

Issued: December 15, 2008

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Certificate No: D835V2-4d070_Dec08 Page 1 of 9

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Measurement Conditions

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

DASY Version	DASY5	V5.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.3 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature during test	(22.5 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.43 mW / g
SAR normalized	normalized to 1W	9.72 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**9.62 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.60 mW / g
SAR normalized	normalized to 1W	6.40 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**6.34 mW / g ± 16.5 % (k=2)**

[1] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

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Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.7 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature during test	(21.8 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.55 mW / g
SAR normalized	normalized to 1W	10.2 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**9.89 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.68 mW / g
SAR normalized	normalized to 1W	6.72 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**6.58 mW / g ± 16.5 % (k=2)**

[2] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Certificate No: D835V2-4d070_Dec08 Page 4 of 9

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DASY5 Validation Report for Head TSL

Date/Time: 08.12.2008 10:31:04

Test Laboratory: SPEAG, Zurich, Switzerland

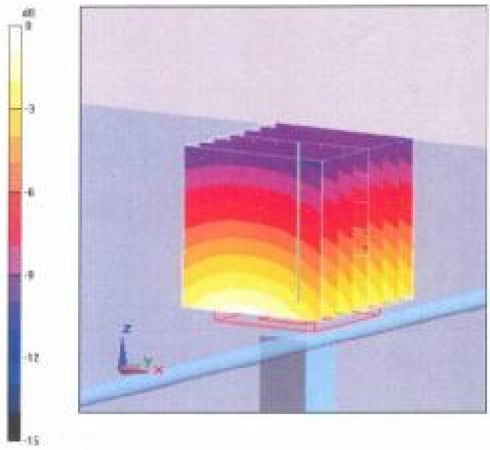
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d070

Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: HSL 900 MHz
Medium parameters used: f = 835 MHz; $\sigma = 0.89$ mho/m; $\varepsilon_r = 40.3$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(5.97, 5.97, 5.97); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 14.03.2008
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

Pin=250mW; dip=15mm; dist=3.4mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.7 V/m; Power Drift = -0.000938 dB
Peak SAR (extrapolated) = 3.56 W/kg
SAR(1 g) = 2.43 mW/g; SAR(10 g) = 1.6 mW/g
Maximum value of SAR (measured) = 2.73 mW/g



0 dB = 2.73mW/g

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DASY5 Validation Report for Body TSL

Date/Time: 15.12.2008 11:58:06

Test Laboratory: SPEAG, Zurich, Switzerland

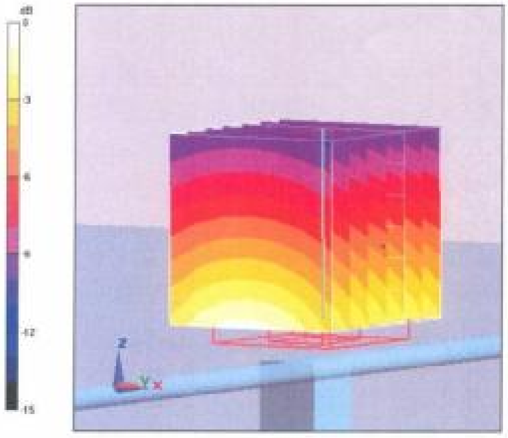
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d070

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: MSL900
Medium parameters used: f = 835 MHz; σ = 1.01 mho/m; ε_r = 54.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(5.9, 5.9, 5.9); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 14.03.2008
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

Pin = 250mW, d = 15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.7 V/m; Power Drift = 0.00608 dB
Peak SAR (extrapolated) = 3.69 W/kg
SAR(1 g) = 2.55 mW/g; SAR(10 g) = 1.68 mW/g
Maximum value of SAR (measured) = 2.87 mW/g



0 dB = 2.87mW/g

Certificate No: D835V2-4d070_Dec08 Page 8 of 9

D1900V2

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

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Accreditation No.: **SCS 108**

Client SGS-SH (Auden)

Certificate No: D1900V2-5d028_Nov09

CALIBRATION CERTIFICATE

Object: D1900V2 - SN: 5d028

Calibration procedure(s): QA CAL-05.v7
Calibration procedure for dipole validation kits

