

Test report no.: SYBH(Z-SAR)027062011-2

**Annex 4 Calibration parameters**

**Annex 4.1 Calibration report “Probe EX3DV4”**




工业和信息化部通信计量中心  
Telecommunication Metrology Center of MIIT  
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Client: **Huawei** Certificate No: **EX3-3736\_Nov10**

### CALIBRATION CERTIFICATE

Object: EX3DV4 - SN: 3736

Calibration Procedure(s): TMC-XZ-01-028  
Calibration procedure for dosimetric E-field probes

Calibration date: November 16, 2010

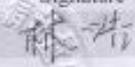
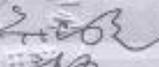
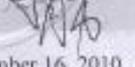
Condition of the calibrated item: In Tolerance

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	SN.	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	11-Sep-10 (TMC, No.JZ10-443)	Sep-11
Power sensor NRV-Z5	100542	11-Sep-10 (TMC, No. JZ10-443)	Sep-11
Reference Probe EX3DV4	SN 3631	13-Dec-09 (TMC, No.EX3-3631_Dec09)	Dec-10
DAE4	SN 771	21-Nov-09 (TMC, No.DAE4-771_Nov09)	Nov-10
RF generator E4438C	MY45092879	19-Jun-10 (TMC, No.JZ10-302)	Jun-11
Network Analyzer 8753E	US38433212	04-Aug-10 (TMC, No.JZ10-056)	Aug-11

	Name	Function	Signature
Calibrated by:	Lin Hao	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Xiao Li	Deputy Director of the laboratory	

Issued: November 16, 2010

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Certificate No: EX3-3736\_Nov10 Page 1 of 9

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**Glossary:**

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
Polarization $\phi$	$\phi$ rotation around probe axis
Polarization $\theta$	$\theta$ rotation around an axis that is in the plane normal to probe axis(at measurement center), i.e., $\theta = 0$ is normal to probe axis

**Calibration is Performed According to the Following Standards:**

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

**Methods Applied and Interpretation of Parameters:**

- NORM<sub>x,y,z</sub>: Assessed for E-field polarization  $\theta = 0$  ( $f \leq 900\text{MHz}$  in TEM-cell;  $f > 1800\text{MHz}$ : waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the  $E^2$ -field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub>\* frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800\text{MHz}$ ) and inside waveguide using analytical field distributions based on power measurements for  $f > 800\text{MHz}$ . The same setups are used for assessment of the parameters applied for boundary compensation (alpha,depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub>\* 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  $\pm 50\text{MHz}$  to  $\pm 100\text{MHz}$ .
- 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.

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### DASY – Parameters of Probe: EX3DV4 SN:3736

#### Sensitivity in Free Space<sup>A</sup>

NormX	0.47 ± 10.1%	$\mu V/(V/m)^2$
NormY	0.44 ± 10.1%	$\mu V/(V/m)^2$
NormZ	0.52 ± 10.1%	$\mu V/(V/m)^2$

#### Diode Compression<sup>B</sup>

DCP X	92mV
DCP Y	93mV
DCP Z	92mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)  
 Please see Page 8

#### Boundary Effect

TSL 900MHz Typical SAR gradient: 5% per mm

Sensor Center to Phantom Surface Distance	2.0 mm	3.0 mm
SARbe[%] Without Correction Algorithm	8.3	4.0
SARbe[%] With Correction Algorithm	0.3	0.1

TSL 1750MHz Typical SAR gradient: 10% per mm

Sensor Center to Phantom Surface Distance	2.0 mm	3.0 mm
SARbe[%] Without Correction Algorithm	7.3	3.3
SARbe[%] With Correction Algorithm	0.2	0.1

#### Sensor Offset

Probe Tip to Sensor Center 1.0 mm

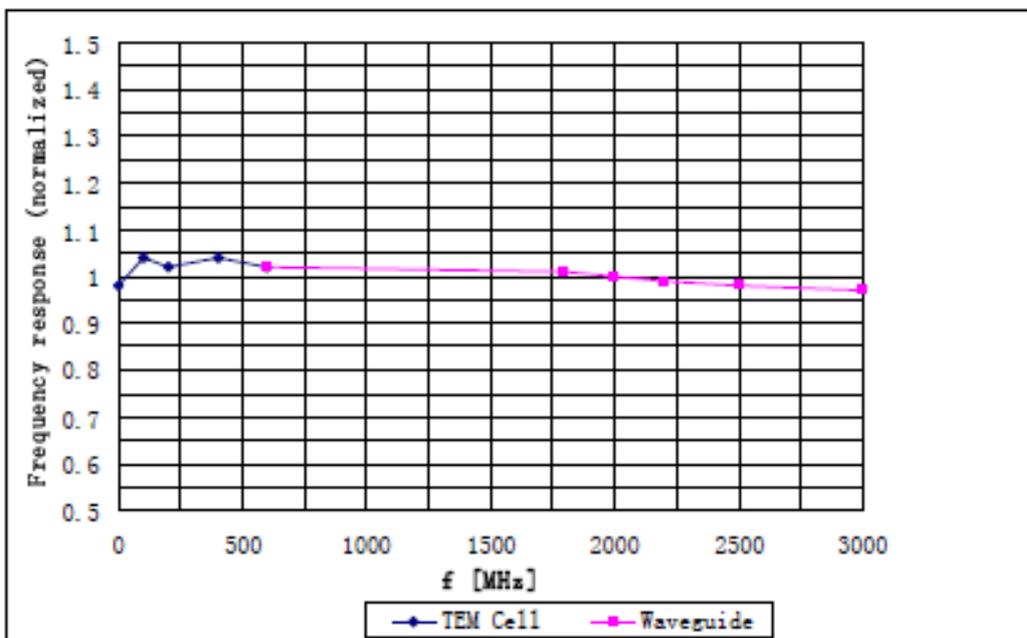
The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution Corresponds to a coverage probability of approximately 95%.

