QUALCOMM
CDMA Technologies

UNDP-1 Hewlett-Packard HSTNN-W47C SAR Test Report

80-VH688-8 Rev. A

May 6, 2008

Submit technical questions to:
regulatory.support@qualcomm.com

QUALCOMM Incorporated
5775 Morehouse Drive
San Diego, CA 92121-1714
U.S.A.

15. SAR System Calibration Data

The following pages show calibration certification data for the Schmid & Partner AG DASY4 SAR system.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Economic Affairs DEA
State Secretariat for Economic Affairs SECO
Swiss Accreditation Service SAS

Accreditation number **SCS 108**
Numero d'accreditamento

Accreditation Standard ISO/IEC 17025:2005
Norma d'accreditamento ISO/IEC

SCS Directory
Registro SCS

Calibration Laboratory for Specific Electric and Magnetic RF Fields and SAR measurements

Schmid & Partner
Engineering AG
Zeughausstrasse 43
8004 Zürich
☎ +41 44 245 97 00
Fax +41 44 245 97 79
mailto:info@speag.com
http://www.speag.com

Head of laboratory	:	Dr. Katja Pokovic
Deputy of head of laboratory	:	Dr. Fin Bomholt
Responsible person for QA	:	Prof. Dr. Niels Kuster
First accreditation (d,m,y)	:	17.09.2004
Last accreditation (d,m,y)	:	17.09.2004
Actual version	:	http://www.sas.ch/

Measured Quantities:
Electric field
Magnetic field
Specific **A**bsorption **R**ate (**SAR**)
Temperature
DC Voltage

Change:

Staff	:	
Scope extension	:	01.10.05, 01.04.08
Address	:	
Edition	:	**SCS108/G**

The given extended measurement uncertainty is the standard uncertainty of the measurement multiplied by an extension factor k = 2, which corresponds to a confidence level of about 95% for a normal distribution.

Measured Quantity Instrument	Range	Condition of measurement	Best Measurement Capability CMC at (22 ± 3) °C	Remarks
Electric field				
Calibration of E-field probes	0.8 V/m … 800 V/m	10 MHz … 3 GHz	5,1 %	e.g. ER3DV6x, EF3DVx, EU2DVx, EE3DVx
Magnetic field				
Calibration of H-field probes	2 mA/m … 2 A/m	10 MHz … 3 GHz	5,1 %	e.g. H2DVx, H3DVx
Calibration of sensitivity for magnetic field probes in the audio range	0,001 ... 0,1 V/(A/m)	1 kHz 0,1 ... 1 A/m	2,2 %	e.g. AM1DVx
Calibration of magnetic field simulator	-30 ... +40 dB A/m	1 kHz		e.g. TMFS (Telephone Magnetic Field Simulator)

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Measured Quantity Instrument	Range	Condition of measurement	Best Measurement Capability CMC at (22 ± 3) °C	Remarks
Specific absorption rate (SAR)				e.g. ET3DVx, ES3DVx, EX3DVx, ET1DVx, EU2DVx
Calibration of dosimetric E-field probes	E* field (typical[1]) 0,5 V/m … 500 V/m	300 MHz … 450 MHz	6,7 % (13,3 % for SAR)	Temperature transfer calibration *) As example, the indicated range corresponds to 0,2 mW/kg … 200 W/kg for head tissue simulating liquid and f = 450 MHz
Calibration of dosimetric E-field probes	E* field (typical[1]) 0,45 V/m … 450 V/m	800 MHz ... 3 GHz	5,5 % (11 % for SAR)	e.g. ET3DVx, ES3DVx, EX3DVx, ET1DVx, EU2DVx Waveguide analytical calibration *) As example, the indicated range corresponds to 0,2 mW/kg … 200 W/kg for head tissue simulating liquid and f = 1800 MHz
	E* field (typical[1]) 0,4 V/m … 450 V/m	3 GHz … 6 GHz	6,5 % (13,1 % for SAR)	e.g. EX3DVx, ET1DVx Waveguide analytical calibration *) As example, the indicated range corresponds to 0,2 mW/kg … 200 W/kg for head tissue simulating liquid and f = 5200 MHz
Calibration of temperature SAR probes	0 °C ... + 60 °C	Tissue simulating Liquids	0,15 K (5 % temperature gradient for SAR)	As example, the temperature gradient of T1Vx and T1V3LAB probes can be determined to 5 %, which is also contribution to SAR accuracy. (Noise is dominating the lower SAR threshold to typically 0,2 W/kg)

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Measured Quantity Instrument	Range	Condition of measurement	Best Measurement Capability CMC at (22 ± 3) °C	Remarks
Calibration of test system validation dipoles	SAR* 1 g and 10 g per 1 W input power	300 MHz … 450 MHz	18,1 % for SAR 1 g 17,6 % for SAR 10 g	e.g. D835V2 … D3000V2 according to IEEE 1528-2003, for 1 g and 10 g SAR
		835 MHz … 3 GHz	17,0 % for SAR 1 g 16,5 % for SAR 10 g	*) SAR given (as example) for head tissue simulating liquid
	SAR* 1 g and 10 g per 1 W input power	3 GHz … 6 GHz	19,9 % for SAR 1 g 19,5 % for SAR 10 g	e.g. D3500V2 … D5GHzV2 according to IEC 62209-2, for 1 g and 10 g SAR *) SAR given (as example) for head tissue simulating liquid
Calibration of dipoles in air	E* field per 0,1 W input power 30 V/m … 300 V/m	800 MHz … 3 GHz	12,8 % for E field	e.g. CD835V3 … CD2450V3 according to ANSI PC 63,19 2001, for E field and H field
	H* field per 0,1 W input power 0,07 A/m … 0,7 A/m		8,2 % for H field	
DC Voltage				
Calibration of readout units for field and SAR probes	2 mV		0,65 %	e.g. DAE3Vx, DAE4Vx, DAEasyVx
	200 mV		0,06 %	

[1] Slightly depending on the frequency and probe type

m e t a s

metrologie und akkreditierung schweiz

Schweizerische Akkreditierungsstelle
Service d'accréditation suisse
Servizio di accreditamento svizzero
Swiss Accreditation Service

Accreditation number SCS 108

SCS Directory

Calibration Laboratory for Specific Electric and Magnetic RF Fields and SAR Measurements

Schmid & Partner
Engineering AG
Zeughausstrasse 43
8004 Zürich
Phone 044/ 245 97 00
Fax 044/ 245 97 79

Head of laboratory : Dr. Katja Pokovic
Deputy of head of laboratory : Dr. Fin Bomholt
Responsible person for QA : Prof. Dr. Niels Kuster
First accreditation (d,m,y) : 17.09.2004
Last accreditation (d,m,y) : 17.09.2004

Measured Quantity:

Electric field
Magnetic field
Specific Absorption Rate (SAR)
Temperature
DC Voltage

Change:

Staff :
Scope extension : 01.10.2005
Address :
Edition : **SCS108/D**

The reported expanded 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%.

Measured Quantity Instrument	Range	Conditions of measurements	Best Measurement Capability BMC at (22 ± 3) °C	Remarks
Electric field Calibration of E-field probes	0.8 V/m ... 800 V/m	10 MHz ... 3 GHz	5,1 %	e.g. ER3DV6x, EF3DVx, EU2DVx, EE3DVx
Magnetic field Calibration of H-field probes	2 mA/m ... 2 A/m	10 MHz ... 3 GHz	5,1 %	e.g. H2DVx, H3DVx
Specific absorption rate (SAR) Calibration of dosimetric E-field probes	E* field (typical[1]) 0,5 V/m ... 500 V/m	300 MHz ... 450 MHz	6,7 % (13,3 % for SAR)	e.g. ET3DVx, ES3DVx, EX3DVx, ET1DVx, EU2DVx Temperature transfer calibration *) As example, the indicated range corresponds to 0,2 mW/kg - 200 W/kg for head tissue simulating liquid and f = 450 MHz

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Calibration Laboratory for Specific Electric and Magnetic RF Fields and SAR Measurements

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Measured Quantity Instrument	Range	Conditions of measurements	Best Measurement Capability BMC at (22 ± 3) °C	Remarks
Specific absorption rate (SAR)				e.g. ET3DVx, ES3DVx, EX3DVx, ET1DVx, EU2DVx
Calibration of dosimetric E-field probes	E* field (typical[1]) 0,45 V/m ... 450 V/m	800 MHz ... 2 GHz	5,5% (11,0 % for SAR)	Waveguide analytical calibration *) As example, the indicated range corresponds to 0,2 mW/kg - 200 W/kg for head tissue simulating liquid and f = 1800 MHz
	E* field (typical[1]) 0,4 V/m ... 400 V/m	2,45 GHz	5,9 % (11,8 % for SAR)	Waveguide analytical calibration *) As example, the indicated range corresponds to 0,2 mW/kg - 200 W/kg for head tissue simulating liquid and f = 2450 MHz
Specific absorption rate (SAR)				e.g. EX3DVx, ET1DVx
	E* field (typical[1]) 0,4 V/m ... 450 V/m	3 GHz ... 6 GHz	6,5 % (13,1 % for SAR)	Waveguide analytical calibration *) As example, the indicated range corresponds to 0,2 mW/kg - 200 W/kg for head tissue simulating liquid and f = 5200 MHz
Calibration of temperature SAR probes	0 °C ... +60 °C	Tissue simulating Liquids	0,15 K (5 % temperature gradient for SAR)	As example, the temperature gradient of T1Vx probe can be determined to 5 %, which is also contribution to SAR accuracy. (Noise is dominating the lower SAR threshold to typically 0,2 W/kg)

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The reported expanded 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%.