Calibration date: November 24, 2009

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-09 (No. 217-01086)	Oct-10
Power sensor HP 8481A	US37292783	06-Oct-09 (No. 217-01086)	Oct-10
Reference 20 dB Attenuator	SN: 5086 (20g)	31-Mar-09 (No. 217-01025)	Mar-10
Type-N mismatch combination	SN: 5047.2 / 06327	31-Mar-09 (No. 217-01029)	Mar-10
Reference Probe ES3DV3	SN: 3205	26-Jun-09 (No. ES3-3205_Jun09)	Jun-10
DAE4	SN: 601	07-Mar-09 (No. DAE4-601_Mar09)	Mar-10

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

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

Issued: November 25, 2009

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Certificate No: D1900V2-5d028_Nov09 Page 1 of 9

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Measurement Conditions

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

DASY Version	DASY5	V5.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.8 ± 6 %	1.44 mho/m ± 6 %
Head TSL temperature during test	(21.5 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 mW / g
SAR normalized	normalized to 1W	40.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**39.3 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.22 mW / g
SAR normalized	normalized to 1W	20.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**20.7 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.5 ± 6 %	1.58 mho/m ± 6 %
Body TSL temperature during test	(21.2 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.3 mW / g
SAR normalized	normalized to 1W	41.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**40.4 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.44 mW / g
SAR normalized	normalized to 1W	21.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 mW / g ± 16.5 % (k=2)**

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DASY5 Validation Report for Head TSL

Date/Time: 24.11.2009 13:29:02

Test Laboratory: SPEAG, Zurich, Switzerland

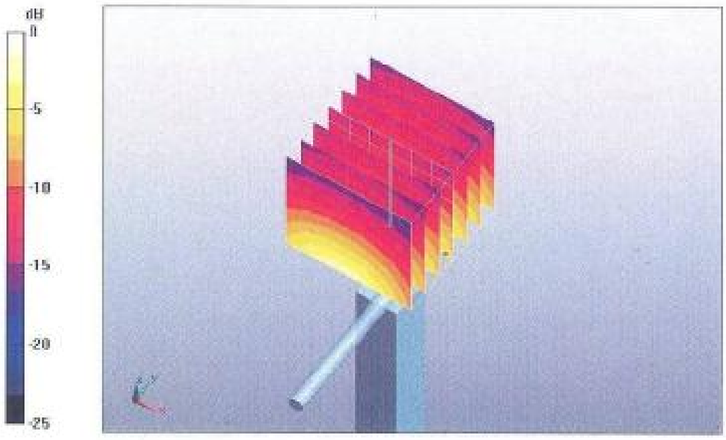
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d028

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL U11 BB
Medium parameters used: f = 1900 MHz; $\sigma = 1.44$ mho/m; $\varepsilon_r = 39.9$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.4 V/m; Power Drift = 0.037 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 10 mW/g; SAR(10 g) = 5.22 mW/g
Maximum value of SAR (measured) = 12.5 mW/g



0 dB = 12.5mW/g

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DASY5 Validation Report for Body

Date/Time: 17.11.2009 13:08:34

Test Laboratory: SPEAG, Zurich, Switzerland

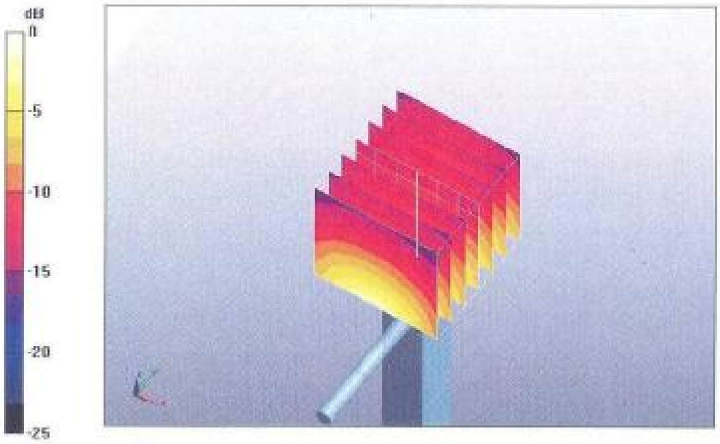
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d028

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: MSL U10 BB
Medium parameters used: f = 1900 MHz; σ = 1.58 mho/m; ε_r = 53.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

Pin250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.9 V/m; Power Drift = 0.00895 dB
Peak SAR (extrapolated) = 17.7 W/kg
SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.44 mW/g
Maximum value of SAR (measured) = 13 mW/g



0 dB = 13mW/g

Certificate No: D1900V2-5d028_Nov09 Page 8 of 9

Annex F Additional SAR Probe Validation

SAR PROBE CALIBRATION

Model No. : A332
FCC ID : YCNA332

The following procedures are recommended for DUT measurements at 150MHz to 3GHz to minimize probe calibration and tissue dielectric parameter discrepancies.

a) In general, CUT SAR measurements below 300 MHz should be within +/- 50 MHz of the probe calibration frequency.