<sup>A</sup> The uncertainties of NormX, Y, Z do not affect the  $E^2$ -field uncertainty inside TSL (see Page 8).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

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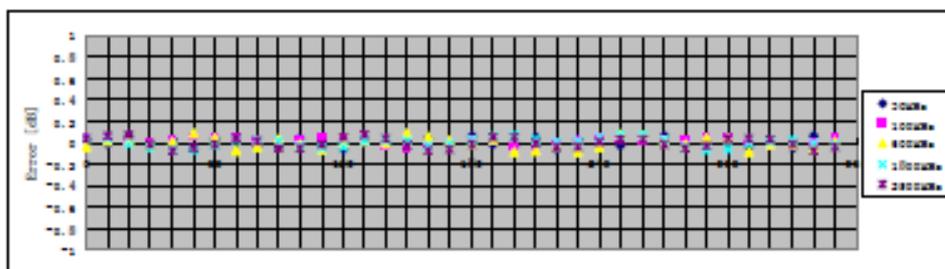
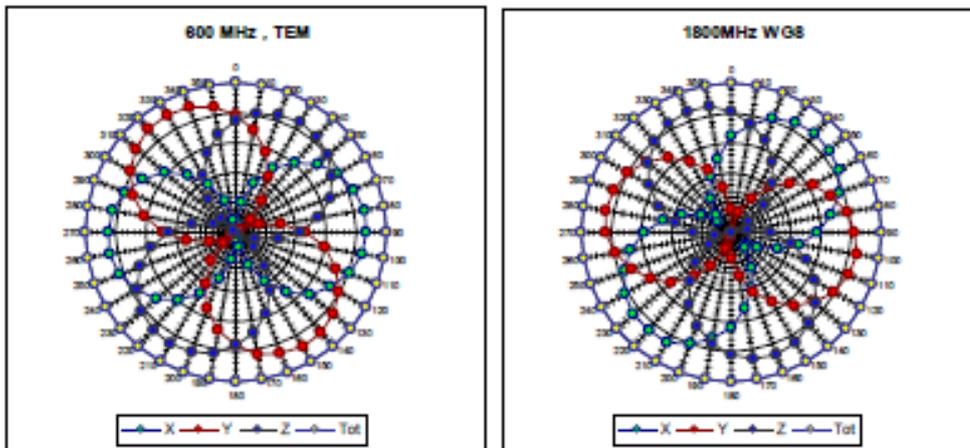
## Frequency Response of E-Field



Uncertainty of Frequency Response of E-field:  $\pm 5.0\%$  (k=2)

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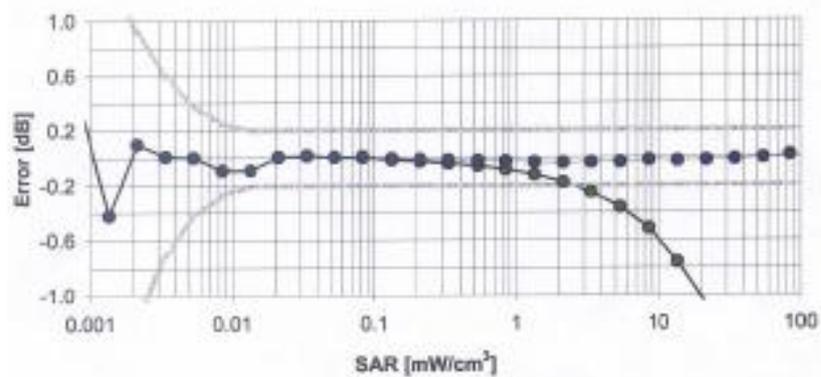
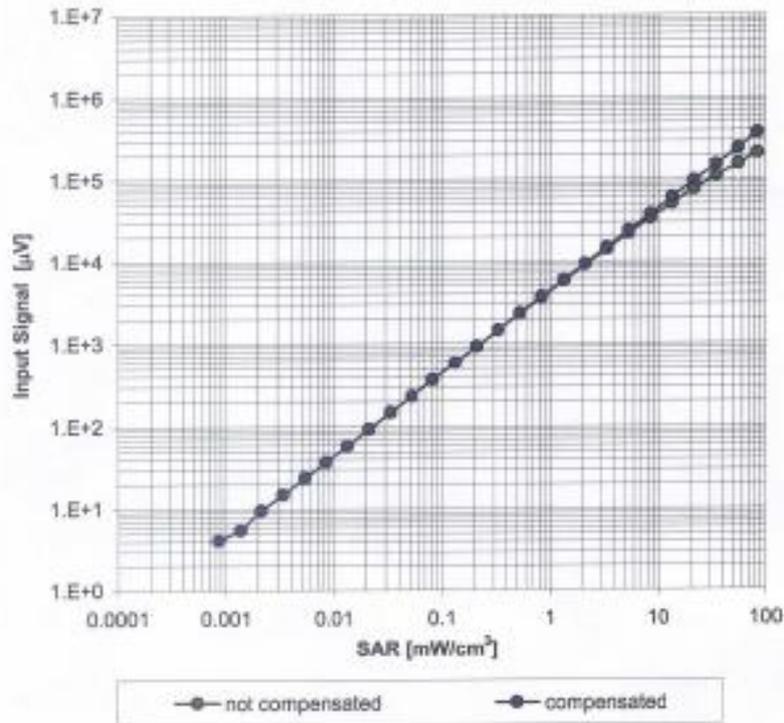
### Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$



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

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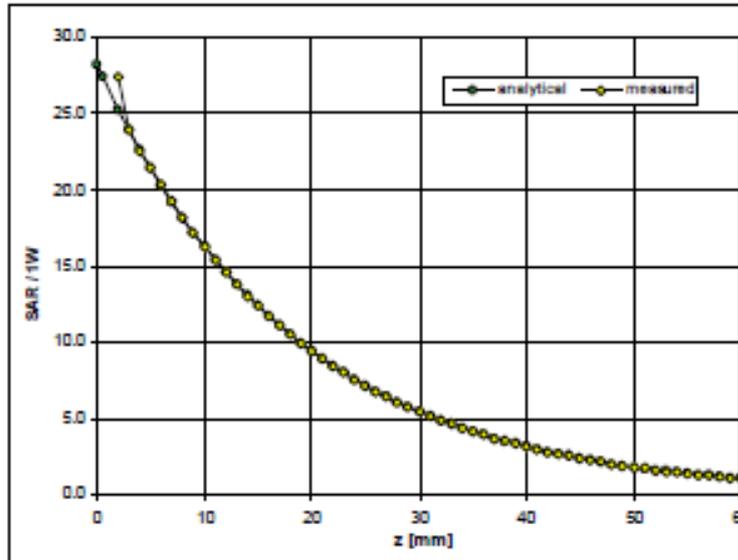
### Dynamic Range f(SAR<sub>head</sub>) (Waveguide: WG8, f = 1750 MHz)