Measured Quantity Instrument	Range	Conditions of measurements	Best Measurement Capability BMC at (22 ± 3) °C	Remarks
Calibration of test system validation dipoles	SAR* 1 g and 10 g per 1 W input power	300 MHz ... 450 MHz	18,1 % for SAR 1 g 17,6 % for SAR 10 g	e.g. D835V2 - D3000V2 according to IEEE 1528-2003, for 1 g and 10 g SAR
		835 MHz ... 3 GHz	17,0 % for SAR 1 g 16,5 % for SAR 10 g	*) SAR given (as example) for head tissue simulating liquid
Calibration of test system validation dipoles	SAR* 1 g and 10 g per 1 W input power	3 GHz ... 6 GHz	19,9 % for SAR 1 g 19,5 % for SAR 10 g	e.g. D3500V2 – D5GHzV2 according to IEC 62209-2, for 1 g and 10 g SAR *) SAR given (as example) for head tissue simulating liquid
Calibration of dipoles in air	E* field per 0.1 W input power 30 V/m ... 300 V/m H* field per 0.1 W input power 0.07 A/m ... 0.7 A/m	800 MHz 3000 MHz	12.8 % for E field 8.2 % for H field	e.g. CD835V3 – CD2450V3 according to ANSI PC63.19-2001, for E field and H field
DC Voltage Calibration of readout units for field and SAR probes	2 mV 200 mV		0,65% 0,06 %	e.g. DAE3Vx, DAE4Vx, DAEasyVx

[1] Slightly depending on the frequency and probe type

m e t a s

metrology and accreditation switzerland

Based on the Accreditation and Designation Ordinance dated 17 June 1996 (as of 9 December 2003) and on the advice of the Federal Accreditation Commission, the Swiss Accreditation Service (SAS) grants to

Schmid & Partner Engineering AG
Zeughausstrasse 43
CH-8004 Zürich

the accreditation as

Calibration Laboratory for Specific Electric and Magnetic RF Fields and SAR Measurements

in accordance with the Standard ISO/IEC 17025. The ranges and measurement uncertainties are listed in the Official SCS-Directory of the Accredited Calibration Laboratories.

Accreditation mark and number: SCS 108

Date of accreditation: 17 September 2004

The accreditation is valid until: 16 September 2009

CH-3003 Berne-Wabern, 17 September 2004

Swiss Accreditation Service

The Head

Hanspeter Ischi

SAS is a signatory of the multilateral agreements of the European co-operation for Accreditation (EA) for calibration, testing, inspection and certification of products, personnel, quality and environmental management systems, of the International Accreditation Forum (IAF) for quality management systems and of the International Laboratory Accreditation Cooperation (ILAC) for calibration and testing.

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Office fédéral de métrologie et d'accréditation
Ufficio federale di metrologia e di accreditamento
Swiss Federal Office of Metrology and Accreditation

Eidg. Justiz- und Polizeidepartement
Département fédéral de justice et police
Dipartimento federale di giustizia e polizia
Swiss Federal Department of Justice and Police

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 Federal Office of Metrology and Accreditation
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 Qualcomm USA

Certificate No: ET3-1733_Sep07

CALIBRATION CERTIFICATE

Object	ET3DV6 - SN:1733
Calibration procedure(s)	QA CAL-01.v6 and QA CAL-12.v5 Calibration procedure for dosimetric E-field probes
Calibration date:	September 4, 2007
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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41495277	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41498087	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Reference 3 dB Attenuator	SN: S5054 (3c)	8-Aug-07 (METAS, No. 217-00719)	Aug-08
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-07 (METAS, No. 217-00671)	Mar-08
Reference 30 dB Attenuator	SN: S5129 (30b)	8-Aug-07 (METAS, No. 217-00720)	Aug-08
Reference Probe ES3DV2	SN: 3013	4-Jan-07 (SPEAG, No. ES3-3013_Jan07)	Jan-08
DAE4	SN: 654	20-Apr-07 (SPEAG, No. DAE4-654_Apr07)	Apr-08

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: September 4, 2007

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

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Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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 $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not 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 (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 $f \leq 800$ 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.

ET3DV6 SN:1733 **September 4, 2007**

Probe ET3DV6

SN:1733

Manufactured:	September 27, 2002
Last calibrated:	September 22, 2006
Recalibrated:	September 4, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1733 **September 4, 2007**

DASY - Parameters of Probe: ET3DV6 SN:1733

Sensitivity in Free Space[A] Diode Compression[B]

NormX	**1.52** ± 10.1%	$\mu V/(V/m)^2$	DCP X	**95** mV
NormY	**1.50** ± 10.1%	$\mu V/(V/m)^2$	DCP Y	**92** mV
NormZ	**1.63** ± 10.1%	$\mu V/(V/m)^2$	DCP Z	**92** mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL **900 MHz** **Typical SAR gradient: 5 % per mm**

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	5.7	3.0
SAR_{be} [%]	With Correction Algorithm	0.3	0.1

TSL **1750 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	11.7	8.0
SAR_{be} [%]	With Correction Algorithm	0.6	0.2

Sensor Offset

Probe Tip to Sensor Center	**2.7** 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%.

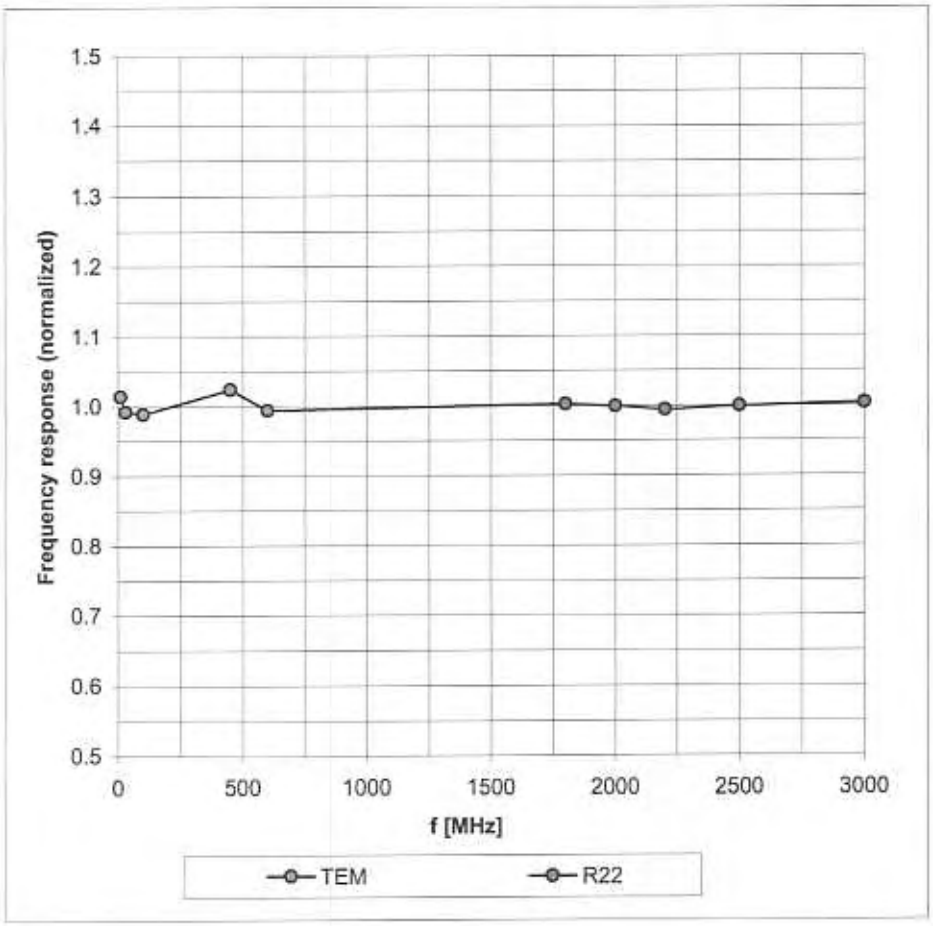
[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 8).

[B] Numerical linearization parameter: uncertainty not required.

ET3DV6 SN:1733 **September 4, 2007**

Frequency Response of E-Field

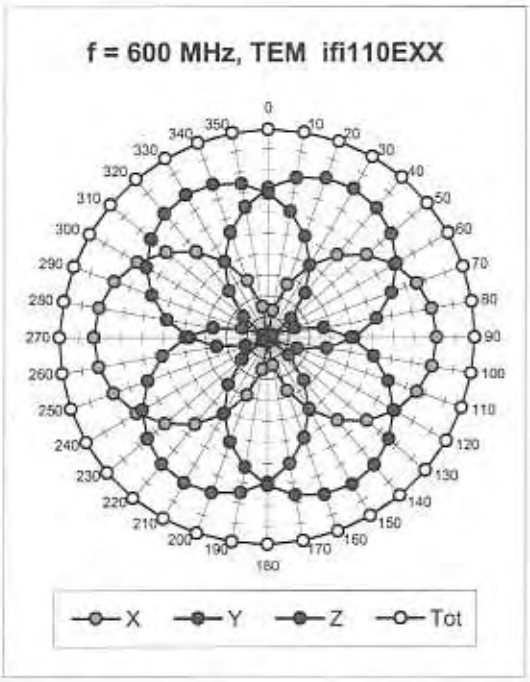
(TEM-Cell:ifi110 EXX, Waveguide: R22)

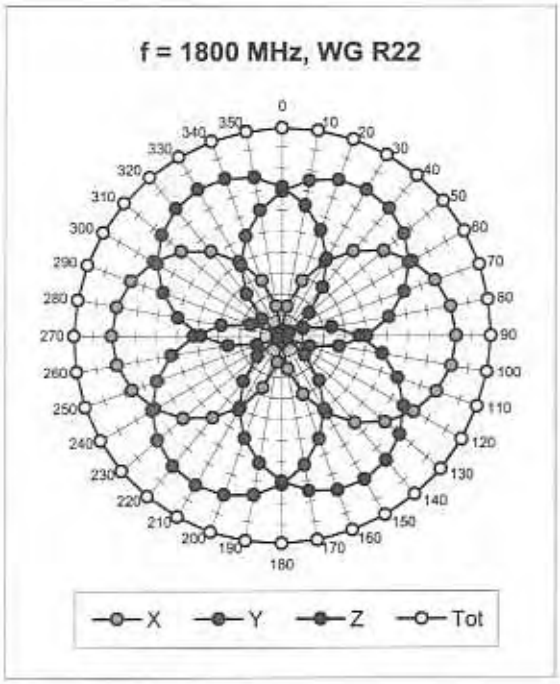


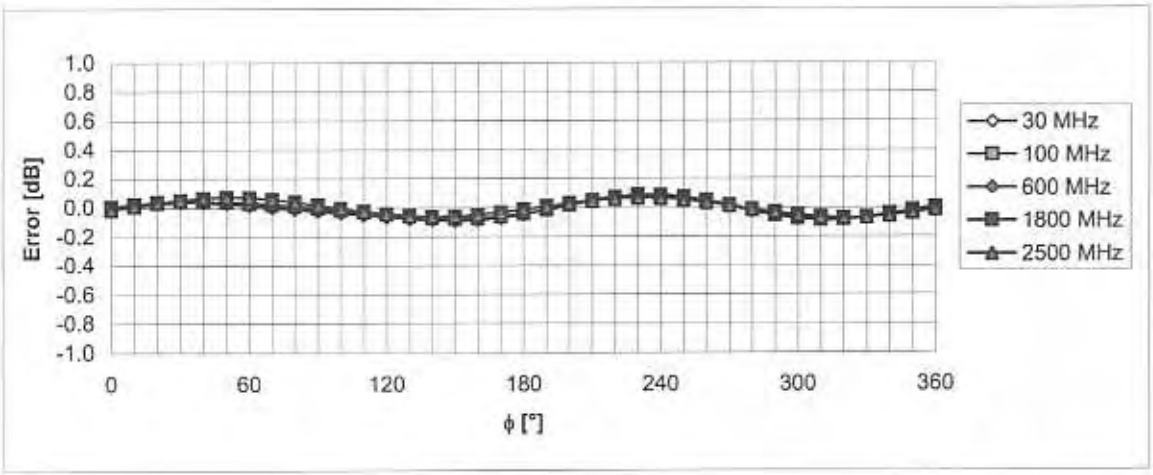
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