SEE ALSO ITEM c).

b) At 300 MHz to 3 GHz, DUT measurements should be within +/- 100 MHz of the probe calibration frequency.

SEE ALSO ITEM c).

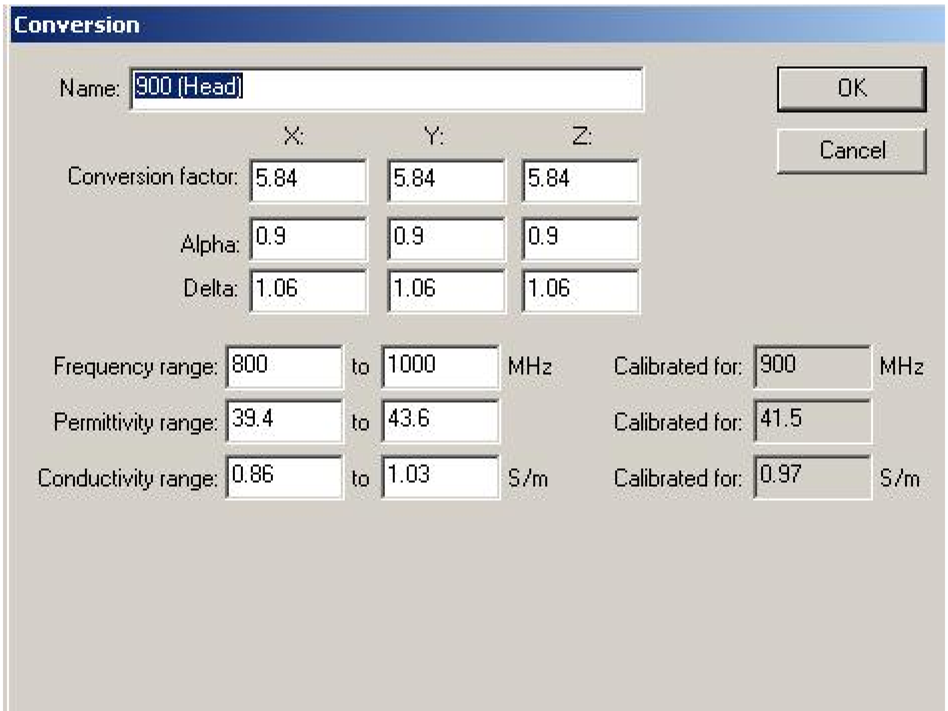
c) Measurements exceeding 50% of these intervals, I.E.,
+/- 25 MHz, DUT f<300 MHz, OR
+/- 50 MHz, DUT f>/=300 MHz,
SHALL APPLY THE FOLLOWING ADDITIONAL STEPS:

1) When the actual tissue dielectric parameters used for probe calibration are available (careful about some probe manuf.list only nominal or range on calib.cert), the differences for relative permittivity and conductivity between probe calibration and routine measurements should each be less than or equal to 5 % while also satisfying the required +/- 5% tolerances in target dielectric parameters.

<Head 900 MHz>

The test frequencies are properly matched as this is a cellular band. The probe calibration for permittivity and conductivity is within +/-5%, were the probe calibrated centre frequency at 900MHz has permittivity and conductivity of 41.5 and 0.97 respectively. At the probe extreme frequencies the following are true: at 800MHz the permittivity and conductivity are 39.4 and 0.86 respectively. At 1000MHz the permittivity and conductivity are 43.6 and 1.03 respectively.

The probe was calibrated at these parameters in order to cover the frequency range 800MHz to 1000MHz.