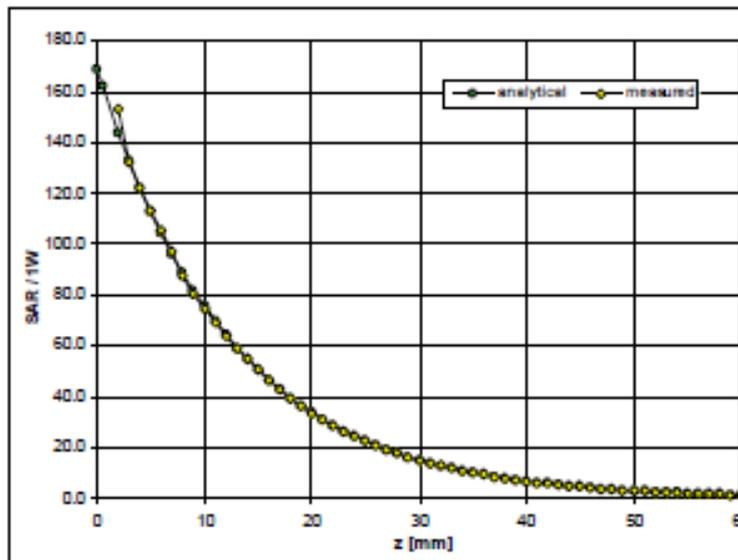
Uncertainty of Linearity Assessment:  $\pm 0.5\%$  (k=2)

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### Conversion Factor Assessment



900MHz



1900MHz

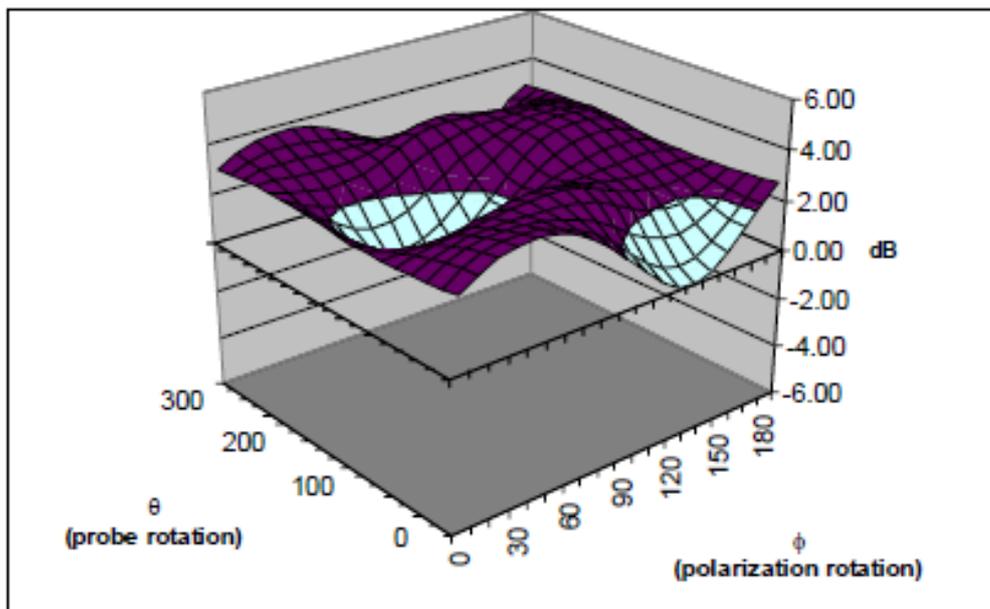
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Freq [MHz]	Frequency Range	ε target ± 5%	σ used ± 5%	ε used	σ used	Sensitivity X sensor			Sensitivity Y sensor			Sensitivity Z sensor			Uncertainty k=2
						ConvF	Alpha	Depth	ConvF	Alpha	Depth	ConvF	Alpha	Depth	
<b>Probe Conversion Factors: Head Tissue Liquid</b>															
850	± 50 / ± 100	41.5	0.9	43	0.88	8.33	0.26	1.74	8.56	0.62	1.09	8.97	0.84	1.06	± 11%
900	± 50 / ± 100	41.5	0.97	42.6	0.94	8.17	0.36	1.47	8.4	0.81	1	8.34	0.39	1.35	± 11%
1750	± 50 / ± 100	40.08	1.37	39.7	1.35	7.76	0.12	2.55	7.86	0.28	1.45	8.22	0.21	1.67	± 11%
1900	± 50 / ± 100	40	1.4	40.5	1.35	7.61	0.09	4.19	7.76	0.1	3.79	8.09	0.1	3.66	± 11%
2000	± 50 / ± 100	40	1.4	40.2	1.45	6.56	0.12	3.58	6.73	0.11	3.18	7.04	0.13	2.12	± 11%
2450	± 50 / ± 100	39.2	1.8	39.9	1.87	8.07	0.13	3.92	8.22	0.15	4.32	8.62	0.18	3.61	± 11%
2600	± 50 / ± 100	39	1.96	39.7	2.05	8.01	0.13	3.29	8.13	0.14	2.82	8.44	0.09	4.43	± 11%
<b>Probe Conversion Factors: Body Tissue Liquid</b>															
850	± 50 / ± 100	55.2	0.97	54.8	0.96	8.79	0.27	1.74	8.99	0.33	1.52	9.47	0.34	1.44	± 11%
900	± 50 / ± 100	55	1.05	54.2	1.02	8.29	0.62	1.1	8.44	0.36	1.38	8.89	0.47	1.24	± 11%
1750	± 50 / ± 100	53.4	1.49	53.7	1.5	8.28	0.07	3.74	8.42	0.06	5.55	8.83	0.12	3.24	± 11%
1900	± 50 / ± 100	53.3	1.52	52.8	1.54	7.49	0.16	3.22	7.65	0.16	3.23	8.03	0.17	3.04	± 11%
2000	± 50 / ± 100	53.3	1.52	53.6	1.58	6.72	0.31	1.37	6.91	0.85	0.87	7.19	0.25	1.51	± 11%
2450	± 50 / ± 100	52.7	1.95	51.9	1.95	7.23	0.14	6.05	7.51	0.16	5.63	7.98	0.15	5.85	± 11%
2600	± 50 / ± 100	52.5	2.16	51.9	2.26	7.38	0.31	2.23	7.46	0.28	2.68	7.92	0.25	2.77	± 11%

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## Deviation from Isotropy

Error ( $\phi, \theta$ ),  $f = 900$  MHz



**Uncertainty of Spherical Isotropy Assessment:  $\pm 2.5\%$  ( $k=2$ )**



Test report no.: SYBH(Z-SAR)027062011-2

**Annex 4.2 Calibration report “Data Acquisition Unit (DAE)”**

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



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

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

Accreditation No.: **SCS 108**

Client **Huawei SH (Auden)**

Certificate No: **DAE4-1236\_Oct10**

**CALIBRATION CERTIFICATE**

Object: **DAE4 - SD 000 D04 BJ - SN: 1236**

Calibration procedure(s): **QA CAL-06.v22  
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **October 26, 2010**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^\circ\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	28-Sep-10 (No:10376)	Sep-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1004	07-Jun-10 (in house check)	In house check: Jun-11