ET3DV6 SN:1733 **September 4, 2007**

Receiving Pattern (ϕ), ϑ = 0°





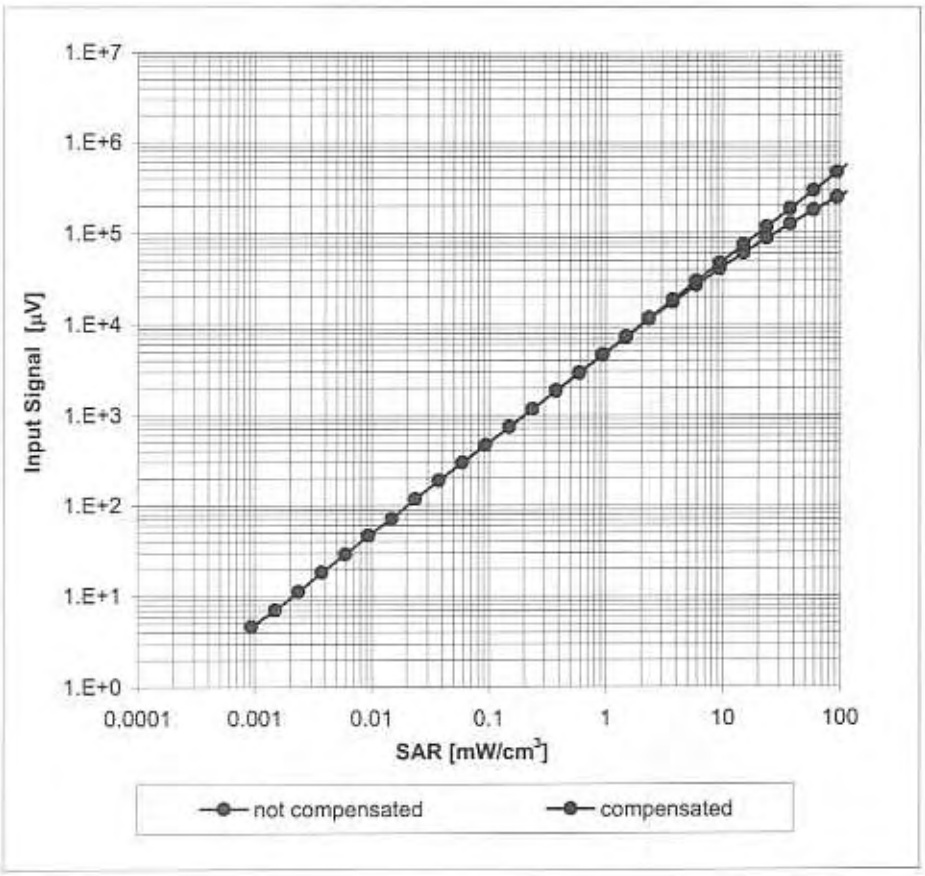


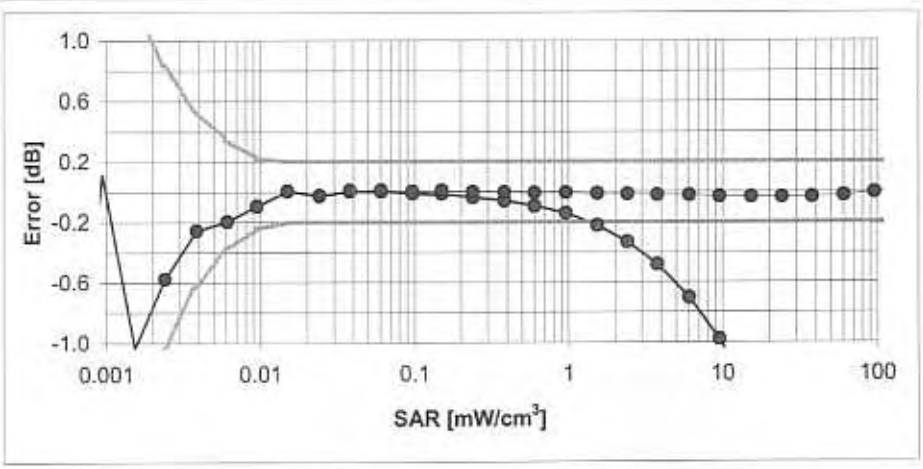
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

ET3DV6 SN:1733 **September 4, 2007**

Dynamic Range f(SAR_{head})

(Waveguide R22, f = 1800 MHz)

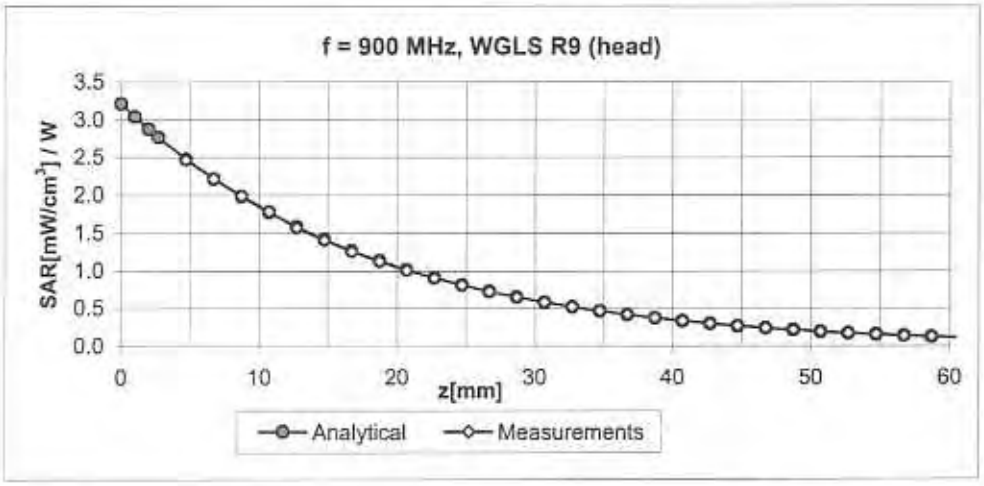




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

ET3DV6 SN:1733 **September 4, 2007**

Conversion Factor Assessment



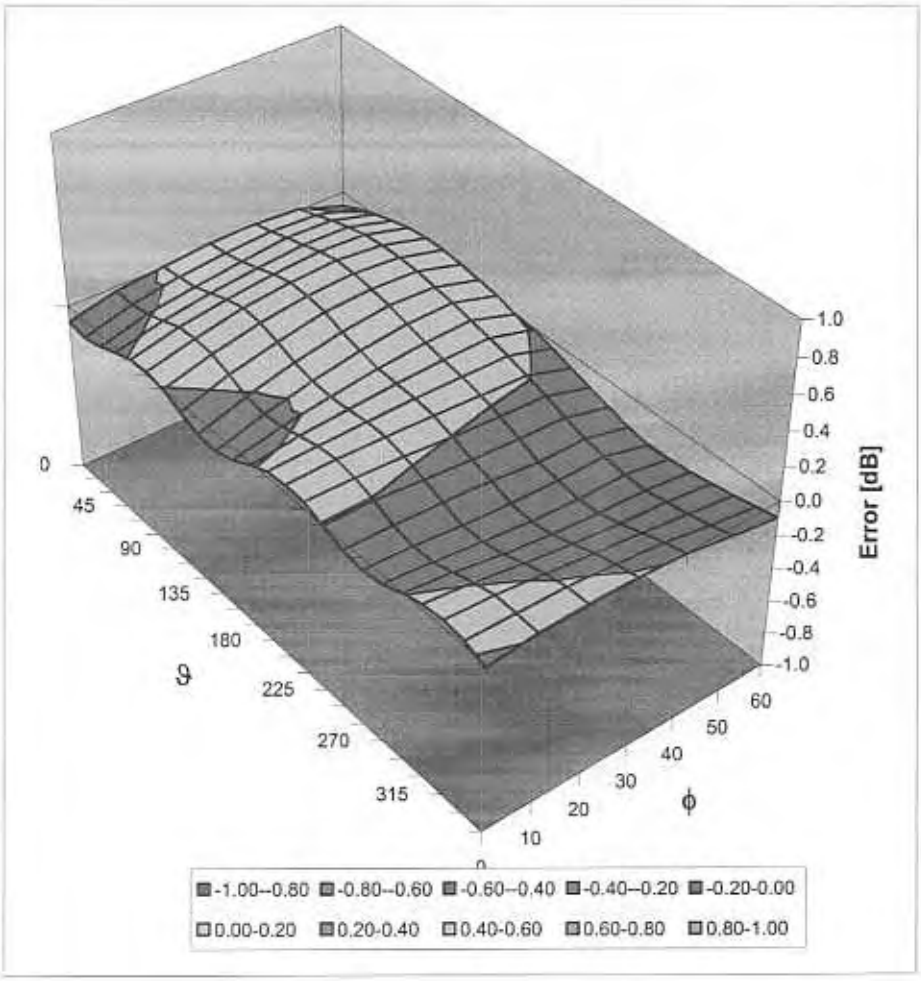
f [MHz]	Validity [MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
450	± 50 / ± 100	Head	43.5 ± 5%	0.87 ± 5%	0.36	1.83	7.34 ± 13.3% (k=2)
835	± 50 / ± 100	Head	41.5 ± 5%	0.90 ± 5%	0.24	2.89	6.89 ± 11.0% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.29	2.89	6.72 ± 11.0% (k=2)
1640	± 50 / ± 100	Head	40.3 ± 5%	1.29 ± 5%	0.54	2.59	5.83 ± 11.0% (k=2)
1750	± 50 / ± 100	Head	40.1 ± 5%	1.37 ± 5%	0.64	2.36	5.42 ± 11.0% (k=2)
1900	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.55	2.77	5.24 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.55	2.75	5.06 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.62	2.11	4.56 ± 11.8% (k=2)
450	± 50 / ± 100	Body	56.7 ± 5%	0.94 ± 5%	0.33	2.65	7.68 ± 13.3% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	0.97 ± 5%	0.35	2.89	6.57 ± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.37	2.89	6.29 ± 11.0% (k=2)
1640	± 50 / ± 100	Body	53.8 ± 5%	1.40 ± 5%	0.50	2.84	5.27 ± 11.0% (k=2)
1750	± 50 / ± 100	Body	53.4 ± 5%	1.49 ± 5%	0.55	2.76	4.95 ± 11.0% (k=2)
1900	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.67	2.43	4.71 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.73	2.29	4.58 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.65	2.17	3.93 ± 11.8% (k=2)

[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.