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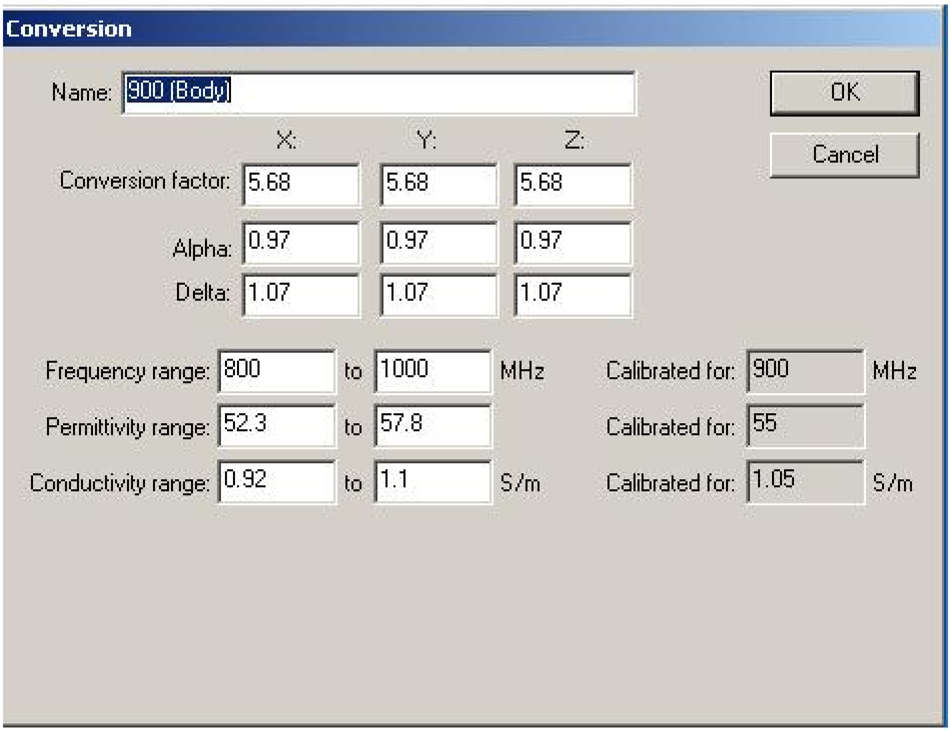
<Body 900 MHz>

The test frequencies are properly matched as this is a cellular band. The probe calibration for permittivity and conductivity is within +/-5%, were the probe calibrated centre frequency at 900MHz has permittivity and conductivity of 55.0 and 1.05 respectively. At the probe extreme frequencies the following are true: at 800MHz the permittivity and conductivity are 52.3 and 0.92 respectively. At 1000MHz the permittivity and conductivity are 57.8 and 1.10 respectively.

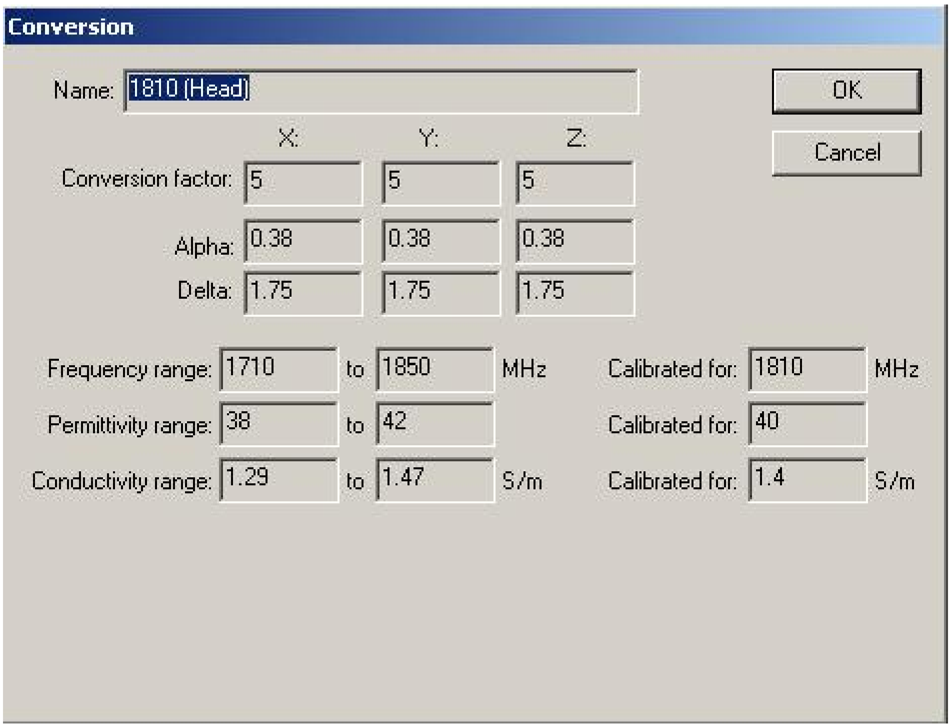
The probe was calibrated at these parameters in order to cover the frequency range 800MHz to 1000MHz.