Calibrated by:	Name	Function	Signature
	Eric Hainfeld	Technician	
Approved by:	Name	Function	Signature
	Fin Bombolt	R&D Director	

Issued: October 26, 2010

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



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

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

Accreditation No.: **SCS 108**

### Glossary

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

### Methods Applied and Interpretation of Parameters

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



**DC Voltage Measurement**

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	404.985 ± 0.1% (k=2)	404.913 ± 0.1% (k=2)	405.914 ± 0.1% (k=2)
Low Range	3.98821 ± 0.7% (k=2)	3.96798 ± 0.7% (k=2)	4.00517 ± 0.7% (k=2)

**Connector Angle**

Connector Angle to be used in DASY system	136.0 ° ± 1 °
---	---------------

## Appendix

## 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	199987.8	-5.07	-0.00
Channel X + Input	19999.45	-0.25	-0.00
Channel X - Input	-19998.46	1.54	-0.01
Channel Y + Input	199997.8	-3.16	-0.00
Channel Y + Input	19996.97	-2.53	-0.01
Channel Y - Input	-20000.89	-1.19	0.01
Channel Z + Input	200011.7	1.18	0.00
Channel Z + Input	19996.30	-3.10	-0.02
Channel Z - Input	-20000.89	-1.19	0.01

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2000.1	0.05	0.00
Channel X + Input	200.81	0.71	0.35
Channel X - Input	-199.97	-0.07	0.04
Channel Y + Input	2000.5	0.57	0.03
Channel Y + Input	199.61	-0.29	-0.15
Channel Y - Input	-201.03	-1.03	0.52
Channel Z + Input	2001.1	1.19	0.06
Channel Z + Input	199.04	-0.86	-0.43
Channel Z - Input	-200.59	-0.59	0.30

## 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 ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	16.27	14.87
	- 200	-14.51	-15.98
Channel Y	200	-15.41	-15.97
	- 200	14.99	14.94
Channel Z	200	-14.10	-14.71
	- 200	12.74	12.83

## 3. Channel separation

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

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	2.01	1.24
Channel Y	200	-0.12	-	2.79
Channel Z	200	1.72	-0.74	-

**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	15748	17238
Channel Y	16003	17264
Channel Z	16296	16350

**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	-0.08	-2.17	2.32	0.78
Channel Y	-0.81	-3.36	2.26	0.79
Channel Z	-0.94	-2.13	0.38	0.54

**6. Input Offset Current**

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

**7. Input Resistance** (Typical values for information)

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

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

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

**9. Power Consumption** (Typical values for information)

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

Annex 4.3 Calibration report “1900 MHz System validation dipole”



Client **Huawei** Certificate No: **D1900V2-5d091\_Feb11**

### CALIBRATION CERTIFICATE

Object: D1900V2 - SN: 5d091

Calibration Procedure(s): TMC-XZ-01-027  
Calibration procedure for dipole validation kits

Calibration date: February 23, 2011

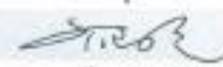
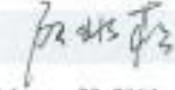
Condition of the calibrated item: In Tolerance

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Calibration Equipment used (M&TE critical for calibration)

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Power sensor NRV-Z5	100333	18-Jun-10 (TMC, No. JZ10-248)	Jun-11
Reference Probe ES3DV3 DAE4	SN 3149	25-Sep-10 (SPEAG, No.ES3-3149_Sep10)	Sep-11
	SN 771	21-Nov-10 (TMC, No.JZ10-653)	Nov-11
RF generator E4438C	MY45092879	17-Jun-10 (TMC, No.JZ10-302)	Jun-11
Network Analyzer 8753E	US38433212	02-Aug-10 (TMC, No.JZ10-056)	Aug-11

	Name	Function	Signature
Calibrated by:	Lin Hao	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: February 23, 2011

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工业和信息化部通信计量中心  
Telecommunication Metrology Center of MIIT



**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**Additional Documentation:**

- DASY System Handbook

**Methods Applied and Interpretation of Parameters:**

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

**Measurement Conditions**

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

DASY Version	DASY5	V5.2.157
Extrapolation	Advanced Extrapolation	
Phantom	2mm Oval Phantom EL14	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.8 $\pm$ 6 %	1.39mho/m $\pm$ 6 %
Head TSL temperature during test	(22.1 $\pm$ 0.2) °C	---	---

**SAR result with Head TSL**

SAR averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.90 mW / g
SAR normalized	normalized to 1W	39.6 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>39.1 mW / g <math>\pm</math> 17.0 % (k=2)</b>

SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.10 mW / g
SAR normalized	normalized to 1W	20.4 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>20.2 mW / g <math>\pm</math> 16.5 % (k=2)</b>

<sup>1</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

**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	51.7 ± 6%	1.58mho/m ± 6 %
Body TSL temperature during test	(21.9 ± 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	10.2 mW / g
SAR normalized	normalized to 1W	40.8 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	39.2 mW /g ± 17.0 % (k=2)

SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.24 mW / g
SAR normalized	normalized to 1W	21.0 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	20.5 mW /g ± 16.5 % (k=2)

<sup>2</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.2Ω - 2.3 jΩ
Return Loss	- 32.5dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.6Ω - 6.1 jΩ
Return Loss	- 24.2dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	4.069 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

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

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**DASY5 Validation Report for Head TSL**

Date/Time: 2011-2-23 16:07:52

Test Laboratory: TMC, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: SN: 5d091

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

Medium: Head 1900MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.39$  mho/m;  $\epsilon_r = 38.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(5.03, 5.03, 5.03); Calibrated: 25.09.10
- Electronics: DAE4 Sn771; Calibration: 21.11.10
- Phantom: 2mm Oval Phantom ELI4; Type: QDOVA001BB
- Measurement SW: DASY5, V5.2.157; Postprocessing SW: SEMCAD, V14.0 Build 57

Pin=250mW; d=10mm/Zoom Scan (7x7x7)/Cube 0:

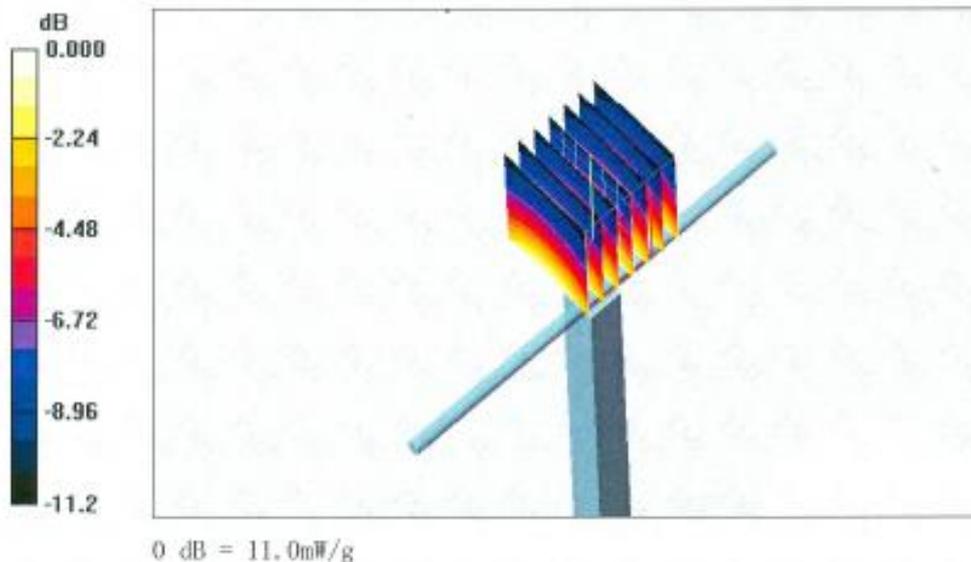
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.4 V/m; Power Drift = 0.048 dB

Peak SAR (extrapolated) = 17.75 W/kg

SAR(1 g) = 9.9 mW/g; SAR(10 g) = 5.1 mW/g

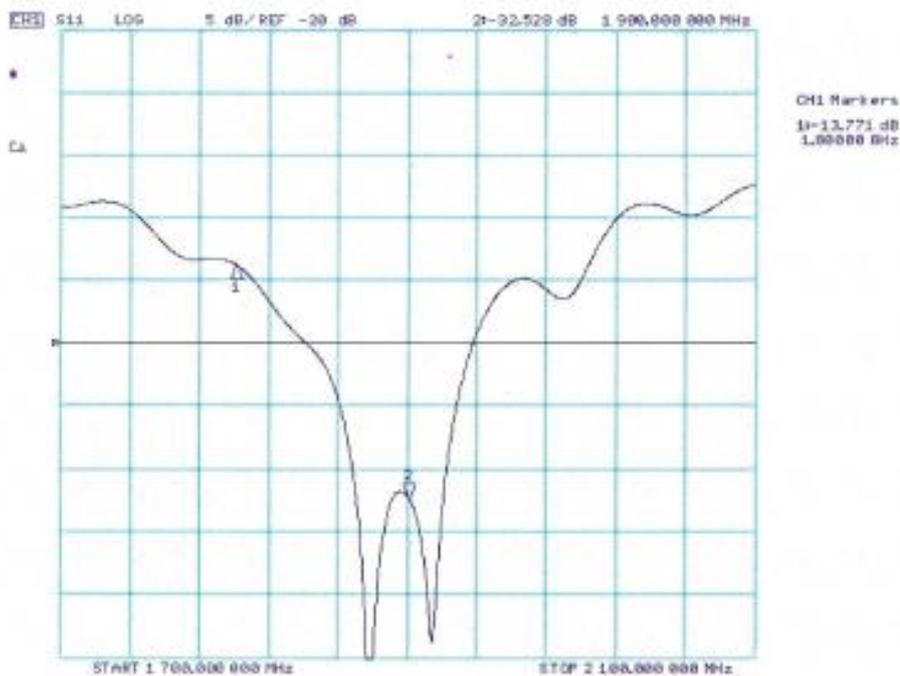
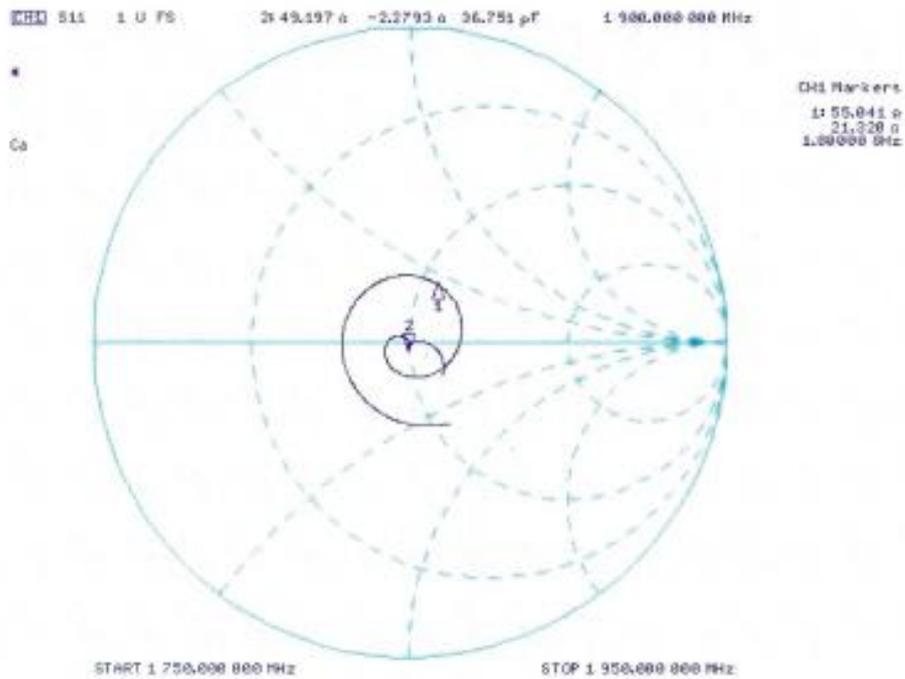
Maximum value of SAR (measured) = 11.0 mW/g



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### Impedance Measurement Plot for Head TSL



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**DASY5 Validation Report for Body TSL**

Date/Time: 2011-2-23 16:58:35

Test Laboratory: TMC, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: SN: 5d091

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

Medium: Body 1900MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.58$  mho/m;  $\epsilon_r = 51.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(4.68, 4.68, 4.68); Calibrated: 25.09.10
- Electronics: DAE4 Sn771; Calibration: 21.11.10
- Phantom: 2mm Oval Phantom ELI4; Type: QDOVA001BB
- Measurement SW: DASY5, V5.2.157; Postprocessing SW: SEMCAD, V14.0 Build 57

Pin=250mW; d=10mm/Zoom Scan (7x7x7)/Cube 0:

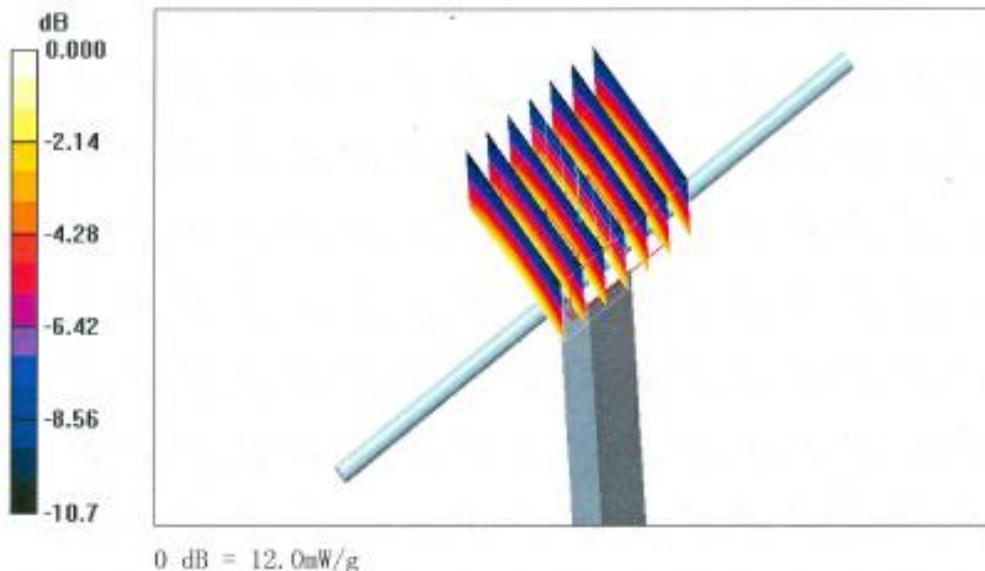
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.3 V/m; Power Drift = -0.076 dB

Peak SAR (extrapolated) = 17.15 W/kg

SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.24 mW/g

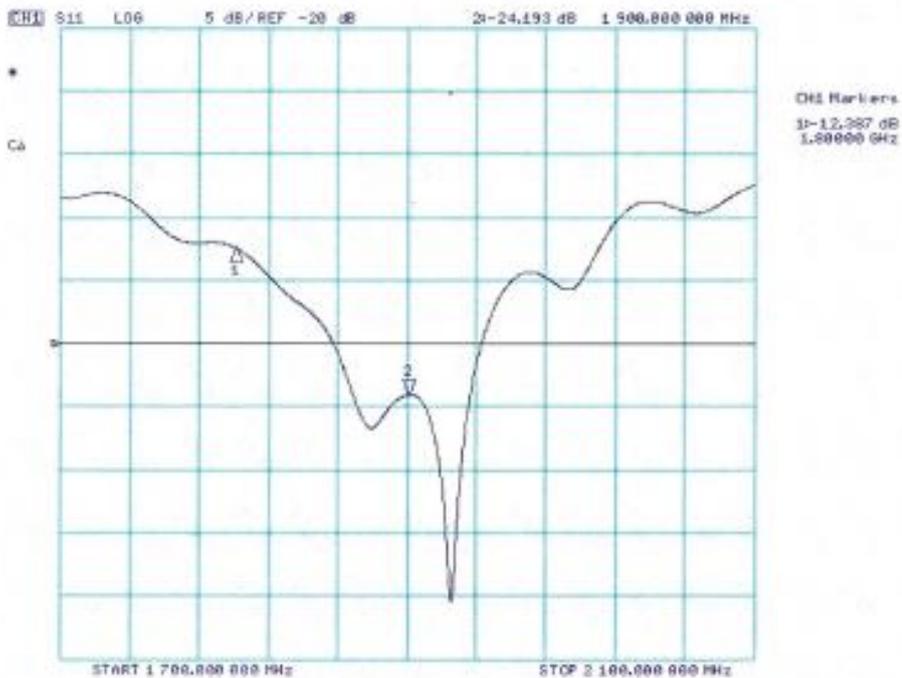
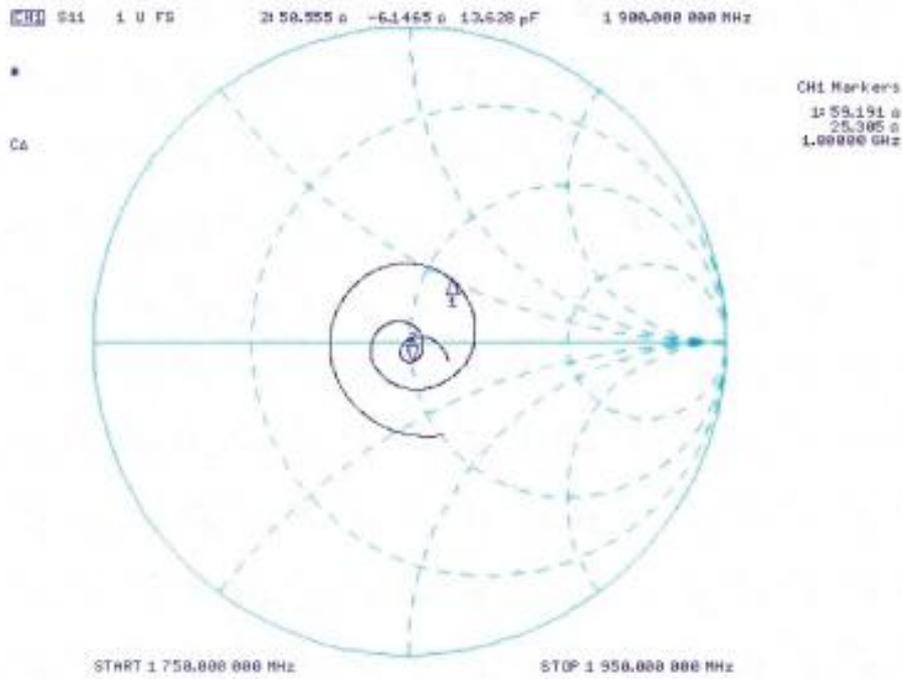
Maximum value of SAR (measured) = 12.0 mW/g



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Impedance Measurement Plot for Body TSL





Annex 4.4 Calibration report “835 MHz System validation dipole”