ET3DV6 SN:1733 **September 4, 2007**

Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz



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

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Accreditation No.: SCS 108

Client Qualcomm USA

Certificate No: D1900V2-5d019_Nov07

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d019
Calibration procedure(s)	QA CAL-05.v7 Calibration procedure for dipole validation kits
Calibration date:	November 13, 2007
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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Power sensor HP 8481A	US37292783	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Reference 20 dB Attenuator	SN: 5086 (20g)	07-Aug-07 (METAS, No 217-00718)	Aug-08
Reference 10 dB Attenuator	SN: 5047.2 (10r)	07-Aug-07 (METAS, No 217-00718)	Aug-08
Reference Probe ET3DV6 (HF)	SN: 1507	26-Oct-07 (SPEAG, No. ET3-1507_Oct07)	Oct-08
DAE4	SN 601	30-Jan-07 (SPEAG, No. DAE4-601_Jan07)	Jan-08

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

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 15, 2007

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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
c) 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:

d) DASY4 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	DASY4	V4.7
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	38.8 ± 6 %	1.45 mho/m ± 6 %
Head TSL temperature during test	(21.4 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	condition	
SAR measured	250 mW input power	9.86 mW / g
SAR normalized	normalized to 1W	39.4 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**38.1 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.15 mW / g
SAR normalized	normalized to 1W	20.6 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**20.2 mW / g ± 16.5 % (k=2)**

[1] 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	53.7 ± 6 %	1.54 mho/m ± 6 %
Body TSL temperature during test	(21.0 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.32 mW / g
SAR normalized	normalized to 1W	37.3 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**37.2 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.99 mW / g
SAR normalized	normalized to 1W	20.0 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**20.0 mW / g ± 16.5 % (k=2)**

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.0 Ω + 2.3 jΩ
Return Loss	- 28.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.6 Ω + 3.0 jΩ
Return Loss	- 29.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 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.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 04, 2002

DASY4 Validation Report for Head TSL

Date/Time: 05.11.2007 14:23:55

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d019

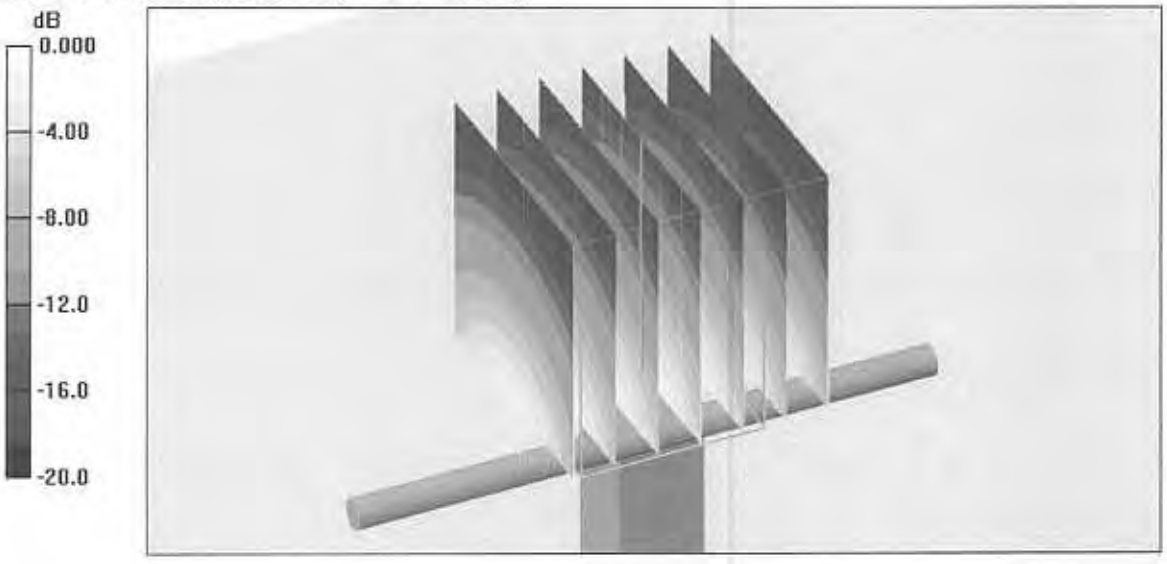
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL U10 BB;
Medium parameters used: f = 1900 MHz; σ = 1.45 mho/m; ε_r = 38.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(4.86, 4.86, 4.86); Calibrated: 26.10.2007
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2007
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; ;
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 172

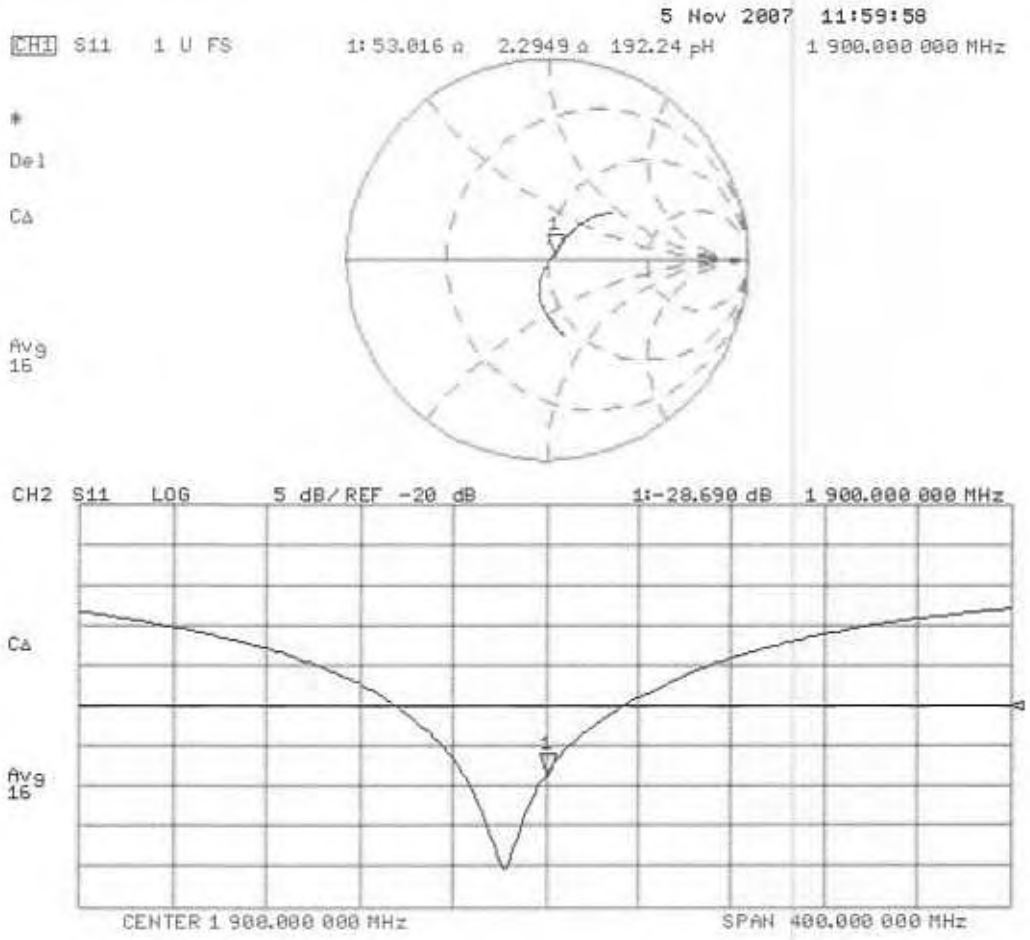
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.1 V/m; Power Drift = 0.036 dB
Peak SAR (extrapolated) = 17.4 W/kg
SAR(1 g) = 9.86 mW/g; SAR(10 g) = 5.15 mW/g
Maximum value of SAR (measured) = 11.1 mW/g



0 dB = 11.1mW/g

Impedance Measurement Plot for Head TSL



DASY4 Validation Report for Body TSL

Date/Time: 13.11.2007 14:09:19

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d019

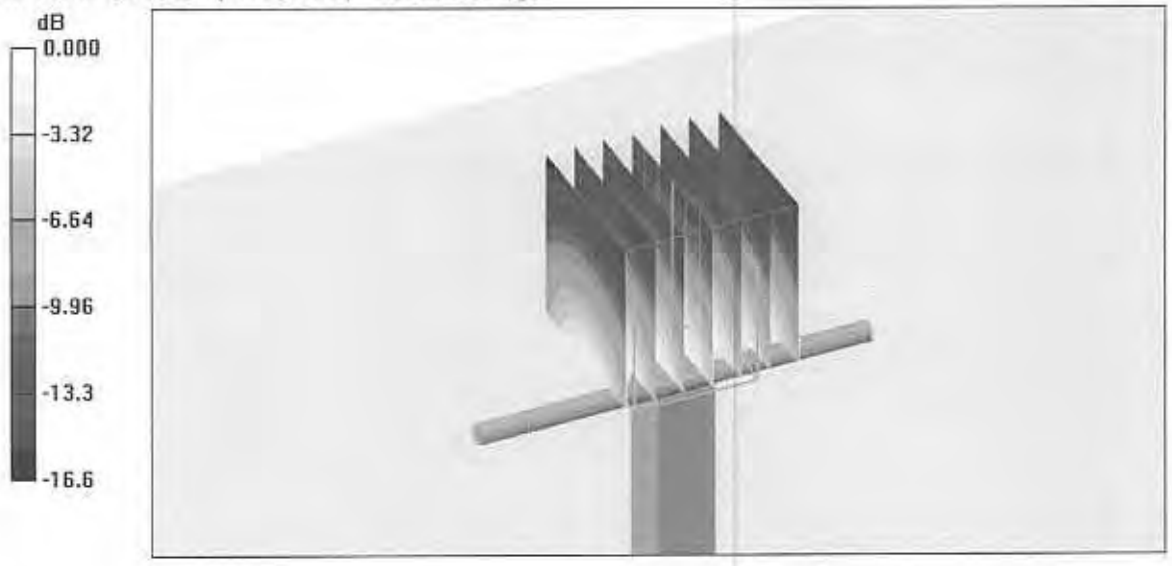
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: MSL U10 BB;
Medium parameters used: f = 1900 MHz; σ = 1.54 mho/m; ε_r = 53.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(4.48, 4.48, 4.48); Calibrated: 26.10.2007
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2007
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; ;
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 172