<Head 1810 MHz>

The test frequencies are properly matched as this is a cellular band. The probe calibration for permittivity and conductivity is within +/-5%, were the probe calibrated centre frequency at 1810MHz has permittivity and conductivity of 40.0 and 1.40 respectively. At the probe extreme frequencies the following are true: at 1710MHz the permittivity and conductivity are 38.0 and 1.29 respectively. At 1910MHz the permittivity and conductivity are 42.0 and 1.47 respectively.

The probe was calibrated at these parameters in order to cover the frequency range 1710MHz to 1910MHz.



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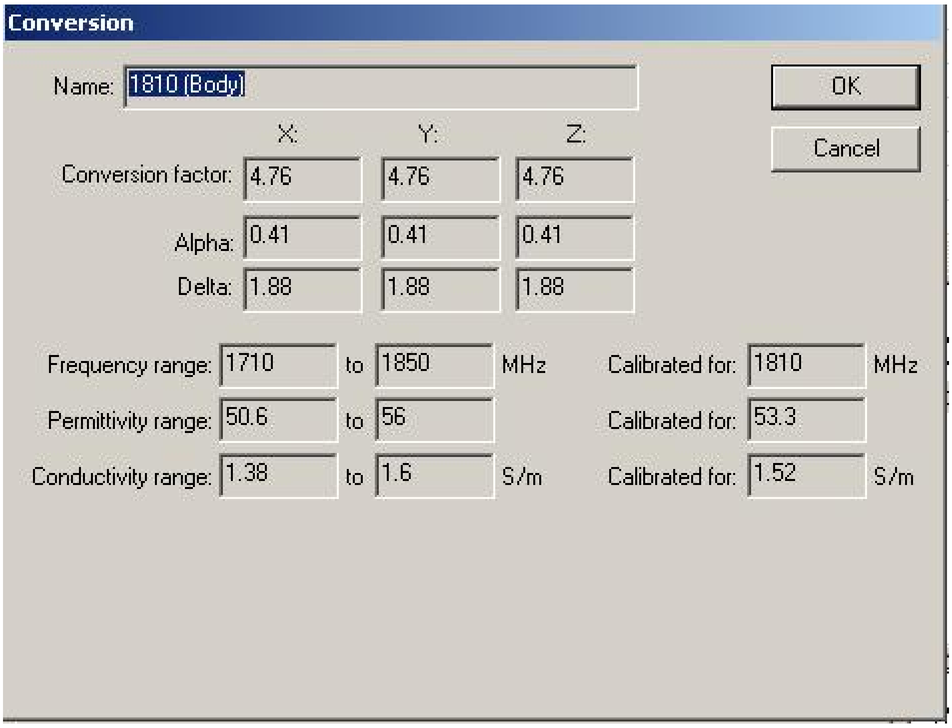
<Body 1810 MHz>

The test frequencies are properly matched as this is a cellular band. The probe calibration for permittivity and conductivity is within +/-5%, were the probe calibrated centre frequency at 1810MHz has permittivity and conductivity of 53.3 and 1.52 respectively. At the probe extreme frequencies the following are true: at 1710MHz the permittivity and conductivity are 50.6 and 1.38 respectively. At 1910MHz the permittivity and conductivity are 56.0 and 1.60 respectively.

The probe was calibrated at these parameters in order to cover the frequency range 1710MHz to 1910MHz.



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The target permittivity and conductivity at 835 MHz is 41.5 and 0.90 and 1900 MHz is 40.0 and 1.40 respectively which is within the calibrated range of the probe parameter. The following parameters are declared in the probe calibration certificate.