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TMC

METRA

CNAS  
校准  
CNAS L0442

Client **Huawei** Certificate No: **D835V2-4d095\_Feb11**

CALIBRATION CERTIFICATE																															
Object	D835V2 - SN: 4d095																														
Calibration Procedure(s)	TMC-XZ-01-027 Calibration procedure for dipole validation kits																														
Calibration date:	February 23, 2011																														
Condition of the calibrated item	In Tolerance																														
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity&lt;70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date(Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power Meter NRVD</td> <td>101253</td> <td>18-Jun-10 (TMC, No.JZ10-248)</td> <td>Jun-11</td> </tr> <tr> <td>Power sensor NRV-Z5</td> <td>100333</td> <td>18-Jun-10 (TMC, No. JZ10-248)</td> <td>Jun-11</td> </tr> <tr> <td>Reference Probe ES3DV3</td> <td>SN 3149</td> <td>25-Sep-10 (SPEAG, No.ES3-3149_Sep10)</td> <td>Sep-11</td> </tr> <tr> <td>DAE4</td> <td>SN 771</td> <td>21-Nov-10 (TMC, No.JZ10-653)</td> <td>Nov-11</td> </tr> <tr> <td>RF generator E4438C</td> <td>MY45092879</td> <td>17-Jun-10 (TMC, No.JZ10-302)</td> <td>Jun-11</td> </tr> <tr> <td>Network Analyzer 8753E</td> <td>US38433212</td> <td>02-Aug-10 (TMC, No.JZ10-056)</td> <td>Aug-11</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration	Power Meter NRVD	101253	18-Jun-10 (TMC, No.JZ10-248)	Jun-11	Power sensor NRV-Z5	100333	18-Jun-10 (TMC, No. JZ10-248)	Jun-11	Reference Probe ES3DV3	SN 3149	25-Sep-10 (SPEAG, No.ES3-3149_Sep10)	Sep-11	DAE4	SN 771	21-Nov-10 (TMC, No.JZ10-653)	Nov-11	RF generator E4438C	MY45092879	17-Jun-10 (TMC, No.JZ10-302)	Jun-11	Network Analyzer 8753E	US38433212	02-Aug-10 (TMC, No.JZ10-056)	Aug-11
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Power Meter NRVD	101253	18-Jun-10 (TMC, No.JZ10-248)	Jun-11																												
Power sensor NRV-Z5	100333	18-Jun-10 (TMC, No. JZ10-248)	Jun-11																												
Reference Probe ES3DV3	SN 3149	25-Sep-10 (SPEAG, No.ES3-3149_Sep10)	Sep-11																												
DAE4	SN 771	21-Nov-10 (TMC, No.JZ10-653)	Nov-11																												
RF generator E4438C	MY45092879	17-Jun-10 (TMC, No.JZ10-302)	Jun-11																												
Network Analyzer 8753E	US38433212	02-Aug-10 (TMC, No.JZ10-056)	Aug-11																												
Calibrated by:	Name Lin Hao	Function SAR Test Engineer	Signature 																												
Reviewed by:	Qi Dianyuan	SAR Project Leader																													
Approved by:	Lu Bingsong	Deputy Director of the laboratory																													
Issued: February 23, 2011																															
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.																															



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**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**Additional Documentation:**

- DASY System Handbook

**Methods Applied and Interpretation of Parameters:**

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

**Measurement Conditions**

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

DASY Version	DASY5	V5.2.157
Extrapolation	Advanced Extrapolation	
Phantom	2mm Oval Phantom ELI4	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.9 $\pm$ 6 %	0.93mho/m $\pm$ 6 %
Head TSL temperature during test	(22.5 $\pm$ 0.2) °C	---	---

**SAR result with Head TSL**

SAR averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.39 mW / g
SAR normalized	normalized to 1W	9.56 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>9.42 mW / g <math>\pm</math> 17.0 % (k=2)</b>

SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.54 mW / g
SAR normalized	normalized to 1W	6.16 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>6.13 mW / g <math>\pm</math> 16.5 % (k=2)</b>

<sup>1</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

**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	53.8 ± 6%	1.00mho/m ± 6 %
Body TSL temperature during test	(22.4 ± 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	2.47 mW / g
SAR normalized	normalized to 1W	9.88 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	9.56 mW /g ± 17.0 % (k=2)

SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.61 mW / g
SAR normalized	normalized to 1W	6.44 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	6.28 mW /g ± 16.5 % (k=2)

<sup>2</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

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## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$47.2\Omega + 7.0\text{ j}\Omega$
Return Loss	- 22.3dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	$46.5\Omega + 3.4\text{ j}\Omega$
Return Loss	- 25.9dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	3.184 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

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

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**DASY5 Validation Report for Head TSL**

Date/Time: 2011-2-23 9:15:24

Test Laboratory: TMC, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: SN: 4d095

Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1

Medium: Head 835MHz

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.93$  mho/m;  $\epsilon_r = 41.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(6.56, 6.56, 6.56); Calibrated: 25.09.10
- Electronics: DAE4 Sn771; Calibration: 21.11.10
- Phantoms: 2mm Oval Phantom ELI4; Type: QDOVA001BB
- Measurement SW: DASY5, V5.2.157; Postprocessing SW: SEMCAD, V14.0 Build 57

Pin=250mW; d=15mm/Zoom Scan (7x7x7)/Cube 0:

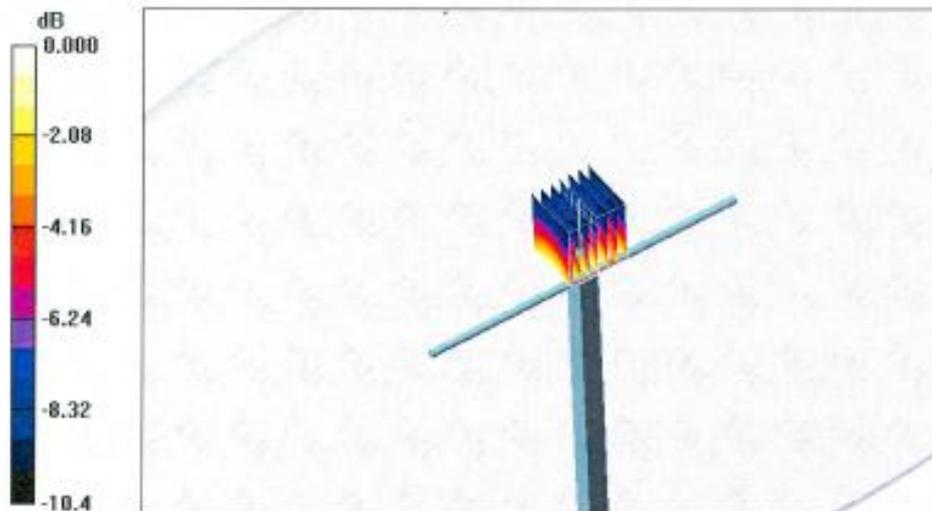
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.3 V/m; Power Drift = 0.104 dB