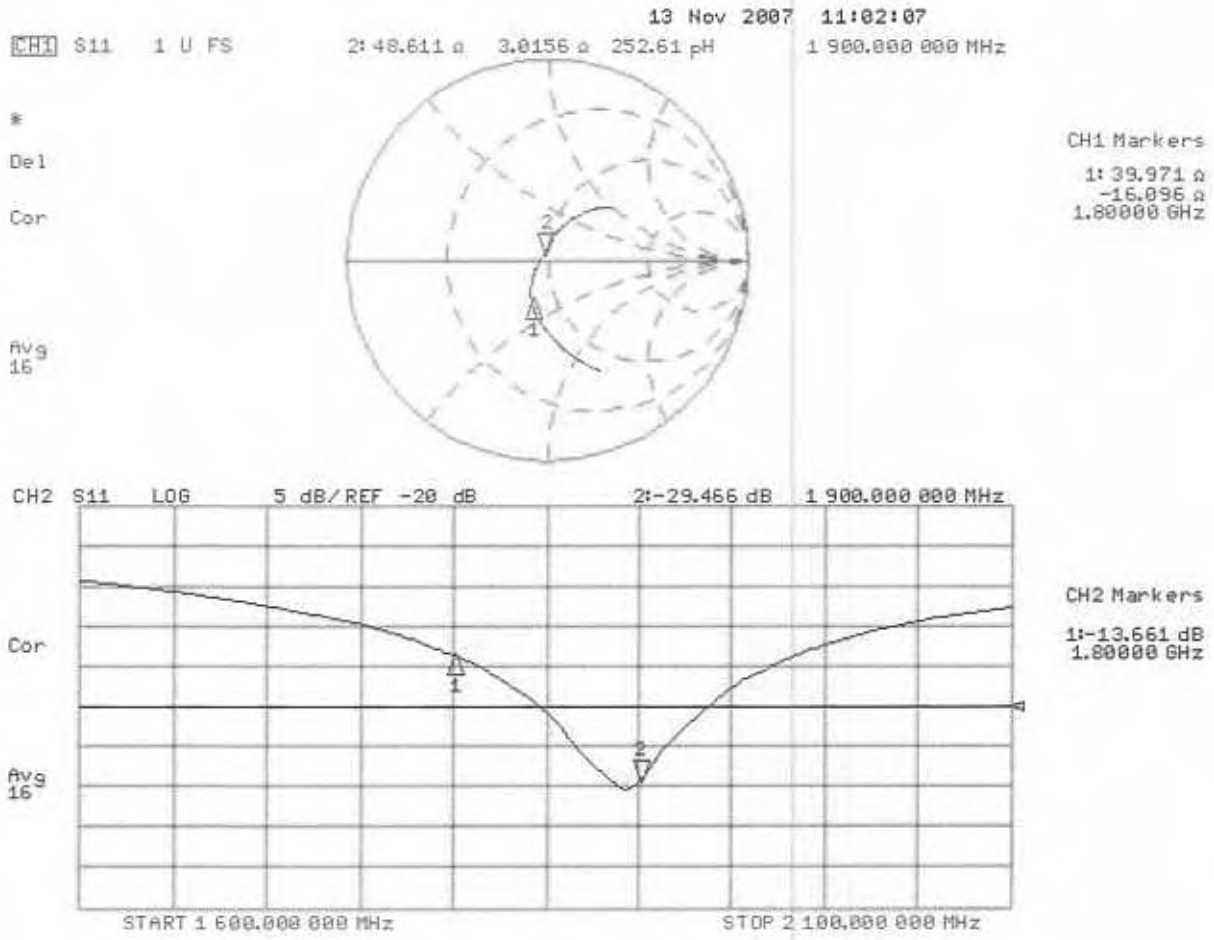
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.5 V/m; Power Drift = -0.006 dB
Peak SAR (extrapolated) = 15.9 W/kg
SAR(1 g) = 9.32 mW/g; SAR(10 g) = 4.99 mW/g
Maximum value of SAR (measured) = 10.6 mW/g



0 dB = 10.6mW/g

Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 108**

Client **Qualcomm USA**

Certificate No: **D835V2-466_Nov07**

CALIBRATION CERTIFICATE

Object D835V2 - SN: 466

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

Calibration date: November 12, 2007

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Power sensor HP 8481A	US37292783	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Reference 20 dB Attenuator	SN: 5086 (20g)	07-Aug-07 (METAS, No 217-00718)	Aug-08
Reference 10 dB Attenuator	SN: 5047.2 (10r)	07-Aug-07 (METAS, No 217-00718)	Aug-08
Reference Probe ET3DV6 (HF)	SN 1507	26-Oct-07 (SPEAG, No. ET3-1507_Oct07)	Oct-08
DAE4	SN 601	30-Jan-07 (SPEAG, No. DAE4-601_Jan07)	Jan-08

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-07)	In house check: Oct-09
RF generator R&S SMT-06	100005	04-Aug-99 (SPEAG, in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Oct-08

	Name	Function	Signature
Calibrated by:	Mike Meili	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 14, 2007

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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
c) 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:

d) DASY4 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	DASY4	V4.7
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	40.4 ± 6 %	0.88 mho/m ± 6 %
Head TSL temperature during test	(21.9 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.34 mW / g
SAR normalized	normalized to 1W	9.36 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**9.34 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 mW / g
SAR normalized	normalized to 1W	6.12 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**6.09 mW / g ± 16.5 % (k=2)**

[1] 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	54.9 ± 6 %	1.00 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.37 mW / g
SAR normalized	normalized to 1W	9.48 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**9.27 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.56 mW / g
SAR normalized	normalized to 1W	6.24 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**6.15 mW / g ± 16.5 % (k=2)**

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.1 Ω - 5.1 jΩ
Return Loss	- 25.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.5 Ω - 6.6 jΩ
Return Loss	- 22.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.384 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.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 27, 2002

DASY4 Validation Report for Head TSL

Date/Time: 07.11.2007 12:23:00

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:466

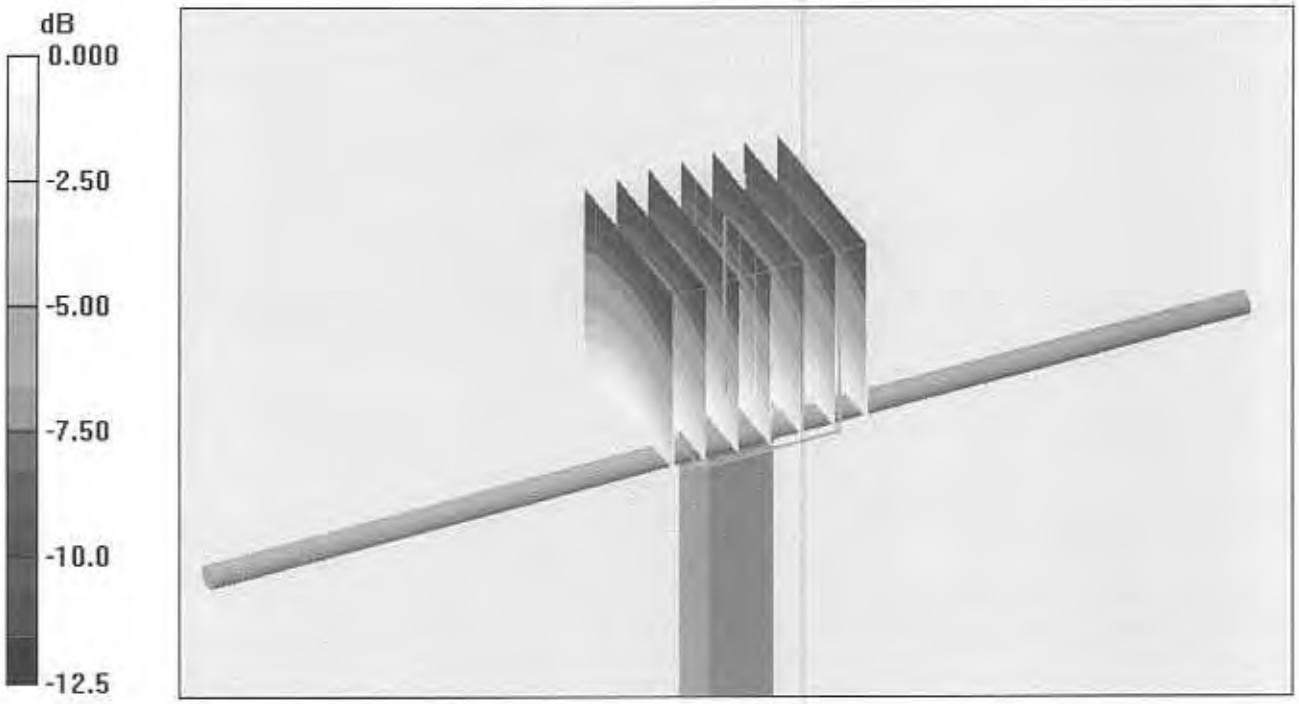
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: HSL 900 MHz;
Medium parameters used: f = 835 MHz; σ = 0.88 mho/m; ε_r = 40.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(6.01, 6.01, 6.01); Calibrated: 26.10.2007
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2007
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 172