DASY - Parameters of Probe: ES3DV3 SN:3088

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz][C]	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
900	± 50 / ± 100	41.5 ± 5%	0.97 ± 5%	5.84	5.84	5.84	0.90	1.06 ± 11.0%
1810	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	5.00	5.00	5.00	0.38	1.75 ± 11.0%
1900	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	4.97	4.97	4.97	0.48	1.53 ± 11.0%
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	4.40	4.40	4.40	0.43	1.79 ± 11.0%

[C] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz]	Validity [MHz][C]	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
900	± 50 / ± 100	55.0 ± 5%	1.05 ± 5%	5.68	5.68	5.68	0.97	1.07 ± 11.0%
1810	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.76	4.76	4.76	0.41	1.88 ± 11.0%
1900	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.58	4.58	4.58	0.36	2.13 ± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	4.20	4.20	4.20	0.99	1.04 ± 11.0%

[C] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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<Head 850 MHz>

Liquid		Parameters	Target	Measured	Deviation[%]
Medium	Freq.[MHZ]				
Body	825.0	Permitivity	41.6	43.05	3.49
		Conductivity	0.90	0.886	-1.56
	835.0	Permitivity	41.5	42.89	3.35
		Conductivity	0.90	0.896	-0.44
	845.0	Permitivity	41.5	42.77	3.06
		Conductivity	0.91	0.906	-0.43

<Body 850 MHz>

Liquid		Parameters	Target	Measured	Deviation[%]
Medium	Freq.[MHZ]				
Body	825.0	Permitivity	55.2	55.26	0.11
		Conductivity	0.97	0.9481	-2.26
	835.0	Permitivity	55.2	55.2	0
		Conductivity	0.97	0.9584	-1.20
	845.0	Permitivity	55.2	55.16	0.07
		Conductivity	0.98	0.9692	-1.10

<Head 1900 MHz>

Liquid		Parameters	Target	Measured	Deviation[%]
Medium	Freq.[MHZ]				
Body	1850	Permitivity	40	39.08	-2.30
		Conductivity	1.4	1.371	-2.07
	1880	Permitivity	40	38.96	-2.60
		Conductivity	1.4	1.404	0.29
	1910	Permitivity	40	38.92	-2.70
		Conductivity	1.4	1.435	2.50

<Body 1900 MHz>

Liquid		Parameters	Target	Measured	Deviation[%]
Medium	Freq.[MHZ]				
Body	1850	Permitivity	53.3	53.85	1.03
		Conductivity	1.52	1.464	-3.68
	1880	Permitivity	53.3	53.82	0.98
		Conductivity	1.52	1.502	-1.18
	1910	Permitivity	53.3	53.79	0.92
		Conductivity	1.52	1.534	0.92

2）when nominal tissue dielectric parameters are PROVIDED in the probe calibration data, the tissue dielectric parameters measured for routine measurements should be less than the target relative permittivity and higher than the target conductivity values, to minimize SAR underestimations. Otherwise, a thorough analysis of the effective frequency interval supported by the probe calibration and dielectric medium should be included in the SAR report to substantiate the test results-SEE ITEM d).
Alternatively, the measured 1-g SAR may be compensated with respect to +5%tolerance in relative permittivity and -5%tolerances in conductivity, computed according to valid SAR sensitivity data, to reduce SAR underestimation and maintain conservativeness.

d) When thorough analysis is required for the additional steps, the following SHALL ASSO BE ADDRESSED. These other items can contribute to additional SAR differences, especially when the probe calibration, tissue dielectric parameters and device test frequencies are misaligned.

1) the probe conversion factor and its frequency response, with respect to the tissue dielectric media used during probe calibration and routine measurements, should be examined to determine if the effective frequency intervals is adequate for the intended measurements, should be examined to determine if the effective frequency interval is adequate for the intended measurements to satisfy protocol requirements.

2) Measurements within the required frequency intervals should satisfy an expanded probe calibration uncertainty (k=2) less than or equal to 15%for all measurement conditions.

3) When SAR is reported within 10% of the SAR limit, differences in field conditions and effects of output power levels on signal modulation between probe calibration and routine measurements should be examined to determine probe calibration validity.

4) Probe isotropy should also be assessed by rotating the probe in 15 degree increments at the peak SAR

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location of the zoom scan and accounted for in the measurement uncertainty.

The measured SAR values in the report are all below 10% of the SAR limit.
The measurement within the required frequency interval satisfy an expanded probe calibration uncertainty (k=2) <=15% for all measurement conditions. Please refer to SAR report for probe and dipole calibration certificates produce by the system manufacturer.

As you can see we used the conductivity and permittivity parameters which are within +/-5%of the target values.

END OF REPORT

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