Peak SAR (extrapolated) = 3.475 W/kg

SAR(1 g) = 2.39 mW/g; SAR(10 g) = 1.54 mW/g

Maximum value of SAR (measured) = 2.56 mW/g

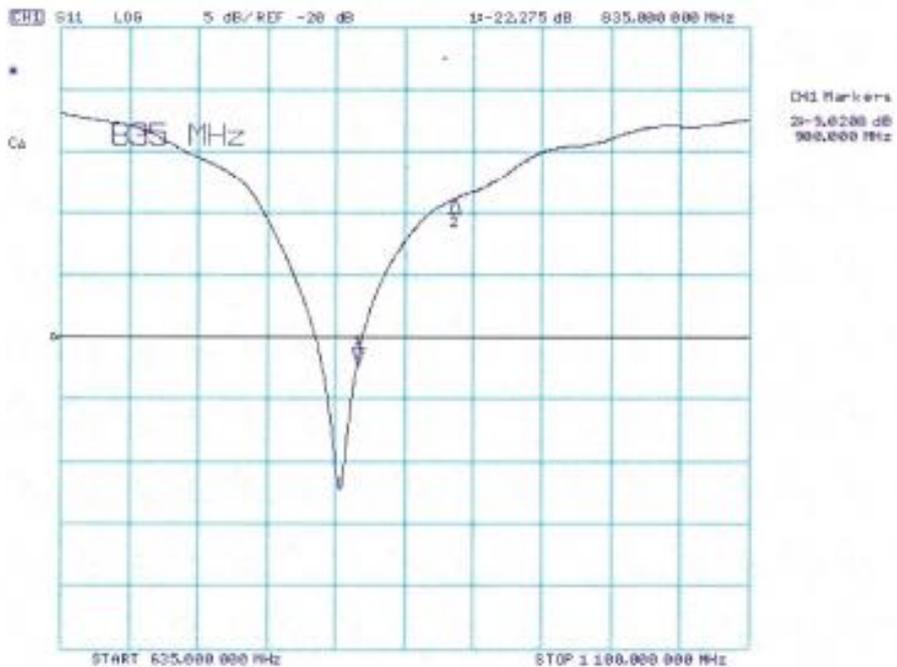
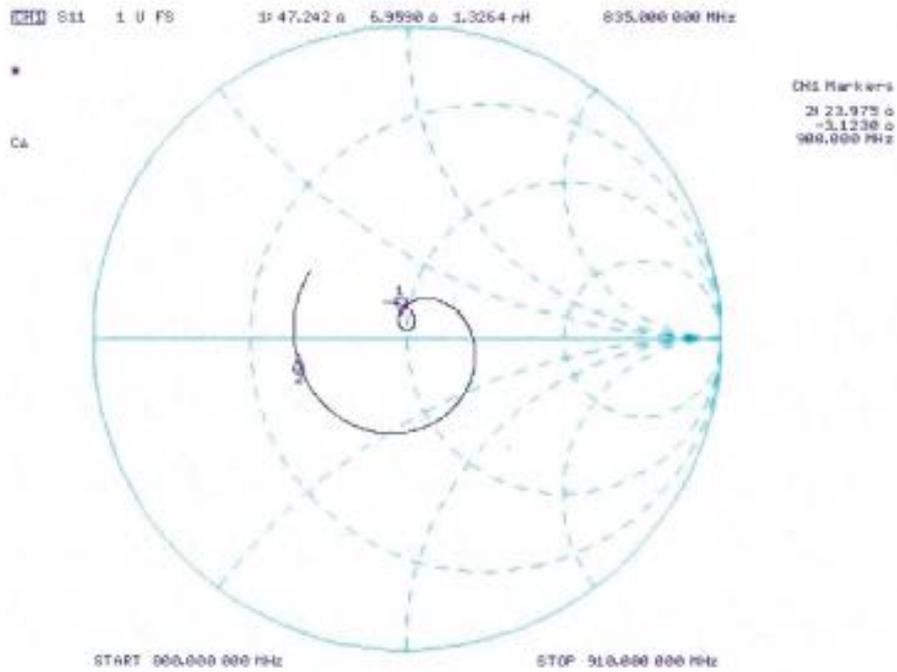


0 dB = 2.56mW/g

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### Impedance Measurement Plot for Head TSL



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**DASY5 Validation Report for Body TSL**

Date/Time: 2011-2-23 10:36:18

Test Laboratory: TMC, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: SN: 4d095

Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1

Medium: Body 835MHz

Medium parameters used:  $f = 835$  MHz;  $\sigma = 1$  mho/m;  $\epsilon_r = 53.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(6.22, 6.22, 6.22); Calibrated: 25.09.10
- Electronics: DAE4 Sn771; Calibration: 21.11.10
- Phantom: 2mm Oval Phantom ELI4; Type: QDOVA001BB
- Measurement SW: DASY5, V3.2.157; Postprocessing SW: SEMCAD, V14.0 Build 57

Pin=250mW; d=15mm/Zoom Scan (7x7x7)/Cube 0:

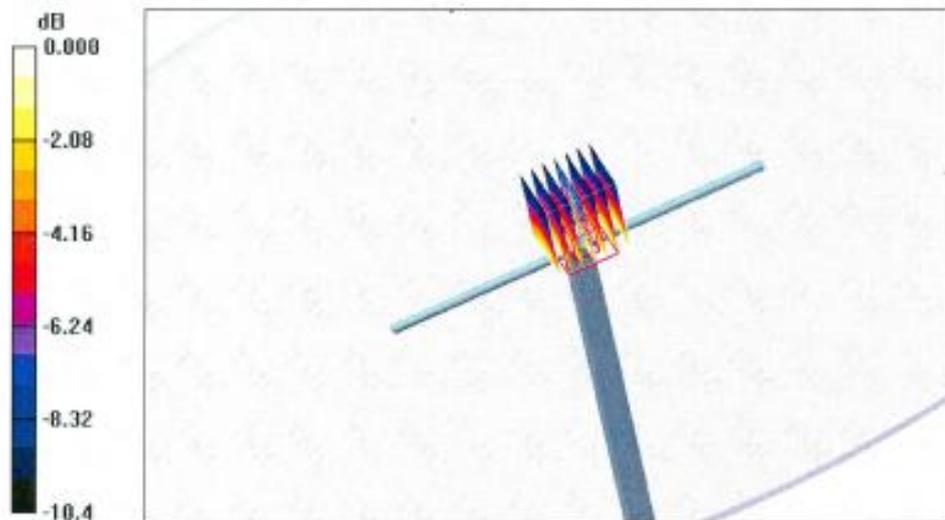
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 41.7 V/m; Power Drift = -0.065 dB

Peak SAR (extrapolated) = 3.475 W/kg

SAR(1 g) = 2.47 mW/g; SAR(10 g) = 1.61 mW/g

Maximum value of SAR (measured) = 2.68 mW/g



0 dB = 2.68mW/g



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Impedance Measurement Plot for Body TSL