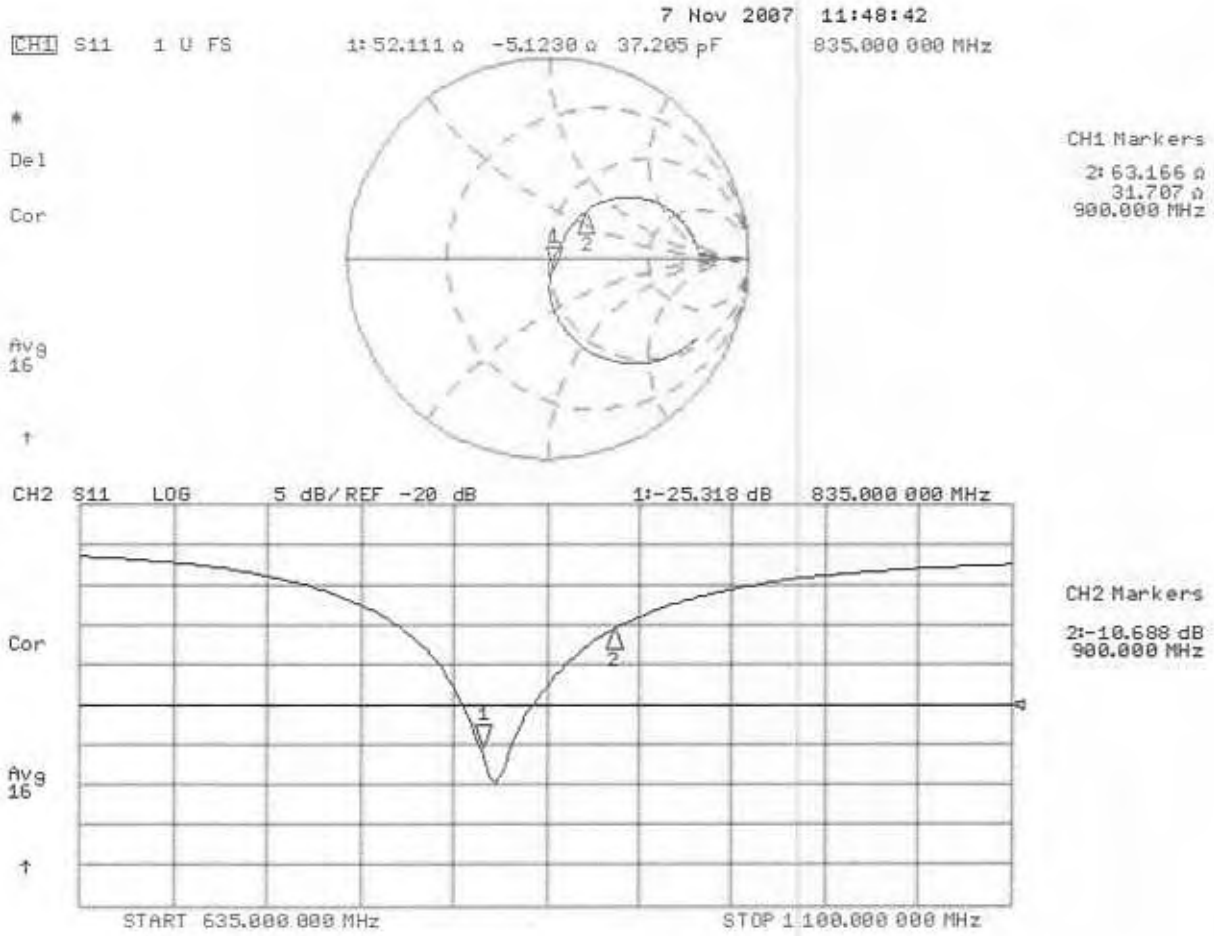
Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.5 V/m; Power Drift = 0.024 dB
Peak SAR (extrapolated) = 3.44 W/kg
SAR(1 g) = 2.34 mW/g; SAR(10 g) = 1.53 mW/g
Maximum value of SAR (measured) = 2.51 mW/g



0 dB = 2.51mW/g

Impedance Measurement Plot for Head TSL



DASY4 Validation Report for Body TSL

Date/Time: 12.11.2007 12:06:39

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:466

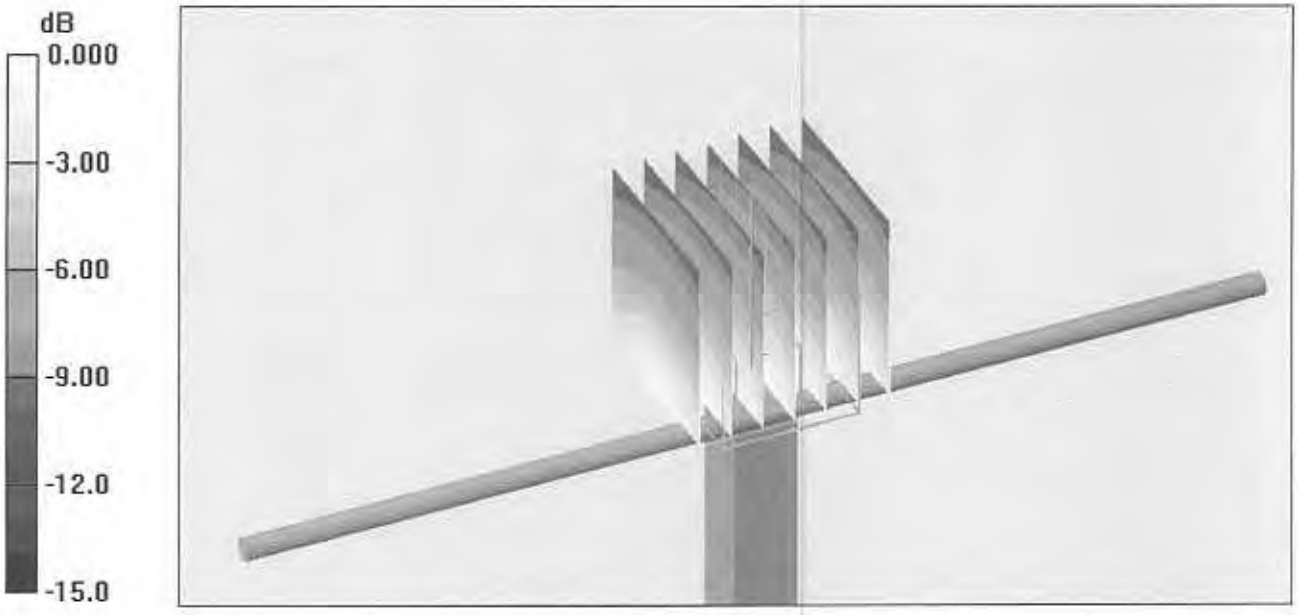
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: MSL900;
Medium parameters used: f = 835 MHz; σ = 1 mho/m; ε_r = 54.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(5.83, 5.83, 5.83); Calibrated: 26.10.2007
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2007
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; ;
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 172

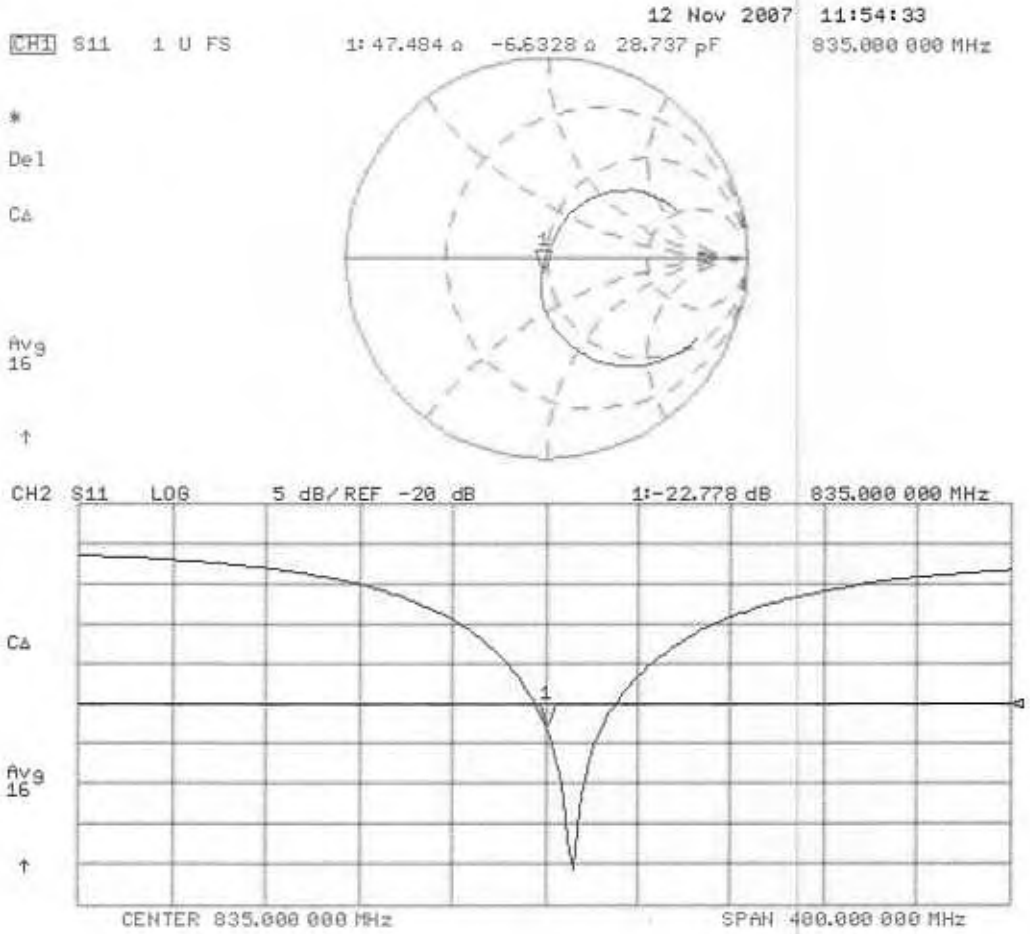
Pin = 250mW, d = 15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.1 V/m; Power Drift = -0.015 dB
Peak SAR (extrapolated) = 3.41 W/kg
SAR(1 g) = 2.37 mW/g; SAR(10 g) = 1.56 mW/g
Maximum value of SAR (measured) = 2.56 mW/g



0 dB = 2.56mW/g

Impedance Measurement Plot for Body TSL



X/9701

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Accreditation No.: **SCS 108**

Client **Qualcomm USA**

Certificate No: **DAE3-400_Mar08**

CALIBRATION CERTIFICATE

Object	DAE3 - SD 000 D03 AA - SN: 400
Calibration procedure(s)	QA CAL-06.v12 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	March 5, 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 (Calibrated by, Certificate No.)	Scheduled Calibration
Fluke Process Calibrator Type 702	SN: 6295803	04-Oct-07 (Elcal AG, No: 6467)	Oct-08
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-07 (Elcal AG, No: 6465)	Oct-08
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Calibrator Box V1.1	SE UMS 006 AB 1004	25-Jun-07 (SPEAG, in house check)	In house check Jun-08

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

Issued: March 5, 2008

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 Federal Office of Metrology and Accreditation
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:* 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	404.689 ± 0.1% (k=2)	405.159 ± 0.1% (k=2)	403.680 ± 0.1% (k=2)
Low Range	3.96738 ± 0.7% (k=2)	3.96885 ± 0.7% (k=2)	3.91978 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	347 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Input (μV)	Reading (μV)	Error (%)
Channel X	+ Input	200000	199999.6	0.00
Channel X	+ Input	20000	20006.05	0.03
Channel X	- Input	20000	-20001.79	0.01
Channel Y	+ Input	200000	199999.8	0.00
Channel Y	+ Input	20000	20006.87	0.03
Channel Y	- Input	20000	-19998.83	-0.01
Channel Z	+ Input	200000	200000	0.00
Channel Z	+ Input	20000	20004.03	0.02
Channel Z	- Input	20000	-20004.39	0.02

Low Range		Input (μV)	Reading (μV)	Error (%)
Channel X	+ Input	2000	2000	0.00
Channel X	+ Input	200	199.82	-0.09
Channel X	- Input	200	-199.40	-0.30
Channel Y	+ Input	2000	2000	0.00
Channel Y	+ Input	200	199.99	0.00
Channel Y	- Input	200	-200.53	0.27
Channel Z	+ Input	2000	1999.9	0.00
Channel Z	+ Input	200	198.94	-0.53
Channel Z	- Input	200	-200.89	0.44

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	-5.64	-7.20
	- 200	9.15	7.89
Channel Y	200	-8.45	-8.44
	- 200	7.61	7.76
Channel Z	200	20.82	20.67
	- 200	-20.24	-23.02

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	-	3.30	-0.21
Channel Y	200	1.14	-	4.22
Channel Z	200	-0.34	1.22	-

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	15653	15677
Channel Y	15956	15909
Channel Z	16453	16956

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	0.55	-1.14	1.75	0.57
Channel Y	-1.31	-3.09	0.00	0.54
Channel Z	-1.26	-2.81	0.25	0.52

6. Input Offset Current

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

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.2001	197.2
Channel Y	0.2002	198.6
Channel Z	0.1999	198.7

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

Schmid & Partner Engineering AG
s p e a g
Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

IMPORTANT NOTICE

USAGE OF THE DAE 3

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE3 unit is connected to a fragile 3-pin battery connector. Customer is responsible to apply outmost caution not to bend or damage the connector when changing batteries.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration Customer shall remove the batteries and pack the DAE in an antistatic bag. The packaging shall protect the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, Customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Schmid & Partner Engineering

QUALCOMM®

5775 Morehouse Drive, San Diego, CA 92121-2779

Report # 14352:1190361639

Certificate of Calibration

Manufacturer: GIGATRONICS **Model #:** 8542C

Asset #: K82228 **Serial Number:** 1834430

Description: POWER METER

QUALCOMM Incorporated hereby certifies that...

the above described instrument met or exceeded all published specifications at the time of calibration specified below; and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology (NIST) within the limitations of the Institute's calibration services, or have been derived from accepted values or physical constants, or have been derived by ratio or self calibration techniques. The collective uncertainty of the measurement standards have not exceeded 4:1 test accuracy ratio for each characteristic calibrated, unless otherwise noted. All calibration activities performed are in compliance with MIL-STD-45662A, ANSI/NCSL Z540-1-1994, ISO-9001-1994, and ISO 10012-1:1992. This report and its results refer only to the item(s) calibrated and are not to be reproduced, except in full, without the written approval of the Qualcomm Incorporated Calibration Laboratory.

CALIBRATION INFORMATION

Cal Date	09/21/2007	**Interval**	12	**Cal Temp**	22
Cal Due	09/21/2008	**Data**	YES	**Humidity**	53
Tech	Troy Howard	**Pass**	YES	**Seals OK**	YES

Condition Received IN TOLERANCE

Condition Returned MEETS MFR'S SPECS

Physical Condition of Equipment GOOD

Out of Tolerance Conditions/Limitation

Cal Procedure Gigatronics 8540C Series Power Meters **Revision** QUAL- 031125 REV 1.1

STANDARDS USED FOR CALIBRATION

Asset Number	MFG	Model	Description	Cal Date	Due Date
X03045	AGILENT TECHNOLOGIES	34401A	MULTIMETER	05/10/07	11/09/07
X11013	AGILENT TECHNOLOGIES	3335A	SYNTHESIZER/LEVEL GENERATOR	07/26/07	07/25/08
X21296	GIGATRONICS	80301A	POWER SENSOR	10/24/06	10/24/07
K65267	AGILENT TECHNOLOGIES	432A	POWER METER	11/22/06	11/22/07
X10665	AGILENT TECHNOLOGIES	478A	THERMISTOR MOUNT	11/08/06	11/08/07

Signed: _____ **Date:** 09/21/2007

QUALCOMM®

5775 Morehouse Drive, San Diego, CA 92121-2779

Report # X21267:QC-235572342

Certificate of Calibration

Manufacturer: GIGATRONICS **Model #:** 80401A

Asset #: X21267 **Serial Number:** 1831694

Description: POWER SENSOR

QUALCOMM Incorporated hereby certifies that...

the above described instrument met or exceeded all published specifications at the time of calibration specified below; and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology (NIST) within the limitations of the Institute's calibration services, or have been derived from accepted values or physical constants, or have been derived by ratio or self calibration techniques. The collective uncertainty of the measurement standards have not exceeded 4:1 test accuracy ratio for each characteristic calibrated, unless otherwise noted. All calibration activities performed are in compliance with MIL-STD-45662A, ANSI/NCSL Z540-1-1994, ISO-9001-1994, and ISO 10012-1:1992. This report and its results refer only to the item(s) calibrated and are not to be reproduced, except in full, without the written approval of the Qualcomm Incorporated Calibration Laboratory.

CALIBRATION INFORMATION

Cal Date	06/19/2007	**Interval**	12	**Cal Temp**	22
Cal Due	06/19/2008	**Data**	NO	**Humidity**	48
Tech	Rick Gill	**Pass**	YES	**Seals OK**	YES

Condition Received OUT OF TOLERANCE

Condition Returned MEETS MFR'S SPECS

Physical Condition of Equipment GOOD

Out of Tolerance Conditions/Limitation

FAILED CAL, LOADED NEW CAL FACTORS

Cal Procedure MANUFACTURER **Revision** NA

STANDARDS USED FOR CALIBRATION

Asset Number	MFG	Model	Description	Cal Date	Due Date
K74805	GIGATRONICS	8541C	POWER METER	09/28/06	09/28/07
K66152	WEINSCHEL	1805B	RF POWER LEVEL CONTROLLER	04/12/07	04/11/08
K131190	TEGAM	F1130	POWER STANDARD	04/09/07	04/08/08
K58132	AGILENT TECHNOLOGIES	83752B	SYNTHESIZED MICROWAVE SWEEPER	03/16/07	03/15/08

Signed: Kathleen Ann Ulrich **Date:** 06/19/2007

1 of 1

Agilent Technologies

AGILENT TECHNOLOGIES
INTERNAL ASSESSMENT
PROGRAM : EMG
E102/1995

U.S. EPSG Service Centers
Irvine Branch
17811 Sky Park Circle BLDG9 SuiteFG
Irvine, CA 92614 (321) 235-2149

Certificate of Calibration

Agilent Calibration

Certificate Number: 1-651985653-1

Manufacturer: Hewlett-Packard Co.
Model Number: 8714C
Serial Number: US38171129
Customer:
Qualcomm Inc
6455 Lusk Blvd

SAN DIEGO CA 92121 United States

Description: RF NETWORK ANALYZER, 3 GHZ
Options Installed:
Customer Asset No: k82012
Location of Calibration:
U.S. EPSG Service Centers
Irvine Branch
17811 Sky Park Circle BLDG9 SuiteFG
Irvine, CA 92614 (321) 235-2149

Procedure: STE-50112873-A.05.00
Date of Calibration: 2 May 2007
Temperature: 23 +/- 5 °C

Customer PO Number Credit Card - F. Cisnero
Humidity: 20-80% RH

This certifies that the above product was calibrated in compliance with a quality system registered to ISO 9001:2000 using applicable Agilent Technologies procedures.

As Received Conditions:

Initial testing found the equipment to be **IN-SPECIFICATION** at the points tested.

As Shipped Conditions:

At the completion of the calibration, measured values were **IN-SPECIFICATION** at the points tested.

Remarks or Special Requirements:

Our calibration procedures are designed to provide measurement uncertainty of less than or equal to one quarter of the specification of the unit under test, where possible, with a coverage factor of 2.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

This certificate is composed of 2 pages containing a summary of calibration information.

Based on the recommended calibration interval, the next calibration is due on 2 May 2008.

Print Date: 2 May 2007

Rick Whitcomb Americas Delivery Mgr.

Agilent Technologies

AGILENT TECHNOLOGIES
INTERNAL ASSESSMENT
PROGRAM : BMG
E102/1995

U.S. EPSG Service Centers
Irvine Branch
17811 Sky Park Circle BLDG9 SuiteFG
Irvine, CA 92614 (321) 235-2149

Certificate of Calibration

Agilent Calibration
Certificate Number: 1-651985653-1

Traceability Information:

Technician ID Number: 78478

Traceability is to national standards administered by the U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc,) or other recognized standards laboratories.

Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements.

Supporting documentation relative to traceability is available for review by appointment.

Calibration Equipment Used:

Model Number:	Model Description:	Trace Number:	Cal Due Date:	Certificate Number:
11667A	DC-18 GHz power splitter, Type N, 50 ohm	11667A14796	22 Sep 2007	1-619263631-1
33250A	FUNCTION/ARB WAVEFORM GENERATO	33250A13225	13 Feb 2008	1-543080812-7
5351B	CW Microwave Frequency Counter	5351B00856	30 Jul 2008	1-424334491-1
8482A	Power sensor, 100 kHz to 4.2 GHz	8482A04503	13 Sep 2007	1-463139233-1
8491A	Coaxial Attenuator, dc-12.4GHz, Type N	8491A7652	13 Sep 2007	1-463215653-1
8491B	Coaxial Attenuator, dc-18 GHz, Type N	8491B21841	30 Jun 2007	1-87061156-1
8491B	Coaxial Attenuator, dc-18 GHz, Type N	8491B21925	30 Jul 2009	1-436507338-1
8491B	Coaxial Attenuator, dc-18 GHz, Type N	8491B24908	30 Sep 2007	1-102116647-1
8496G	0-110dB Prog. Step Attenuator, 0-4GHz	8496G14573	10 Jan 2008	1-519424863-1
85032B	50-ohm Type N cal. kit for 8752A/C	85032B00590	2 Jun 2007	1-304431023-1
8563E	9 kHz - 26.5 GHz MW spectrum analyzer	8563E11516	22 Jun 2007	1-306141118-5
E4419B	Dual channel EPM series power meter	E4419B11188	4 Oct 2007	1-469421033-1

AGILENT TECHNOLOGIES
17811 SkyPark Cir
Irvine, CA 92614
CSC Address Line 3

Report Number: 1-651985653-1
Manufacturer: Hewlett-Packard Co.
(Agilent Technologies)
Model Number: 8714C (HP8714C)
Options Installed: none
Firmware Version:

Customer: QUALCOMM INC

Cust. Unit No.: K82012
Serial Number: US38171129

Test Date: 2 May 2007
Temperature: 23.0+/-5 DEG C

Tested By: 78478
Humidity: 20 to 80% RH

Test Program Name: HP871X Part No. 5011-2873
Test Program Version: A.05.00
Test Executive: STE/9000 C.07.21C (MENDOR B.06.09ZD)

Specification Limits:

Unless indicated otherwise, the units for minimum and/or maximum specification limits are the same as the units stated for the measured value.

Calibration Standards Used

Model No.	Serial No.	Trace No.	Cal Due Date
AGT33250A	MY40013225	33250A13225	13 Feb 2008
HP11667A	14796	11667A14796	22 Sep 2007
HP5351B	3032A00856	5351B00856	30 Jul 2008
HP8482A	1925A04503	8482A04503	13 Sep 2007
HP8491A	7652	8491A7652	13 Sep 2007
HP8491B	21841	8491B21841	30 Jun 2007
HP8491B	21925	8491B21925	30 Jul 2009
HP8491B	2708A24908	8491B24908	30 Sep 2007
HP8496G	3247A14573	8496G14573	10 Jan 2008
HP85032B	2541A00590	85032B00590	02 Jun 2007
HP8563E	3943A11516	8563E11516	22 Jun 2007
HPE4419B	GB39511188	E4419B11188	04 Oct 2007

Measurement Report Page 2 of 6

Report Number: 1-651985653-1
Model Number: HP8714C
Serial Number: US38171129

Test Date: 2 May 2007

Cust. Unit No.: K82012

PERFORMANCE TEST RESULTS SUMMARY

Test Name	Status
INITIAL SETUP	DONE
FREQUENCY ACCURACY	PASSED
GAIN COMPRESSION	PASSED
NOISE FLOOR	PASSED
DYNAMIC ACCURACY	PASSED
POWER FLATNESS	PASSED
ABSOLUTE ACCURACY	PASSED
BROADBAND FREQUENCY RESPONSE	PASSED
DIRECTIVITY	PASSED
HARMONICS	PASSED

Measurement Report Page 3 of 6

Report Number: 1-651985653-1
Model Number: HP8714C
Serial Number: US38171129

Test Date: 2 May 2007

Cust. Unit No.: K82012

FREQUENCY ACCURACY

PASSED

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM
Frequency Error at			
10.000000 MHz	-0.050	-0.006 kHz	0.050
50.000000 MHz	-0.250	-0.031 kHz	0.250
123.456789 MHz	-0.617	-0.077 kHz	0.617
500.000000 MHz	-2.500	0.000 kHz	2.500
1000.000000 MHz	-5.000	0.000 kHz	5.000
1300.000000 MHz	-6.500	0.000 kHz	6.500
1905.000000 MHz	-9.525	0.000 kHz	9.525
1915.000000 MHz	-9.575	0.000 kHz	9.575
2500.000000 MHz	-12.500	0.000 kHz	12.500
2850.000000 MHz	-14.250	0.000 kHz	14.250

GAIN COMPRESSION

PASSED

TEST CONDITIONS	MEASURED	MAXIMUM
0.3 MHz	0.000 dB	0.367
1.0 MHz	0.000 dB	0.367
10.0 MHz	0.000 dB	0.367
100.0 MHz	0.000 dB	0.367
500.0 MHz	0.000 dB	0.367
1000.0 MHz	0.000 dB	0.367
2000.0 MHz	0.000 dB	0.367
3000.0 MHz	0.000 dB	0.367

NOISE FLOOR

PASSED

TEST CONDITIONS	MEASURED	MAXIMUM
Narrowband Detector Mode Fine BW, Spur Avoid ON 300 kHz - 5 MHz	-109.0 dBm	-50.0

continued...

Measurement Report Page 4 of 6

Report Number: 1-651985653-1
Model Number: HP8714C
Serial Number: US38171129

Test Date: 2 May 2007

Cust. Unit No.: K82012

NOISE FLOOR

TEST CONDITIONS	MEASURED	MAXIMUM
5 MHz - 3000 MHz	-99.0 dBm	-90.0
Broadband Detector Mode Narrow BW, Spur Avoid OFF 300 kHz - 3000 MHz	-52.9 dBm	-50.0

DYNAMIC ACCURACY

PASSED

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM
Nominal Input Level			
-10 dBm	-0.233	0.029 dB	0.233
-20 dBm	-0.100	0.004 dB	0.100
-30 dBm	-0.100	0.007 dB	0.100
-40 dBm	-0.100	0.008 dB	0.100
-50 dBm	-0.100	0.012 dB	0.100
-60 dBm	-0.100	0.009 dB	0.100
-70 dBm	-0.100	0.004 dB	0.100
-80 dBm	-0.400	0.010 dB	0.400
-90 dBm	-0.700	-0.174 dB	0.700
-100 dBm	-1.000	0.228 dB	1.000

POWER FLATNESS

PASSED

TEST CONDITIONS	MEASURED	MAXIMUM
Nominal Power Level		
10.00 dBm	0.58 dB	2.00
Maximum: +10.30 dBm, found at:	2884.6 MHz	
Minimum: +9.77 dBm, found at:	.3 MHz	
0.00 dBm	0.40 dB	2.00
Maximum: +.24 dBm, found at:	2884.6 MHz	

continued...

Measurement Report Page 5 of 6

Report Number: 1-651985653-1
Model Number: HP8714C
Serial Number: US38171129

Test Date: 2 May 2007

Cust. Unit No.: K82012

POWER FLATNESS

TEST CONDITIONS		MEASURED	MAXIMUM
Minimum:	-.16 dBm, found at:	.3 MHz	
-5.00 dBm		0.24 dB	2.00
Maximum:	-4.85 dBm, found at:	2884.6 MHz	
Minimum:	-5.09 dBm, found at:	.3 MHz	

ABSOLUTE ACCURACY

PASSED

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM
+16.0 dBm	-0.55	0.26 dB	0.55
+10.0 dBm	-0.50	0.20 dB	0.50
+5.0 dBm	-0.50	0.25 dB	0.50
0.0 dBm	-0.50	0.22 dB	0.50
-5.0 dBm	-0.50	0.13 dB	0.50
-10.0 dBm	-0.50	0.15 dB	0.50
-15.0 dBm	-0.50	0.38 dB	0.50
-20.0 dBm	-0.50	0.39 dB	0.50
-25.0 dBm	-0.50	0.34 dB	0.50
-30.0 dBm	-0.50	0.35 dB	0.50
-35.0 dBm	-0.75	0.13 dB	0.75
-40.0 dBm	-1.00	0.15 dB	1.00
-45.0 dBm	-1.50	0.35 dB	1.50
-50.0 dBm	-2.00	0.06 dB	2.00
-55.0 dBm	-7.00	1.22 dB	7.00

BROADBAND FREQUENCY RESPONSE

PASSED

TEST CONDITIONS	MEASURED	MAXIMUM
Nominal Input Level -6 dBm	0.70 dB	2.00

Measurement Report

Report Number: 1-651985653-1
Model Number: HP8714C
Serial Number: US38171129

Test Date: 2 May 2007

Cust. Unit No.: K82012

DIRECTIVITY

PASSED

TEST CONDITIONS	MEASURED	MAXIMUM
Directivity	-45.3 dB	-30.0
Source Match	-24.7 dB	-20.0
Input Match	-20.9 dB	-18.0

HARMONICS

PASSED

TEST CONDITIONS	MEASURED	MAXIMUM
+7 dBm Source Level		
2nd Harm. measured at		
0.3 MHz	-41.3 dBc	-20.0
1.0 MHz	-45.2 dBc	-30.0
3.0 MHz	-42.0 dBc	-30.0
10.0 MHz	-51.8 dBc	-30.0
30.0 MHz	-51.7 dBc	-30.0
100.0 MHz	-61.7 dBc	-30.0
200.0 MHz	-43.2 dBc	-30.0
300.0 MHz	-41.0 dBc	-30.0
400.0 MHz	-36.8 dBc	-30.0
500.0 MHz	-34.8 dBc	-30.0
600.0 MHz	-35.7 dBc	-30.0
700.0 MHz	-38.0 dBc	-30.0
800.0 MHz	-38.2 dBc	-30.0
900.0 MHz	-38.8 dBc	-30.0
1000.0 MHz	-40.7 dBc	-30.0
1100.0 MHz	-43.7 dBc	-30.0
1200.0 MHz	-56.7 dBc	-30.0
1440.0 MHz	-37.8 dBc	-30.0

Agilent Technologies

Agilent Service Request Number:
1-651985593

Agilent Service Order Number:
1-651985653

Customer Service Information

Qualcomm Inc
6455 Lusk Blvd
SAN DIEGO CA 92121
United States

Customer Contact:
Fito Cisneros

Telephone:
(858) 651-0348

Receive Date:
24/APR/2007

Schedule Date:
01/MAY/2007

Shipped Date:

Product Number:
AGILENT 8714C

Product Serial Number:
US38171129

Product Description:
RF Network analyzer

Purchase Order Number:
K82012

Problem Description:
Agilent Calibration /

Cal Interval: 12 Months /
Installed Options: /
Special Requirements:K82012

Services Provided:
Calibration complete unit met MFG spec

Accessories

Parts Used

Qty	Part Number	Description